Children and Adolescents' Affective Responses to Physical Activity

Submitted by Charlotte Claire Hamlyn Williams to the University of Exeter as a thesis for the degree of Doctor of Philosophy in Sport and Health Sciences (December, 2012)

I certify that all material in this thesis which is not my own work has been identified and that no material has previously been submitted and approved for the award of a degree by this or any other University.

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Abstract

Abstract

Research suggests that optimising affect during exercise may be key to exercise adherence (Van Landuyt, Ekkekakis, Hall & Petruzzello, 2000; Williams et al. 2008; 2012). Recent advances in this area have explored factors that contribute to affective responses in adult populations (Ekkekakis, 2003), but whilst it has been hypothesised that these factors are the same for children and adolescents they have not been explored systematically in the same way. As such, one aim of this thesis was to investigate the relationships between affect and physical activity in child and adolescent populations. Following on from this, a further aim was to explore the factors that contribute to affective responses. Given the research that suggests positive affect experienced during exercise may result in enhanced adherence to physical activity (Williams et al. 2012), the final aim of this study was to determine how to elicit the most positive affective responses during an acute exercise session. This thesis comprises a review of relevant literature, and six study chapters which were the result of three empirical studies; two acute exercise studies and one questionnaire based study. The findings of Study 1 demonstrated that, as with adults, affective responses declined after the onset of ventilatory threshold in both children and adolescents, indicating that to achieve optimum affective responses, particularly with younger children, exercise needs to be prescribed at an intensity below the ventilatory threshold. The findings from studies 2 - 4 highlighted specific factors that contribute to affective responses, reporting that preference for, and tolerance of, different exercise intensities may be an important factor to consider when prescribing exercise (studies 2 & 4). Results also showed that affective associations with physical activity played a significant role in determining overall physical activity behaviour (study 3). The findings from studies 4 and 5a and b revealed that encouraging adolescents to self-select their own exercise intensity may

elicit a more positive affective response during the exercise session compared to the affective responses elicited during a prescribed exercise session. This thesis provides substantial evidence to support the link between affect and physical activity in children and adolescents. More specifically, it highlights several important factors that should be considered when attempting to enhance affective responses during an acute exercise session.

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Chapter 1 - Introduction

Current physical activity (PA) data (The NHS Information Centre, 2012) indicates that only 24% of girls, and 32% of boys aged between 2-15years old, meet the current recommended levels of PA. Research suggests that there is a steep decline in PA levels in young people between the ages of 9 and 15 (Kimm, 2002; Nader, Bradley, Houts, McRitchie, & O'Brien, 2008).

The benefits of PA to one's health have been well-documented; and include both physiological and psychological benefits (Macera, Hootman, & Sniezek, 2003; PAGAC, 2008; Rowland, 2007; Sothern, Loftin, Suskind, Udall, & Blecker, 1998). Sothern et al., (1998) indicated that activities of a moderate intensity may enhance overall health, and assist in preventing chronic disease in at-risk youths. The benefits of PA include both physiological and psychological components. There is increasing evidence that PA is associated with a number of health benefits, including greater bone density (Hind & Burrows, 2007), reduced risk of obesity (Ness et al. 2007), and reduced clustering of cardiovascular disease risk factors (Andersen et al., 2006; Ferreira et al., 2007). It is also suggested that there are psychological benefits to PA, which include an improvement in self-esteem (Biddle, 2000), and have a positive effect on mental and psychological health by reducing depression, anxiety and stress (Armstrong & Welsman, 1997; Mutrie & Parfitt, 1998). There is evidence to suggest that PA is important for children and adolescent's psychological well-being, with results showing that children with lower physical activity levels have more symptoms of psychological distress than more active children (DofH, 2004). These well documented benefits of PA highlight the importance of encouraging individual's to be physically active.

Coupled with this, there is extensive research to show the effects that physical inactivity can have. Physical inactivity is now identified as the fourth leading risk factor for global mortality, 6% of deaths globally (WHO, 2011), insufficient physical activity is responsible for 3.2 million or 5.5% of all deaths (WHO, 2011). Physical inactivity is estimated as being the principal cause for approximately 21-25% of breast and colon cancer burden, 27% of diabetes and 30% of ischaemic heart disease burden (WHO, 2009). Recent reports have highlighted the severity of inactivity in children (The NHS Information Centre, 2012), and suggest that this decline in PA, coupled with a subsequent increase in sedentary pursuits, is contributing to the upsurge in childhood obesity (WHO, 2004; Chinn & Rona, 2001). The detrimental effects on health of inadequate PA in young people are well established (Dencker, 2008; Jiménez-Pavón, Kelly, & Reilly, 2010; Reichert, 2009) and subsequently the need to increase PA behaviour and reduce physical inactivity levels is of high importance.

One obvious concern related to low levels of PA and increasing levels of physical inactivity is that it predisposes children and adolescents to obesity (Hardman & Stensel, 2009) The WHO (2004) has stated that childhood obesity is one of the most serious public health challenges of the 21st century. Globally, obesity is affecting an increasing proportion of children (Lobstein, Baur, & Uauy, 2004), and there are a number of potential health consequences associated with excess body fat during the growing years. These health problems may include cardiovascular disease (CVD) along with metabolic, pulmonary, psychological and social disorders (Lloyd, Langley-Evans, & McMullen, 2010) many of which may predispose the individual to risk factors for type 2 diabetes, CVD, asthma and impaired mobility (WHO, 2000). Whilst there is now worldwide acceptance that PA is an important element of a healthy lifestyle (WHO, 1995; Macera et al., 2003; (Penedo, 2005) levels of PA are declining rapidly (DoH, 2004) as sedentary lifestyle choices are increasing.

Given the evidence to show that children and adolescents are not participating in adequate PA, and the associated health risks of physical inactivity and benefits of PA, it is important for future research to explore how to encourage long-term adherence to PA. Two quantitative reviews (Salmon, Booth, Phongsavan, Murphy, & Timperio, 2007; VanSluijs, McMinn, & Griffin, 2007) indicated that PA interventions with children are seldom successful, highlighting the need to explore other methods of increasing PA participation.

Research suggests that optimising affect during exercise may be one solution in increasing low levels of PA, with recent evidence from studies with adults indicating that affect may be the first link in the exercise adherence chain (Van Landuyt, Ekkekakis, Hall, & Petruzzello, 2000; VanSluijs et al., 2007; Williams et al., 2008). Metcalf et al (2012) also showed that there was a small to negligible effect from PA interventions on total time spent in PA. The findings from these reviews suggest that the relative failure of PA interventions in increasing PA may be due to several factors. Where interventions have failed to increase activity, authors have speculated about poor delivery or poor uptake of the activity sessions (Reilly et al., 2006), or suggested that the physical activity component of the intervention was not sufficiently intense. However, whilst these reasons are intuitive and plausible, they are difficult to test. An alternative explanation could be that the intervention specific exercise sessions may simply be replacing periods of equally intense activity. For example, after school activity clubs may simply replace a period of time that children usually spend playing outdoors or replace a time later in the day/week when the child would usually be active. There are multiple explanations relating to the relative inadequacy of PA interventions, indicating that research needs to explore further why interventions to increase PA have thus far proved relatively unsuccessful.

Parfitt, Rose and Burgess (2006) indicated that experiencing positive affect during exercise has an impact upon motivation and behaviour, and Williams et al. (2008; 2012) said that it may influence decisions regarding whether or not to repeat the behaviour in the future. Affect is regarded as a generic term that characterises the subjective experience of any valenced (pleasant or unpleasant) state and includes the concepts of emotions and moods (Ekkekakis & Petruzzello, 2002).

Several factors have been shown to contribute to the affective responses an individual experiences during PA, with the most studied area related to exercise intensity; an area which is theoretically driven by the dual-mode theory (Ekkekakis, 2003). The dual-mode theory suggests that affective responses during exercise are a result of the combination of cognitive processes (e.g. personality variables, exercise efficacy, expectations and goals) and interoceptive cues (e.g. cues from baroreceptors, thermoreceptors and visceroreceptors in the heart and lungs) (Ekkekakis, 2003). While neither the cognitive or interoceptive cues have complete control over affective responses, their contribution will vary across different exercise intensities. At moderate intensity (below VT) affective responses are independent of physiological change (Hall, Ekkekakis, & Petruzzello, 2002) with cognitive factors contributing more significantly. At heavy intensity (from VT to the highest work rate at which blood lactate can be stabilised) there is likely to be great inter-individual variability in affective responses as responses depend on both physiological changes along with individual factors related to coping/tolerance or preference. Hall et al. (2002) and Ekkekakis (2003) suggest that cognitive cues are the over-riding factor in determining affective responses at this intensity. The third intensity is severe (from maximal lactate steady state to the level of maximal aerobic capacity), and it is suggested that affective responses are likely to be driven mainly by physiological changes and interoceptive cues.

Results from previous studies assessing this theory indicate a significant decline in affective responses after ventilatory threshold (VT) (Hall et al., 2002; Sheppard & Parfitt, 2008; Welch, Hulley, Ferguson, & Beauchamp, 2007). Differences occurred prior to VT dependent on the population, highlighting the contribution that cognitive factors have in determining affective responses. Whilst there has been research in support of the dual-mode theory with adults and adolescent boys (Welch et al. 2007; Sheppard & Parfitt, 2008; Hall et al. 2002), there has been limited research to date that has explicitly explored whether the tenets of the dual mode theory are applicable to adolescent girls or younger children. This is an important area to explore further given the differences in overall engagement in PA between boys and girls (NHS Information Centre, 2012) and the various factors that may contribute to this. Boys and girls may differ in their ability to perform PA or may have different past experiences of PA, which is a factor thought to determine affective responses to PA (Parfitt & Hughes, 2009). It is important to explore differences in affective responses between boys and girls, and in younger children as there will be different factors that determine affective response to exercise based on both internal and external factors.

Previous research has examined factors that contribute to the elicitation of positive affective responses; with studies investigating whether allowing individuals to self-select their exercise intensity results in more positive affective responses than during prescribed exercise sessions (Lind, Vazou, & Ekkekakis, 2008; Sheppard & Parfitt, 2008a; Stych & Parfitt, 2011; Vazou-Ekkekakis & Ekkekakis, 2009). Findings indicate that affective responses are more positive during the self-selected exercise sessions, suggesting that a sense of autonomy over one's exercise experience is an important contributing factor to positive affective responses. Two previous studies (Sheppard & Parfitt, 2008; Stych & Parfitt, 2011) allowed adolescents to self-select their own exercise intensity, but limited changes to the intensity to every 5-minutes.

This gap in the literature directed the content of this thesis to explore the relationships that exist between PA and affect in a child and adolescent population. There has been minimal research exploring the relationships between affect and PA in children and adolescents. Given the recent PA data to indicate that young people are not sufficiently active (The NHS Information Centre, 2012), combined with the strength of the data supporting the importance of affect to adherence with adult populations (Williams et al. 2008; 2012), future research should focus on this concept. Understanding the cognitive factors that are proposed to determine affective responses is an understudied area within the child and adolescent population. Given that the dual mode theory indicates cognitive factors are one of two key determinants of affective responses this is an area that deserves increased research attention.

The dual mode theory indicates that the cognitive factors that may contribute to affective responses include individual preference or tolerance of different intensity exercises. Previous research has led to the development of a psychometric measure to determine preference for, and tolerance of exercise intensity (Ekkekakis, Hall, & Petruzzello, 2005c). However, this measure was developed with adults, and may not be specific to children or adolescents. Given the importance that is currently being given to individual preferences during exercise (ACSM, 2010), it is necessary to explore the utility of this measure to determine individual preference for, and tolerance of, different exercise intensities in younger populations including children and adolescents.

Dishman, Farquhar and Cureton (1994) suggested that individuals’ preferred intensity is a possible determinant of self-selected exercise intensity. Allowing adolescents to self-select their exercise intensity may result in more positive affective responses, which has the potential to increase PA participation. Previous research has limited reporting changes to intensity during a self-selected exercise session to every 5-minutes.

However, this does not allow researchers to fully understand the patterning of affective responses throughout a self-selected exercise session where changes in intensity are allowed at any time point. This gap in the literature requires further attention, not only to establish whether self-selection of exercise does result in positive affective responses and to determine whether individuals choose to work at an intensity that will bring about physiological benefits if maintained in the future. Further attention is also required to determine whether individual preference for different intensity exercise is a determinant of self-selected exercise intensity in an adolescent population.

Summary of Thesis:

The aim of this thesis was to enhance and further current knowledge in the area of affect and physical activity with children and adolescents, more specifically, to explore how to elicit the most positive affective responses to exercise in child and adolescent populations. There were three main aims to the thesis, with the first being to examine whether the dual-mode theory was applicable to a child and adolescent population. The findings of Study 1 demonstrated that, as with adults, affective responses declined after the onset of ventilatory threshold in both children and adolescents. There were differences between children and adolescents, with there being a significant decline in affective responses from the onset of exercise within the child population; a pattern that did not emerge in the adolescent group. There was large inter-individual variability in affective responses to exercise of the same intensity which lead to the development of the subsequent studies within this thesis.

The second aim of this thesis was to explore potential reasons for this large inter-individual variability by investigating individual factors that may contribute to affective responses. These factors included assessing personality variables and exploring individual preferences for, and tolerance of, different exercise intensities (Study 2), as well as exploring the contribution that cognitive beliefs, relating to the theory of planned behaviour, had on affective responses and associations (Study 3). The findings of Study 2 revealed that to assess child and adolescent preferences for, and tolerance of, different intensity exercises a specific, modified, measure was required. Results were in contrast with previous findings with adult populations, reinforcing the necessity of exploring this relationship with a younger population. Furthermore, the modified measure was confirmed as an appropriate means of assessing preference for, and tolerance of, exercise intensity in children and adolescents in Study 5a, as well as being able to predict the intensity of exercise that individuals chose to work at during a self-selected exercise session. Study 3 reinforced findings with adult populations and showed the importance of exploring the relationship between affective associations, cognitive beliefs and PA behaviour. The results showed that regardless of age or gender, affective associations with PA mediated the relationships between cognitive beliefs and PA behaviour, highlighting the importance of assessing individual's affective associations with PA, but also indicated that modification of affective associations may contribute to changes in PA behaviour.

The third aim of this thesis was to investigate how to elicit the most positive affective responses during an acute exercise session. Initial findings from Study 4, which were further reinforced by findings from Study 5b, indicated that allowing individuals to self-select their exercise intensity, opposed to someone else prescribing the intensity, resulted in more positive affective responses. Self-selection also resulted in more positive anticipated affective responses. These findings linked closely to self-determination theory (Deci & Ryan, 1987), and suggested that autonomy over one's exercise experience is key to eliciting positive affective responses.

Overall, this thesis provides substantial evidence to support the link between affect and PA in children and adolescents. More specifically, it introduces two methods of exercise prescription for adolescents, based on both current and previous research findings, to enhance affective experiences; self-selection and through the application of the preference for, and tolerance of, questionnaire to determine preferred intensity that would most likely elicit the most positive affective responses.

Chapter 2 - Literature Review

2.1 Hedonic Theory

One aspect that may play a significant role in people's decisions to adhere (or not) to exercise programmes is how the physical activity makes them feel whilst they engage in it. This viewpoint is embedded in hedonic theory, which focuses on affective responses to behaviour as a determinant of future behaviour (Kahneman, 2003). Hedonic psychology is the study of what makes experiences and life pleasant or unpleasant. There is substantial evidence from health psychology research to suggest that humans have a tendency to seek out pleasurable situations and avoid displeasure, and that pleasure may be a guide for behaviour (Rozin, 2003) (p. 113). Cabanac (1971, 1992) argued that hedonic responses (i.e., pleasure versus displeasure) provide an index of the usefulness of behaviour and its immediate outcomes relative to existing internal states, and that humans will therefore seek out all pleasant stimuli and avoid unpleasant stimuli. Hedonic theory explains behaviour as a function of its affective consequences or anticipation of its affective consequences. Kahneman (2003) suggested that the perceived utility of a behaviour (or experience) is defined by one's affective response to the behaviour, and will determine whether the behaviour will be repeated.

2.2 Affect

Affect is regarded as a generic term that characterises the subjective experience of any valenced (pleasant or unpleasant) state and includes the concepts of emotions and moods (Ekkekakis & Petruzzello, 2002; Rose, & Parfitt, 2008). It has been argued that the affective domain can be conceptualised as having a hierarchical structure which extends from basic affect, or 'core' affect (Russell, 2009) through to distinct emotions as the stimulus-linked affective states that are elicited following specific patterns of cognitive appraisals (Ekkekakis & Petruzzello, 2002).

2.3 Affect, Emotion & Mood

The mood states and emotions associated with physical activity have potentially important roles in health promotion. Physical activity is a positive health behaviour to be encouraged and promoted; how people feel during and after activity may be critical in determining whether they maintain their involvement (Biddle, 2000; Biddle & Nigg, 2000). There are several constructs that can fall under the term affect, and it is important to differentiate between them. There is an emerging consensus that the term emotion refers to those immediate responses to specific stimuli (i.e. are directed at a specific object), and are typically characterised by a relatively short duration and high intensity (Ekkekakis & Petruzzello, 2002). In contrast to emotion, moods are considered to be lacking a specific target, and are typically associated with low or no action tendencies; moods are also thought to be less intense and generally last longer than emotions (Ekkekakis & Petruzzello, 2000a; Watson & Clark, 1997).

2.4 Measurement of Affect

In studies examining affective changes associated with physical activity, affect has traditionally been examined from a categorical perspective; this means that affective states are organised in categories that are taken to be conceptually different, whereas dimensional approaches are based on the idea that affective states are systematically interrelated and can offer adequate representations of the entire affective space by relying on only a small number of basic dimensions (Ekkekakis, Hall, VanLanduyt, & Petruzzello, 2000; Ekkekakis & Petruzzello, 2002). Both categorical and dimensional approaches have relative strengths and weaknesses and the decision to adopt one over the other depends on the nature of the question being investigated (Ekkekakis et al., 2000). Williams (2008a) indicated that the dimensional approach is more appropriate for testing hypotheses concerning the exercise-affect-adherence relationship than the categorical approach; the reasons for this are that theoretically a dimensional approach can capture the full range of basic affective responses to exercise (Ekkekakis & Petruzzello, 2002) and this approach tends to involve single-item assessments of basic affective dimensions that are easier to administer and assess before, during and after exercise bouts. An important consideration when choosing a measure to assess affect and affective responses is whether the goal is to assess a specific, narrowly defined state (or set of distinct states) or broad dimensions that are theorised to underpin a global domain (such as mood or core affect). In the last 20 years, more than 20 different measures of affective constructs have been used in studies of acute exercise, and thus researchers need to be aware of the pros and cons of both dimensional and categorical models.

2.4.1 Dimensional models

Dimensional models can offer a representation of the entire affective space by relying on a small number of basic dimensions. With the breadth of scope that is offered by taking a dimensional approach, specificity is reduced, making dimensional models inadequate for the study of distinct emotions. However, a dimensional approach is considered well suited for the study of basic affect from a more global perspective. A dimensional approach offers the opportunity to gain a comprehensive representation of the global affective space.

2.4.1.1 Single-Item Dimensional Measures of Affect

Single-item measures only take a few seconds to administer and as such, reduce the interruptions of any continuous tasks. Single-item measures are convenient in studies in which affective states are repeatedly measured in order to track any changes that may occur. With scores being based on a single-item and dependent entirely on only one response there is the possibility of erroneous responses (due to confusion or carelessness) and as a result, single-item measures tend to be less reliable than multi-item measures of the same constructs (Russell & Carroll, 1999).

2.4.1.1.1 Self-Assessment Manikin

The Self-Assessment Manikin (SAM) (Lang, 1980) assesses three dimensions of affect using pictures of a cartoon character. The valence scale shows a character with facial expressions ranging from pleasure (smiling face) to displeasure (frowning face). The arousal scale depicts a character with facial expressions ranging from sleepiness (eyes closed) to high arousal (shaking and heart pounding). The third scale, dominance, shows a figure ranging from small size (indicating submissiveness) to large size (indicating dominance). The SAM has been successfully used in previous exercise studies (Ekkekakis, 2000). SAM is an inexpensive, easy method for quickly assessing reports of affective response in many contexts (Bradley & Lang, 1994).

2.4.1.1.2 Affect Grid

The Affect Grid (J.A. Russell, Weiss, & Mendelsohn, 1989) was developed using Russell's (1980) circumplex model of affect. It provides two scores; one for pleasure and one for arousal. The Affect Grid is a 9x9 grid, with affective valence being represented by the horizontal dimension (unpleasantness to pleasantness) and perceived activation represented by the vertical dimension (ranging from sleepiness to high arousal). Participants place a single X in 1 of the 81 cells of the grid and this response is scored along both valence and activation. Given the potential problems associated with this unfamiliar format relatively few researchers have used this method of assessment (Ekkekakis et al., 2000) and have chosen to use simple rating scales instead.

2.4.1.1.3 Feeling Scale and Felt Arousal Scale

The Feeling Scale (FS) (Hardy & Rejeski, 1989) is an 11-point bipolar scale of pleasure and displeasure. The scale ranges from -5 to +5. Anchors are provided from (-5) 'very bad’ (-3) bad, (-1) fairly bad through (0) ‘neutral’ to (+1) ‘fairly good’, (+3) ‘good’ to (+5) ‘very good’. The Felt Arousal Scale (FAS) (Svebak & Murgatroyd, 1985) is a 6-point single-item scale, ranging from 1-6, with anchors at 1 ‘Low Arousal’ and 6 ‘High Arousal’. The Feeling Scale is a good measurement tool for recording affective responses during an exercise bout as it is easy to administer with only one question. This scale enables one to plot affective responses across time and the duration of an exercise bout.

2.4.1.2. Multi-Item Dimensional Measures of Affect

Multi-item measures take longer to administer than single-item measures, and thus are less appropriate for repeated measures within a short time frame. They may distract from the on-going tasks and may affect respondent reactivity to testing or fatigue. However, multi-item measures are less susceptible to measurement error issues than single-item measures. Typically these measures are used to investigate the chronic effects of exercise (days, weeks or months between measurements) or in studies of acute exercise when only pre-to-post changes are measured (Kwan & Bryan, 2010a).

2.4.1.2.1 Positive and Negative Affect Schedule

The Positive and Negative Affect Schedule (PANAS) (Watson, Clark, & Tellegen, 1988) consists of 20-items, 10 for the PA scale (positive affect; e.g. interested, excited) and 10 for the NA scale (negative affect; e.g. distressed, upset). Each item is accompanied by a 5-point scale ranging from ‘very slightly or not at all’ to ‘extremely’. There are distinct limitations of the PANAS; predominantly that the items in the scale represent a mixture of emotion (e.g. afraid, nervous,), mood (jittery, active), and affect, and thus cannot be considered a measure solely of affect.

2.4.1.2.2 Activation Deactivation Adjective Check List

The Activation Deactivation Checklist (AD ACL) taps two bipolar dimensions. One termed ‘Energetic Arousal’ (EA) which extends from high-activation pleasant affect (e.g. energetic, vigorous, and lively), labelled as ‘Energy’, to low-activation unpleasant affect, labelled ‘Tiredness’ (e.g. sleepy, tired, drowsy). The other dimension is termed ‘Tense Arousal’ (TA) and goes from high-activation unpleasant affect, labelled ‘Tension’ (e.g. jittery, tense) to low-activation pleasant affect, named ‘Calmness’ (e.g. clam, placid, and at rest). Each of the 20-items has a 4-point response scale, from ‘Definitely Feel’, through ‘Feel Slightly’, ‘Cannot Decide’ and ‘Definitely Did Not Feel’. The AD ACL can be scored either in terms of the two bipolar dimensions (EA, TA) or in terms of four unipolar dimensions (Energy, Tiredness, Tension, Calmness), meaning that it gives a more complete picture of the positive and negative affect circumplex. However, there have been problems associated with this measure, particularly with reference to the item ‘fearful’ (of the Tension pole), with previous research indicating that is exhibits very low mean and variance (Ekkekakis, Hall, & Petruzzello, 1999). Other items within the measure have also shown to be ambiguous and not easily understood.

2.4.2 Categorical models/distinct-states approach

The primary strength of categorical measures is their specificity and ability to distinguish between affective states. Because of these strengths categorical models are deemed preferable in the study of distinct emotions (Ekkekakis & Petruzzello, 2002). According to this approach, each state is, and should be, examined as unique and distinct from all others (Ekkekakis, 2012). Categorical models can highlight the unique features of emotions and moods. Categorical models are recognised as being able to offer the advantage of specificity and the potential for finer discriminations of psychological meanings.

2.4.2.1 Multi-Item Measures

2.4.2.1.1 Multiple Affect Adjective Checklist

The Multiple Affect Adjective Checklist (MAACL) (Zuckerman & Lubin, 1965) assesses transient states as opposed to stable traits. Several versions of this measurement tool have been developed (Zuckerman, Lubin, & Rinck, 1983). The final version of the measurement tool comprised 66 scored and 66 filler items, to assess anxiety, depression, hostility, positive affect and sensation seeking. The MAACL has been used in earlier studies (Goldfarb, Hatfield, Sforzo, & Flynn, 1987; Hardy & Rejeski, 1989), however it has become less popular over recent years. The MAACL is not a good measure for affect as it only assesses positive affect, overlooking negative affect, but also, as with PANAS it cannot be considered a measure solely of affect given that it also assesses other constructs.

2.4.3 Exercise-Specific Measures of Affect

Researchers proposed that exercise is characterised by unique sensations and affective responses, which lead to the development of several exercise-specific measures of affect such as Exercise-Induced Feeling Inventory (EFI; Gauvin & Rejeski, 1993), and the Subjective Exercise Experiences Scale (SEES; McAuley & Courneya, (1994). Lox, Jackson, Tuholski, Wasley and Treasure (2000) combined the EFI and SEES scales. However, these scales have all been heavily criticised as a result of their development not following theoretical guidelines, and that the items developed for these scales were based on a group of young, healthy and active college students. As a result, these scales may not be valid for use with other populations, such as the elderly, physically inactive or those individuals with disabilities.

2.5 Circumplex Model of Affect:

The dimensional model of affect, with the wide scope that it offers could provide the template for systematically recording and assessing the changes in affective responses to exercise (Ekkekakis & Petruzzello, 2000a). Ekkekakis and Petruzzello (2002) advocated a dimensional approach to assessing affective response. Specifically, Russell's circumplex model (Russell, 1980) is recommended as a conceptual framework for measuring 'basic' or 'core' affect along two dimensions: pleasure/displeasure and high/low arousal. The circumplex model of affect indicates that affective space is defined by two orthogonal dimensions: an affective valence dimension and an activation dimension (Ekkekakis et al., 2000a). Russell (1980) states that there is evidence to suggest that affective dimensions are interrelated in a highly systematic fashion and that these interrelationships can be represented by a spatial model (Figure 1).

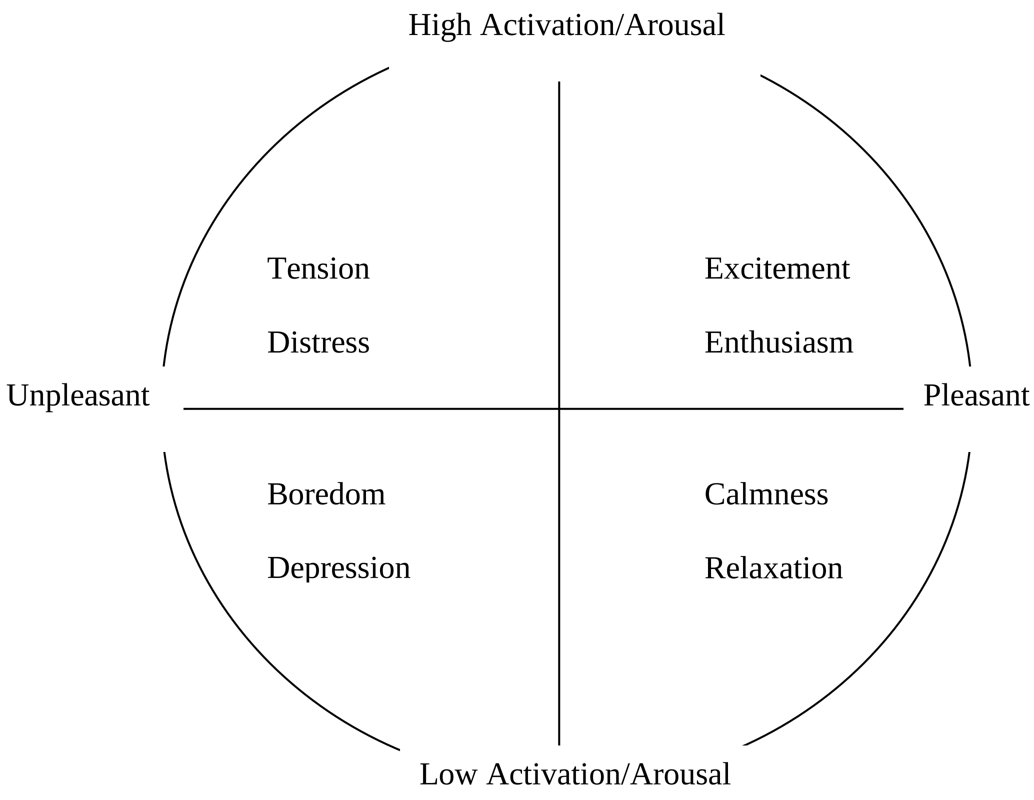

Figure 1 Model of the Affective Circumplex

Each sector of the circle reveals different meaningful variants: (a) unactivated pleasant affect (relaxation and calmness); (b) unactivated unpleasant affect (boredom, fatigue, or depression); (c) activated unpleasant affect (tension and distress); and (d) activated pleasant affect (energy, excitement and enthusiasm). The circumplex model is a very useful method for studying the effects of acute exercise stimuli on affect.

2.7 Temporal Measurement

The temporal patterning of affective responses is an important consideration in the understanding of the dose-response relationship. Affective responses generated during exercise appear to play an influential role in the overall representation of the affective dynamics of acute exercise (Bixby, Spalding, & Hatfield, 2001; Hall et al., 2002; Van Landuyt et al., 2000). Many of the earlier studies measure pre- and post-exercise affective responses, missing out the dynamic changes that occur throughout exercise (Reed & Ones, 2006). Limiting the assessment of affect to the periods before and after exercise, and excluding the assessment of affect during exercise would result in a failure to discriminate the paths leading to post-exercise outcomes.

Bixby et al. (2001) suggested three temporal patterns that characterise affective change from baseline to recovery. 1) The Maintenance Model: the affective state experienced/reported during exercise is maintained during recovery, and both states are different from baseline; 2) The Rebound Model: the affective state reported during exercise would be opposite from that experienced during recovery, and both these states would be different from baseline; and 3) There is a change in affective state from baseline to work, in either direction, with a subsequent return to baseline following the exercise.

2.6 Affect and Intensity

Several reviews support the idea that a single acute bout of exercise is associated with a reduction in negative and/or an increase in positive affect (Arent, Landers, & Etnier, 2000; Landers & Arent, 2001; Petruzzello, Landers, Hatfield, Kubitz, & Salazar, 1991). The intensity of an exercise session has been shown to be one variable that influences affective response. Reed and Ones (2006) stated that the intensity at which exercise is performed is a determinant of the affective response. Understanding the relationship between affect and exercise intensity is important because of the practical significance that the dose-response relationship has for the maintenance of exercise adherence and the prevention of drop-out; two major public health concerns. The most common suggestion regarding the shape of the dose-response relationship between the intensity of PA and affect is that it is an inverted-U. Specifically, it has been assumed that moderately vigorous intensity (not ‘too low’, not ‘too high’) optimises the conditions for positive affective changes. It has been suggested that low intensity activity is not sufficient to produce a significant change in affect and high intensity is either ineffective or experienced as aversive or negative (Ekkekakis, Hall, & Petruzzello, 2005a; Kirkcaldy & Shephard, 1990; Ojanen, 1994).

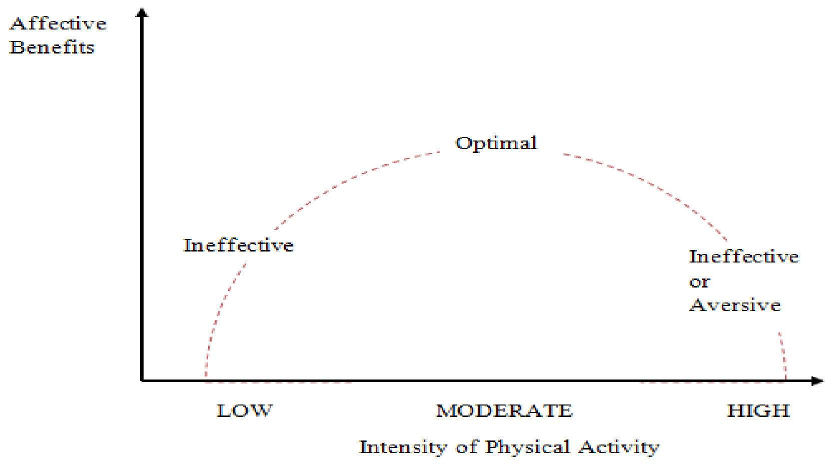

Figure 2 The Inverted-U Theory of Affect and Intensity

The idea that the relationship between the intensity of PA and affective response is akin to the dose-response model has caused concern. These concerns come from the notion that affective responses to PA are subject to a multitude of interacting personal, social, physical and physiological factors, to which individuals tend to respond as ‘active’ rather than ‘passive’ agents (Rejeski, 1994). This inverted-U theory does not take into account any inter-individual differences or variation, but these inter-individual differences may be of considerable psychological significance. This theory is inconsistent with recent data; it has been found that low-intensity and short duration exercise can produce temporary but significant positive changes (Ekkekakis et al., 2000) and that high-intensity exercise, such as an incremental exercise protocol to volitional exhaustion may lead to some positive changes such as improvements in self-esteem (Pronk, Crouse, & Rohack, 1995). These data have led to the development of the dual-mode theory (Ekkekakis, 2003) which may provide potential explanations for individual variability in affective responses.

2.7 Dual-Mode Theory

Ekkekakis (2003) suggested that affective responses during exercise are the products of the continuous interplay between two general factors: cognitive processes and interoceptive cues, both of which have access to the affective centres of the brain via subcortical routes. The cognitive processes originate primarily in the pre-frontal cortex (involving processes such as appraisals of the meanings of exercise, goals, self-perceptions including self-efficacy, attributions, and considerations of the social context of exercise) whilst the interoceptive cues come from a variety of receptors stimulated by exercise-induced physiological changes. While neither mode is likely to have complete control over affective responses to exercise, their relative dominance and influence will vary across three distinct domains of exercise intensity: *moderate, heavy and severe* (Gaesser & Poole, 1996). The relative significance of the cognitive and interoceptive cues is hypothesised to shift systematically as a function of the exercise intensity (P. Ekkekakis & Acevedo, 2006).

At intensities around and below the ventilatory threshold (VT) (the point at which there is a systematic increase in the ventilatory equivalent of oxygen without a corresponding increase in the ventilatory equivalent of carbon dioxide) (Ekkekakis, 2003) it is suggested that affective responses are influenced primarily by cognitive processes (e.g. exercise efficacy, personality variables) and the appraisal of the exercise experience (Rose, & Parfitt, 2008; Sheppard & Parfitt, 2008). At this intensity, below VT, it is thought that individuals evaluate the exercise intensity differently, and this cognitive individuality could explain the variability in affective responses at this intensity. As intensity increases, affect during exercise generally becomes less positive or more negative, particularly as the intensity increases above VT. Above VT this decline in affective response is homogenous between individuals. Exercise intensity that requires a transition from aerobic to anaerobic metabolism can have a transient but substantial negative impact on affect and this may, in turn, reduce adherence to exercise programmes (Hall et al., 2002). Interoceptive cues gain salience as intensity approaches the individual's functional limits and the maintenance of a physiological steady-state becomes impossible (Ekkekakis, 2003).

2.7.1. Moderate Intensity:

The first is the domain of moderate exercise; this includes intensities below the lactate threshold (LT) or VT, where aerobic metabolism is the primary source of energy. Activities that fall into this category can be maintained for a long period of time, while the individual can remain in a physiological steady state. Activities at this intensity include walking, gardening and moderate swimming. When exercise intensity is in the moderate range, the maintenance of homeostasis is not threatened and, consequently, affective responses, if any, are largely independent of physiological changes (Hall et al., 2002).

2.7.2 Heavy Intensity:

The second domain, heavy exercise, extends from the LT/VT to the highest work rate at which blood lactate can be stabilised. In this domain, lactate appearance and removal rates can regain balance over time, but at elevated lactate concentration levels. The activity cannot be continued indefinitely, but it can be continued for a considerable period. The events in this range present a challenge, as considerable physiological changes (e.g., ventilatory, cardiovascular, neuroendocrine) must take place to allow the maintenance of the work rate. Within this domain the amount and intensity of interoceptive information increases and many bodily signals enter consciousness. Like the ability to tolerate pain, the ability to tolerate these bodily cues depends on individual differences or cognitive factors (e.g., physical self-efficacy) (Ekkekakis, 2003). During this domain people become more aware of their bodily cues and may interpret these in a variety of ways depending on several factors. In the heavy domain, affective responses alert the consciousness to the strain placed upon the metabolic system. In this domain affective responses depend partly on physiological changes and partly on various individual-difference and cognitive factors related to coping/tolerance and preference. Thus affective responses are likely to vary greatly from individual to individual, and may be positive or negative (Hall et al., 2002). Ekkekakis (2003) suggests that this marked inter-individual difference is a result of cognitive cues being the over-riding factor in determining affective responses at this intensity.

2.7.3 Very Heavy or Severe Intensity:

The final range is the very heavy or severe domain. This extends from the maximal lactate steady state to the level of maximal aerobic capacity. Oxygen consumption and blood lactate rise continuously until the activity is terminated due to exhaustion, a physiological steady-state can no longer be maintained. Within this domain cues from the body override cognitive cues. Several authors have noted that the primary means by which disruptions in homeostasis enter consciousness is through noticeable surges of displeasure (Cabanac, 1971, 1979; Panksepp, 1998). Affective responses to physical activity performed at this intensity likely depend on pathways that link somatosensory afferents to the affective centres of the brain (i.e., the amygdala, anterior cingulated and insular cortex) directly, bypassing the frontal cerebral cortex and, therefore, allowing little or no influence from cognitive processes. Consequently, this explains why there are similar affective responses across individuals to exercise at this severe intensity. Hall et al. (2002) stated that affective responses in the severe domain represent an evolutionary primitive 'alarming' function, which, much like pain, is aimed to stop and withdraw from the activity that is causing the severe disruptions to homeostasis. In this domain affective responses are likely to be driven mainly by physiological changes and interoceptive cues, and thus be mostly negative.

Moderate Intensity Domain	Heavy Intensity Domain	Severe Intensity Domain
• Homogenous affective responses • Primarily elicits Pleasure • Low-to-moderate influence of cognitive factors	• Variability in affective responses between individuals • May elicit Pleasure or Displeasure • Strong influence of cognitive factors	• Homogenous affective responses • Primarily elicits Displeasure • Strong influence of interoceptive factors

Table 1 Affective Responses by exercise intensity domain

Table 1 highlights that there is large inter-individual variability in affective responses within the *heavy* domain, with cognitive factors having a strong influence on these responses. This suggests that research should focus on exploring the cognitive factors that influence affective responses in order to attempt to elicit more positive affective responses, and thus increase pleasure elicited from PA. As previously discussed within the literature regarding Hedonic Theory, individuals are more likely to seek out activities they perceive to be pleasurable, thus if positive affective responses can be elicited within the heavy domain this may enhance the PA experience and encourage future PA participation.

Research examining the affective responses below and above VT has demonstrated greater variability in responses below or around the VT than above it (Ekkekakis et al., 2005a; Parfitt et al., 2006; Rose & Parfitt, 2007; Sheppard & Parfitt, 2008). Below VT there is interplay between the cognitive and interoceptive mechanisms, but above VT the interoceptive cues (which signal physical harm) dominate. Around and below the VT, cognitive processes (e.g. exercise efficacy, personality variables) influence how the interoceptive cues are interpreted. As a result, affective responses should be more variable as the interoceptive cues may be interpreted positively by one person and negatively by another.

Previous studies have mapped the acute affective responses across the transition from aerobic to anaerobic metabolism (Ekkekakis, Hall, & Petruzzello, 2004; Hall et al., 2002; Sheppard & Parfitt, 2008). Results indicated that after the transition to anaerobic metabolism (after VT) there was a significant negative shift in affective valence. Hall et al. (2002) proposed that these results show a clear dose-response pattern, and provide a link between exercise-induced physiological changes and affective responses. However, Welch et al. (2007) reported a significant decline in affective responses from the first minute of exercise to the minute before VT, and then a continuous decline until exhaustion, suggesting that affective responses prior to VT are not universally positive, and there are large inter-individual differences. Results from Sheppard and Parfitt (2008) supported these findings, as boys and men were found to respond in a similar manner to exercise intensity above the VT but not below the VT.

2.7.4 Support for the Dual-Mode Theory (DMT)

Several studies have demonstrated that the transition from aerobic to anaerobic metabolism results in a decline in affective responses. Welch et al (2007) sought to test the DMT with an inactive female sample. Participants completed a graded exercise test (GXT) and VT was identified. Results partially supported the DMT; with a decline in affective responses occurring as the exercise intensity increased, however, data indicated that this decline in affective valence began before the VT. Results suggested that declines in affective responses seem to occur earlier in an inactive group, compared to active ones. Sheppard and Parfitt (2008) examined the relationships between exercise intensity and affective responses in two sedentary groups of males; men (mean age = 35.5 ± 7.2 years) and boys (mean age = 12.5 ± 0.5 years) with both groups of participants performing a GXT and VT being identified. Affective valence declined significantly after VT in both groups, supporting the DMT. However, men's affective valence decline significantly from the onset of exercise, as per the findings by Welch et al. (2007); a pattern not present in the boys' data. Results from this study reinforce the DMT in that exercise above VT brings about declines in affective response. Boys and men were found to respond in a similar way after VT, but differences occurred prior to VT.

Studies have also sought to explore the patterning of affective change in acute bouts of exercise at intensities relative to VT. Participants performed exercise at intensities above and below VT with data supporting a negative decline in affect during exercise above VT. Kilpatrick, Kraemer, Bartholomew et al. (2007) had 37 college students (mean age = 23.9 years) exercise for 30-minutes at 85% of VT, and for 24.2-minutes at 105% of VT (to equate total work) and recorded FS responses pre- and post- and throughout the exercise session. Results showed a significant intensity*time interaction, with significant decreases from baseline throughout 105%VT session, with no changes reported during the 85%VT session. Results from this study sought to show that it is intensity that affects affective responses rather than total work performed. Ekkekakis, Hall and Petruzzello (2008a) had 30 college students (14 Female, mean age = 21.2 years; 16 male, mean age = 21.5 years) perform exercise on a treadmill at 20% below VT, at VT and 10% above VT for 15-minutes. Results showed that during exercise, FS responses declined significantly in the above VT condition, whereas decreases during the below VT condition and at VT condition were smaller and not significant. Rose and Parfitt (2007) had 19 sedentary females (mean age = 39.37 years) exercise below lactate threshold (LT), at LT, above LT and at a self-selected intensity for 20-minutes on a treadmill. Results indicated that FS responses were less positive above LT than below it, at LT or in the self-selected intensity session, suggesting that affective responses decline uniformly above LT, and in general individuals find exercise above LT aversive. Results also showed that affective responses were more positive in the self-selected intensity than in the at LT intensity. Results from this study revealed that the relationship between prescribed and self-selected exercise intensity relative to affective responses may be an important relationship to explore.

Whilst there has been research to support the dual-mode model with adults and adolescent boys, limited research to date has explored the applicability of the DMT to adolescent girls or younger children. This gap in the literature suggests that future research should explore whether the uniform decline in affective responses, after VT, found in previous research studies is also true of adolescent girls and younger children. Given the differences that occur prior to VT across all other groups it would also be of interest to explore the inter-individual variability in affective responses below VT.

2.8 Affect and Physical Activity

Several reviews support the idea that a single acute bout of exercise is associated with a reduction in negative and/or an increase in positive affect (Arent et al., 2000; Landers & Arent, 2001; Petruzzello et al., 1991). With recent evidence from studies with adults indicating that affect may be the first link in the exercise adherence chain (Williams et al., 2008) this link between affect and adherence is an important link to explore. 60% of individuals who undertake an exercise programme fail to adhere for longer than 6-months (Dishman, 2001). Exploring the link between affect and adherence may contribute significantly to reducing this dropout phenomenon and understanding the mechanisms behind it.

Vara and Epstein (1993) stated that if given a choice between physically active and sedentary behaviour choices, most individuals opt for the sedentary ones. Hedonic principles suggest that individuals choose to participate in behaviours which are pleasant (lead to positive affective responses) and avoid those that are unpleasant, and as such are more likely to make behavioural choices that increase their pleasure and, conversely, tend to avoid behavioural choices that consistently decrease their pleasure or induce pain (Higgins, 1997; Kiviniemi, Voss-Humke, & Seifert, 2007; Vazou-Ekkekakis & Ekkekakis, 2009; Williams et al., 2008). Schneider et al. (2009) reported that individuals who have a more positive affective response to exercise will engage in more MVPA, suggesting that in order to promote greater participation in PA exercise programmes should be designed to facilitate positive affective experience during exercise.

2.9 Affect & Adherence:

Affective responses have an impact upon motivation and behaviour (G. Parfitt et al., 2006) and may influence decisions regarding whether or not to repeat the behaviour (Williams et al., 2008; Parfitt, Rose & Burgess, 2006). Research has also suggested that affective responses experienced during exercise may lead to a greater enjoyment of an exercise session and could ultimately play a significant role in predicting exercise adherence (Parfitt, Rose, & Markland, 2000; Williams et al., 2008; Williams et al., 2012). Williams et al. (2008) showed that a 1-unit increase in Feeling Scale responses (Hardy & Rejeski, 1989) to an acute bout of exercise was associated with 38 additional minutes of moderate PA per week at the 6-month follow-up, and 41 minutes more at the 12-month follow-up. Schneider, Dunn and Cooper (2009) measured pleasure during a 30-minute cycle at 80% of their VT. Those individuals who reported increases in pleasure during the exercise session averaged 54.25 minutes of daily moderate-to-vigorous physical activity (MVPA), assessed by accelerometers. After controlling for aerobic fitness and gender, a 1-unit increase in FS responses predicted 4.18 minutes of additional daily MVPA. Both these studies (Williams et al., 2008; Schneider et al. 2009) highlight the importance of ensuring positive affective responses are elicited during exercise sessions. As previously stated in the literature regarding Hedonic Theory, people are more likely to make behavioural choices that increase their pleasure and, conversely, tend to avoid behavioural choices that consistently decrease their pleasure or induce displeasure (Vazou-Ekkekakis & Ekkekakis, 2009).

Whilst there is much literature and research to suggest that exercise and physical activity is consistently associated with positive affect and mood (Biddle & Mutrie, 2001) recent arguments suggest that affective responses to exercise might be more variable. Hoffman and Hoffman (2008) suggested that non-exercisers may experience less positive responses than regular exercisers, and Backhouse et al. (2007) indicated that some individuals may experience decreases in pleasure.

2.10 Affect and Self-Selection

It is important to identify methods of exercise regulation that avoid declines in affect and ensure that affective responses are positive. Studies by Daley and Maynard (2003), Miller, Bartholomew and Springer (2005), and Parfitt and Gledhill (2004) provided initial evidence to show that giving individuals the opportunity to select their preferred mode of exercise is associated with improved affective responses. Allowing individuals to self-regulate their exercise intensity to one they prefer is has resulted in reduced inter-individual variability in affective response (Ekkekakis, 2009; Ekkekakis, Lind, & Joens-Matre, 2006; Lind et al., 2008; Rose, & Parfitt, 2010a; Rose & Parfitt, 2007). Williams (2008a) proposed that the exercise stimulus (prescribed or self-selected) will influence acute affective responses to exercise. Research has suggested that the importance of allowing individuals to self-select their own exercise intensity is linked closely to self-determination theory (Deci & Ryan, 1987). This theoretical framework relating to PA and exercise is discussed further on page 47.

Sheppard and Parfitt (2008a) asked 22 (11 males and 11 females) young adolescents (13.3±.33 years) to complete two prescribed intensities (one above VT and one below) and one self-selected intensity (set by asking participants to "select an intensity that [they] would be happy to sustain for fifteen minutes and that [they] would feel happy to do regularly"). Results showed that affective valence (assessed by the FS) remained positive in the self-selected and low-intensity sessions, but declined during the high-intensity condition. The self-selected intensity was significantly different to either the high- or low-intensity intensity sessions; however, FS responses were similar to those found in the low-intensity session and remained stable and positive (between 'fairly good' and 'good') and did not deteriorate with increased intensity. The data from this study gave an insight into the intensity of exercise that young adolescents choose to work at. Results indicated that when a fit, young adolescent population were given the choice of exercise intensity, they chose to work at an intensity of physiological benefit (around the VT). Results from this study highlighted that by allowing individuals to self-select exercise intensity they will choose to work at an intensity that will bring about health benefits, but also, they will exercise at an intensity that feels 'good' or 'fairly good' which is an important finding. Vazou and Ekkekakis (2009) asked participants (19 females, mean age = 21 ± 2.0 years) to visit the laboratory on two separate occasions; once to undertake 30-minutes of treadmill exercise of self-selected intensity, with the opportunity to change the speed every 5-minutes. In the second session the intensity was controlled by an investigator (with any modifications of speed from session 1 being replicated in the second session). Results indicated that affect was more negative during the prescribed session compared to the self-selected session, even though the speed and intensity were identical. This study offers a case for the promotion of self-paced exercise and physical activity.

Allowing individuals to self-select their preferred exercise is a concept that may have important implications for increasing PA levels in the general public (Ekkekakis, 2009). As previously stated children and adolescents are dropping out of PA and failing to adhere to exercise programmes it is important to explore ways in which this trend can be altered. More autonomous forms of behaviour regulation have been shown to result in more positive affective responses and greater levels of enjoyment (Vallerand & Rousseau, 2001). Dishman, Farquhar and Cureton (1994) indicated that feelings of well-being and enjoyment appear to be stronger motives for continued participation than knowledge and beliefs about the health benefits of PA. Consequently, it is important to examine further the relationships between self-selected exercises and affect in a child and adolescent population. If children have positive experiences of PA, they will be more likely to remain active, thus this is an important relationship to examine with regard to PA levels. Research has shown that as children move in to adolescence through school the degree of structure and organisation of PA changes from unstructured play towards structured and organised PA (Harris, 2013). This structured activity might include elements of formality or facilitation by adults, thus reducing self-selection or autonomy of exercise and PA behaviour. Consequently, the opportunity to explore the relationship between self-selection and affective response, and potentially change the way PA is promoted or prescribed, is important as autonomy is often removed through physical education (PE) at school, potentially contributing to the previously reported decline in PA participation.

2.11 Affect and Exercise Regulation

Whilst allowing individuals to self-select exercise intensity has reduced inter-individual variability in affective responses, it is not eliminated completely. Rose and Parfitt (2008) examined the possibility of using the Feeling Scale (Hardy & Rejeski, 1989) to regulate exercise intensity, whereby individuals exercised to feel 'good' or 'fairly good'. Results of the study showed that individuals can use the FS to self-regulate their exercise intensity, and can maintain that affective response over time. Moreover, results also showed that individuals worked between 6-8% above VT, an intensity that has the potential to accrue health benefits. More recent research (Parfitt, Alrumh, & Rowlands, 2012) has explored whether individuals can use the FS to affect-regulate exercise training over a number of weeks, and if this method of exercise regulation leads to improved physiological fitness. Results showed that participants who complied with the 8-week affect-regulated exercise programme improved their physical fitness. Parfitt, Blissett, Rose and Eston (2012) assessed both the physiological and perceptual responses to affect-regulated exercise in a group of healthy young women. Two studies asked participants to affect-regulate their exercise session to elicit 'good' or 'fairly good' affective responses. Results showed that the intensities participants chose to work at to elicit these specific affective responses were close to VT. Results supported the evidence to show that women can use affective responses to regulate exercise intensity and exercise is at an intensity that would bring about health benefits if maintained.

2.12 Exercise Intensity, Affect and Personality

Considerable inter-individual variability in affective responses at VT and below has been shown across populations, indicating that individuals respond differently to the same prescribed intensity levels (Van Landuyt et al., 2000). Evidence shows that some people find exercise more pleasant and enjoyable than others do (Ekkekakis et al., 2005a, 2005c; Rose & Parfitt, 2007; Schneider & Graham, 2009; Welch et al., 2007) and that there is some portion of affective response to acute exercise that reflects an inherent affinity (or lack thereof) for exercise that varies between individuals. As such, there has been increased research attention on individual differences in the preference for and tolerance of exercise intensity (ACSM, 2010). Dishman et al. (1994) indicated that there is "scientific consensus that preferred and perceived exertion are possible determinants of self-selected exercise intensity" (p.783), and went on to suggest that these areas are understudied, and that there is potential for exercise prescriptions based on preferred intensities to increase adherence to exercise programmes. The ACSM (2000) reinforced this concept, and suggested that as well as physiological considerations when prescribing exercise "individual preferences for exercise must be considered to improve the likelihood that the individual will adhere to the exercise programme" (p.145).

Previous research has suggested the presence of stable individual-difference traits that influence the intensity of exercise a person is predisposed to select or tolerate (Ekkekakis et al. 2005c). Preference and Tolerance have been proposed as two key factors that may contribute to exercise intensity selection. Preference refers to a predisposition to select a particular level of exercise intensity when given the opportunity (e.g. when engaging in self-selected exercise), and Tolerance refers to a trait that influences one's ability to continue exercising at an imposed level of intensity even when the activity becomes uncomfortable or unpleasant (Ekkekakis et al. 2005c).

Research has shown that both preference and tolerance accounted for significant variance in affective responses during exercise intensities around the VT, and the tolerance construct explained significant variance in exercise intensity exceeding the VT (Ekkekakis et al. 2005c). If the constructs of intensity-preference and intensity-tolerance predict inter-individual differences by identifying trait differences between individuals then there is potential to improve the way in which exercise is prescribed. By linking exercise prescription to an individual's personal preference and tolerance levels, this may potentially increase adherence to exercise by reducing negative exercise experiences. This concept of Preference and Tolerance have not been explored extensively within child or adolescent populations, and given that research highlights the steady decline in PA participation in these population groups (Hallal et al., 2012; The NHS Information Centre, 2012) it may be an important concept to explore further in the hope to increase PA participation and adherence.

2.13 Anticipated Affective Responses

When dealing with future behaviours such as future PA it is appropriate to investigate the impact of anticipated affective reactions. Anticipated emotions occur as a result of self-regulatory processes, and are dynamic responses to real or imagined feedback. As a result, anticipated emotions, such as anticipated affective responses, are dependent on appraisal processes thus can change depending on the situation (Bagozzi, Dholakia, & Basuroy, 2003). Anticipated affective responses to PA represent an understudied class of outcome expectancy (Kirsch, 1995; van der Pligt & de Vries, 1998). Expectancy-value models often neglect the role of anticipated affective consequences of behaviour. Richard et al. (1996) showed that anticipated affective reactions predicted a significant proportion of variance in behavioural expectations and self-reported behaviour, over and above the components of the TPB. Several studies have included measures of anticipated affect (i.e., what respondents would expect to feel about the consequences of a behaviour) as predictors of intention (Parker, Manstead, & Stradling, 1995; Richard, van der Plight, & De Vries, 1996). The inclusion of these measures has improved the prediction of intention beyond that of the traditional TPB variables, suggesting that the addition of a measure of anticipated affect is valuable.

2.14 Peak-End Rule:

Kahneman and Riis (2005) suggested that one makes decisions about future behaviour based upon evaluative memories of previous affective experiences of the behaviour. Emmons and Diener (1986) also indicated that the affect experienced in a situation is a strong predictor of the amount of time people will subsequently choose to spend in that situation, and more importantly, whether or not people choose to repeat the behaviour.

Individual differences in affective response to exercise have been shown to be a significant predictor of exercise behaviour (Annesi, 2005; Berger & Owen, 1992; Bryan, Hutchinson, Seals, & Allen, 2007; Williams et al., 2008; Williams et al., 2012). Current research and literature have highlighted the idea that a positive affective to exercise would support maintenance of exercise over time (Dishman & Buckworth, 1996; Kwan, & Bryan, A., 2010; Rodgers & Gauvin, 1998; Williams et al., 2008).

Kahneman and colleagues' research has shown that when formulating a retrospective evaluation of a behaviour (or experience) people tend to place greater emphasis on the most intense (i.e., peak) and most recent (i.e., ending) acute affective experiences that occurred during the behaviour (Frederickson & Kahneman, 1993). Individuals form a global evaluation of episodes by the Peak-End rule and this can determine future participation in such an episode (Kahneman, 2003) (p.20). In relation to an exercise session, the 'peak' occurs at the moment when the highest intensity of affect is recalled, and can be positive or negative by nature. In contrast, the 'end' is characterised by recollection of affective valence the moment the experience ends (Larsen & Frederickson, 1999). The peak-end rule is applicable to the dual-mode theory where it is suggested that individuals who exercise above their VT would record a high negative peak in affective valance and would therefore be reluctant to repeat the exercise. However, those who exercise below their VT would be more likely to recall an overall positive affective evaluation of the episode and will therefore be more willing to continue exercising (Parfitt & Hughes, 2009). Parfitt and Hughes (2009) examined the peak-end rule with previously sedentary participants by manipulating the intensity participants exercised at and assessed acute affective responses during and up to 4 weeks post exercise. The participants were put into one of two groups; group 1 exercised 10% above VT for 15 minutes and group 2 exercised 10% above VT for 15 minutes followed by 5-minutes 20% below VT. The preliminary evidence from this study supports the notion of the peak-end rule. Participants from group 2 reported 'pleasant' feelings because the end was 'nice'. Whereas those participants in group 1 reported more negative affect and remembered the physical demands of the experience. These data provide support for the idea for the relevance of affective responses during and after exercise for future exercise participation. A positive affective response to exercise, or the memory of a positive response, may reduce the problems of dropout and encourage increased adherence to exercise programmes.

2.15 Other Relevant Theories

2.15.1 Self-Determination Theory

Self-determination Theory (SDT) is a theory of motivation. It is concerned with supporting one's natural or intrinsic tendencies to behave in effective and healthy ways. Deci and Ryan (1987) suggested that conditions supporting the individual's experience of autonomy, competence, and relatedness are related to intrinsically motivated behaviour. Competence refers to striving to control outcomes and to experience mastery; autonomy is related to self-determination, and refers to feelings of perceived control and a sense of feeling that actions originate from the self; and relatedness refers to striving to relate to, and care for others, and to feel that others can relate to one's self also. Deci and Ryan (1991) said that these three psychological needs help to explain a considerable amount of variance in human behaviour, and went on to say that the very nature of motivated behaviour is based on striving to satisfy these three basic needs.

This psychological theory can be applied to the motivational implications of self-selected (autonomous) and prescribed or dictated (non-autonomous) behaviours. The SDT suggests that the degree of pleasure that an individual experiences when they act autonomously (e.g. when they set their own exercise intensity) is likely to be higher than that experienced when behaviour is externally controlled (e.g. when exercise intensity is imposed). Deci and Ryan (1987, 2000) therefore suggest that under autonomous conditions, positive affect is more likely to occur.

Several studies have supported the theorised link between perceived autonomy and broadly defined positive affect (Black & Deci, 2000; Kasser & Ryan, 1999; Sheldon, Ryan, & Reis, 1996), with results showing that non-autonomous conditions are typically associated with less positive affective states compared to autonomous conditions. Vazou-Ekkekakis and Ekkekakis (2009) sought to examine whether manipulating an exerciser's perception of autonomy, by allowing or disallowing individual's to set their own exercise pace, could have an impact on affective responses. Results were consistent with the SDT and indicated that the loss of perceived autonomy in setting one's level of exercise intensity can negatively impact affect and thus lessen the enjoyment that the individual derives from the physical activity participation. This previous research suggests that to enhance affect during exercise and ultimately increase adherence to physical activity individuals should be given autonomy over their exercise intensity and be able to self-select the intensity of their own exercise sessions.

2.15.2 Theories of Behaviour Change

Many researchers have indicated that the understanding and promotion of health-related exercise and PA should be based on appropriate theory (Biddle & Nigg, 2000). Designing interventions to increase PA and bring about changes in behaviour need to consider the theory underpinning behaviour, and use this knowledge to develop appropriate interventions. Theories of behaviour change can provide insight into methods that may be successful in encouraging and promoting PA and healthy lifestyles. Health promotion needs to be carefully planned to be efficient and effective; theory can help guide programme planning and ensure that interventions have a demonstrable impact on individuals.

2.15.2.1 Theory of Reasoned Action (TRA)

Ajzen and Fishbein (1980) proposed the TRA model. This model is based on the idea that intention is an immediate determinant of behaviour, and that intention is predicted by attitude and subjective norms (see figure 3). Ajzen and Fishbein (1980) indicated that the attitude component of the model is a combination of the beliefs held about the specific behaviour, coupled with the evaluation of the likely outcome.

2.15.2.2 Theory of Planned Behaviour (TPB)

The TPP is an extension of the previously mentioned TRA. The TPB suggests that an individual's intention to engage in a behaviour is the most proximal predictor of behaviour. It is theorised (Ajzen, 1991) that intention mediates the influence of three cognitive constructs on behaviour; attitudes, subjective norms and perceived behavioural control (PBC) (figure 3).

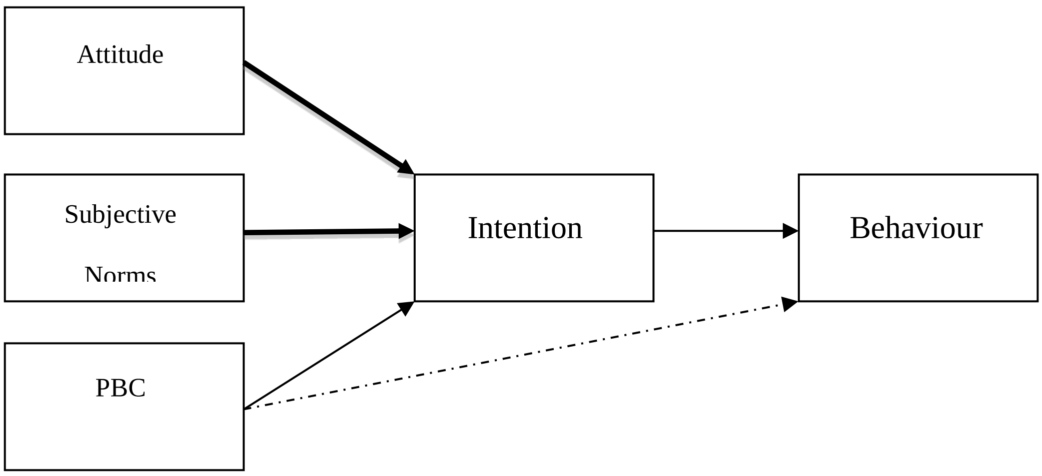

Figure 3 Theory of Reasoned Action (excluding perceived behavioural control) and Theory of Planned Behaviour (including perceived behaviour control) (Ajzen, 1991)

Attitude refers to the degree to which a person has a favourable or unfavourable evaluation or appraisal of the behaviour in question. Subjective norm refers to the perceived social pressure to perform or not to perform the behaviour, and PBC refers to the perceived ease or difficulty of performing the behaviour. This model assumes that humans are rationale decision makers and base their actions on a consideration of these cognitive beliefs. Within the TPB, outcome expectancy is incorporated in the behavioural beliefs underlying the attitude construct – specifically the belief (or expectation) that a behaviour will produce a given outcome. The TPB has been shown to be an excellent predictor of exercise behaviour (Hagger, Chatzisarantis, & Biddle, 2002) and a wide range of other related health behaviours (Armitage & Conner, 2001; Godin & Kok, 1996). Numerous authors, however, have argued that the relationships between these constructs do not focus sufficiently on the affective aspects of making a decision (Crites, Fabrigar, & Petty, 1994; Van Der Pligt, Zeelenberg, Van Dijk, De Vries, & Richard, 1998) and thus needs to be modified in order to fully predict PA and be useful in developing PA interventions.

2.15.2.2.1 Theory of Planned Behaviour and Affective Associations

It has been suggested that individuals' affective associations with behaviours may significantly influence activity choices (Kiviniemi et al., 2007). Affective associations refer to the feelings associated with a specific behaviour. It has been suggested that an association of positive affect with exercise can lead to increased motivation to engage in PA (Laverie, 1998) and also predict future activity behaviour (McAuley, Jerome, Elavsky, Marquez, & Ramsey, 2003). Research has explored the relationships between affective associations and decision-making, with results showing that affective associations with behavioural choices can predict behaviour over and above cognitive beliefs (Richard et al., 1996) and can work as cues to indicate which choices of action are the most appropriate (Damasio, 1994). It is only recently that research has begun to explore whether affective associations with PA have a role to play in influencing behavioural choices pertaining to PA. Kiviniemi, Voss-Humke and Seifert (2007) examined the role that affective associations have in individuals' PA behaviour, as well as exploring how the influence of affective associations relates to the decision-making model, the Theory of Planned Behaviour. Participants were 433 adults (180 males and

249 females, average age 33.4±16.2 years). Results from this study indicated that affective associations play a central role in the decision-making process individuals use when deciding whether or not to engage in health-related behaviours, such as PA. Results from the study highlight the importance that future theory-based PA interventions should focus on affective associations with the health behaviour, as well as the traditional cognitive beliefs and constructs if successful changes in health behaviour are to be brought about. Findings from this study indicated that affective associations served as a mediating variable between the cognitive belief constructs from the TPB and overall PA behaviour, suggesting that the inclusion affective associations within the model explains the mechanisms behind the relationships that exist between cognitive beliefs and PA behaviour. Given the current decline in PA in children and adolescents future research should explore whether affective associations have the same mediational effect with a child and adolescent population as they do with adults.

2.17 Overview of Thesis

Given the current gaps in affect literature and research, the five studies making up the body of research in this thesis sought to strengthen previous findings regarding the affect-intensity relationship, but also to extend this research to different populations to expand research knowledge. This thesis also seeks to explore the mechanisms behind the affect-intensity relationship.

2.17.1 Study One

Study one sought to explore whether the dual-mode model was applicable to adolescent girls and boys, as well as younger children. As previously discussed (page 16) many studies have carried out research in support of the dual-mode model; however there has been limited research exploring the applicability of the dual-mode model to adolescents, and younger children. One study (Sheppard & Parfitt, 2008) has plotted affective responses across a GXT with adolescent boys to establish the affect-intensity relationship, however no studies to date have sought to explore whether these findings are transferable across to adolescent girls and/or younger children. The aim of study one was to explore the patterning of affective responses during a GXT to establish differences across exercise intensity domains.

Results from study one led on to the development of studies 2-4. Given the variability in affective responses prior to VT shown in study one; a finding confirming results from previous studies, studies 2 to 4 sought to explore potential explanations for these changes in affective responses and any differences that occurred between individuals. In particular the studies focused on personality traits and affective associations with exercise and PA. Ekkekakis et al (2005c) suggested the presence of stable individual-difference traits that influence the intensity of exercise a person is predisposed to select or tolerate; a concept that directed study 2 and led to the development of a continued thread throughout the subsequent research studies.

2.17.2 Study Two

Given the inter-individual variability in affective responses reported at VT, Ekkekakis et al. (2005c) developed a questionnaire to assess exercise-specific measures of individual differences in preference for and tolerance of exercise intensity; the Preference and Tolerance of the Intensity of Exercise Questionnaire (PRETIE-Q). Several studies have validated this questionnaire for use with adults; both sedentary and active, however little research has explored the utility of this questionnaire with children and adolescents. Personality types that may predispose individuals to respond to PA with a particular affective profile have, for the most part, not been explored among adolescents. Knowing which subgroup of adolescents are least likely to possess personalities that predispose them to enjoy being physically active would enable interventions to be designed to target those at-risk individuals (Schneider & Graham, 2009). Study 2 sought to develop a modified, child-specific version of the PRETIE-Q to enable researchers to identify individual's specific preferences for different intensity exercise. If the constructs of intensity-preference and intensity-tolerance predict inter-individual differences by identifying trait differences between individuals, this may offer ways to improve the way in which exercise is prescribed.

2.17.3 Study Three

To follow on from study 2, the next study continued exploring behavioural choices and affective responses from an individual perspective. Research suggests that PA behaviours are individually chosen and regulated (Kiviniemi et al. 2007) and because of this it is important to understand how individuals make health behaviour choices, such as deciding whether or not to participate in PA. Although there are a variety of factors that influence individuals' choices about behavioural options (Bowen, Helmes, & Lease, 2001) it has been suggested recently that individual affective associations with behaviours may significantly influence behavioural choices (Kiviniemi et al. 2007). Many PA interventions base their foundations on theories of behaviour change, such as the Theory of Planned Behaviour (TPB). However, the main focus of these theories of behavioural decision making is on cognitive beliefs as the primary influence on behaviour. Recent work has implied that affective associations may also contribute to and influence behavioural choices (Schuettler & Kiviniemi, 2006), with Kiviniemi et al (2007) suggesting that affective associations mediate the relationships between cognitive beliefs and behavioural choices. All previous research within this area to date has been limited to examining this relationship in adult populations, as a result study 3 sought to explore whether affective associations significantly guided individuals health-related behaviour choices in a child and adolescent population, over and above the TPB cognitive constructs.

2.17.4 Study Four

Study 4 sought to build on the dual mode model (Ekkekakis, 2003) and gain further insight in to both the cognitive and interoceptive cues that contribute to affective responses. Following on from study 3, the particular focus was on the attitude component of the TPB. The TPB indicates that beliefs about the consequences of performing a behaviour determine attitude toward the behaviour, which in turn leads to intention to perform the behaviour, and on to behaviour itself (French et al., 2005; Sutton et al., 2003). However, it has been argued that the relationships between these constructs often do not consider both the affective and instrumental components of attitude (Crites, Fabrigar & Petty, 1994). Previous research has indicated a distinction between affective and instrumental attitudes, with different beliefs underlying the two kinds of attitudes (Breckler & Wiggins, 1989; French et al., 2005). This distinction between these two attitude components needs to be explored further in order to gain a fuller understanding of overall attitudes. The work by French et al. (2005) suggested that along with the traditional TPB constructs, both components of attitude (affective and instrumental) should be included in to the TPB model in order to explain further variance in PA behaviour and gain more insight in to behavioural choices. This distinction between affective and instrumental attitudes contributed to the first part of study 4, with a focus on the contribution of different attitude constructs to PA behaviour being explored.

The second part of study 4 explored the idea that anticipated affective responses may contribute to PA behaviours. When dealing with future behaviours such as future PA it is appropriate to investigate the impact of anticipated affective reactions. Richard et al. (1996) showed that anticipated affective reactions predicted a significant proportion of variance in behavioural expectations and self-reported behaviour, over and above the components of the TPB. The idea that anticipated affective responses may predict PA behaviour has not been explored in a child or adolescent population, and given the strength of literature to support the relationship between anticipated affective responses and PA it is an important relationship to consider.

2.17.5 Study Five

Results from the previous four studies lead to the development of the final study. Study 5 was split in to two parts; a and b. Study 5a explored further the utility of the previously modified child-specific PRETIE-Q. This study explored whether the Preference construct from the PRETIE-Q could predict the intensity an individual chose when given the choice to self-select. Differences between those who reported preference for high intensity and preference for low intensity exercise were explored to establish whether there were significant differences in self-selected intensity between different preference groups. Study 5b explored the implications of allowing individuals to self-select their own exercise intensity compared to prescribing an intensity. This study examined affective responses during two exercise sessions of identical intensity, but with the intensity of one being prescribed and the other being self-selected. This study also sought to establish whether individuals chose to work at an intensity of a great enough intensity to elicit health benefits when given the opportunity to self-select the intensity.

Chapter 3

Study 1 - Patterning of affective responses during a Graded Exercise Test in children and adolescents[1]

[1] This study has contributed to the following publications and presentations:
Publications:
Benjamin, C., Rowlands, A., Parfitt, G. Patterning of Affective Responses During a Graded Exercise Test in Children and Adolescents. *Pediatric Exercise Science*, 2012, 24, 275-288.
Presentations:
Benjamin, C., Rowlands, A., Parfitt, G. Patterning of Affective Responses During a Graded Exercise Test in Children and Adolescents. *27th Pediatric Work Physiology Conference*, Cornwall, UK, September 2011.

Abstract

Objective: Past studies have shown the patterning of affective responses during a graded exercise test (GXT) in adult and male adolescent populations, but none have explored the patterns in adolescent girls or younger children. This study explored the patterning of affective responses during a GXT in adolescents and younger children.

Methods: Forty-nine children (21 male and 28 female) aged between 8-14 years (10.8 ± 1.8 years) completed a GXT. Ventilatory threshold (VT) was identified. At the end of each incremental step, participants reported affective valence.

Results: Results revealed that affective valence assessed by the Feeling Scale (FS) significantly declined from the onset of exercise until the point of VT in the younger children, but remained relatively stable in the adolescents. Exercise above the VT brought about significant declines in affective valence regardless of age or sex, but the decrease was significantly greater in adolescents.

Conclusion: Results suggest it may be preferable to prescribe lower exercise intensities (below VT) for children, compared to adolescents, to ensure a positive affective response.

Introduction

National reports have highlighted the increasing levels of inactivity in children in the UK (DofH, 2004), therefore, understanding the determinants and correlates of physical activity (PA) in children and adolescents is critical (Strauss, 2001). A quantitative review (VanSluijs et al., 2007) indicated that PA interventions with children are seldom successful, highlighting the need to explore other methods of increasing PA participation. Research suggests that maintaining a positive affect (feelings of pleasure) during exercise may be the solution with recent evidence from studies with adults indicating that affect may be the first link in the exercise adherence chain (Van Landuyt et al., 2000; Welch et al., 2007; Williams et al., 2008).

Affect is a generic term that characterises the subjective experience of any valenced (pleasant or unpleasant) state (Ekkekakis & Petruzzello, 2002). Evidence indicates that a positive affective response experienced during exercise may lead to greater enjoyment of an exercise session and could ultimately play a significant role in predicting exercise adherence (Ekkekakis, Lind, & Vazou, 2009; Schneider & Cooper, 2011; Williams et al., 2008). Reviewing literature in leisure-time PA settings, the Surgeon General's Report (1996) reported a consistently positive association between enjoyment and levels of PA in children and adolescents, a finding supported by Sallis, Prochaska, Taylor et al. (1999) across multiple PA domains (e.g. physical education classes, leisure time PA etc.). Raedeke (2007) suggests that enjoyment and positive affect are related, reinforcing the idea that positive affective responses and enjoyment can lead to greater exercise adherence. In support of this, there is increasing evidence to show that affective judgements regarding exercise are a strong correlate of PA behaviour in adults (Rhodes, Fiala, & Conner, 2009) and in adolescents (Schneider et al., 2009) and may influence future attitudes towards PA behaviour (Kiviniemi et al., 2007).

The relationship between the intensity of exercise and affective responses is complex. Ekkekakis (2003) developed the dual-mode theory (DMT: an evolutionary adaptive theory) that can explain individual differences in affective responses at different exercise intensities. The theory suggests that affective responses are influenced by the interplay of two general factors: 1) cognitive processes (e.g. personality variables, goals, expectations, exercise -efficacy that require frontal cortex activation); and 2) interoceptive cues (e.g. signals from baroreceptors, thermoreceptors, visceroreceptors in the heart, lungs and muscle). Whilst it is argued that both factors are important in determining affective responses to exercise, the balance between the two is hypothesised to shift as a result of the exercise intensity domain (*moderate, heavy or severe* (Gaesser & Poole, 1996)). In the *moderate* intensity domain (below ventilatory threshold (VT)), exercise is likely to produce primarily positive affective responses, with low interindividual variability where cognitive processes have a low-to-moderate influence on affective responses (Hall et al., 2002). At *heavy* intensity (between VT and Maximal Lactate Steady State (MLSS)), affective responses are likely to vary greatly between individuals. While some individuals may report changes towards pleasure, others may report the opposite: feelings of displeasure. Ekkekakis (2003) suggests that this marked inter-individual difference is a result of cognitive processes being the over-riding factor in determining affective responses at this intensity. At a *severe* intensity (above MLSS), interoceptive cues bombard the system, and the DMT proposes that the frontal cortex is bypassed (negating cognitive process involvement) to avoid physiological harm and it is the interoceptive cues that dictate affective responses. At this intensity, affective valence responses are homogenously negative as the cues signal physical harm (P. Ekkekakis, 2005b).

Ekkekakis and Petruzzello (2002) have suggested that the assessment of affect is best measured by taking a dimensional approach. Specifically, they recommend employing a circumplex model (Russell, 1980) to measure affect along two dimensions: affective valence (pleasure/displeasure) and activation (low to high arousal). The circumplex is divided into sections to reveal 4 quadrants, each characteristic of different affective states: 1) unactivated pleasant affect, which is characterised by contentment, calmness and relaxation, 2) unactivated unpleasant affect, characterised by lethargy, boredom or fatigue, 3) activated unpleasant affect, characterised by tension, stress or nervousness and 4) activated pleasant affect, an affective state characterised by excitement, enthusiasm or happiness (Hall et al., 2002). The Feeling Scale (FS): (Hardy & Rejeski, 1989) has been used consistently to assess affective responses, while the Felt Arousal Scale (FAS): (Svebak & Murgatroyd, 1985) has been used to assess activation levels (P. Ekkekakis, 2003; Van Landuyt et al., 2000). Taking a dimensional approach to the measurement of affect can, theoretically, capture the full range of basic affective response to exercise. Previous research assessing patterning of responses has typically assessed FS, FAS, ratings of perceived exertion (RPE) and heart rate (HR) across a Graded Exercise Test (GXT) to capture a full picture of individuals' responses across exercise intensities. Most research exploring affective responses to exercise has been conducted with adult populations, and whilst this has proven useful in understanding the relationship between affective responses to exercise and different intensities in adults, it is not known if the same pattern of affective responses exists in adolescent girls and younger children. Studies with adults show a uniform pattern of decline in affect after VT (16, 43), but inter-individual differences exist prior to VT. For example, inactive women show a quadratic decline in affect from the start of exercise (Welch et al., 2007), whereas active university students report stable, positive affective responses prior to VT (Hall et al., 2002). Sheppard and Parfitt (2008a) compared affective responses across a Graded Exercise Test (GXT) between low-active men and low-active adolescent boys. In both groups, affect declined rapidly after VT. However, in the adolescent boys, there was no significant decline in affect before VT in contrast to a rapid, quadratic decline in affect before VT in the men. The relatively stable positive affective responses of the adolescent boys prior to VT, with no significant differences between time points, suggest that exercise performed at this intensity may elicit positive responses and may therefore encourage positive attitudes to exercise and not have a detrimental effect on future PA participation. Recent studies with adults have reported that activation levels decline significantly after VT (Hall et al., 2002; Welch et al., 2007), indicating that this is a relationship that needs to be explored with children and adolescents.

The precise patterning of affective responses, at various exercise intensities are unknown in children and girls, although acute studies do indicate that we may know what happens at discrete intensities (Schneider et al., 2009; Stych & Parfitt, 2011); there is limited evidence to indicate where the decline in affective responses start.

The aim of this study was to investigate affective responses to a maximal incremental exercise test to volitional exhaustion in children and adolescents. It was hypothesised that affective valence (FS) would decline significantly after VT had been reached in both age groups. Given the inconsistency of literature with regard to affective responses prior to VT, no a priori hypotheses were formulated regarding how affect may differ across age and sex prior to VT. Children and adolescents were therefore grouped separately to explore any possible sex or age effects. Based on previous studies with adults, it was also hypothesised that activation levels would decline significantly after VT had been reached.

Methods

Participants

Power calculations were conducted using GPower (Erdfeld, Faul & Buchner, 1996) and indicated that fifty participants were required to ensure adequate sample size. Multiple schools, both primary and secondary, were approached and a member of the research team presented the proposed study to teachers (either the head teacher or PE staff) from schools who expressed an interest in pupils from their school participating in the study. Information letters were sent out by the teachers to all eligible children and their parents. All participants who expressed interest and returned completed and signed consent and assent forms to their teacher were recruited in to the study. Fifty children and adolescents were recruited in to the study; however one participant dropped out before testing. Forty-nine children and adolescents (21 males and 28 females; (23 children; school years 4-6, age: 8-11y and 8 months), 26 adolescents; school years 7-9, age: 11y and 9 months-14 years) from schools in the South West of England were successfully recruited for this study. All participants, as well as their parent/guardian, read and signed informed consent forms approved by the Institutional Ethics Committee prior to participating (see appendix 1a- 4a). Participants completed a child-specific Physical Activity Readiness Questionnaire (PAR-Q) and were healthy and free from muscular-skeletal injury.

Measures

Affect:

Affect was measured from the perspective of the circumplex model, using two independently validated single-item scales: The Feeling Scale (FS) and the Felt Arousal Scale (FAS).

The Feeling Scale (FS)

Affective valence (pleasure/displeasure) was measured using the FS (Hardy & Rejeski, 1989). Participants rated their current feelings on an 11-point bipolar scale ranging from +5 to -5, with verbal anchors of very good (+5), good (+3), fairly good (+1), neutral (0), fairly bad (-1), bad (-3), and very bad (-5). The FS has been found to correlate between 0.51 and 0.88 with the valence scale of the Self-Assessment Manikin (SAM); (Lang, 1980), and from 0.41 to 0.59 with the valence scale of the Affect Grid (Van Landuyt et al., 2000), and has been used successfully with child and adolescent populations previously (Schneider et al., 2009; Sheppard & Parfitt, 2008, 2008a)

Felt Arousal Scale (FAS)

Activation levels were measured using the Felt Arousal Scale (FAS). The FAS of the Telic State Measure (Svebak & Murgatroyd, 1985) is a single-item measure of perceived activation, with participants asked to rate themselves on a 6-point scale ranging from 1 to 6, with anchors at 1 'low arousal' and 6 'high arousal.' The FAS has been found to exhibit correlations ranging from .45 to .70, with the arousal scale of Lang's (1980) self-assessment Manakin, and from .47 to .65 with the Arousal Scale of Russell et al. (1989) Affect Grid (Van Landuyt et al., 2000).

Participants were given standardised instructions on how to use the scales and had time to practice during the familiarisation stage.

Previous Exercise Experience

All participants prior to exercising on the treadmill were asked to indicate whether they had exercised on a treadmill before or not. Participants were also asked to describe their usual PA by responding to the question, *'how active are you normally*?'

Instruments

K4 Breath Analyser

The K4 Cosmed Breath analyser (Cosmed K4, Italy), with a junior face mask, head net and harness, was used in order to measure breath by breath expired gases throughout the duration of the testing. The K4 has been shown to provide valid measurements of oxygen uptake across a range of exercise intensities (McLaughlin, King, Howley, Bassett, & Ainsworth, 2001). The K4 was calibrated before every test in accordance with manufacturer's guidelines against known concentrations of cylinder gases and a 3-L syringe (for flow volume).

Polar Heart Rate Monitor

A Polar heart rate monitor (Polar Electro, Finland) was used in order to measure heart rate throughout the duration of the testing. Heart Rate (HR) was recorded continuously using a wireless chest strap telemetry system with a watch worn on the right wrist.

Ratings of Perceived Exertion (RPE)

Perceived exertion was assessed using the Eston-Parfitt (E-P) curvilinear Ratings of Perceived Exertion Scale (Eston, Lambrick, & Rowlands, 2009). This scale depicts a character at various stages of exertion on a concave slope with a progressively increasing gradient at the higher intensities. The distance between each numbered increment on the horizontal axis (0-10) is increasingly reduced in relation to its antecedent. The area under the curve is also progressively shaded from light to dark from left to right, respectively. The E-P scales has verbal anchors from 'very, very easy' (0), 'easy' (2), 'starting to get hard' (4), 'very hard' (7) up to 'so hard I am going to stop' (10). Strong linear (R^2=.93) and curvilinear (R^2=.94) relationships between RPE from the E-P Scale and work-rate in children aged 7 - 11 have confirmed the robustness of the E-P Scale (Eston et al., 2009). The same verbal instructions were given to all participants prior to undertaking any exercise, and participants were given several minutes to familiarise themselves with the scale. (For full instructions see Eston et al. 2009).

Procedures

Height, seated height, and mass, using Tanita BIA BF-350 body composition analyser (foot to foot) scales, (Tanita UK Ltd., Middlesex, UK) were measured upon arrival at the laboratory and body mass index (BMI) and body mass percentile was calculated. Prior to testing each individual was fitted with a Polar heart rate monitor and a K4 Cosmed Breath analyser complete with a face mask.

Participants were briefed on the procedures for the Graded Exercise Test (GXT). The GXT was completed on a Woodway PPS 55 Sport slat-belt treadmill (Woodway GmbH, Weil am Rhein, Germany) in 1-minute stages at a comfortable, self-selected running speed, increasing the gradient by 1% every minute. The test was continued until the participant reached volitional exhaustion. During the test, at the end of every incremental step (last 20-seconds of every period) FS, FAS and RPE scores were collected.

Prior to the GXT participants were given a familiarisation session on the treadmill, which involved both walking and running at different speeds on various gradients for several minutes at each speed and gradient. The familiarisation period gave the participants the opportunity to gain experience of using both the treadmill and familiarising themselves with the sensations associated with walking and running, as well as and familiarising themselves with the scales used throughout.

Whilst the GXT is far removed from young children's typical PA experiences it was felt an appropriate test to use in the current study. It enabled affective responses to be plotted and recorded at intensities below-, at- and above-VT for all participants. By performing the GXT it meant that participants' affective responses could readily be compared for exercise bouts of the same metabolic intensity, thus allowing direct comparisons between individuals and groups.

Data reduction and analysis

$\dot{V}O_2$peak, the greatest amount of oxygen consumed during strenuous aerobic exercise, was calculated for all participants. Research has indicated that many children may not be able to attain a plateau in $\dot{V}O_2$, which is necessary to calculate $\dot{V}O_2$ max, despite a maximal effort (McMurray, Guoin, Ainsworth et al. 1998). VT was determined from the GXT data as the first disproportionate increase in carbon dioxide output ($\dot{V}CO_2$) relative to the increase in $\dot{V}O_2$. This was achieved from visual inspection of individual plots of $\dot{V}CO_2$ versus $\dot{V}O_2$ by two independent assessors. Breath-by-breath data from each test were smoothed to average every 10 seconds, to make visual identification of the break point clearer. This point was verified by plotting ventilatory equivalents of CO_2 ($\dot{V}E/\dot{V}CO_2$) and O_2 ($\dot{V}E/\dot{V}O_2$) against time, and identifying the point at which $\dot{V}E/\dot{V}O_2$ systematically increased, independent of an increase in $\dot{V}E/\dot{V}CO_2$ (Beaver, Wasserman, & Whipp, 1986). VT was independently identified by two assessors.

Given that the duration of the GXTs varied among participants and following the method of data reduction and analysis used in Hall et al.'s (2002) study, exercise data for all dependent variables (HR, RPE, FS and FAS) were standardised following the identification of VT. The following time points were used: the first minute (Min 1), the minute of VT (VT), the first minute after VT (VT+1) and the last minute (End); a similar pattern to that used by Sheppard and Parfitt (2008).

A series of Two-factor ANOVAs were run on descriptive data (height, mass, BMI, waist, $\dot{V}O_2$ Peak and VT). Three factor mixed-model analyses of variance (ANOVAs) with repeated measures across time were conducted to examine differences between age group (children: school years 4-6, aged 8-11 and adolescents: school years 7-9, aged 11-14) sex (boys, girls) and time points (min1, VT, VT+1, end) on each dependent variable: HR, RPE, FAS and FS. Where sphericity was violated, Greenhouse-Geisser was used to adjust the degrees of freedom and these are reported. Post-hoc Tukeys tests were carried out on significant interactions to examine where differences lay. FS and FAS responses were plotted within the affective space of the circumplex model (J.A. Russell, 1980) to identify the patterning of the data.

Results

Variable	Sex	Years 4-6	Years 7-9
Age (y)	Boys Girls	9.3 ± 1.0 8.9 ± 0.8	12.2 ± 0.8 12.4 ± 0.9
Height (cm) *a***	Boys Girls	140.6 ± 10.2 137.8 ± 10.0	157.2 ± 10.9 158.4 ± 7.8
Mass (kg) *a***	Boys Girls	35.4 ± 6.8 34.3 ± 7.9	42.4 ± 6.9 48.6 ± 11.5
Body Mass Index (BMI) ($kg.m^{-2}$)	Boys Girls	17.9 ± 1.9 18.1 ± 3.1	17.1 ± 1.0 19.3 ± 3.4
Body Mass Percentile (%)	Boys Girls	64^{th} ± 0.2 58^{th} ± 0.3	31^{st} ± 0.3 *a*** *b*** 48^{th} ± 0.3
VO_2 Peak ($mL \cdot kg^{-1} \cdot min^{-1}$) *a**	Boys Girls	46.7 ± 12.8 *b** 37.0 ± 9.0 *b**	51.5 ± 6.7 *b** 43.7 ± 8.8 *b**
VT ($mL \cdot kg^{-1} \cdot min^{-1}$) *a** *b**	Boys Girls	36.9 ± 10.5 27.2 ± 8.2	41.3 ± 6.7 *b** 36.2 ± 6.5 *b**
VT as a % of VO_2 max (%)	Boys Girls	79.1 ± 5.9 73.0 ± 9.2	80.3 ± 10.0 84.4 ± 14.6

Table 2 Mean Descriptive Characteristics of Participants

*a= age main effect *p <0.5 **p <0.01*

*b= gender main effect *p<0.5 **p<0.01*

Two-factor ANOVAs were run to determine any significant differences between age and sex on the descriptive data (Table 2). The adolescents were significantly taller ($F_{1, 45}$ =44.7, p<.001) and heavier ($F_{1, 45}$ =16.9, p<.001) than the children, but there were no differences between boys and girls or age X sex interactions. BMI did not differ significantly across either age-group or sex. However, when reported as percentiles, body mass was significantly lower in the older boys (years 7-9) compared to both girls of that age and the younger boys. $\dot{V}O_2$ peak was significantly higher in the adolescents ($F_{1,4.2}$ = 376.4, p<.05) and the boys ($F_{1, 9.8}$ = 879.9, p<.01, but no interactions were evident. $\dot{V}O_2$ at VT was also significantly higher in the adolescents ($F_{1,9.3}$ =822.4, p<.01) and the boys ($F_{1, 4.4}$ = 390.9, p<.05), but there were no significant differences in the % of $\dot{V}O_2$ max at VT for age or sex .

HR and RPE

The HR and RPE ANOVAs revealed significant main effects for time ($F_{1.6,\ 52.4} = 102.4$, $P<0.01$: $F_{2.2,\ 96.2} = 120.7$, $P<0.01$ respectively), with significant increases between each time point for both physiological variables (Table 3). No further significant main effects or interactions emerged.

Variable	Time Point	Boys		Girls	
		Years 4-6	Years 7-9	Years 4-6	Years 7-9
HR	Min1	171.5 ± 22.0	179.0 ± 16.5	171.2 ± 17.6	178.4 ± 13.6
	VT	181.4 ± 20.2	187.0 ± 19.7	185.6 ± 14.3	186.6 ± 14.6
	VT+1	185.9 ± 19.6	191.5 ± 18.7	189.2 ± 13.1	192.6 ± 12.1
	End	195.1 ± 17.5	200.7 ± 12.2	203.11 ±5.8	199.0 ± 11.0
RPE	Min1	5.6 ± 2.7	4.9 ± 2.2	4.8 ± 1.7	4.3 ± 1.7
	VT	6.6 ± 2.7	6.3 ± 1.9	6.1 ± 1.9	5.8 ± 1.5
	VT+1	7.5 ± 2.4	7.6 ± 1.7	6.8 ± 1.5	6.6 ± 1.5
	End	8.6 ± 1.8	9.3 ± 0.9	9.1 ± 1.0	8.3 ± 1.7
FS	Min1	0.5 ± 3.4	1.0 ± 1.9	1.2 ± 1.6	0.9 ± 1.8
	VT	0.0 ± 3.7	-0.9 ± 3.0	0.3 ± 1.7	0.9 ± 2.0
	VT+1	0.1 ± 3.7	-1.8 ± 3.4	0.2 ± 2.2	0.3 ± 1.9
	End	-1.5 ± 3.6	-1.7 ± 2.8	-2.4 ± 1.9	-2.2 ± 1.8
FAS	Min1	4.0 ± 1.7	2.8 ± 1.0	3.6 ± 1.0	3.0 ± 0.9
	VT	4.3 ± 1.7	4.2 ± 1.8	3.9 ± 1.0	2.9 ± 0.8
	VT+1	4.2 ± 1.8	4.0 ± 1.9	4.3 ± 1.2	3.3 ± 0.8
	End	4.7 ± 1.8	3.7 ± 2.1	5.3 ± 0.9	3.6 ± 1.4

Table 3 Mean Values of Variables over the GXT across Age and Gender

FS

The FS ANOVA showed a significant main effect for time ($F_{2.3,\ 82.7} = 74.3$, $P <0.01$, and a significant time by age-group interaction ($F_{2.3,\ 82.7} = 3.8$, $p<0.05$), no further significant effects were evident (Figure 4). An adjustment was made to the alpha level and post-hoc tests confirmed that the main effect was due to significant changes in FS scores between each time point; from min 1 to VT, and from VT to VT+1 and then from

VT+1 to the end of the GXT. For the interaction, post-hoc tests revealed that the temporal patterns of FS scores differed between age groups with children reporting significant declines in FS responses from the onset of exercise, whilst the adolescents' affective responses remained relatively stable and did not change significantly over time before VT. After VT patterns of FS responses were similar for both age groups until after VT+1 where significant group differences were evident. Differences between children and adolescents reached statistical significance only after the VT+1 to end exercise period. End scores were lower in the adolescent group (-2.17±0.5) than in the children (-1.31± 0.6).

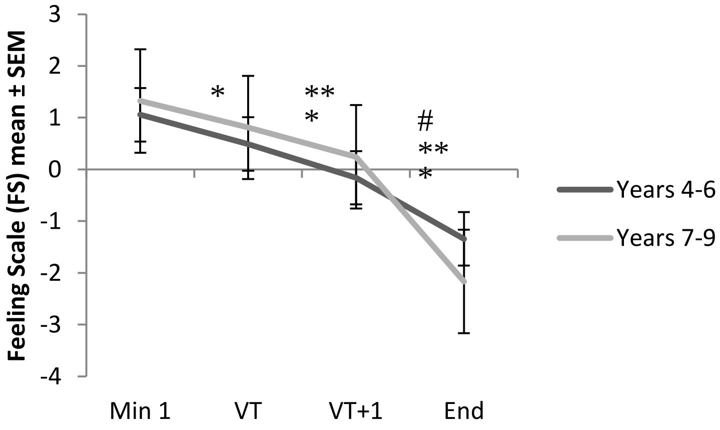

Figure 4 Change in Affective Valence During the GXT

**=significant changes between time points (years 4-6)*

***=significant changes between time points (years 7-9)*

#=significant changes between groups

FAS

The FAS ANOVA revealed a significant main effect for time ($F_{2.039,\ 73.411} = 13.40$, $p<.001$) but no other significant effects. Post hoc tests of the significant time main effect revealed that there were no significant changes in FAS scores from min 1 to VT or from VT to VT+1 but there were significant increases in FAS scores from min 1 to end, VT to end and VT+1 to end (Table 3).

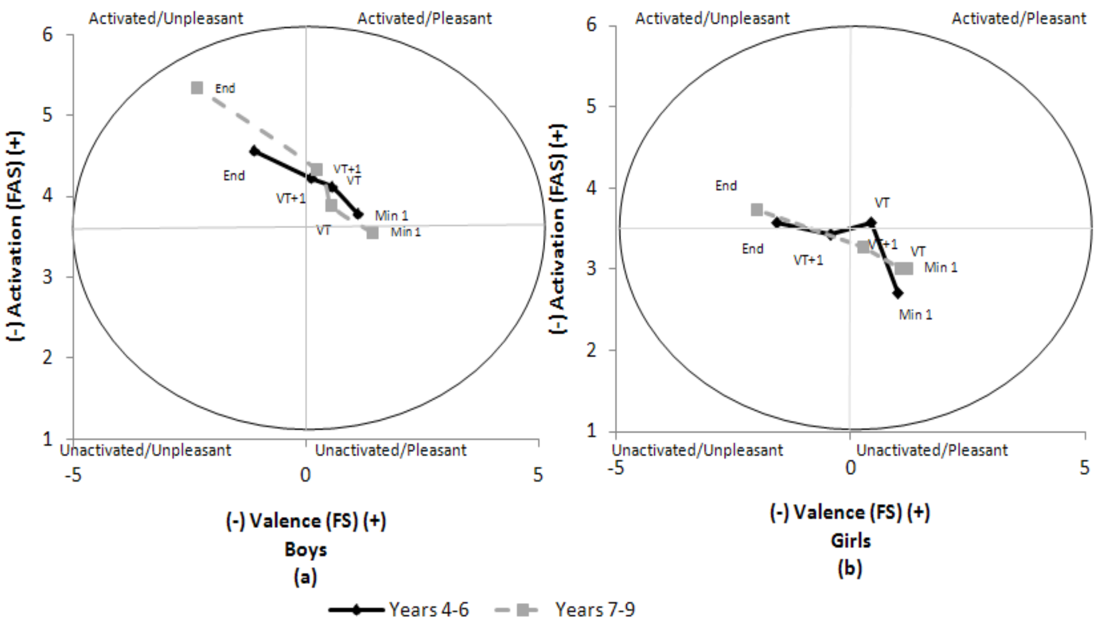

Figure 5 Valence and Activation responses during GXT plotted on to circumplex space

Valence and activation responses during the GXT were plotted onto a circumplex model to further explore the differences in responses between boys and girls and the children and adolescents (Figure 5). The boys reported pleasant feelings until after VT+1 when there was a shift into the activated/unpleasant domain. In contrast, the girls initially reported feeling unactivated/pleasant, with the older girls indicating that they felt unactivated until after VT+1 when there was a shift to the activated/unpleasant domain. The younger girls reported 'unpleasant' feelings immediately after VT at VT+1.

Discussion

The purpose of this study was to explore the patterns of responses in affective valence in boys and girls (ranging in ages from 8-14 y) to a GXT and to compare these results to those found in previous adolescent (Sheppard & Parfitt, 2008) and adult populations (Hall et al., 2002; Sheppard & Parfitt, 2008; Welch et al., 2007). Consistent with the hypothesis and previous literature (Ekkekakis et al., 2009; Hall et al., 2002; Sheppard &

Parfitt, 2008; Welch et al., 2007) affective valence significantly declined after VT in both children and adolescents. However, affect did not significantly decline until after VT in the adolescents. In the children, similar to the pattern of responses found in sedentary men (Sheppard & Parfitt, 2008), there was a significant decline in FS responses from the onset of exercise through to exhaustion. This decline before the VT highlights that even exercise at a lower intensity can represent a negative experience (Parfitt, Eston, & Connolly, 1996; Sheppard & Parfitt, 2008). It should be noted that, despite this decrease in affect from the start of exercise in children, differences between children and adolescents reached statistical significance only after the VT+1 exercise period. Previous studies exploring the temporal pattern of FS (Sheppard & Parfitt, 2008) have revealed results similar to those observed in the adolescents' data: Stable positive affective valence prior to VT followed by significant declines after VT. In the current study, the steep drop in affect between VT+1 and the end point (End) in the adolescents led to a significantly lower affect in the adolescents relative to the children. It should be noted that the duration of GXTs were substantially longer for the adolescents than the younger children, with the average length of the GXT at 6.3 minutes for the adolescents and only 5.3 for the children. Adolescents spent 26.4% of the GXT from Min1 to VT, 18.2% of time from VT to VT+1 and 37.3% of time from VT+1 to End, whilst the children spent 24.1% of the GXT from Min1 to VT, 21.2% of time from VT to VT+1 and 33.7% of time from VT+1 to End. These results indicate that the adolescents spent substantially more time from VT+1 to end than the children, suggesting that the adolescents have relatively longer for the interoceptive cues to be registered more acutely, hence the steeper drop in affective responses after VT+1. The continuous nature of the GXT may influence affective responses, particularly in the younger participants. Research suggests that children generally engage in short, sporadic bursts of activity (Bailey et al., 1995; Berman, Bailey, Barstow, & Cooper, 1998) and is characterised by short, intermittent bouts of activity (Stone, Rowlands, Middlebrook, Jawis, & Eston, 2009) rather than the continuous exercise bouts that were imposed in this study. As the GXT did not reflect the natural activity pattern of the children, it may have contributed to the decline in affective responses.

The pattern of decline in FS responses before VT in the children may be related to their lack of experience of continuous exercise and thus lack of cognitive cues to draw upon. McAuley and Courneya (1992) suggested that self-efficacy is an important factor underlying affective responses brought about by exercise, suggesting that the more positive one's self-efficacy, the more positive affective responses one reports having. McAuley and Courneya (1992) proposed that a highly efficacious person is expected to exhibit more positive affect compared to a less self-efficacious one. Given that the younger children had no experience of treadmill exercise, and will rarely have participated in long, continuous bouts of exercise it could be suggested that their beliefs in their own competence in this exercise would be relatively low and could contribute to this decline in affective responses from the onset of exercise. Welch at al., (2007) found similar response patterns in their cohort of inactive woman who also revealed a continual, significant, decline in FS throughout the GXT, with significant differences in FS between each time point.

A mean decline in affective valence was observed much earlier in the children's responses compared to those found in previous studies (Hall et al., 2002) with active university students. These results were similar to those found in sedentary women (Welch et al., 2007) and inactive men (Sheppard & Parfitt, 2008). The mean decline in affective valence that occurred before VT suggests that, for children, affective change is not as homogeneously positive within the moderate intensity domain as suggested by Ekkekakis et al. (2005a). These results are important because they indicate that more attention needs to be paid to exercise prescription with regards to intensity for children to avoid negative affective responses being reported. Children appear to report more positive affective responses below VT than above them, a result that needs to be considered when developing different exercise programmes for children and adolescents. Caution needs to be taken, however, to not assume that below VT there is no variability in affective response. Stych and Parfitt (2011) reported high variability in affective responses below VT, indicating that research needs to focus on individual differences alongside exercise intensity.

Bandura (1986, 1997) suggested that limited mastery opportunities will negatively influence a person's cognitions, particularly with reference to task completion. Perhaps, given the age and limited experience of continuous exercise of the younger participants, it is unsurprising that they reported declines in affective valence even within the moderate intensity domain. Other than the familiarisation period in the lab, none of the younger participants had ever walked or run on a treadmill which could be a contributory factor towards the continual decline in affective valence. Parfitt and Hughes (2009) indicated that the previous activity history of the participant may influence affective responses during exercise and contribute to their perception of ability and perception of the intensity of the exercise (Rose & Parfitt, 2007) and thus their overall affective response. Parfitt and Hughes (2009) also report that based on previous activity history, affective responses were universally more negative in less active individuals (30 minutes of activity less than once per week). This could link to the younger children in this study, as it may be appropriate to suggest that the younger participants' previous experiences of continuous exercise history was not as extensive as that of the older participants hence the continual decline in affective responses from the beginning of the GXT in comparison to the stabilised affective responses seen over the same time-period in the older participants.

After VT has been reached there is a significant decline in affective valence in both the children and adolescents; an expected outcome. It has been theorised (P. Ekkekakis, 2005b) that as intensity increases above VT affective response will become much more negative and exhibit little variability due to the over-riding influence of interoceptive cues. This is because affective responses are no longer influenced by cognitive processes, such as exercise experiences and goals, but the actual physiological cues that are being experienced by the individual, which do not vary. This is an important result with relation to the exercise-adherence relationship. With exercise above the VT eliciting a uniformly negative response it suggests that exercise prescription should focus on identifying a level of intensity near the VT, at which participants can maintain a constant or improving (but not diminishing) level of pleasure (Ekkekakis, Parfitt, & Petruzzello, 2011) in order to ensure a positive affective response and thus encourage continued exercise adherence.

Using the circumplex model (Bixby et al., 2001) helps to a) illustrate that affective responses change dynamically to changes in the intensity of exercise and b) highlight that the transition between exercise domains represents an inherently negatively-charged stimulus. Once exercise exceeded VT and entered the heavy domain there was a continued increase in perceived activation, accompanied by a progressive deterioration in valence. Described in terms of the circumplex model, the mean affective responses moved from the unactivated pleasant domain, via the pleasant activated domain into the activated unpleasant domain after VT+1. This pattern is similar to that found by Hall et al. (2002) and Welch et al. (2007).

Data from the circumplex model revealed apparent differences across all groups. The boys followed a similar pattern to that found in low active men (Sheppard & Parfitt, 2008), university students (Hall et al., 2002) and inactive women (Welch et al., 2007);

moving from the unactivated pleasant domain, through the pleasant activated domain and ending in the activated unpleasant domain after VT had occurred. Whilst the girls reported similar responses after VT, with activated unpleasant feelings, there were differences prior to this (Figure 5). Although these circumplex models suggest big differences between ages and sex, there were no statistical differences between groups in the separate FS (apart from between VT+1 and end exercise) or FAS responses (Table 3). The circumplex do show that feelings of pleasure clearly decreased across time continually from the onset of exercise and can be useful to highlight the dynamic changes in affect across different intensities and support the differential response of children to exercise compared to results found in previous adult studies

Conclusion

The data fit the expected pattern of responses predicted by the dual-mode theory and demonstrate that exercise above the VT brings about significant declines in affective valence regardless of sex, but the patterning of affect differed across the age-groups. In children, affective valence declined significantly prior to VT whereas the decline in adolescents was not significant. The differences between boys and girls responses to the GXT plotted onto the circumplex model demonstrated that boys and girls responded differently during the GXT, whilst both groups finished the maximal test feeling 'activated and unpleasant', the different routes taken by boys and girls requires further exploration in terms of the individual differences that may influence these responses, an idea supported by qualitative analysis carried out by Stych and Parfitt (2011).

These results may be important with regards to exercise prescription as acute affective responses have been shown to predict future exercise adherence. Results suggest the need to prescribe exercise intensities lower than VT for children to ensure a positive affective response

Limitations and future recommendations

Given that by its nature the GXT creates an unfamiliar and uncommon exercise experience for the children, it is not necessarily unexpected that a decline in affective response occurs from the onset of exercise. This bout of continuous exercise is not typical of children's habitual activity and thus offers a considerable limitation to this study. Future research needs to explore affective responses to different intensity activities using activities that are more applicable and appropriate for younger children. Studies need to investigate affective responses to short bursts of different exercises and activities with varying intensities to give a more in-depth overview of the patterning of the affect and exercise relationship in children.

Previous research (Parfitt & Hughes, 2009) has shown that previous experiences of PA or exercise can contribute to affective responses, whilst the current study collected very basic data regarding individual's usual PA behaviour and previous treadmill experience, future studies should seek to collect a more in-depth PA history in order to explore relationships between previous PA experience and history and affective responses. Affective responses in the current study may have been affected by previous PA experiences, however, lack of PA history data mean that this relationship could not be assessed.

Given that none of the participants had performed a GXT prior to the current study affective responses may not have been accurately reflected across the different exercise intensities. Subsequently, a limitation of the current study is that it did not give participants the opportunity to perform a familiarisation GXT before affective responses were recorded. With the GXT being an unfamiliar experience to participants it may have resulted in more negative affective responses across the exercise intensities as participants did not know how it would feel or what to expect.

An additional source of bias in the data exists with regard to social desirability. Some participants may have reported more positive affective responses to the exercise session as they believed that this was how they should be responding. Alongside this, as none of the participants had performed a GXT to volitional exhaustion it is plausible that participants did not know what exhaustion was and thus did not reach their VO2 Peak. To overcome some of these sources of bias future studies should allow participants the opportunity to have a familiarisation GXT to ensure that all participants are aware of what to expect.

In order to establish a more complete picture of the changes in affective response across exercise domains future studies may consider recording FS responses more frequently so that once data has been standardised into time points more data is available to give greater insight into the patterning of affective responses across different exercise intensity domains in children and adolescents. Future research should explore other factors that contribute to affective responses in order to further understand the findings in the current study.

Chapter 4

Study 2 - The construction and development of a modified version of the Preference for, and Tolerance of, Exercise Intensity Questionnaire (PRETIE-Q) for an adolescent population[2]

[2] Manuscript in preparation, in conjunction with study 5a, for submission to *Journal of Personality and Social Psychology*

Abstract:

Objective: Preference and tolerance have been proposed as two key factors that may contribute to exercise intensity selection. Originally a 16-item, 2-factor questionnaire was developed to assess preference for, and tolerance of, exercise intensity in an adult population. The objectives of the current study were to explore the content and structure of this questionnaire to establish a child and adolescent-specific questionnaire.

Methods: 568 young people (377 females, 191 males, age = 13.2±1.4 years) completed a 22-item questionnaire to assess preference and tolerance. The factor structure of the questionnaire was tested using Confirmatory Factor Analysis (CFA). Internal consistency, correlations and test-retest analysis were run upon conclusion of the CFA. Reliability of the proposed structure was assessed with a different adolescent population.

Results: Analysis resulted in an 11-item, 4-factor model that exhibited good psychometric properties and was shown to be a 'good fit'; $X^2(38)$ test = 3.4, CFI = .96, RMSEA = .07, GFI = .96, SRMR = .05, with good internal consistency and test-retest reliability. The structure remained a good fit in an additional group of adolescents.

Conclusion: Preference and Tolerance traits are best measured as dichotomous factors given the lack of experience that adolescents may have when defining themselves within these domains. Results show it is important to identify preference and tolerance scores so that exercise practitioners can match exercise intensity to the individual in order to elicit more positive affective responses.

Introduction:

Considerable inter-individual variability in affective responses at Ventilatory Threshold (VT) and below has been shown between individuals, indicating that individuals respond differently to the same prescribed intensity levels (Van Landuyt et al., 2000). Coupled with this, research also indicates that individuals self-select very different exercise intensities when given the choice (Spelman, Pate, Macera, & Ward, 1993). This presents problems when trying to prescribe safe (avoidance of injury, over exertion), effective (in terms of health and fitness benefits) and positive (in terms of affective valence) exercise experiences which all may impact on adherence. There has been increased research attention on individual differences in the preference for, and tolerance of, exercise intensity (ACSM, 2000; Dishman et al., 1994; Ekkekakis et al., 2005c). Dishman et al. (1994) stated that "there is scientific consensus that preferred and perceived exertions are possible determinants of self-selected exercise intensity" (p.783). They went on to suggest that these areas are understudied, and that there is potential for exercise prescriptions that focus on preferred intensities to contribute to an increase in adherence to exercise programs. The ACSM (2011) reinforced this notion, and indicated that a focus on individual preferences should be incorporated into behaviour change strategies in order to enhance adoption and maintenance of regular exercise and physical activity.

Ekkekakis et al. (2005c) reported that differences between individuals appear to be substantially larger than the difference within the same individuals across observations, suggesting the presence of stable individual-difference traits that influence the intensity of exercise a person is predisposed to select or tolerate (Ekkekakis et al., 2005c). Preference and Tolerance have been proposed as two key factors that may contribute to exercise intensity selection (Ekkekakis et al., 2005c). Preference refers to a predisposition to select a particular level of exercise intensity when given the opportunity (e.g. when engaging in self-selected or unsupervised exercise). Tolerance refers to a trait that influences one's ability to continue exercising at an imposed level of intensity even when the activity becomes uncomfortable or unpleasant (P. Ekkekakis et al., 2005c).

Research has shown that both Preference and Tolerance accounted for significant variance of affective valence at exercise intensities around the VT and the tolerance construct explained significant variance in exercise intensity exceeding the VT (Ekkekakis et al., 2005c). Further research by Ekkekakis et al. (2006) found that preference is able to predict physiologically defined self-selected exercise intensity. Preference for, and Tolerance of, exercise intensities are thought to be closely linked to affective valence responses, due to the specific areas of the brain that are involved in generating responses being relevant to individual differences in intensity-preference and intensity-tolerance (Ekkekakis et al., 2005c).

The Original PRETIE-Q

Researchers have developed a self-report measure aimed at capturing individual differences in the preference for and tolerance of exercise intensity: The Preference for and Tolerance of the Intensity of Exercise Questionnaire (PRETIE-Q) (Ekkekakis et al. 2005c). The PRETIE-Q is a 16-item, 2-factor measure. The PRETIE-Q has been shown to be stable and consistent with a 3-month test-retest reliability coefficients of .67 for Preference and .85 for Tolerance and the 4-month test-retest reliability coefficient .80 for Preference and .72 for Tolerance (Ekkekakis et al., 2005c). Confirmatory factor analysis showed a reasonably close fit (with goodness-of-fit indices) to the two-factor structure; $x^2(103) = 216.3$, $p<.001$, $x^2/df = 2.10$, CFI = .87, GFI = .87, and RMSEA = .078. Internal consistency was also examined, with Cronbach's alpha coefficients for the preference scale being .85, .83 and .81, and scores of .87, .82 and .86 for the tolerance scale. Concurrent validity was assessed against the Behavioural Inhibitions/Behavioural Activation questionnaire, with results supporting the concurrent validity of the PRETIE-

Q, but also justifying the need for the PRETIE-Q as a separate measure. The PRETIE-Q was developed for use with adult populations and items were developed with young, healthy adult participants, indicating that this model may not be applicable or generalizable to other population groups, such as children or older adults.

Previous Research using the PRETIE-Q in different populations

Results suggested that the PRETIE-Q could be a useful tool in capturing inter-individual differences in the Preference for and Tolerance of exercise intensity. Whilst this questionnaire has shown acceptable reliability and validity for use with adult populations, Sheppard (2008) examined the PRETIE-Q in a young adolescent population and found it did not fit the proposed model. Confirmatory factor analysis was run to test a better model specific for use with children and adolescents, with modifications being made to items, including the removal of items and modification of language. Results indicated that a 7-item, 2-factor structure was a better fit for the adolescent population. Failure to confirm the model structure with a child and adolescent population suggests that the development of population-specific PRETIE-Q measures may be appropriate.

Structure of the PRETIE-Q

Although the 16-item, 2-factor model of the PRETIE-Q has advanced research on the Preference and Tolerance factors of personality, Sheppard (2008) suggested that the content was not appropriate for use with a child and adolescent population. This directed research to explore different contents and items. The original PRETIE-Q was conceptualised around two traits; Preference and Tolerance, and developed from a pool of 4 individual constructs; high preference, low preference, high tolerance and low tolerance. Factor analysis revealed 2 clear factors, in support of the trait theory. Given the clear findings to support the 2-factor structure, there is little precedent for exploring other factor models within the adult population. However, self-schema literature and self-concept literature suggest that adolescence is a time during which there is continual development of the 'self' (Monge, 1973; Simmons, Rosenberg, & Rosenberg, 1973). As such, there may be some individuals who cannot conceptualise Preference and Tolerance as they may lack past experiences upon which to base the verbalisation of these traits. Individuals may also not be able to clearly differentiate between traits or readily identify themselves as possessing certain traits. Therefore, this study sought to explore whether adolescents found it easier to identify with four dichotomous factors rather than relying on their cognitive ability to identify specific personal traits. As a result it may be appropriate to assess the factor structure to determine whether a different factor structure may account for differences across adolescents. The inclusion of four factors, relating to the pool of 4 constructs initially used by Ekkekakis to develop the PRETIE-Q, may be worthwhile to enable individuals to more readily understand the questions and relate more easily to them. Ekkekakis et al. (2005c) suggested that future research should focus on reducing content overlap within the questionnaire and syntactical similarities between the items. This desire for a more parsimonious model, with greater exploratory power, directs research to explore not only the content of the questions in the model, but also to question the applicability of a 2-factor structure for children and adolescents.

Content of the PRETIE-Q

Concluding comments from Sheppard (2008) indicated that whilst the 7-item questionnaire demonstrated good qualities, the reduction of the scales meant that it lost some of its sensitivity. As such, researchers should look to further develop the questionnaire and make it more child and adolescent specific by adding new or re-worded statements to suit a young adolescent population. Results from Sheppard's analysis indicated that the strongest item in the 7-item questionnaire (according to the path diagram factor loadings and standardised residuals) was "Low-intensity exercise is boring." This is a clear, concise statement which uses simple language. Sheppard intimated that for the questionnaire to be effective with adolescents other items in the scale should be developed following this example. Sheppard also found that statements with the word 'fatigue' were consistently weakest in relation to the latent factors, and suggested that in the future development of the PRETIE-Q for children and young adolescents, re-wording 'fatigue' to simpler words such as 'tired' or 'low energy' might improve the strength of the questionnaire for this population.

Following Sheppard's concluding comments, this study sought to examine the utility of a newly formed version of the PRETIE-Q with the addition of 6 newly worded items to the original 16-items. To achieve this, the structural validity, internal consistency and test-retest reliability were investigated. Whilst both the original PRETIE-Q and Sheppard's modified version indicated a 2-factor model, this study also aimed to test the structure using factor analysis to establish whether the 2-factor model is the most appropriate for the use with children and adolescents. Upon conclusion, an additional study was carried out to establish the validity of the proposed questionnaire structure and content in a different population group. Results aimed to ensure that results were generalizable across other adolescent populations and did not merely reflect the results of the individuals in the original test group.

Methods:

Participants

The sample size calculation was based on the recommendations by Bentler and Chou (1987) indicating that for CFA n=10 per parameter; the 16-item, 2-factor model that was to be tested had the most parameters, 33, therefore following Bentler and Chou's recommendations 330 participants were required for an adequate sample size. Five hundred and sixty-eight children (377 females, 191 males; in school years 7-11 (mean age 13.2 years ± 1.4 years) from schools across South England were recruited for this study from a convenience sample. The school teachers acted in loco-parentis due to the non-invasive nature of the study. All participants read and signed consent forms approved by a University Ethics Committee prior to participating. Parents or Guardians were given opt-out consent forms that only needed to be returned if parents did not wish for their child to participate in the study, otherwise it was assumed that parental consent was gained.

PRETIE-Q

The original 16-item questionnaire was used to assess the variables of Preference for and Tolerance of exercise, with the addition of six new questions based on Sheppard's findings (2008) to make a 22-item questionnaire to enable the younger participants to understand and fully complete the questionnaires. The original 16-items were all included to enable comparisons to be drawn between findings from this study and the results presented by Sheppard. 10-items tapped 'Preference' and 12-items tapped 'Tolerance'. A 5-point response scale accompanied each item: (1= 'I totally disagree'; 2= 'I disagree'; 3= 'Neither disagree nor agree'; 4= 'I agree'; 5= 'I strongly agree').

Development of additional questions

Based on Sheppard's assertion that 'clear and concise' statements were most effective when attempting to elicit an accurate response 6 new questions were added to the original 16-items. These were derived from a combination of statements made by a cohort of children (n=49; 21 male and 28 females, Mean age = 10.8±1.8 years) and a group of researchers attempting to simplify the original statements.

Proposed Data Analysis:

The first study tested the original 16-item, 2-factor PRETIE-Q to confirm Sheppard's findings regarding the lack of fit to this model with a child and adolescent population. Following this, Sheppard's 7-item, 2-factor PRETIE-Q was tested to assess the goodness-of-fit of this model. Finally, upon the development of 6 new items based on research findings by Sheppard, a new 13-item model was assessed. Confirmatory factor analysis was also performed to determine whether a 4-factor model delivered the best fit and thus best structure, content and format. Once the best factor model had been established the goodness-of-fit of this model was assessed in an additional group of participants.

Analyses

The data were screened for outliers, missing values, and indices of non-normality. Items with low correlations to the latent variables in the path diagram were analysed in the standardised residuals matrix to identify which correlations were not well accounted for by the model. Large residuals indicate values that are not well accounted for by the model (Schumacker & Lomax, 2004). These variables identified with poor correlations in the path diagram and the largest residuals in the residual matrix were removed from the model. The criteria used to refine the CFA model was to examine the standardised residuals and identify those residuals larger than 1.96, alongside this modification indices were also examined, and those items with the largest modification indices (>7.0) were addressed first.

Structural Equation Modelling (SEM) enables researchers to specify a set of theoretically plausible models in order to assess whether the model proposed is the best set of possible models. Analyses were run to explore whether a different model could offer a better fit for the data and explain the preference-tolerance constructs more adequately.

Confirmatory Factor Analysis

The factor structure of the PRETIE-Q was tested using confirmatory factor analysis (CFA) with LISREL 8.30 (Joreskog & Sorbom, 1999). Single factor models were tested before testing paired models and then alternative models. Latent factors were fixed, with only the items designed as indicators of the relevant factors free to be estimated. The correlation among the Preference and Tolerance latent factors was not constrained but was left to be estimated. Assessment of fit was examined using the x^2 goodness-of-fit statistics and fit indexes. The x^2 test (x^2/df) was used to assess the model's fit (a level of 2.0 or less is indicative of adequate fit). Fit indices included standardised root mean square residual (SRMR, <.08 suggests a relatively good fit), the Comparative Fit Index (CFI), (a type of incremental fit index, measuring the improvement in fit offered by the hypothesised model over a baseline model, usually the 'null' or independence model (P.M. Bentler, 1990). For the maximum likelihood model of estimation and sample sizes >250, a level of 0.90 or higher is considered indicative of adequate fit (Hu & Bentler, 1995) and >.95 indicates a good fit, and the Root Mean Squared Error of Approximation (RMSEA). The RMSEA is a measure of 'badness of fit' or, more specifically a 'measure of discrepancy per degree of freedom' (Browne & Cudeck, 1992). A value of 0.05 or lower is considered indicative of a 'close fit' and 0.08 is considered a 'reasonable fit' (Browne & Cudeck, 1992) and <.06 indicates a relatively good fit. The goodness-of-fit index (GFI) represents a measure of 'absolute fit' and assesses the extent to which the hypothesised model can reproduce the sample variance/covariance matrix (Joreskog & Sorbom, 1993) For the maximum likelihood model of estimation and samples >250, a level of 0.90 or higher is considered indicative of adequate fit (Hu & Bentler, 1995).

Internal consistency, correlations and test-retest analysis were also run upon the conclusion of the CFA. The test-retest reliability of the PRETIE-Q was examined using a subsample (*n*=56; M=28, F=28, mean age = 13 yrs.) with the second assessment taking place 4-weeks after the initial assessment.

Results:

Model	Number of Items	Number of Factors	Chi Square	Df	x^2 test	CFI	RMSEA	GFI	SRMR
1	16	2	461.5	43	10.7	.74	.14	.86	.11
2	7	2	123.43	13	9.5	.81	.14	.93	.09
3	13	2	1005.82	64	15.7	.89	.17	.77	.09
4	13	4	274.48	59	4.7	**.96**	.09	**.93**	**.06**
5	11	4	129.83	38	3.4	**.96**	**.07**	**.96**	**.05**

Table 4 Results from the Structural Equation Modelling: Models 1 to 3 suggest 2-factor models; models 4 and 5 suggest 4-factor models

Initially the original 16-item, 2-factor model was tested to establish whether, as suggested by Sheppard, this structure was appropriate for use in a child and adult population. Results (table 4) confirmed Sheppard's findings. Next, the 7-item, 2-factor model proposed by Sheppard (2008) was tested to explore whether this model offered a good fit with the current population, and was generalizable beyond the previous test population. Results from the current study showed a relatively poor fit. These first two results demonstrate that previously proposed models are inadequate, suggesting the necessity for a revision of the model, its structure and content. Upon recommendation from Sheppard and the development of child-specific additional items a new 13-item, 2-factor model was assessed. Results showed a better fit than the previous models. However, results revealed that this 13-item, 2-factor model still was not a good fit, so the previously proposed 4-factor structure was assessed. Results supported the 4-factor model. A 13-factor, 4-item model was subsequently assessed and results supported the idea of a 4-factor structure. However, with the removal of 2-items (items 12 and 21) it offered an even better fit, all items in the questionnaire had good correlations with the latent variables and thus remained in the model. These results lead to the proposal of an 11-item, 4-factor model. The results shown in table 4 showed that there were no differences in CFI between model 4 and 5, so as a result other fit-indices were examined to explore differences between the 13- and 11-item models. All fit indices were indicative of a good fit, apart from the X^2test which showed that whilst the 11-item, 4-factor model provided a better fit than the 13-item, 4-factor model there was still scope for the questionnaire to be further improved. However, the indices suggest that the favoured model for the questionnaire was good and acceptable.

New No.	Original No.	Item	M	SD	Item Factor Loading			
					HP	LP	HT	LT
1	1	Feeling tired during exercise is my signal to slow down or stop	3.24	1.16				0.79
2	9	I'd rather slow down or stop when a workout starts to get too tough	3.07	1.20		0.80		
3	10	Exercising at a low intensity does not appeal to me at all	2.97	1.10	0.50			
4	13	When my muscles start burning during exercise, I usually ease off some	2.84	1.06				0.63
5	14	The faster and harder the workout, the more pleasant I feel	3.11	1.16	0.72			
6	16	Low-intensity exercise is boring	3.10	1.17	0.73			
7	17	Feeling tired during exercise does not make me stop	3.26	1.11			0.88	
8	18	I only stop exercising once I have reached my goals	3.15	1.13			0.72	
9	19	I always try to keep going	3.34	1.15			0.75	

		even if my muscles are sore and I feel tired				
10	20	Low intensity exercise appeals to me	3.17	1.13		0.56
11	22	I prefer high intensity exercise than low intensity exercise	3.24	1.15	0.89	

Table 5 Descriptive Statistics of final 11-items in the modified PRETIE-Q. Note: HP=High Preference, LP=Low Preference, HT=High Tolerance, LT=Low Tolerance

Internal Consistency and Test-Retest Reliability

Cronbach’s alpha coefficient of internal consistency was .74 for high tolerance, .68 for low tolerance, .73 for high preference and .65 for low preference. The 4-week test-retest reliability coefficient was .68 for high tolerance, .94 for low tolerance, .97 for high preference and .97 for low preference.

Correlations between Preference and Tolerance items

	HighPref	LowPref	HighTol	LowTol
HighPref	-	.35**	.46**	.12**
Low Pref		-	.23**	.52**
High Tol			-	.12**
Low Tol				-

Table 6 Correlations between Preference and Tolerance subscales. **=significant to .001

Study Part 2:

A second study was carried out to determine the validity of the proposed structure with a different adolescent population. The questionnaire was administered to 333 adolescent females (mean age = 13.87 ± .69 years) recruited for Study 5 from several local secondary schools in the South West who had expressed an interest in taking part in future research projects. Each item was again accompanied with a 5-point response scale, ranging from ‘I totally disagree’ to ‘I totally agree’. Fit indices reinforced the strength of the 11-item, 4-factor structure for use with this population: $x2$ test (38) = 138.43, x^2/df = 3.6, RMSEA = 0.08, CFI = .94, GFI = .93, SRMR = .062.

Conclusion and Discussion

This study aimed to expand Sheppard's 7-item PRETIE-Q with the addition of extra items, and compare this structure to the original 16-item, 2-factor version developed by Ekkekakis et al (2005c). The previously validated 16-item, 2-factor model by Ekkekakis (2005c) was developed and validated with healthy, college students who had extensive exercise experience (mean age 22.4 yrs); with no previous published research exploring the utility of the PRETIE-Q in a child and adolescent population. The objective of this study was to investigate the reliability and utility of, the modified PRETIE-Q for use with a young adolescent population so that results from such questionnaires could be used in future exercise prescription protocols. Results from this study indicated that the newly modified PRETIE-Q is both a valid and reliable method to assess an individual's preference for, and tolerance of, exercise intensity. Results also showed that these results are generalizable across other groups of young individuals, reinforcing the strength of the 11-item, 4-factor model.

The 11-item, 4 factor version of the PRETIE-Q found to be the best model differs significantly in structure from the original 16-item, 2-factor questionnaire developed by Ekkekakis et al (2005c) in that it proposes 4-factors, rather than 2. This 4-factor model appreciates that the basis of the original PRETIE-Q was conceptualised around the two Preference and Tolerance traits; however, the 4-factors present in the new model were a result of the dichotomisation of the two traits to make the model more child specific. Simmons et al (1973) suggested that there is a high degree of variability in aspects of self-concept and that it develops continually across the adolescent years (Monge, 1973). Knowledge of the self will be constrained by individual's general level of cognitive development (Harter, 1999) and will most likely progress unevenly. Harter (1999) went on to suggest that self-concept is multidimensional with stage like changes. Results from the current study lead to the possibility that preference or tolerance may be personality traits that are not well defined in adolescents as they may have lack of experience of defining themselves in this way, thus do not have the cognitive ability to define themselves in either a preference or tolerance schema. This suggests that for children and adolescents' individual preference for and tolerance of exercise intensity is best assessed by measuring one's preference for high intensity and low intensity separately, as well as individuals' tolerance of high and low intensity exercise. Specific questions aimed at establishing high preference and low preference mean that identifying those individuals with particularly high or low preference or tolerance are easier to recognise, thus enabling exercise practitioners to prescribe exercise sessions on a much more individual basis.

Previous studies have shown considerable inter-individual variability in affective valence responses at-VT and below-VT intensity conditions (Van Landuyt et al., 2000). Qualitative data (Sheppard & Parfitt, 2008a) indicated that two important influencing factors on affective valence responses were the ability to cope with exercise intensity and interpretation of exercise intensity. Individuals differ in the intensity of exercise they prefer (as shown by the variability in self-selected exercise intensity) and the intensity that they can tolerate before affective valence responses decline (Ekkekakis et al., 2005c). If individuals respond differently to the same prescribed intensity levels, as well as self-selecting different exercise intensities when given the choice, it presents a problem to health professionals trying to prescribe exercise intensities that will suit all individuals. Ekkekakis et al. (2005c) speculated that both preference for, and tolerance of, exercise intensity will be closely linked to the formation of affective valence responses to exercise, thus reinforcing the importance of the PRETIE-Q and measurement of preference for, and tolerance of exercise intensity, within an exercise prescription domain.

Through the development of the PRETIE-Q, and the newly modified version relevant to adolescent populations, research has sought to overcome this problem. Through the implementation of the PRETIE-Q prior to exercise prescription it has the potential to avoid the problems associated with traditional exercise prescriptions and takes into account individual differences. By matching exercise intensity to the individual, and thereby increasing the opportunity for positive exercise experiences, this could potentially lead to better rates of maintenance and adherence.

Limitations

Some of the alpha reliability scores for internal consistency were below .7, the recommended cut off for acceptable reliability(Nunnally, 1978). This may have been due to the number of items in each factor (ranging from two to four). Future studies should attempt to increase the number of items per factor to increase the alpha scores.

When modelling data using SEM, one or more models may fit the same covariance matrix, and no CFA model should be accepted on statistical grounds alone; theory, judgement and a persuasive argument should play a role in defending the adequacy of any estimation. Whilst the data from the current study showed that the final model was a reasonably good fit, neither cognitive development or self-schema were measured to justify the 4-factor approach and thus the theoretical justification was not as strong as it could have been had these constructs been examined. Similarly, the 4-factor approach did not take in to account the different age groups recruited into the study, and may have overlooked differences in cognitive development or self-schema identification between those individuals who were older or younger.

A further source of bias within the data may have occurred as a result of individuals responding to the items in the questionnaire in a socially desirable manner, rather than giving an accurate response. Bias may arise from the way individual questions are designed, the way the questionnaire as a whole is designed, and how the questionnaire is administered or completed. Questionnaires that are too long can induce fatigue among respondents and result in uniform and inaccurate answers, as the PRETIE-Q questionnaire formed part of a questionnaire pack there is a possibility that this may have influenced individual's answers and thus introduced a further source of bias.

Future research

Following the development and modification of the PRETIE-Q future studies should explore the predictive validity of the new scale to determine whether the scale measures the theorised psychological constructs that it purports to measure. Studies should investigate the ability of the PRETIE-Q to predict relationships between the preference for, and tolerance of, exercise intensity constructs and affective valence responses given during exercise.

In conclusion, the study contributes to evidence on the validity of the PRETIE-Q and reinforces previous results found by Sheppard (2008) with regard to the utility of the PRETIE-Q with young adolescents.

Chapter 5

Study 3 - Affective Associations, Cognitive Beliefs and their influences on Physical Activity Behaviour in Children and Adolescents[3]

[3] Submitted for publication to *Journal of Pediatrics*

Abstract:

Objective: Individuals have affective associations with behaviours. These associations have been shown to play a central role in influencing adults' physical activity behaviour, but no research has explored this concept with an adolescent group. This study examined whether affective associations with physical activity (PA) predicted adolescents' activity behaviour, how these associations related to other decision-making constructs to influence PA, and if there were differences between male and female adolescents.

Methods: Adolescent males (*n*=199) and females (n=377) reported their current physical activity levels and affective associations with physical activity. The Theory of Planned Behaviour (TPB) constructs were also assessed.

Results: More positive affective associations with PA significantly predicted greater physical activity behaviour (b=.159, $t(529) = 3.144$, p<.005, r^2 =.274). The relationships between TPB constructs and PA were mediated through affective associations regardless of age or gender.

Conclusion: These results suggest that the inclusion of affective associations in health decision-making models should be considered for adolescents as these associations may influence PA behaviour. Results show that affective associations predict PA behaviour; with more positive affective associations predicting more reported PA. Results also suggest that improving affective associations and making them more positive may aid behaviour change interventions.

Introduction

It has been suggested the individuals' affective associations with behaviours may significantly influence activity choice and play a central role in the decision-making process individuals use when deciding whether or not to engage in specific behaviours

(Kiviniemi et al., 2007). Affective Associations refer to the feelings associated with a specific behavior. Previous research exploring affective associations has indicated that a positive affective association with exercise leads to increased motivation to engage in PA (Laverie, 1998), that affective associations can prospectively predict future activity behavior and can significantly influence behavioural intention (McAuley et al., 2003). Research in other health domains such as food choices (Berridge, 1996; Shiv & Fedorikhin, 1999) alcohol consumption (Simons & Carey, 1998) and smoking (Trafimov & Sheeran, 1998) reinforce the idea that affective associations with health behaviours can influence behavioural choices.

Theories are helpful for explaining and predicting health behaviours such as PA, and theory-based interventions are more efficacious than a theoretical approach (Michie & Abraham, 2004). Understanding the determinants of physical activity in children may be best understood by using theoretical models of human motivation (Sallis, Prochaska, & Taylor, 2000). The Theory of Planned Behaviour (TPB) (Ajzen, 1991) is a popular psychological model used in health behavior research. The TPB has been widely used for understanding PA in numerous populations (Conner & Sparks, 2005), hence the decision to focus on this theory in order to understand the determinants of PA in children.

The TPB suggests that an individual's intention to engage in a behavior is the most proximal predictor of behaviour. Ajzen (1991) theorised that intentions mediate the influence of two cognitive constructs, attitudes and subjective norms, on behaviour and partially mediate the influence of perceived behavioural control. Attitude refers to the degree to which a person has a favourable or unfavourable evaluation or appraisal of the behaviour in question. Subjective norm refers to the perceived social pressure to perform or not to perform the behaviour, and perceived behavioural control refers to the perceived ease or difficulty of performing the behaviour. A meta-analysis of the prospective prediction of health-related behaviours indicated that the TPB is an adequate predictor, explaining between 26-30% of the variance in behaviour (McEachan, Conner, Taylor, & Lawton, 2011). In youth-related research to date, the TPB has been found to predict significant variance in exercise intentions and behaviour (Craig, Goldberg, & Dietz, 1996;Godin & Shephard, 1986).

Current research investigating health behaviour decision-making focuses mainly on the cognitive beliefs present in the TPB as the primary influence on behaviour. Recent work with adult populations, however, has indicated that affective associations may also contribute to, and influence, behavioural choices (Schuettler & Kiviniemi, 2006). Research in other decision-making domains, with adult populations, has demonstrated that both the influence of affective associations on decision making and the interplay of affective associations and cognitive beliefs are significant in decision making (Kiviniemi et al., 2007). Richard et al (1996) suggested that affective associations with behavioural choices can predict behaviour over and above the TPB cognitive constructs. Kiviniemi et al. (2007) indicated that the decision-making impact of the cognitive constructs in the TPB was mediated through affective associations, indicating the importance of affective associations in health behaviour decision making. Following this research, Kiviniemi et al. (2007) suggested that a *behavioural affective associations model,* in which the effects of cognitive beliefs about a health behaviour are mediated through affective associations with the behaviour, can account for an individuals' activity behaviour decision-making.

It has been reported that PA interventions with children and adolescents are seldom successful (VanSluijs et al., 2007) and that new methods are needed in order to increase PA levels. Kiviniemi et al. (2007) suggested that it may be useful to consider intervention approaches that target affective associations. Although this may be applicable to an adult population (Kiviniemi et al., 2007) research has yet to be carried out in a child or adolescent population to assess whether affective associations influence or contribute to health behaviour decision-making. The present study sought to establish the role that affective associations may have in influencing children and adolescents' PA behaviours.

Research incorporating the TPB constructs and behaviour in child and adolescent populations has showed differences in cognition, behaviour and emotions between children and adolescents (Lenroot & Giedd, 2006). Lenroot et al. (2006) suggested that this was a result of the brain developing at different rates in males and females, and that this would influence cognitions and beliefs. (Mummery, Spence, & Hudec, 2000) assessed the relative importance of each TPB construct in children and adolescents and found that the magnitude of the contributions of each cognitive construct changed with age and gender. These findings suggest that age and gender may contribute to differences in the affect that both TPB constructs and affective associations have on PA behaviour.

Methods:

Participants

Five hundred and sixty-eight children (377 females, 191 males; in school years 7-11 (mean age 13.2 years ± 1.4 years) from schools across South England were recruited for this study from a convenience sample. The school teachers acted in loco-parentis due to the non-invasive nature of the study. All participants read and signed consent forms approved by a University Ethics Committee prior to participating. Parents or Guardians were given opt-out consent forms that only needed to be returned if parents did not wish for their child to participate in the study, otherwise it was assumed that parental consent was gained.

Theory of Planned Behaviour Constructs:

Three types of constructs were assessed: cognitive belief variables from the theory of planned behaviour (TPB), affective associations with physical activity, and physical activity behaviour.

Attitudes and Beliefs towards PA:

Attitudes towards Physical Activity: Attitudes towards PA were measured with four items assessing the expected value of engaging in physical activity previously validated by Crites et al. (1994). Each question consisted of a semantic differential (e.g., *enjoyable* - *unenjoyable*) at each end of a 7-point scale following the statement, "Overall I think that physical activity is…" The mean of the items served as an overall measure of attitudes. Kiviniemi et al. (2007) revealed a cronbach's alpha α=.85 for these items; (Hagger et al., 2002) reported α=.86.

Social Norms: Two items assessed perceptions of Subjective norm about physical activity (Povey, Conner, Sparks, James, & Shepherd, 2000). The first item stated that "people who are important to me think I should do physical activity" with responses being given on a 7-point scale from '*Strongly Disagree*' (1) to '*Strongly Agree*' (7). The second measured stated that "people I know well think physical activity is…" with responses being answered on a 7-point scale with responses ranging from '*A very good idea*' (7) to '*A very bad idea*' (1). The mean of the items served as a measure of social norms.

Perceived Behavioural Control: Four items assessed participants' PBC (e.g., "How much control do you feel you have over doing physical activity?") (Povey et al., 2000). Responses were given on a 7-point scale anchored at both ends, from '*No control*' (1) to '*Complete control*' (7). The mean item of the items served as a measure of perceived behavioural control. Kiviniemi et al. (2007) showed reliability coefficients of α=.83 (a 3-item questionnaire).

Affective associations with Activity Behaviour:

Five items assessed affective associations with PA (Crites et al., 1994). The items tap multiple aspects of affective associations. These items have previously been used successfully to assess association with health behaviours (Giner-Sorolla, 2004; Simons & Carey, 1998). Each item asked participants to report how they feel when considering physical activity (e.g., bored-excited). Participants responded using 7-point scales with 1 and 7 anchored by the semantic differentials. The mean of the five items served as the measure of affective associations. Kiviniemi et al. (2007) demonstrated high reliability coefficients α=.89. Interclass correlations revealed high internal consistency across age and gender in this data set; boys school years 7-9 α=.857, boys school years 10-11 α=.828, girls school years 7-9 α=.889 and girls school years 10-11 α=.861.

Physical Activity:

PA was measured using the Physical Activity Questionnaire for Older Children (PAQ-C) (Crocker, Bailey, Faulkner, Kowalski, & McGrath, 1997). The PAQ-C is a self-administered, 7-day recall instrument. It consists of nine items that are used to form a summary activity score with a 5-point frequency response scale ('*none*' to '*more than seven times*' in a week). A total PAQ-C summary score ranges from low (1) to high activity (5). The PAQ-C has been shown to have acceptable validity, with one week test-retest reliability at r=0.75 for boys and 0.82 for girls in grades 4-8 (P. R. E. Crocker et al., 1997). The PAQ-C has been found to show moderate correlations with the Caltrac motion sensor, the Physical Activity Recall interview, the Leisure time Exercise

Questionnaire, and the recall of moderate to vigorous activity in grades 4-8 students (Crocker et al., 1997; Kowalski, Crocker, & Faulkner, 1997).

Hypotheses:

The main aim of the study was to explore whether affective associations mediated the relationships between the cognitive constructs of the TPB and PA behaviour, and more specifically, whether Kiviniemi's *Behavioural Affective Association Model* (2007) was relevant to children and adolescents

Hypothesis 1: Given the strength of literature to support the role of affective association as an influence on adults' behaviour it was hypothesized that affective associations with PA would predict children and adolescents' actual PA.

Hypothesis 2: It was hypothesised that affective associations would mediate the relationships between the cognitive constructs and PA but that age and gender would moderate this mediation.

Data Analysis:

To test hypothesis 1 a hierarchical regression model was estimated to examine predictors of PA, with demographic variables and the TPB constructs entered at step 1 and affective associations at step 2 to demonstrate that affective associations make an independent contribution to the prediction of PA over and above the TPB constructs.

To test hypothesis 2 and examine whether affective associations mediated the relationships between cognitive beliefs and PA behaviour Hayes (2012) PROCESS analysis method was used, with bias-corrected 95% bootstrap confidence intervals to establish both direct and indirect effects. The PROCESS method enabled any mediations and moderated-mediations to be assessed, i.e. whether age or gender moderated any of the mediations present. Moderated mediation focuses on the estimation of the extent to which the indirect effect of X on Y through the mediator (M) depends on the moderator (W). Hypothesis 2 sought to examine whether age and gender moderated any mediations between PA, TPB constructs and affective associations, thus moderated-mediations were carried out.

Results:

Regression analysis revealed that affective associations significantly predicted PA behaviours, even when demographics and cognitive belief variables were controlled: *b*=.159, *t(*529) =3.144, p<.005, r^2 change=.094.

	B	**SE B**	**β**	**t**	***p***	**R Square**	**R Square Change**	***p***
Step 1								
Constant	2.113	.270		7.823	.000			
Age	-.017	0.19	-.037	-.903	.367			
Gender	.442	.057	.320	7.78	.000	.106	.106	.000
Step 2								
Constant	1.301	.264		4.926	.000			
Age	-.045	.017	-.099	-2.600	.010			
Gender	.396	.052	.287	7.58	.000			
Attitude	.060	.022	.125	2.738	.006			
PBC	.170	.024	.319	7.096	.000			
SN	.013	.021	.025	.585	.559	.268	.162	.000
Step 3								
Constant	1.169	.265		4.406	.000			
Age	-.041	.017	-.090	-2.371	.018			
Gender	.384	.052	.278	7.398	.000			
Attitude	.028	.024	.058	1.150	.251			

PBC	.145	.025	.272	5.798	.000			
SN	.004	.021	.008	.188	.851			
AffAssoc	.087	.028	.159	3.144	.002	.362	.094	.002

Table 7 Regression Analysis between Age, Gender, TPB constructs and Affective Associations with Physical Activity

Attitudes:

Results from the mediation analysis indicated that there was a significant indirect effect of attitudes on PA through affective associations (effect .07-.08) (95%CI .03 - .12) regardless of age or gender. Additionally, results from the moderated-mediation showed that there was a direct effect between Attitudes and PA levels in the older males. Results indicated that the relationship between Attitudes on PA levels through Affective Associations is not moderated by age or gender.

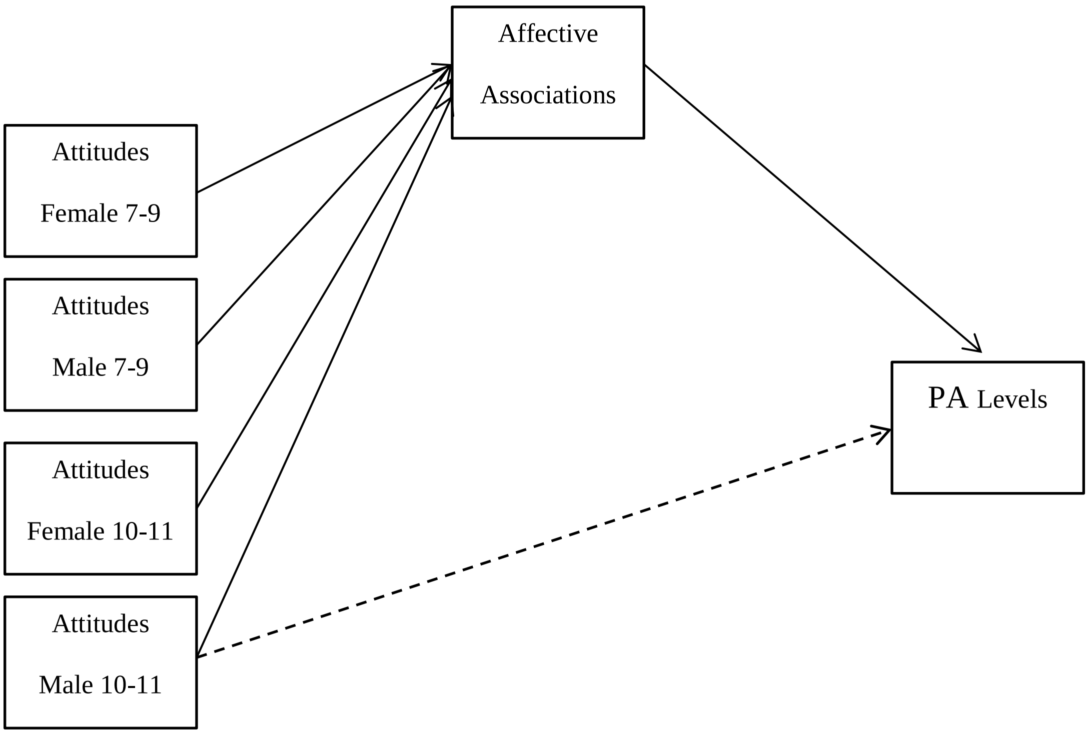

Figure 6 A descriptive model of the relationships between Attitudes, Affective Associations and PA levels by age and gender

—— **= indirect relationship** - - **= direct relationship**

Perceived Behavioural Control:

Results from the mediation analysis showed a significant indirect effect of PBC on PA through affective associations regardless of age and gender (effect .04 - .06) (95%CI .01 - .09). Results from the moderated-mediation analysis revealed significant direct effects across all ages and both genders between PBC and PA levels.

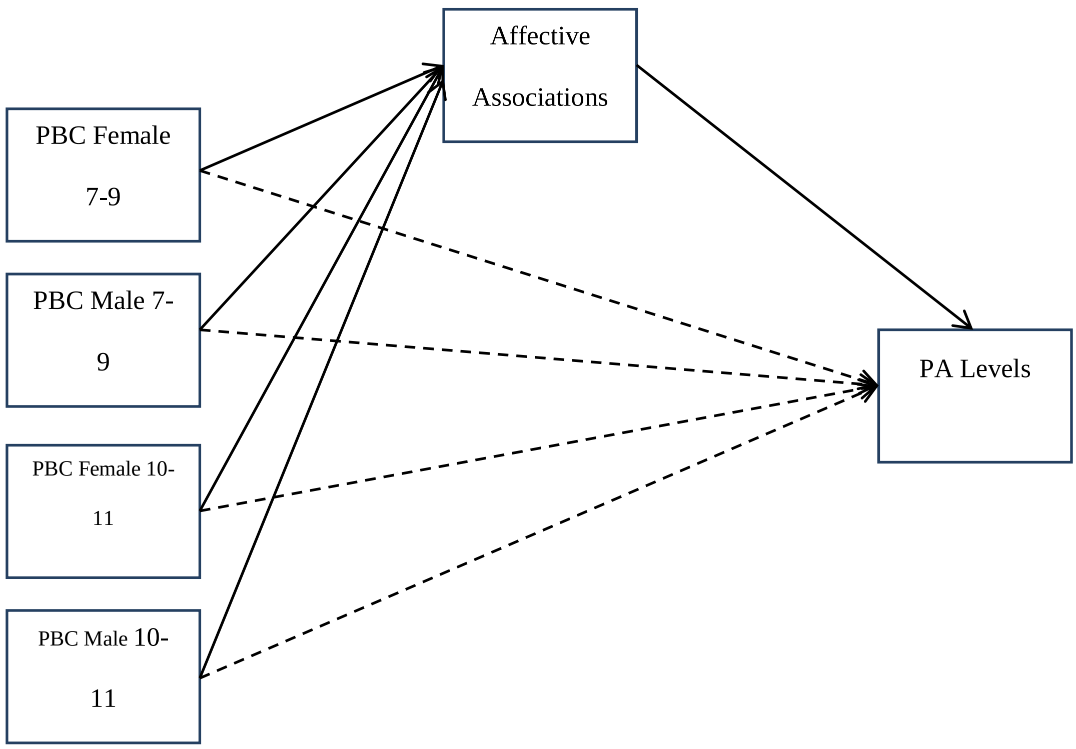

Figure 7 A descriptive model of the relationships between PBC, affective associations and PA levels split by age and gender

= indirect relationship - - - = direct relationship.

Subjective Norms:

Results from the mediation analysis revealed a significant indirect effect of subjective norms on PA through affective associations (effect .04 - .08) (95%CI .01 - .12), showing that affective associations mediated the relationship between Subjective Norms and PA. Results from the moderated-mediation analysis revealed an additional direct effect between subjective norms and PA in older males.

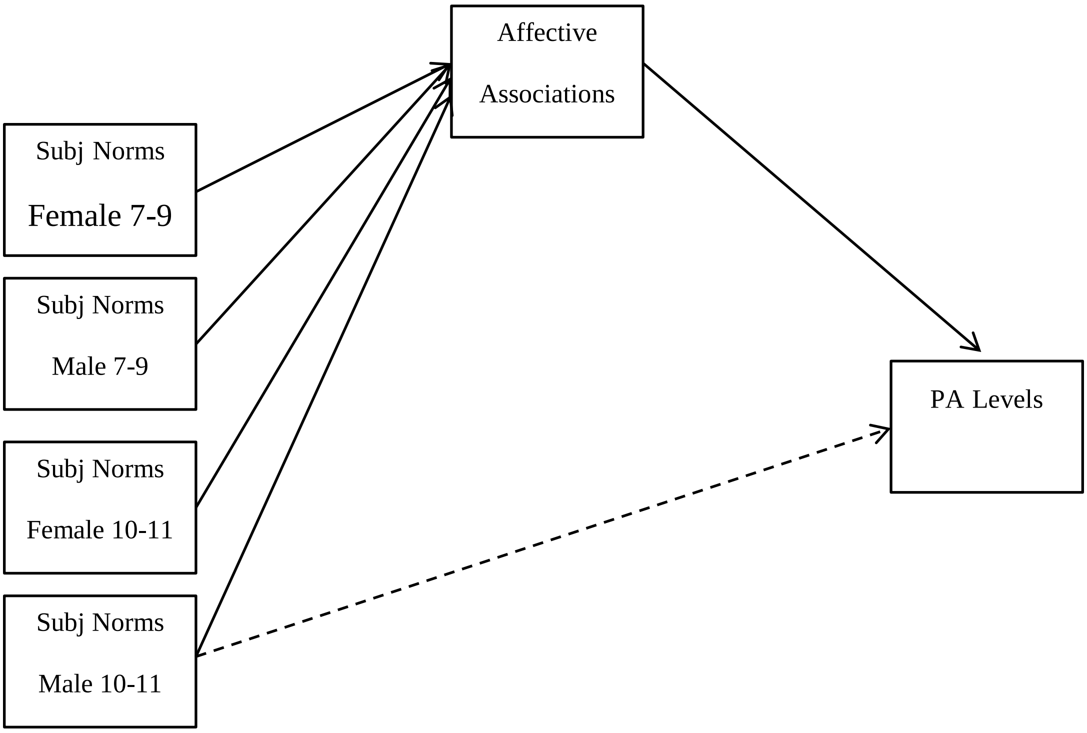

Figure 8 A descriptive model of the relationships between Subjective Norms, Affective Associations and PA levels split by age and gender

—— = indirect relationship - - - = direct relationship

Discussion

The objective of the study was to explore the relationships that existed between affective associations and PA, and whether affective associations mediated the relationships between cognitive belief structures and PA in a child and adolescent population. Results highlight the importance of affective associations with regard to PA; those participants who reported more positive affective associations also reported more PA. Results showed that affective associations significantly predicted PA behaviour, over and above demography and cognitive constructs. This finding indicates the importance of including affective associations in future theories of behaviour change, or in PA interventions given their independent contribution to overall PA behaviour.

Data support previous findings from Kiviniemi et al. (2007) with an adult population, more specifically, that the decision-making impact on PA of the TPB constructs was mediated through affective associations when the entire sample was used. The results of the mediation analysis suggest that the TPB constructs cause or determine affective associations with PA, which in turn determine PA behaviour. These results suggest that affective associations with activity behaviour play an important role in the decision-making processes individuals use when deciding whether or not to engage in health-related behaviours, such as PA. Recent research surrounding affect and decision making suggest that affective associations can serve as a 'cognitive shorthand,' thereby enabling people to make decisions more quickly and proficiently (Damasio, 1994; Frijda, 1988). These theories reinforce the findings from this study as affective associations are shown to mediate the relationships between TPB constructs and PA behaviour. These theories suggest that an individual will go through an affective mediational route allowing for quicker decisions because the affective associations can signal decision choices without the individual having to work through the cognitive beliefs each time a decision is made, thus making it easier to make decisions.

There is now increasing research into the importance of emotion in decision making (Berkowitz, 1993), for example the 'decision' to engage in specific behaviour with long-term health consequences, such as smoking a cigarette, drinking alcohol, and doing physical activity. This decision-making process cannot be completely understood within the framework of cognitive processes. Bechara et al. (1999; Bechara, Damasio, & Damasio, 2000) suggested that affective influences are very relevant to decisions that are made on a day-to-day basis, which are based on instinct about what to do in a particular situation, rather than working through cognitive beliefs each time a decision has to be made. Bechara et al. (1999; 2000) stated that these instinctive actions appear to be the product of the affective systems in the brain, which are performing, for the most part, outside conscious awareness. This research supports the findings of the current study, with affective associations not only mediating the relationships between TPB cognitive constructs, but also contributing the PA behaviour independently.

Epstein (1993) suggested that there are two conceptual systems that operate in parallel to any given task: an experiential system that is affective in nature and is associated with rapid processing and decision making, and a rational system, which is cognitive in nature and associated with refined and more deliberate through processing (Shiv & Fedorikhin, 1999). Leventhal (1984) also proposed a similar theory, and suggested that affective reactions come from two routes; an 'innate route' associated with primitive or partially formed affective reactions and a 'memory route' that involves conceptual processing and is more deliberate (Shiv & Fedorikhin, 1999). Hoch and Lowenstein (1991) and Zajonc (1980) also proposed that affective reactions can occur relatively automatically, without an active role of cognitive processes; linking back to the earlier proposed 'cognitive shorthand' (Damasio, 1994; Frijda, 1988). This idea of 'cognitive shorthand' is supported by the current findings, with results indicating that affective associations determine PA behaviour over and above cognitive constructs, as well as mediating the relationships between these two variables. Results suggest that cognitive constructs determine an individual's affective associations with a specific behaviour, and it is these associations that determine actual behaviour, rather than only cognitive constructs having a direct effect on PA behaviour.

Given that the results from this study suggest affective associations are the most proximal predictor of behaviour within the current model, it would seem pertinent to suggest that a health decision-making model would be missing a vital element without the inclusion of affective associations. Age and gender were assessed as moderating variables to explore if the effect of the Affective Associations on the relationships between the TPB constructs and PA behaviour were dependent on age and gender as moderating variables. Age and gender were included as moderating variables as a result of previous research that has shown differences in cognitive development between children and adolescents (Lenroot, 2006), and thus these two variables may have a significant role to play in the relationships between PA, TPB constructs and affective associations. Whilst affective associations were shown to mediate all the relationships between TPB constructs and PA, results also showed direct effects between attitudes and subjective norms and PA for the older boys, and for all ages and both genders between PBC and PA. This suggests a more complex relationship between the constructs and behavioural change; with specific differences between age and gender regarding direct and indirect relationships between attitudes, subjective norms and PA, whereas PBC results suggest that these findings are generalizable across age and gender. Results from the current study suggest that both beliefs and affective associations need to be considered to enhance behaviour change methods. The results from the current study suggest that the modification of the TPB to include affective associations as a mediator between the original TPB constructs and PA behaviour is plausible and should be examined in more detail in future studies.

Limitations:

There are several limitations to the current study, the first being the reliance on self-report measures throughout. PA behaviours are based on retrospective, self-report questionnaires, future work following on from this would benefit from using objective measures of PA behaviour in order to get a truer representation of PA levels. Second, maturation level or pubertal status of participants were not assessed, meaning that results being attributed to developmental differences between individuals can only be hypothetical and require further exploration.

Although the correlational nature of this study prevents making causal statements about the relationship between affective association and activity behaviour, the findings of the mediational analysis, along with the literature indicating that both cognitive beliefs and affective associations are causally antecedent to behaviour (Courneya, Plotnikoff, Hotz, & Birkett, 2000; McAuley et al., 2003; Quine, Rutter, & Arnold, 2000) make the assertion that affective associations are a key part of the decision making process regarding PA quite credible.

Future Research:

When designing and implementing interventions it is important to understand the factors that influence physical activity in order to develop more effective interventions (Sallis, Prochaska & Taylor, 2000). Results from this study, coupled with Kiviniemi et al. (2007), suggest that enhancing positive affective associations may aid behaviour change interventions. As results from the current study show, affective associations are proximal to PA in the *behavioural affective associations* model, and therefore, as the closest construct to PA it would be sensible for interventions to focus on changing affective associations in order to change PA. This is particularly relevant with the current study population, as affective associations were shown to mediate all relationships between TPB constructs and PA.

The data from the current study support the inclusion of affective responses as an additional construct within the TPB. The addition of affective associations to the TPB model has the potential to further enhance understanding of the determinants of PA, and thus contribute to the development of appropriate interventions to focus on the constructs presented in the TPB model. Further research to explore the relationships between the TPB and proposed new construct, affective associations, is warranted and would be required to strengthen the assertion that affective associations should be included in the TPB model. The data at present provides good evidence that the inclusion of affective associations within the TPB should be considered by those individuals developing and implementing intervention programmes. The results from the current study highlight the importance that affective associations have with regard to PA behaviour and thus should not be overlooked Further studies, including longitudinal studies, would be required to support the inclusion of affective associations within the TPB model and intervention programmes. Future research should also explore whether there are other constructs, cognitive or otherwise, that may also have an impact on PA behaviour as well as affective associations.

Given the age range of the participants in the current study, and the potential for variation in age-related maturation and development it was not unreasonable to expect to see differences in the relationships between affective associations, TPB constructs and PA behaviour. However, results from the current study showed that, regardless of age or gender, affective associations mediated the relationships between all TPB constructs and PA. To gain further insight into any potential differences, future research should explore whether these relationships are moderated by maturation level rather than age. Steinberg (2005) reinforced the need for this future research by highlighting that the brain and cognitive systems develop at different rates between individuals. Steinberg (2005) indicated that developmental differences may in part account for the differences in the mediational strength of this relation between boys and girls of different ages; an implication that requires further exploration.

Chapter 6

Study 4 - Exploring the relationship between Interoceptive Associations, Instrumental Attitudes, Affective Associations and Anticipated Affective responses with Physical Activity

Abstract:

Objectives: The Theory of Planned Behaviour (TPB) has been used to explore variance in physical activity (PA) behaviour. However, research suggests that the TPB overlooks some important factors that could explain further variance in PA behaviours. The current study explored whether these additional variables contributed significantly to the TPB and PA. Given that PA is a future behaviour it is also important to investigate how individuals anticipate that PA will make them feel to determine whether this contributes to decisions regarding whether to participate in PA or not.

Methods: 568 young people (377 females, 191 males, age = 13.2±1.4 years) answered a series of questionnaires to assess affective associations, interoceptive and instrumental attitudes, PA levels, anticipated affective responses and anticipated ratings of perceived exertion (RPE) to a proposed self-selected or prescribed exercise scenario. Factor analysis was run to examine factor structures of the questionnaires, followed by multiple linear regressions to determine variance in PA that the additional factors accounted for. A series of 3-factor ANOVAs examined differences in anticipated affective responses and RPE between the prescribed and self-selected scenarios.

Results: Affective associations, interoceptive and instrumental attitudes accounted for 24% of variance in PA behaviour over and above the TPB constructs. RPE was anticipated to be higher in the prescribed scenario than in the self-selected scenario, with females anticipating higher RPE than boys.

Conclusion: Results highlight the importance of attitudes and beliefs about the consequences and outcomes of PA with regard to participation; variables that need to be considered in future PA interventions. The autonomy of an individual's exercise experience also needs to be considered, by allowing individual's to self-select their own

exercise intensity rather than prescribing intensities this could enhance anticipated affective responses and RPE, thus encourage future PA participation.

Introduction

Preadolescence marks the beginning of a critical developmental transitional stage (Erikson, 1968). During this transition it has been reported that many individuals become sedentary (Department of Health (DofH) (2004; Jiménez-Pavón et al., 2010; Strong, Malina, & Blimkie, 2005; Troiano et al., 2008), thus a better understanding of specific influences on physical activity (PA) during this period could assist efforts made by exercise practitioners to increase PA levels during this transition and reduce the number of sedentary adolescents. A quantitative review (VanSluijs et al., 2007) indicated that PA interventions with children are seldom successful. Over recent years, there has been increased attention to research that has focused on psychosocial determinants of PA (Biddle & Mutrie, 2008), however there is still work that needs to be done to further explore these relationships, as there are some issues that have remained unaddressed. The relative failure of many PA promotion efforts may be a result of insufficient research exploring some of these additional determinants.

The Theory of Planned Behaviour (TPB) indicates that salient behavioural beliefs (beliefs about the consequences of performing a behaviour) determine attitude toward the behaviour, which in turn leads to intention to perform the behaviour, and on to behaviour itself (French et al., 2005; Sutton et al., 2003). However, it has been argued that the relationships between these constructs often do not consider both the affective and instrumental components of attitude (Crites et al., 1994).

Breckler and Wiggins (1989) and French et al. (2005) indicated that there is a distinction between affective and instrumental attitudes, with different beliefs underlying the two kinds of attitudes. Breckler and Wiggins (1989) defined the affective component of attitude as the 'emotions and drives engendered by the prospect of performing a behaviour' (p.254), whereas the instrumental component of attitude refers to a more cognitive consideration of the extent to which performing a behaviour would be advantageous. This distinction supports the idea that both these components of attitude need to be explored in order to gain a fuller understanding of overall attitudes.

Previous research (study 3; French et al., 2005) has explored the relationships that exist between the TPB constructs and affective associations. The term *affective associations* refers to the feelings associated with a specific health behaviour (Kiviniemi et al., 2007). Kiviniemi et al. (2007) indicated that affective associations play a central role in the decision-making process individuals use when deciding whether or not to engage in health-related behaviours, such as PA. Results from recent studies (French et al., 2005; Kiviniemi et al., 2007; and study 3) support the theory that affective associations explain unique variance in PA behaviour, above and beyond that explained by the standard TPB variables. Findings from these studies (Kiviniemi et al. 2007; study 3) also indicate that affective associations mediate the relationships between TPB cognitive constructs and PA behaviour, reinforcing the importance of their inclusion within theories of behaviour change. The work by French et al. (2005) suggested that along with the traditional TPB constructs, both components of attitude; affective and instrumental should be included in the TPB model to explain further variance in PA behaviour and gain more insight in to behavioural choices. Whilst results from study 3 showed that affective associations mediated the relationships between TPB constructs and PA behaviour regardless of age and gender, there were some relationships that were still some reported direct relationships between TPB constructs and PA behaviour dependent on age and gender. This indicates that age and gender are potentially important, thus were included as moderating variables in the current study.

When dealing with future behaviours such as future PA it is appropriate to investigate the impact of anticipated affective reactions. Anticipated emotions occur as a result of self-regulatory processes, and are dynamic responses to real or imagined feedback. As a result, anticipated emotions, such as anticipated affective responses, are dependent on appraisal processes thus can change depending on the situation (Bagozzi et al., 2003). This suggests that anticipated affective responses could be modified as anticipated emotions are not thought to be stable over time. Anticipated affective responses to PA represent an understudied class of outcome expectancy (Kirsch, 1995; van der Pligt & de Vries, 1998). Expectancy-value models often neglect the role of anticipated affective consequences of behaviour. Richard, van der Pligt and De Vries (1996) showed that anticipated affective reactions predicted a significant proportion of variance in behavioural expectations and self-reported behaviour, over and above the components of the TPB. Several studies have included measures of anticipated affect (i.e., what respondents would expect to feel about the consequences of a behaviour) as predictors of intention (Parker et al., 1995; Richard et al., 1996). The inclusion of these measures has improved the prediction of intention beyond that of the traditional TPB variables, suggesting that the addition of a measure of anticipated affect is valuable. Results reinforce the theory that the predictive power of TPB may improve if anticipated, post-behavioural affective reactions are incorporated in the model along with affective and instrumental attitudes.

According to social cognitive theory, expectations of these affective responses should influence PA behaviour (Kirsch, 1995; van der Pligt & de Vries, 1998), although little research exists to support this. The basic assumption from the few studies that exist is that the anticipation of affective consequences of behavioural actions could have an impact on decisions about health behaviour and thus behavioural choices. Research has built on this and sought to explore whether anticipated affective responses differ between a prescribed or self-selected exercise scenarios. Preliminary results from this study (Parfitt & Hughes, 2009) indicated that perceived exertion was significantly higher following the reading of the prescribed intensity scenario (16.4±1.8) compared to the self-selected intensity scenario (12.8±2.9), even though the physiological cues were the same. Coupled with this, anticipated affect was more negative in the prescribed scenario. These preliminary findings suggest that when exercise is prescribed, and the exerciser has no autonomy over the intensity of the exercise session, individuals perceive that they will be working harder and feeling worse than if they were in control of the exercise intensity; a result that requires further investigation.

Following on from recent research, this study had four aims: 1) conduct a factor analysis on a previously un-validated interoceptive and instrumental questionnaire; 2) to explore the relationships that exist between instrumental and interoceptive attitudes and affective associations and whether they explain a significant amount of variance in PA levels. Following on from findings in study 3, this study also sought to explore whether affective associations mediated the relationships between both interoceptive and instrumental attitudes and PA levels with age and gender as moderating variables; 3) to see if anticipated affective responses could predict or contribute to the level of PA that an individual participates in; and 4) to see if there are significant differences between perceived exertion and anticipated affective response dependent on the intensity of the scenario given to participants.

Methods:

Participants

Five hundred and sixty-eight children (377 females, 191 males; in school years 7-11 (mean age 13.2 years ± 1.4 years) from schools across South England were recruited for this study from a convenience sample. The school teachers acted in loco-parentis due to the non-invasive nature of the study. All participants read and signed consent forms approved by a University Ethics Committee prior to participating. Parents or Guardians were given opt-out consent forms that only needed to be returned if parents did not wish for their child to participate in the study, otherwise it was assumed that parental consent was gained.

Theory of Planned Behaviour Constructs:

Three types of constructs were assessed: cognitive belief variables from the theory of planned behaviour (TPB), affective associations with physical activity, and physical activity behaviour.

Attitudes and Beliefs towards PA:

Attitudes towards Physical Activity*:* Attitudes towards PA were measured with four items assessing the expected value of engaging in physical activity previously validated by Crites et al. (1994). Each question consisted of a semantic differential (e.g., *enjoyable* - *unenjoyable*) at each end of a 7-point scale following the statement, "Overall I think that physical activity is…" The mean of the items served as an overall measure of attitudes. Kiviniemi et al. (2007) revealed a cronbach's alpha α=.85 for these items; (Hagger et al., 2002) reported α=.86.

Social Norms: Two items assessed perceptions of Subjective norm about physical activity (Povey et al., 2000). The first item stated that "people who are important to me think I should do physical activity" with responses being given on a 7-point scale from '*Strongly Disagree*' (1) to '*Strongly Agree*' (7). The second measured stated that "people I know well think physical activity is…" with responses being answered on a 7-point scale with responses ranging from '*A very good idea*' (7) to '*A very bad idea*' (1). The mean of the items served as a measure of social norms.

***Perceived Behavioural Control**:* Four items assessed participants' PBC (e.g., "How much control do you feel you have over doing physical activity?") (Povey et al., 2000). Responses were given on a 7-point scale anchored at both ends, from '*No control*' (1) to '*Complete control*' (7). The mean item of the items served as a measure of perceived behavioural control. Kiviniemi et al. (2007) showed reliability coefficients of α=.83 (a 3-item questionnaire).

Affective associations with Activity Behaviour:

Five items assessed affective associations with PA (Crites et al., 1994). The items tap multiple aspects of affective associations. These items have previously been used successfully to assess association with health behaviours (Giner-Sorolla, 2004; Simons & Carey, 1998). Each item asked participants to report how they feel when considering physical activity (e.g., bored-excited). Participants responded using 7-point scales with 1 and 7 anchored by the semantic differentials. The mean of the five items served as the measure of affective associations. Kiviniemi et al. (2007) demonstrated high reliability coefficients α=.89. Interclass correlations revealed high internal consistency across age and gender in this data set; boys school years 7-9 α=.857, boys school years 10-11 α=.828, girls school years 7-9 α=.889 and girls school years 10-11 α=.861.

Physical Activity:

PA was measured using the Physical Activity Questionnaire for Older Children (PAQ-C) (Crocker et al., 1997). The PAQ-C is a self-administered, 7-day recall instrument. It consists of nine items that are used to form a summary activity score with a 5-point frequency response scale ('*none*' to '*more than seven times*' in a week). A total PAQ-C summary score ranges from low (1) to high activity (5). The PAQ-C has been shown to have acceptable validity, with one week test-retest reliability at r=0.75 for boys and 0.82 for girls in grades 4-8 (Crocker et al., 1997). The PAQ-C has been found to show moderate correlations with the Caltrac motion sensor, the Physical Activity Recall interview, the Leisure time Exercise Questionnaire, and the recall of moderate to vigorous activity in grades 4-8 students (Crocker et al., 1997; Kowalski et al., 1997).

Interoceptive Associations with Activity Behaviour:

Nine items assessed interoceptive associations with physical activity. Each item provided participants with a physiological feeling associated with exercise (e.g., sweating, breathing heavily etc). Participants responded on a 10-point scale for each item from 'Very Bad' (0) through 'Bad' (2), 'Fairly Bad' (4), 'Neutral' (5), 'Fairly Good' (6), and 'Good' (8) to 'Very Good' (10).

Instrumental Attitudes with Activity Behaviour/Beliefs about the consequences of being physically active:

Sixteen items assessed instrumental attitudes with physical activity (Saunders et al., 1997; Saunders, 1986). Each item began with the phrase "If I were to be physically active on most days it would..." and then a statement followed to assess beliefs about the consequences of being physically active (e.g., 'make me tired', 'get or keep me in shape'). Participants responded on a 7-point scale anchored at each end from 'Strongly Agree' (1) to 'Strongly Disagree' (7).

Anticipated Affective Responses:

Participants read descriptions of two imagined exercise experiences (based on qualitative reports from Rose & Parfitt (2007), one where the exercise intensity was prescribed at a given level, and a separate scenario where the participant had selected the intensity themselves. The participant was first asked to 'imagine that [they] are the exerciser and.....are exercising at an intensity that has been selected for [them]' for the prescribed exercise scenario, and then were asked to 'imagine that [they] are the exerciser and.....are exercising at an intensity that [they] have selected [them]selves' for the self-selected exercise scenario. Participants then read the same description of an exercise experience, 'You have been running on the treadmill at a given level. You are beginning to feel your body warming up and you notice that you are breathing more heavily. Your heart rate has increased and your legs are beginning to feel tired. You are beginning to struggle...' In the prescribed intensity participants are told that they 'have to keep the treadmill at the same speed' whereas in the self-selected intensity scenario they are told they 'can change the speed of the treadmill to one [they] prefer.' Participants were asked to rate their affective and perceived exertion responses at that moment using the Feeling Scale (Hardy & Rejeski, 1989) and Borg's Rating of Perceived Exertion Scale (Borg, 1998). Participants were then asked if their anticipated affective responses and ratings of perceived exertion would influence their future PA behaviour, indicating 'yes' or 'no'. For those responders who replied 'yes' the participant then indicated whether it would influence them to do 'less' or 'more' PA.

Hypotheses

Six hypotheses were set: 1) Affective associations, instrumental attitudes, and interoceptive attitudes would be significantly correlated with each other and with anticipated affective responses; 2) the inclusion of Instrumental Attitudes, Interoceptive Attitudes and Affective Associations in the TPB would explain more variance in PA levels over and above TPB variables alone; 3) Affective associations would mediate the relationship between both instrumental and interoceptive attitudes and PA levels, with age and gender moderating the relationship; 4) Anticipated Affective Responses would correlate with one's level of PA; 5) Perceived exertion (RPE) would be significantly higher within the prescribed exercise intensity scenario; 6) Anticipated Affective

Responses would be significantly lower within the prescribed exercise scenario in comparison to the Anticipated Affective Responses in the self-selected scenario.

Data Analysis

First a principal-component factor analysis was conducted to examine the factor structure of both the interoceptive and instrumental questionnaires. Following this, to test hypothesis one, correlations were run to explore the relationships that may exist between affective associations, instrumental and interoceptive associations. To test hypothesis two, multiple linear regression analyses were run to attempt to determine the proportion of variance in PA levels accounted for by affective associations, interoceptive associations and instrumental attitudes. Hypothesis three was tested by running mediation analysis between instrumental, interoceptive attitudes, affective associations and PA levels using Hayes (2012) PROCESS analysis. Hypothesis four was tested by running correlations between anticipated affective responses and reported levels of PA. To test hypotheses five and six, a series of three-factor ANOVAs were run to examine differences between scenario (self-selected, prescribed) sex (male, female) and age group (school years 7-9, school years 10-11) on each dependent variable: FS and RPE.

Results:

Initially the factorability of the 9 Interoceptive Attitudes items was examined. All intercorrelations exceeded .3, suggesting reasonable factorability. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was .88, above the recommended value of .6, and Bartlett's test of sphericity was significant (χ^2 (36) =2302.8, p<.001). The communalities were all above .5, further confirming that each item shared some common variance with other items. Given these overall indicators, factor analysis was conducted with all 9 items.

A principal-component factor analysis was conducted. The initial eigenvalues showed that the first factor explained 53% of the variance and the second factor explained 12% of the variance. The remaining factors had eigenvalues under one, and therefore a 2-factor solution, which explained 65% of the variance, was used. The two factor solution was examined using varimax rotations of the factor loading matrix with Kaiser Normalisation. All items had primary loadings over .57 (see table 7).

Interoceptive Attitudes	Factors	
	Primary Factor	Secondary Factor
Sweating	**.58**	.45
Legs Aching	.42	**.68**
Breathing Heavily	.24	**.75**
Heart Racing		**.83**
Muscles Aching	.44	**.69**
Hot	**.68**	.41
Hurting	**.72**	.31
Red	**.79**	
Sticky	**.86**	

Table 8 Factor analysis results exploring Interoceptive Attitudes towards Physical Activity, showing the two factor solution

Note: Factor Loadings <.2 are suppressed

The factors were then labelled, Primary and Secondary Factors. Internal consistency was examined for each scale using Cronbach's alpha. The alphas were high for both Factor 1 (.85) and 2 (.81).

Composite scores were created for both of the two factors, based on the mean of the items which had their primary loadings on each factor. Descriptive statistics are presented in Table 8. The skewness and kurtosis were well within the range for assuming a normal distribution.

	No. Of items	M (SD)	Skewness	Kurtosis	Alpha
Primary	5	3.9 (2.0)	.32	.01	.85
Secondary	4	4.8 (1.9)	.16	.31	.81

Table 9 Descriptive statistics for Interoceptive Factors: Primary and Secondary

Next the factorability of the 16 Instrumental items was examined. Of the original 16 items, 14 correlated at least .3 with at least one other item, suggesting again reasonable factorability. The KMO measure was .82, and Bartlett's test of sphericity was significant (χ^2 (120) = 2516.6, p <.001). Communalities were above .3 for all 16 items. However, given that 2 of the 16 items did not correlate above .3 with any of the other items they were removed from the remaining factor analysis as they shared minimal common variance with other factors.

A principal-component factor analysis was then conducted with the remaining 14 items. The initial eigenvalues showed that the first factor explained 30.6% of the variance, the second factor explained 15.4% of the variance and the third factor explained 10.8% of the variance. The remaining 11 factors had eigen values under one, and therefore a 3-factor solution, explaining 56.8% of the variance was used. The three factor solution was examined using varimax rotations of the factor loading matrix with Kaiser Normalisation. All loadings had primary loadings over .49 (see table 9).

	Factor 1	Factor 2	Factor 3
Be Fun	.29	**.50**	.44
Be Boring	.20	.21	**.71**
Get or keep me in shape	**.83**		
Make me better in sports	**.82**	.21	
Help me be healthy	**.81**		
Help me control my weight	**.74**		
Make me embarrassed in front of others	.29		**.67**
Cause pain and muscle soreness			**.67**
Help me look good to others	.31	**.65**	-.21
Help me make new friends		**.69**	
Make me more attractive to	.20	**.64**	-.22

the opposite sex			
Help me work out my anger		**.70**	
Help me spend more time with my friends		**.70**	
Make me get hurt			**.67**

Table 10 Factor Analysis of Instrumental Attitudes showing a 3-factor solution

Note: Factor Loadings <.2 are suppressed

The factors were then labelled **'Physical Outcomes', 'Positive Outcomes' and 'Negative Outcomes',** and then internal consistency was examined for each scale using Cronbach's alpha. The alphas were moderate for all 3 factors; physical outcomes (.84), positive outcomes (.76) and negative outcomes (.66). Next composite scores were created for all of the three factors, based on the mean of the items which had their primary loadings on each factor. Descriptive statistics are presented in Table 10. The skewness and kurtosis for all three factors were within the range for assuming a normal distribution.

	No of items	M (SD)	Skewness	Kurtosis	Alpha
Physical Outcomes	4	2.2(1.2)	1.2	1.2	.84
Positive Outcomes	6	3.4(1.2)	.23	-.13	.76
Negative Outcomes	4	3.5(1.2)	.43	-.04	.66

Table 11 Descriptive Statistics for Instrumental Attitude Factors

Hypothesis 1:

Table 12 shows the results of the correlations run to assess the relationships between PA levels, affective associations, interoceptive associations and instrumental attitudes and test hypothesis 1 (see table 12).

	PA Levels	AffAssoc	Primary Interoceptive Factor	Secondary Interoceptive Factor	Physical Outcomes	Positive Outcomes	Negative Consequences
PA levels	-	.34**	.26**	.28**	.07	.22**	-.26**
AffAssoc		-	.19**	.23**	.06	.01	-.40**
Primary Int.			-	.68**	.01	.05	-.17**
Secondary Int				-	.08	.10*	-.20**
Physical Outcomes					-	.49**	-.02
Positive Outcomes						-	.19**
Negative Consequences							-

Table 12 Correlations between PA, Affective Associations, Interoceptive Associations and Instrumental Attitudes

Hypothesis 2:

Hierarchical regression analyses revealed affective associations accounted for 11.8% of the variance in PA ($p<.001$), interoceptive attitudes accounted for 3.9% of variance ($p<.01$) and instrumental attitudes accounted for 7.8% of variance ($p<.001$) (see table 13)

	B	SE B	β	t	*p*	R Square	R Square Change	*p*
Step 1								
Constant	2.697	.146		18.425	.000			
SN	-.018	.025	-.035	-.711	.477			
PBC	.002	.027	.003	.061	.952			
Attitude	-.028	.025	-.057	-1.093	.275	.006	.006	.03
Step 2								
Constant	2.031	.158		12.819	.000			
SN	-.006	.024	-.011	-.239	.811			
PBC	-.004	.026	-.007	-.155	.877			
Attitude	-.029	.024	-.060	-1.213	.226			
AffAssoc	.135	.016	.344	8.472	.000	.124	.118	.000
Step 3								
Constant	1.775	.164		10.819	.000			
SN	-.004	.023	-.008	-.171	.864			
PBC	-.006	.025	-.012	-.246	.806			
Attitude	-.023	.023	-.048	-.981	.327			
AffAssoc	.117	.016	.299	7.330	.000			
Primary Int.	.006	.004	.092	1.682	.093			
Secondary Int.	.011	.005	.130	2.339	.020	.163	.039	.000

Step 4								
Constant	1.878	.170		11.071	.000			
SN	.008	.022	.015	.353	.724			
PBC	-.008	.024	-.015	-.336	.737			
Attitude	-.018	.022	-.037	-.731	.430			
AffAssoc	.093	.017	.238	5.632	.000			
Primary Int.	.006	.003	.090	1.718	.086			
Secondary Int.	.007	.004	.082	1.537	.125			
Physical Outcomes	.010	.006	.076	1.731	.084			
Positive Outcomes	-.024	.004	-.290	-6.440	.000			
Negative Outcomes	.023	.005	.204	4.684	.000	.241	.078	.000

Table 13 Multiple Regressions between the TPB constructs Affective Associations, Interoceptive Associations, and Instrumental Associations with Physical Activity Behaviour. B = unstandardised beta coefficient, SE B = standard error, β = standardised beta coefficient, t = t-test statistic and *p*= significance value.

Hypothesis 3:

Results from mediation analysis revealed a significant indirect effect for primary interoceptive factors on PA levels through affective associations regardless of age and gender (effect =.04- .07) (95%CI .02-.08) and a significant indirect effect for secondary interoceptive factors on PA through affective associations regardless of age or gender(effect = .04- .06) (95%CI .03-.07). Mediation analysis also indicated significant indirect effects for physical outcomes regardless of age or gender (effect =.06- .07) (95%CI .02-.07) positive outcomes regardless of age or gender (effect =.04- .07) (95%CI 0.1-0.7) and negative outcomes regardless of age or gender (effect = 0.5- .08) (95%CI 0.3-0.8) on PA levels through affective associations.

Hypothesis 4:

Of significance to note from the correlations in table 14 is that those individuals who had more positive affective associations with PA reported anticipating more positive affective responses in both the proposed prescribed and self-selected exercise sessions, as well as reporting participating in more PA than those who reported less positive affective associations with PA.

	AffAssoc	RPEpres	FSpres	RPEss	FSss	PALevels
AffAssoc	-	.119*	.248**	.149**	.210**	.337**
RPEpres		-	-.025	.701**	-.059	-.003
FSpres			-	.051	.648**	.327**
RPEss				-	.014	.055
FSss					-	.263**
PALevels						-

Table 14 Correlations between Affective Associations, Ratings of Perceived Exertion and Anticipated Affective Response using the Feeling Scale

Hypothesis 5:

To test hypothesis 5 a series of three-factor ANOVAs were run to examine differences between scenario (self-selected, prescribed) sex (male, female) and age group (school years 7-9, school years 10-11) on each dependent variable: FS and RPE. Where sphericity was violated, Greenhouse-Geisser was used to adjust the degrees of freedom.

	Females	Males	School Years 7-9	School Years 10-11	Females Years 7-9	Males Years 7-9	Females Years 10-11	Males Years 10-11	Overall
RPE prescribed	13.2 ± 2.4	12.4 ± 2.8	12.5 ± 2.9	13.3 ± 2.2	12.9 ± 2.8	11.8 ± 3.0	13.4 ± 2.1	13.0 ± 2.5	**12.9 ± 2.6***
RPE self-selected	12.8 ± 2.6	12.2 ± 3.3	11.9 ± 3.2	13.0 ± 2.5	12.3 ± 3.0	11.4 ± 3.4	13.1 ± 2.2	12.9 ± 3.0	**12.6 ± 2.8***
RPE Overall	**12.1 ± 2.7***	**11.8±2.9***	**11.7±2.8***	**12.3±2.7***	11.8±2.8	12.1±3.0	12.3±2.6	11.6±2.8	12.7±2.7
FS prescribed	1.6±1.9	1.7±1.9	1.8±2.1	1.7±1.9	1.8±2.2	1.8±1.9	1.5±1.8	2.2±2.1	1.7±1.9
FS self-selected	1.7±1.9	2.1±1.9	2.0±1.9	1.7±1.9	2.0±1.9	2.2±1.8	1.5±1.9	2.1±1.9	1.8±1.9
FS Overall	1.8±2.1	2.0±2.1	1.8±2.3	1.9±1.9	1.8±2.4	2.3±2.1	1.8±1.9	1.8±2.2	1.8±1.9

Table 15 Means and Standard Deviations of RPE and FS responses by scenario (* denotes significant relationship)

Anticipated FS Responses:

There were no significant main effects or interactions for the FS response data across scenario, sex or age group.

Anticipated Ratings of Perceived Exertion:

A within-subjects main effect was evident with results showing that RPE was anticipated to be significantly higher in the prescribed scenario compared to the self-selected scenario ($F(1,405) = 8.493$, $p<.005$, $\eta^2=.021$). Between-subject effects were also evident, with females reporting significantly higher anticipated RPE than boys ($F(1,405) = 5.872$, $p<.05$) and older participants (school years 10-11) reported significantly higher anticipated RPE than younger participants (school years 7-9) ($F(1,405) = 13.509$, $p<.001$). There were no other significant effects.

Discussion:

The main aims of this study were to explore the relationships that may exist between interoceptive, instrumental and affective associations towards PA, and whether these constructs explained a significant amount of variance in PA levels between individuals. The results indicate that affective associations are correlated with interoceptive and instrumental associations, suggesting that how one feels about PA and the associated outcomes are related. If an individual has positive affective associations with PA, i.e., they find it ‘enjoyable’, ‘pleasant’ and ‘good’, it makes sense that they will report more positive instrumental attitudes, and report that being physically active on most days would ‘be fun’. Regression analysis confirmed this relationship, and indicated that one’s interoceptive and instrumental associations combined with affective associations explained a significant amount of variance in PA behaviours (23.5%). These are important results, as they could be used in future interventions to increase PA. As the three scales measure unique elements and the results from this study have shown that they all have independent relationships with PA, focusing on one, two or all three of these variables may be useful when considering interventions to increase PA levels. The correlations indicate that increases in affective associations, instrumental or interoceptive attitudes, has the potential to increase PA.

Upon addition of the final set of variables it is important to note that not all of the previously significant variables remained significant. As additional variables were introduced into the hierarchical regression some variables became non-significant. Upon the inclusion of physical outcomes, positive outcomes and negative outcomes, secondary interoceptive cues were no longer significant (p=.125). However, it is important to note that affective associations accounted for significant variance in PA behaviour in all steps of the model. This is a significant finding, given the previous assertions regarding the importance of the inclusion of affective associations both within the TPB model and as an independent construct.

Previous research has demonstrated that the application of techniques to change affective associations have been successful (Aylesworth, Goodstein, & Kalra, 1999; Pechmann & Stewart, 1989), suggesting that this method may be a useful approach to altering associations to be more positive and thus change behaviour. Results from the mediation analysis supported previous findings in study 3, where affective associations mediated the relationships between attitudes and PA behaviour. The current study showed that both interoceptive and instrumental attitudes, whilst both contributing to PA behaviour, were mediated by affective associations. However, it is important to note that some factors did not initially predict PA after controlling for other factors, and thus these results need to be explored further. These findings reinforce the importance of including affective associations within theories of behaviour change, and the importance that these associations may play with regard to determining PA behaviour.

Results from the current study indicate that in both a prescribed and self-selected scenario the amount of PA one reports participating in correlates both positively and significantly with anticipated affect – that is, the more PA one reports performing, the more positive their anticipated affect is. Previous research (B. M. Kwan & Bryan, 2010a) confirms that anticipated affective responses are an important factor in determining PA levels. Kwan and Bryan (2010a) indicate that those individuals who anticipate that exercise will not yield any affective benefits (i.e., it will not be pleasurable or enjoyable), may find it particularly difficult to want to engage in PA. The results from the current study support these findings and suggest that attempts to enhance anticipated affective responses or ratings of perceived exertion could be a key concept to consider with regard to increasing PA participation. That is, if an individual's anticipated affective responses can be manipulated or changed to elicit positive anticipated responses, this has the potential to increase PA participation. However, it must be noted that this was a cross-sectional study and therefore causality cannot be assumed from the current findings.

Bagozzi, Utpal and Basuroy (2003) suggested that the strength of an individual's desire to achieve a goal depends partly on the anticipated emotions they have regarding the goal. They suggest that if an individual has negative anticipated emotions about a goal they will be less inclined to pursue it, whereas, if an individual has positive anticipated emotions towards a goal they will be more willing to attempt to achieve the goal. Anticipated emotions have been implicated in decision-making processes in a number of ways (Richard et al., 1996; Simonson, 1992). Future research should attempt to explore methods in which anticipated affect regarding physical activity can be manipulated or altered to be more positive. The results from the current study suggest that those individuals who have more positive anticipated affective responses to PA reportedly participate in more PA. By encouraging individuals to anticipate positive outcomes of PA may be a suitable method of initiating behaviour change and encouraging positive associations with PA.

Research indicates that a positive affective response experienced during exercise may enhance future exercise behaviour (Williams et al., 2008; Williams et al., 2012). Ensuring individuals experience positive affective responses during exercise may be the first step in improving individuals' associations with PA and exercise in the hope of increasing PA levels. One aspect that may play a significant role in people's decisions to adhere (or not) to exercise programmes is how the physical activity makes them feel whilst they engage in it. This viewpoint is embedded in hedonic theory, which focuses on affective responses to behaviour as a determinant of future behaviour (Larsen & Frederickson, 1999). There is substantial evidence from health psychology research to suggest that humans have a tendency to seek out pleasurable situations and avoid displeasure, and that pleasure may be a guide for behaviour (Rozin, 2003).

Results show that anticipated RPE was significantly higher in the prescribed scenario compared to the self-selected scenario, suggesting that when exercise intensities are prescribed, individuals anticipate that they will be working harder than if they were to choose the intensity themselves. Research exploring the relationship between the physiological demands of performing an exercise task and the perception of effort associated with performing the task has suggested that these two factors are interdependent (Robertson et al., 2004) This research suggests that the perceptual response (i.e. the perceived degree of strain, or exertion) provides much of the same information regarding the exercise performance as physiological variables do (Robertson & Noble, 1997). The perceptual continuum suggests that perceptions play an important and essential role in shaping behaviour and responses to external situations or events (Borg, 1998), indicating that anticipated ratings of perceived exertion may influence behavioural choices and responses to certain behaviours. Anticipating that work will be harder in a prescribed scenario may deter individuals from participating in prescribed intensity exercise sessions, suggesting that future exercise programmes should encourage individuals to self-select their exercise intensity. In both the prescribed and self-selected scenarios the physiological cues provided were identical, so it would be pertinent to suggest that the control, or lack of control, that the individual perceived they had over the exercise session contributed to the anticipated ratings of perceived exertion.

Self-selected exercise intensity provides individuals with autonomy over their actions and gives them increased perception of control over behaviour which is a key influencing factor linked to exercise adherence (Vallerand & Rousseau, 2001), confirming the idea that self-selecting exercise may prove invaluable for exercise adherence. When provided with choice or preference, as in the self-selected scenario, an individual's autonomy is being supported. This perceived control that the individual feels they have could lead to a more positive affective experience, greater levels of enjoyment and enhanced intrinsic motivation (Vallerand & Rousseau, 2001). A study that has directly assessed the role of autonomy (Vazou-Ekkekakis & Ekkekakis, 2009) indicated that a loss of autonomy in setting the exercise intensity negatively influenced exercise motivation and some affective responses. These studies support the findings from the current study, with anticipated RPE being significantly higher in the prescribed exercise scenario where the individual would have no autonomy over the intensity, in comparison the self-selected exercise scenario where the intensity would be entirely autonomous.

Females reported significantly higher anticipated RPE than boys, and the older participants (school years 10-11) reported significantly higher anticipated RPE than younger participants. These findings suggest that females relative perceptions of effort required to meet the demands of the physiological cues provided in the statement were higher than the males' perceptions. Current PA data (The NHS Information Centre, 2012) indicates that fewer girls (24%) participate in the recommended amounts of PA compared to boys (32%), along with this data there is also a large decline in the amount of PA that girls take part in from aged 2 (35%) to girls aged 14 (12%). These statistics, coupled with the findings in the current study, suggest that the perceived exertion of PA may be a contributing factor to this decline in PA across the ages. Current PA levels in females and adolescents may therefore be indicative of these findings. To try and alter one's perceptions of how hard they anticipate that they will be working may be one way of overcoming this problem and potentially encourage increased participation in more PA.

Limitations:

The cross-sectional nature of the current study prevents causal links from being made. The findings from the current study are confined to a specific point in time, meaning that results may not generalisable to other population groups or other time points.

Conclusions and future research:

Findings from this study reinforce previous findings in study 3, showing the importance of including affective associations in future attempts to increase PA, as well as incorporating it in to theories of behaviour. Results from this study show the importance of anticipated affective response and anticipated ratings of perceived exertion on PA levels, particularly in a female population. Future research needs to explore possible ways in which one's anticipated affective responses can be altered and made more positive, as a possible determinant of PA behaviour to encourage increased participation. This study also indicates that an individual's autonomy over their exercise session may contribute to anticipated ratings of perceived exertion, directing future research to focus on ratings of perceived exertion and affective responses to acute self-selected and prescribed exercise sessions. Individuals need to have positive, enjoyable exercise and PA experiences in order to increase PA levels, and change perceptions of how PA will make them feel. This study suggests that by altering one's instrumental and/or interoceptive attitudes with PA this may also contribute to a change in PA behaviour. Attitudes and beliefs about the consequences and outcomes of PA are key with regard to participation, and this study highlights the need to consider these constructs relative to bringing about changes in PA behaviours.

Chapter 7

Study 5

Study 5 was the final set of data collection and was designed to address a number of independent questions that arose from the previous studies in this thesis. As a result, Study 5 is split into two studies; A and B. Both studies shared a common methods section which is detailed before the two studies are described in further detail.

Common Methods:

Participants:

Power calculations, using GPower (Erdfelder, Faul, & Buchner, 1996) indicated that a sample size of 28 participants was required for the study (α= 0.05, power =0.95). This equated to 14 high preference and 14 low preference participants. Multiple schools were approached and a member of the research team presented the proposed study to teachers (either the head teacher or PE staff) from schools who expressed an interest in pupils from their school participating in the study. Information letters were sent out by the teachers to all eligible children and their parents along with a copy of the adolescent specific PRETIE-Q. Participants were recruited into the study using the previously validated, adolescent specific, shortened version of the Preference for and Tolerance of Exercise Intensity Questionnaire (PRETIE-Q) (study 2**)**. Individuals who returned the PRETIE-Q and had a preference for particularly low intensity exercise (mean = 7.8 ± 0.7) (coupled with a weak score for high preference (mean = 11.8 ± 3.3)) and those who had a preference for high intensity exercise (mean = 18.6 ± 1.2) (coupled with a weak score for low preference (mean = 3.6 ± 1.1)) were invited to participate further in the study (determined as those recording the lowest or highest tertile scores from a cohort of adolescent females) (*n*=13 high, *n*=14 low) and were given further information sheets, and consent and assent forms to return. All participants were free from illness and injury and were able to exercise to exhaustion. Three hundred and thirty three females returned completed PRETIE-Q forms and from there twenty-eight females (age Mean= 14.6 years ± 0.8 years, mass Mean=54.7 kg ± 9.1kg, height Mean=1.6m ± 0.1m, BMI Mean= 20.9 kg/m2 ± 3.0kg/m2) were recruited into the study, with one dropping out after the completion of one exercise session, leaving twenty-seven participants to complete the study.

Measures:

Preference for and Tolerance of Exercise Intensity Questionnaire (PRETIE-Q):

The adolescent-specific PRETIE-Q was used to assess trait variables of preference for high and low and tolerance of high and low exercise intensity. The preference for high intensity scale contains four items that tap preference for high intensity exercise (e.g. "I prefer high intensity exercise to low intensity exercise") and the preference for low intensity exercise has two items that tap preference for low intensity exercise (e.g. "Low intensity exercise appeals to me"). The scale for high tolerance of exercise contains three items that tap a high tolerance for exercise intensity (e.g. "Feeling tired during exercise does not make me stop") and the scale for low tolerance of exercise has two items tapping this construct (e.g. "Feeling tired during exercise is my signal to slow down or stop"). Each item is accompanied by a five-point response scale, ranging from "I totally disagree" (1) to "I totally agree" (5). Study 2 reported alpha coefficient of internal consistency of .74 for high tolerance, .68 for low tolerance, .73 for high preference and .65 for low preference, and test-retest reliability of .68 for high tolerance, .94 for low tolerance, .97 for high preference and .97 for low preference.

Affective Associations:

Five items assessed affective associations with PA (selected from (Crites et al., 1994). The items tap multiple facets of affective associations. Each item asked participants to report how they feel when considering PA (e.g. bored-excited). Participants responded using 7-point scales with 1 and 7 anchored by the semantic differentials. The mean of the five items served as the measure of affective associations. Interclass correlations from previous studies (Study 3; (Kiviniemi et al., 2007) revealed high internal consistency across age and gender; boys years 7-9 α=.86, boys years 10-11 α=.83, girls years 7-9 α=.89 and girls years 10-11 α=.86. Kiviniemi et al. (2007) demonstrated high reliability coefficients with α=.89.

Affective Responses:

Affective valence (pleasure/displeasure) was measured using the Feeling Scale (FS) (Hardy & Rejeski, 1989). Participants rated their current feelings on an 11-point bipolar scale ranging from +5 to -5, with verbal anchors of *very good* (+5), *good* (+3), *fairly good* (+1), *neutral* (0), *fairly bad* (-1), *bad* (-3) and *very bad* (-5). The FS has been found to correlate between .51 and .88 with the Valence scale of the Self-Assessment Manikin (SAM) (Lang, 1980) and from .41 to .59 with the Valence scale of the Affect Grid (Van Landuyt et al., 2000) and has been successfully used with adolescents (Benjamin, Rowlands, & Parfitt, 2012; Schneider et al., 2009; Schneider & Graham, 2009; Sheppard & Parfitt, 2008).

Ratings of Perceived Exertion (RPE):

Perceived exertion was assessed using the Eston-Parfitt (E-P) curvilinear Ratings of Perceived Exertion Scale (Eston et al., 2009). This scale depicts a character at various stages of exertion on a concave slope with a progressively increasing gradient at the higher intensities. The distance between each numbered increment on the horizontal axis (0-10) is increasingly reduced in relation to its antecedent. The area under the curve is also progressively shaded from light to dark from left to right, respectively. The E-P scales has verbal anchors from ‘very, very easy’ (0), ‘easy’ (2), ‘starting to get hard’ (4), ‘very hard’ (7) up to ‘so hard I am going to stop’ (10). Strong linear (R^2=.93) and curvilinear (R^2=.94) relationships between RPE from the E-P Scale and work-rate in children aged 7 - 11 have confirmed the robustness of the E-P Scale (R. G. Eston et al., 2009). The same verbal instructions were given to all participants prior to undertaking any exercise, and participants were given several minutes to familiarise themselves with the scale. (For full instructions see Eston et al., 2009).

Anticipated Affective Responses and Perceived Exertion:

Participants were asked prior to each exercise session, using the Feeling Scale (Hardy & Rejeski, 1989) and Borg’s Rating of Perceived Exertion Scale (Borg, 1998), to rate their anticipated affective responses and perceived exertion, depending on whether the exercise session was being prescribed by the researcher or self-selected by the individual.

Physical Activity:

Objective Measure:

Physical activity was measured using the GENEActiv accelerometer which was worn for 7-days on their dominant wrist following the completion of the exercise sessions and was set to record at 100Hz. The PA data was collected post-testing due to time restrictions within the school and issues of practicality. The research team had to ensure that all participants’ PA data was collected during a normal school week, rather than during school holidays, and this resulted in the collection of PA data post testing as opposed to prior to the testing sessions.

The GENEActiv has been previously validated as an accurate and reliable measure of children's activity (Phillips, Parfitt, & Rowlands, 2012) and can determine the different intensities of physical activity that individuals participate in. Lack of compliance with guidelines for wearing waist worn accelerometers, for the measurement of PA, commonly leads to loss of data, reduced sample size and statistical power and may introduce bias. Reasons for non-wear time include participant removal to protect the device from water or due to discomfort (Crocker, Holowachuk, & Kowalski, 2001). The GENEActiv was chosen over other previously validated accelerometers for several reasons; it is worn on a wrist strap like a watch and is therefore less restrictive than other accelerometers that are worn at the waist; as the accelerometer could be worn on the wrist it was felt that compliance issues would be negated as there would be less reason for the participant to remove the accelerometer throughout the week, particularly when changing clothes or going to bed; the GENEActiv is also waterproof so can be worn in the shower or bath as well as in the swimming pool. Participants were informed that the GENEA could be worn at all times so should only be removed due to discomfort. Participants' data was used if they had recorded ≥10 hours/day of wear time for at least 3 week days and one weekend day (Trost, Pate, Freedson, Sallis, & Taylor, 2000) with 89% of participants recording adequate wear time to be included in the data analysis. Data were analysed to determine time spent in different intensity activities; sedentary, light, moderate, vigorous. Following on from findings by Philips et al. (2012) the cut points from their study were used (see table 15). Overall PA was computed from time spent in light, moderate and vigorous exercise, and did not include time spent in sedentary behaviour.

Intensity	Cut Point (gravity adjusted counts per second)
Sedentary	<6
Light	6-21
Moderate	22-56
Vigorous	>56

Table 16 Cut Points for different intensity activities

Instruments:

K4 Breath Analyser

The K4 Cosmed Breath analyser (Cosmed K4, Italy), with a junior face mask, head net and harness, was used in order to measure breath by breath expired gases throughout the duration of the testing. The K4 has been shown to provide valid measurements of oxygen uptake across a range of exercise intensities (McLaughlin et al., 2001). The K4 was calibrated before every test in accordance with manufacturer's guidelines against known concentrations of cylinder gases and a 3-L syringe (for flow volume).

Polar Heart Rate Monitor

A Polar heart rate monitor (Polar Electro, Finland) was used in order to measure heart rate throughout the duration of the testing. Heart Rate (HR) was recorded continuously using a wireless chest strap telemetry system with a watch worn on the right wrist.

Procedures:

Prior to participation the participants, as well as their parent, guardian or care giver, read and signed consent and assent forms approved by the University's ethics committee. Height and mass were measured upon arrival at the gym and body mass index (BMI) was calculated. Participants were asked to complete a brief questionnaire (based on Crites et al. 1994) about their affective associations with physical activity.

Participants took part in four gym-based exercise sessions (three submaximal sessions; two at a self-selected intensity and one prescribed, and one graded exercise test), at least 48-hours apart. Following on from limitations found by Vazou-Ekkekakis and Ekkekakis (2009) and Rose and Parfitt (2010a) where order effects occurred as a result of performing a self-selected and then prescribed exercise session in the same order, there were three sub-maximal exercise sessions with an initial self-selected, familiarisation session followed by a self-selected and prescribed exercise session. The last 2 sessions were randomised to counterbalance any order effects that may have occurred if all participants had performed the second self-selected session and prescribed exercise sessions in the same order. Participants wore the GENEA activity monitors for 7-days after completion of all 4 exercise sessions to gain an objective measure of their overall PA levels, and to be able to differentiate between the amount of light, moderate, and vigorous PA that all individuals were participating in over a 7-day period.

Prior to each gym session participants were asked to rate their anticipated affective responses and perceived exertion using the Feeling Scale (Hardy & Rejeski, 1989) and the Eston-Parfitt (E-P) curvilinear Ratings of Perceived Exertion Scale (R. G. Eston et al., 2009)

Session 1 – Self Selected Familiarisation Session:

Session 1 acted as a familiarisation session for the participants to ensure they were comfortable with the sensations associated with running and walking on a treadmill, as well as giving them the opportunity to familiarise themselves with the Feeling Scale and E-P scale. Participants warmed up for 3-minutes at a comfortable speed on the treadmill and then a self-selected intensity was chosen by asking the participant to 'select any intensity they wanted to, whether it was a walk or a run, whatever felt the most comfortable.' Participants were also told they could modify the self-selected intensity at any point throughout the 20-minute exercise session, but the time and speed of the session was kept blind from participants. Any adjustments to the intensity were recorded.

Session S – Self Selected:

Session S followed an identical protocol to the first self-selected exercise session.

Session P – Prescribed:

Participants again warmed up for 3-minutes at a comfortable speed on the treadmill and then a prescribed exercise intensity was set. The prescribed exercise session was set to the same speed and intensity as the initial self-selected exercise session and any modifications to the speed that the participants made in the first session were replicated by the investigator, time and speed were again kept blind from participants so as not to contribute to affective responses or ratings of perceived exertion. (For the purpose of study 5a the prescribed session data was not analysed, instead it contributed to study 5b).

During each session direct measurements of oxygen uptake were collected and analysed using the K4 portable online gas analyser. Responses to the FS were taken in the first minute of the session (min1) as well as the last 45s of each 5-minute period (minutes 5, 10, 15 and 20). Post exercise responses were recorded immediately upon cessation of exercise (Post 0), 5 minutes after (+5) and 10 minutes after (+10). Heart rate and Ratings of Perceived Exertion were also recorded at these time points.

Session 4 – Graded Exercise Test:

In the final visit to the gym, all participants completed a maximal graded exercise test (GXT) to volitional exhaustion to establish peak aerobic capacity ($\dot{V}O_{2\ peak}$) and Ventilatory Threshold (VT). The GXT was completed on a Fitness Suite Treadmill in 1-

minute stages at a comfortable, self-selected running speed, increasing the gradient by 1% every minute after a 3-minute warm-up. The test was continued until the participant reached volitional exhaustion. During the test, at the end of every incremental step (last 20-seconds of every period) FS, HR and RPE scores were collected. Post-test FS scores were collected immediately upon the cessation of exercise (Post 0) and 5-minutes after (+5).

Data Reduction:

Ventilatory Threshold: $\dot{V}O_2$peak, the greatest amount of oxygen consumed during strenuous aerobic exercise, was calculated for all participants. Research has indicated that many children may not be able to attain a plateau in $\dot{V}O_2$, which is necessary to calculate $\dot{V}O_2$ max, despite a maximal effort (McMurray, Guoin, Ainsworth, & Harrell, 1998). VT was determined from the GXT data as the first disproportionate increase in carbon dioxide output ($\dot{V}CO_2$) relative to the increase in $\dot{V}O_2$. This was achieved from visual inspection of individual plots of $\dot{V}CO_2$ versus $\dot{V}O_2$ by two independent assessors. Breath-by-breath data from each test were smoothed to average every 10 seconds, to make visual identification of the break point clearer. This point was verified by plotting ventilatory equivalents of CO_2 ($\dot{V}E/\dot{V}CO_2$) and O_2 ($\dot{V}E/\dot{V}O_2$) against time, and identifying the point at which $\dot{V}E/\dot{V}O_2$ systematically increased, independent of an increase in $\dot{V}E/\dot{V}CO_2$ (Beaver et al., 1986).

Overall PA: Total physical activity was calculated by totalling time spent in light, moderate and vigorous PA based on previously established cut-points (Phillips et al. 2012). Sedentary behaviour was not included as sedentary behaviour is independent of active behaviour, and thus did not contribute to overall PA behaviour.

Chapter 8

Study 5a - Can Preference for High or Low Intensity Exercise Predict the Exercise Intensity of a Self-Selected Exercise Session?[4]

[4] Manuscript in preparation, in conjunction with study 2, for submission to *Journal of Personality and Social Psychology*

Abstract:

Objectives: It has been suggested that preference for different intensity exercise should be incorporated in to behaviour change strategies in order to enhance positive affective responses and future physical activity (PA) participation. The objectives of the current study were to investigate the ability of the adolescent-specific PRETIE-Q to predict the self-selection of exercise intensity, and to further the validation of this questionnaire. Further aims were to examine differences in intensity chosen and affective responses to self-selected exercise between those individuals with a preference for high intensity exercise compared to those with a preference for low intensity exercise. The final aim was to explore the relationships between preference scores and habitual PA.

Methods: Twenty seven females (age = 14.6±0.8 years) were recruited following the completion of the PRETIE-Q to identify those individuals with a particular preference for high intensity exercise (n=13) and low intensity exercise (n=14). Participants completed three 20-minute exercise sessions (2 self-selected and 1 prescribed) and a graded exercise test. Linear regressions examined the variance in self-selected exercise intensity accounted for by preference scores. ANOVAs examined differences in intensity selected between high and low preference groups, along with affective responses and ratings of perceived exertion. One-way ANOVAs determined the relationships between preference scores and habitual PA.

Results: Preference for either high or low intensity exercise accounted for between 13.4% - 43.3% of variance in exercise intensity at minutes-5, -10, -15 and -20, with significant differences being evident in the intensity selected between the two groups. Affective responses were significantly more positive at minutes-10, -15 and -20 in the high preference group compared to the low preference group. Results showed no significant differences in ratings of perceived exertion between the groups, but both

groups perceived the exercise session to get harder towards the end of the 20-minutes. Those individuals with a preference for high intensity exercise participated in significantly more moderate, vigorous and moderate-to-vigorous PA than those with a preference for low intensity exercise.

Conclusion: Understanding individual preferences for high and low intensity exercise before prescribing exercise is important to ensure that individuals are not prescribed an intensity that is too high or low to elicit positive affective responses. By accounting for individual preferences this may have a positive effect on future exercise participation and adherence.

Introduction

Adolescence is generally characterized by marked declines in physical activity (PA) (Hallal et al., 2012; Troiano et al., 2008), particularly in females (Department of Health, 2011; Hallal et al., 2012; Nelson, Neumark-Stzainer, Sirard, & Story, 2006). Data shows that 32% of boys aged between 2-15 meet the current recommended levels of PA, compared to only 24% of girls aged 2-15 (DofH, 2011). This is a common and consistent finding in many longitudinal studies. The National Institute of Child Health and Human Development Study of Early Child Care and Youth Development (Nader et al., 2008) observed a steep decline in PA levels in young people between the ages of 9 and 15, and the National Heart, Lung and Blood Institute Growth and Health Study reported substantial declines in PA from the ages of 9 or 10 to the ages of 18 or 19 (Kimm, 2002). Given the overwhelming evidence that indicates adolescent girls are not participating in adequate PA it is important for future research to explore how to encourage long-term adherence to PA.

Previous research (Dishman, 2001) has indicated that the exercise experience an individual has can influence future PA behaviour. Understanding how an individual experiences exercise, i.e. whether they find it pleasant or unpleasant, may help to predict and promote adolescents' future PA. Research has indicated that enjoyment of PA is an important factor to consider, and that increased enjoyment can increase PA participation and encourage adherence (Dishman et al., 2005; Schneider & Cooper, 2011). Several authors have noted that taking individual preferences for different exercise intensities into account could improve the quality of the exercise experience rather than prescribing 'moderate intensity' exercise to all, and thus could enhance long-term adherence (Dishman et al., 1994; King & Martin, 1993; Van Landuyt et al., 2000). The American College of Sports Medicine (ACSM) Position Stand (ACSM, 2011) have now started to consider the importance of individual preference, and have suggested that preferences should be incorporated into behaviour change strategies in order to enhance adoption and maintenance of regular exercise and PA. Ekkekakis, Lind and Joens-Matre (2006) defined preference as "a predisposition to select a particular exercise intensity level when engaging in unsupervised exercise" (p.83). Ekkekakis, Parfitt and Petruzzello (2011) indicated that at the very core of the 'preference' construct was the idea that what determines whether an exercise intensity is preferred is the pleasure or displeasure that is experienced as a result. Ekkekakis et al. (2005c) speculated that one's preference for exercise intensity will be closely linked to the formation of affective valence responses to exercise, reinforcing the importance of individual preference within an exercise prescription domain. Ekkekakis, Thome, Petruzzello and Hall (2008) stated that individuals differ greatly in the intensity of exercise that they prefer (i.e. that which would elicit an optimal affective response). This suggests that 'preference' and 'affect' are closely linked, and as previous research has shown, exercise prescriptions that promote a positive exercise experience (i.e. one that induces positive affective responses) promote long-term exercise behaviour and therefore improve public health (Rose & Parfitt, 2007; Williams et al., 2008; Williams et al., 2012).

This link between an individual's preferred exercise intensity and affective responses suggests that by prescribing exercise based on individual preference may induce positive affective responses, thus encourage individuals to continue to participate in PA and adhere to exercise programs. Whilst there is a growing body of research surrounding the relationships that may exist between PA, preference and adherence, no research to date has explored these relationships in a child or adolescent population. As previously stated, levels of PA decline significantly during adolescence, and given the recent findings regarding affect, intensity and adherence with adults, this is an important area to explore relative to children and adolescents.

Given the literature to suggest that preference for and tolerance of exercise intensities are important factors to consider with regard to exercise adherence and participation, Ekkekakis et al. (2005c) developed a scale to specifically investigate one's preference for, and tolerance of, high or low intensity exercise (PRETIE-Q). Data from this study suggested that the PRETIE-Q could be a useful tool in capturing individual differences in the preference for and tolerance of exercise intensity. Whilst this questionnaire has shown acceptable reliability and validity for use with adult populations, research by Sheppard (2008) and in Study 2 in this thesis have shown that the original structure and content of the PRETIE-Q was not appropriate for use with children and adolescents. As a result, a modified child-specific PRETIE-Q was developed in Study 2 in order to explore, in more depth, relationships that may exist between affect, intensity preference and PA.

A previous study by Ekkekakis et al. (2006) sought to investigate the ability of the PRETIE-Q preference scale to predict the self-selection of exercise intensity. Results indicated that the preference scale accounted for significant portions of the variance in the percentage of oxygen uptake associated with the ventilatory threshold (VT) at minute 15 and minute 20 of a 20-minute session at self-selected intensity, beyond that which was accounted for by age, BMI and VO2peak ($ml \cdot kg^{-1} \cdot min^{-1}$). These results were consistent with previous research (Cabanac, 1986) that found intensity gradually increased during the first 10-15 minutes of the exercise session and stabilised to a 'preferred' level during the last 5-10 minutes of the session. Results showed that, on average, the self-selected exercise intensity was around VT.

There is conflicting evidence surrounding the intensity of exercise that individuals choose when given the opportunity to self-select intensity. Some research suggested that individuals choose an intensity that is too low to confer health benefits (Spelman et al., 1993), while others indicate that individuals self-select an intensity that would be equal to or exceed the minimum level of the recommended range by the American College of Sports Medicine (ACSM, 2010) Given this contrasting evidence it is important to determine whether preference predicts intensity, and subsequently, whether those individuals with preference for particularly low intensity exercise self-select an intensity that is too low to confer physiological benefits.

No known research to date has explored the relationships between intensity-preference and habitual PA. This is an important relationship to consider, particularly given the previously mentioned declines in PA in adolescence. Research needs to consider whether those individual's with a preference for low-intensity exercise participate in more low intensity PA compared to those with a preference for high-intensity exercise, whether those individuals with a preference for high intensity exercise participate in more moderate or vigorous PA, and whether there is a difference in overall PA recorded between groups.

Results from previous studies with adults suggest that the preference scale can predict exercise intensity (Ekkekakis et al., 2006). However, at present there is no evidence to suggest that this relationship is applicable to adolescents or children. The first aim of this study, therefore, was to investigate the ability of the newly formed, adolescent-specific PRETIE-Q to predict the self-selection of exercise intensity within a group of adolescent females. The second aim of the current study was to continue the validation of the adolescent-specific PRETIE-Q by providing construct validity of the preference scales, and the discriminant validity of the high and low preference scales. A third aim of this study was to explore the relationship between intensity-preference and habitual PA.

Following on from findings from study 3, exploring the relationships between affective associations and PA, this study also sought to examine whether affective associations predict objectively measured volume and intensity of PA. It went beyond this to also investigate whether affective associations predicted specific intensity exercise (i.e. light, moderate or vigorous).

Hypotheses:

Five hypotheses were made: 1) preference scores would predict %±VT in the self-selected exercise session, and account for a significant % of variance in the intensity chosen, beyond that accounted for by age, BMI, VO2peak and VT; 2) those individuals reporting preference for high intensity exercise would work at a higher %VO2-at-VT than those with a preference for low intensity exercise; 3) there would be no difference in affective responses and ratings of perceived exertion during the exercise sessions between the High and Low preference groups; 4) those participants reporting preference for high intensity exercise would participate in higher levels of moderate and vigorous physical activity compared to those reporting a preference for low intensity exercise, and 5) affective associations would predict overall PA, however, no priori-hypothesis was made regarding the relationships between affective associations and the different intensities of exercise.

Data Analysis:

To test hypothesis one multiple linear regression analyses were conducted to examine the variance in self-selected intensity at minutes 1, 5, 10, 15 and 20, expressed as the % of oxygen uptake at the VT, accounted for by preference for high and low exercise intensity. Age, BMI, VO2peak and VT were entered as predictors in the first step, and High/Low preference was entered as a predictor in the second step. The standardized regression coefficients (β), multiple correlation coefficients (*R)*, change in variance accounted for per step (R^2 change), and associated *F* values and significance levels were reported.

To test hypotheses two and three a series of repeated measure ANOVAs were run to establish differences across the time points of each exercise session on FS, RPE, HR and %±VT with High or Low preference as a between-participants factor. Where sphericity was violated, Greenhouse-Geisser was used to adjust the degrees of freedom. Pairwise comparisons were carried out on significant effects. Post-hoc Tukeys tests were carried out on significant effects to examine where differences lay.

Hypothesis four was tested by running correlations between PA output levels from the GENEA and preference scores to establish if there was a significant association between the amount of moderate or vigorous activity one participates in and reported preference scores.

Hypothesis five was tested by running correlations between PA output levels from the GENEA and affective associations, followed by regression analysis to determine whether affective associations predicted PA levels when split by intensity using Phillips et al. (2012) cut points (sedentary, light, moderate, and vigorous). Data was only included in this analysis if participants had recorded 7-days wear time.

Results:

Descriptive anthropometric and physiological data is displayed in Table 16, along with physiological indices utilised for statistical analysis. Independent sample t-tests revealed no significant differences between groups for any of the demographic variables.

	Low Preference Mean (SD)	High Preference Mean (SD)
Height (m)	1.6 (0.5)	1.6 (0.7)
Mass (kg)	56.2 (10.0)	53.3 (8.0)
BMI (kg/m^2)	21.5 (3.6)	20.4 (2.2)
VO2 Peak (ml.min^{-1}.kg^{-1})	40.3 (5.6)	45.9 (8.8)
Ventilatory Threshold (VT) (ml.min^{-1}.kg^{-1})	32.6 (3.9)	34.6 (7.3)

Table 17 Mean of descriptive characteristics of Participants by Exercise Intensity Preference

Hypothesis One: Preference for high and low intensity exercise scores were a significant predictor of the %VO2-at-VT at Minutes 5, 10, 15 and 20. Low preference scores accounted for 28.6%, 33.1%, 43.3% and 32.1% of the variance, respectively, beyond that accounted for by age, BMI, VO2 peak and VT. High Preference scores accounted for 26.6%, 33.4%, 26.2% and 13.4% of variance respectively, beyond that accounted for by age, BMI, VO2 peak and VT (table 17).

		β	*P*	R	R2 change	F Value	*P*
Minute 5	Age	-.035	.879				
	BMI	.186	.415				
	VO2 Peak	.139	.751				
	VT	.080	.848	.233	.054	.315	.865
	LP	**-.696**	**.007**	**.583**	**.286**	**2.162**	**.009**
	HP	**.577**	**.009**	**.565**	**.266**	**1.974**	**.024**
Minute 10	Age	-.155	.494				
	BMI	-.157	.480				
	VO2 Peak	.201	.636				
	VT	-.097	.812	.322	.104	.637	.641
	LP	**-.749**	**.002**	**.660**	**.331**	**3.234**	**.025**
	HP	**.648**	**.002**	**.662**	**.334**	**3.275**	**.024**
Minute 15	Age	-.246	.234				
	BMI	-.330	.107				
	VO2 Peak	-.006	.988				
	VT	.144	.694	.522	.272	2.056	.121
	LP	**-.856**	**.000**	**.840**	**.433**	**10.03**	**.000**
	HP	**.574**	**.002**	**.731**	**.262**	**4.823**	**.004**
Minute 20	Age	-.209	2.77				
	BMI	-.445	.024				
	VO2 Peak	.232	.518				
	VT	-.115	.736	.604	.365	3.163	.034
	LP	**-.738**	**.000**	**.828**	**.321**	**9.187**	**.000**
	HP	**.411**	**.027**	**.707**	**.134**	**4.913**	**.008**

Table 18 Hierarchical regression analyses examining the variance in self-selected intensity at Minutes 5, 10, 15 and 20, expressed as the percentage of oxygen uptake at the ventilatory threshold, accounted for by preference for high or low exercise intensity scores. LP= Low Preference, HP= High Preference

Hypothesis Two:

To test hypothesis two a series of mixed-model ANOVAs were run to establish differences across the time points of each exercise session (min5, min10, min15 and min20) on FS, RPE, HR and %±VT with between participants factors being assigned to separate those with either High or Low preference.

The %VO2-at-VT ANOVA indicated a significant main effect for overall time (figure 9) ($F_{1.9,\ 49.9}$ = 5.06, p<.01, η^2 = .168), a main effect for group ($F_{1,\ 25}$ = 32.9, *p*<.001, η^2 = .57) but no time*preference interaction. Pairwise comparisons revealed that there was a significant difference (14.98% ± 2.4, p<.001) in mean %VO2-at-VT depending on preference group; high (M=105.2% ± 1.76) and low (M=90.2 ± 1.7). A one-way ANOVA also revealed significant differences between the High and Low preference groups at all-time points: minute-5 ($F_{1, 26}$ = 11.5 p<.005), minute-10 ($F_{1, 26}$ = 26.8, p<.001), minute-15 ($F_{1, 26}$ = 25.4, p<.001) and minute-20 ($F_{1, 26}$ = 17.9, p<.001) (figure 10).

	%VO2-at-VT	
Time (mins)	High Preference	Low Preference
5	100.1 ± 2.6	88.0 ± 2.5
10	104.6 ± 2.3	87.7 ± 2.3
15	108.1 ± 2.2	92.8 ± 2.1
20	107.9 ± 2.7	92.1 ± 2.6

Table 19 Mean and Standard Error %VO2-at-VT for High and Low Preference groups

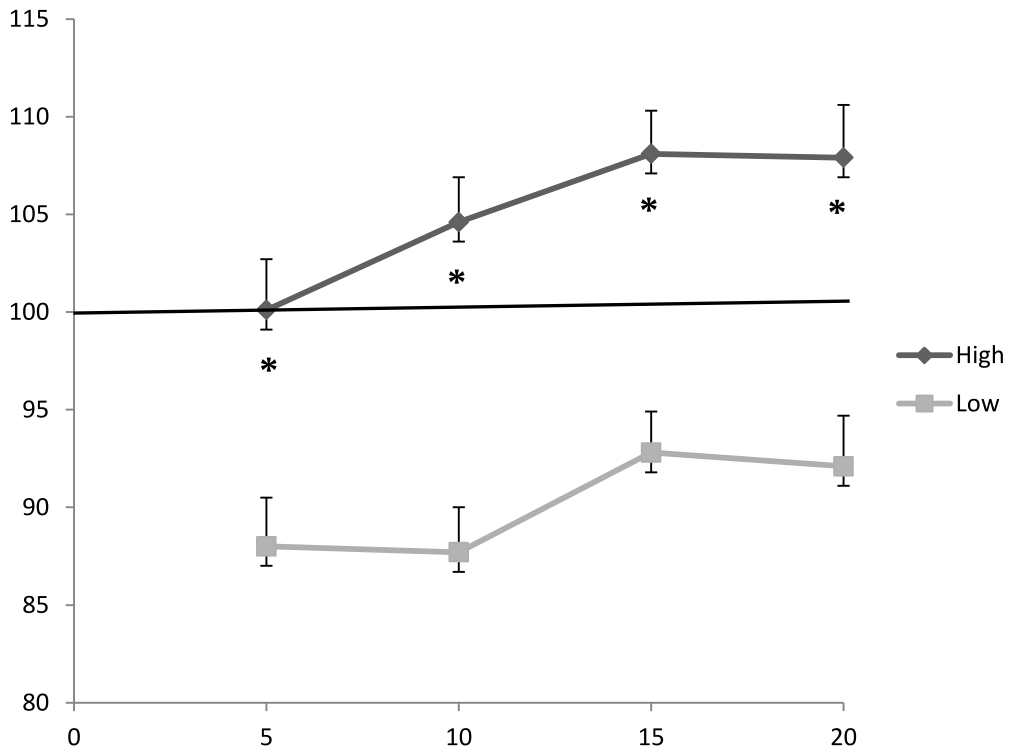

Figure 9 Differences in %VO2-at-VT across time between High and Low preference groups

*significant differences between groups, with error bars

Hypothesis Three:

The FS ANOVA demonstrated a significant main effect for time ($F_{2.4,\ 59.3}$ =6.11, p<.001, η^2 =.196), a significant effect for group ($F_{1,\ 25}$ = 8.1, p<.01, η^2=.25) but no time*group effect was shown. Pairwise comparisons indicated significant differences (1.6 ± .6, p<.01) in mean FS responses between High (M= 2.0 ± .43) and Low (.46 ± .39) preference groups. One-way ANOVAs revealed that there were significant differences in affective responses between High and Low groups at minute 10 ($F_{1,\ 26}$ =6.4, p<.05), minute 15 ($F_{1,\ 26}$ =7.9, p<.01) and at minute 20 ($F_{1,\ 26}$ =7.4, p<.05). Pairwise comparisons revealed significantly higher FS responses overall at minute-5 (M=1.8 ± .25, p<.001) than at all subsequent time points. After minute-5 affective responses were relatively stable and positive.

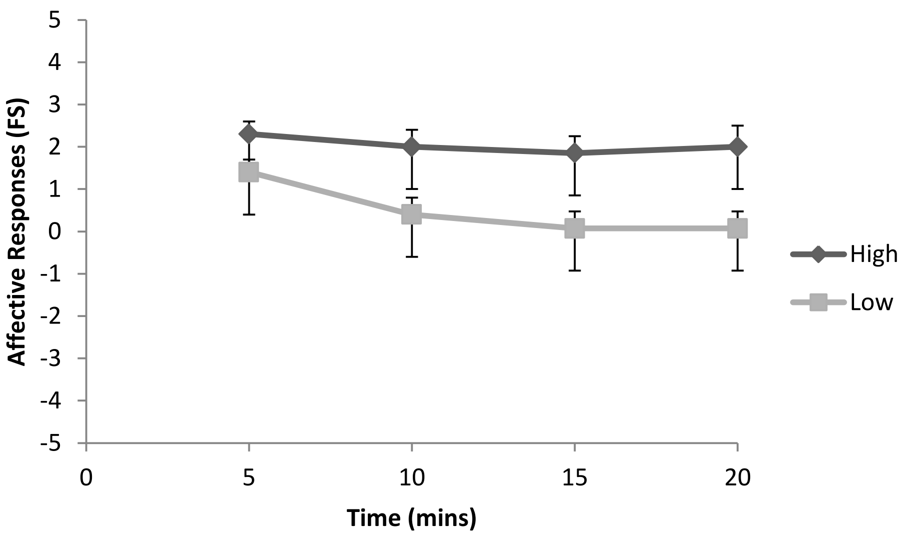

Figure 10 Affective Responses across the self-selected exercise session between high and low preference groups (with error bars)

The RPE ANOVA revealed a significant main effect for time ($F_{1.85,\ 46.2}$ = 13.04, p<.001, η^2 = .343) but no significant difference between preference groups ($F_{1,\ 25}$ =0.39, p=.54, η^2=.02). Pairwise comparisons showed that participants perceived minute-5 (M = 4.2 ± .29) to require less exertion than all other time points, with exertion perceived to be highest at minute 20 (M=5.9 ± .38).

Hypothesis Four:

Correlations were run to establish relationships that may exist between different exercise intensities and preference groups. Results supported the hypothesis that those individuals with a preference for high intensity exercise would participate in more vigorous, high intensity activity in comparison to those reporting a preference for lower intensity activity. Results revealed a significant, positive relationship between a reported preference for high intensity exercise and the amount of time spent in both moderate (.707**, $p<.001$) and vigorous PA (.580**, $p<.002$), suggesting that those with a preference for high intensity activity participated in activity of a higher intensity than those with a low preference for high intensity.

One-way ANOVAs were run to determine differences in the overall amount of PA at different intensities that individuals participated in between the High and Low preference groups. Results revealed significant between-group differences in the amount of moderate ($F_{(1,24)} = 24.4.$, $p<.001$), and vigorous ($F_{(1,24)} = 11.7$, $p<.005$) PA that individuals undertook dependent on preference for either high or low intensity exercise. These results show that those individuals with a preference for high intensity exercise recorded significantly more moderate and vigorous PA than those who reported a preference for low intensity exercise (table 19). There were no significant differences in the amount of sedentary or light PA between groups.

Intensity	Preference	Mean (minutes of activity) (SD)
Sedentary	High	4159.5 (748.9)
	Low	4338.1 (740.7)
	Overall	4248.8 (735.5)
Light	High	1425.8 (306.2)
	Low	1453.5 (317.4)
	Overall	1439.7 (305.9)
Moderate	High	321.4 (71.2)
	Low	191.5 (62.5)
	Overall	256.4 (93.3)
Vigorous	High	45.8 (35.2)
	Low	11.4 (8.9)
	Overall	28.6 (30.7)

Table 20 Means and Standard Deviations of amount of PA recorded of different intensities, split by individual preference for high or low intensity exercise

Hypothesis Five:

Correlations were run to establish the nature of the relationships between affective associations and different exercise intensities. Results revealed that those individuals who reported more positive affective associations recorded higher outputs of moderate (.408, $p<.05$) physical activity on the GENEA accelerometer. Following the correlations, regression analysis was run to determine whether affective associations predicted PA behaviours. Results showed that affective associations significantly predicted moderate (R=.41, R^2 change=.17, F Value=4.9, $p<.05$) physical activity. These results indicate that affective associations predict between 17% of variance in moderate physical activity.

Discussion:

The overall aim of this study was to investigate the role of individual preferences in determining physiologically defined self-selected exercise intensity. Results supported hypothesis one, with an individual's preference for high and low intensity exercise predicting the self-selected treadmill exercise intensity, when expressed as a %VO2-at-VT. These results are also supported by previous findings by Ekkekakis et al. (2006), by showing that preference for specific exercise intensities can predict self-selected exercise intensity in an adolescent population; and this is not a phenomenon only relevant to adults. These results indicate that an individual's preferences for high and low intensity exercise can be a useful measure to determine or predict the intensity that one will choose to work at during a self-selected exercise session and confirm the predictive validity of the newly-formed adolescent-specific PRETIE-Q.

Both preferences for high and low intensity exercise scores predicted significant amounts of variance in the intensity that individuals chose to work at, suggesting that the inclusion of two factors to assess high and low preference independently was an appropriate decision (see Study 2). At minutes-15 and -20 the preference for low intensity exercise scores accounted for a greater % of the variance in the intensity chosen, compared to the preference for high intensity scores. However, both sets of preference scores still accounted for significant amounts of variance, indicating that both factors are important with regard to predicting the intensity that individuals would work at.

There were significant differences in the self-selected exercise intensity between the High and Low preference groups. On average the individuals in the High preference group worked at 5.2% above their VT, while those in the Low preference group worked, on average, 9.8% below VT. These results support the second hypothesis; that there would be significant differences in the self-selected intensity between the two groups. These results highlight the importance of differentiating between high and low preference individuals, with significant differences occurring between groups. Those individuals with a preference for high intensity exercise worked above their VT, with those individuals reporting a preference for low intensity exercise below their VT. Previous research by Stych and Parfitt (2011) explored the intensity that low-active, low preference adolescents chose during a self-selected exercise session. On average participants chose to work at an intensity below-VT, a finding similar to the current study. Ekkekakis et al (2006) found that when women were given the choice of exercise intensity, results centred on VT (an average of 97% VO2-at-VT at minute-20). This previous research used the original 2-factor PRETIE-Q, hence would have assessed preference as one factor, and not two as in the current study. As a result, the current findings are novel in this research area and explore the relevance of separating preference in to two factors; high and low. No previous studies have investigated the intensity that those individuals with a preference for high intensity choose to work at when given the choice, reinforcing the novelty of the findings of the current study.

Results showed that there were no significant differences across time in either group (%VO2-at-VT). This suggests that when self-selecting exercise intensity individuals work at a relatively steady pace and once they have found this preferred intensity they maintain it until the end of exercise. Whilst %VO2-at-VT was relatively stable across time, this contradicted findings by Ekkekakis et al. (2006) and Cabanac (1986) who suggested that exercise intensity will gradually increase during the first 10-15 minutes and then stabilise to a preferred level. The current study allowed changes in intensity to occur at any time throughout the 20-minute exercise session, whereas previous studies have limited changes to every 5-minutes. By allowing individuals to alter the speed/intensity of the exercise session it is more likely that they will stabilise to a preferred level much quicker than if changes in speed were limited. Giving participants the freedom to change their speed throughout meant that they were able to increase or decrease the intensity and thus find their preferred level without any restrictions.

Results did not fully support hypothesis three; with significant differences in affective responses at minutes-10, -15 and -20 between High and Low preference groups. Results also revealed that those individuals with a preference for high intensity exercise reported more positive overall affect than those with a preference for low intensity exercise. Whilst there was a difference in average affect between groups, it is important to note that at no point during the exercise sessions did either the High preference or Low preference group report negative affective responses. These results confirm findings from several other studies (Lind, Joens-Matre, & Ekkekakis, 2005; Lind et al., 2008; Parfitt et al., 2006; Rose & Parfitt, 2007) where individuals have performed 20-minutes exercise on a treadmill and self-selected the exercise intensity; mean affective responses remained positive throughout. Results showed that whilst affective responses changed across time, however, they remained positive throughout the exercise session, suggesting that by allowing individuals to self-select exercise intensity has the potential to elicit positive affective responses, and still be at an intensity that will have physiological benefits.

The dual-mode model (see literature review) (Ekkekakis, 2003) suggests that there is a uniform decline in affective responses above VT. However, previous studies (Lind et al., 2005; Lind et al., 2008; Parfitt et al., 2006; Rose & Parfitt, 2007; Vazou-Ekkekakis & Ekkekakis, 2009) and a review by Ekkekakis and Petruzzello (1999) showed that providing individuals with autonomy over exercise intensity have shown that individuals often self-select intensities above VT which coincide with positive affective responses. Previous studies with adolescents (Stych & Parfitt, 2011) showed that when individuals were in control of their intensity affective responses were more positive compared to when individuals were prescribed an intensity. Given that, on average, the exercise intensity for the High preference group was above VT from minute-5 through to minute-20, these findings support the importance of autonomy and links closely to the theory of self-determination (SDT) (Deci & Ryan, 1987). The SDT focuses on the motivational implications of self-selected (autonomous) and prescribed or dictated (non-autonomous) behaviours.

There were no significant differences in the overall amount of PA individuals participated in between the high and low preference groups. However, there were significant, positive relationships between those with preference for high intensity exercise and the amount of time spent in moderate PA. This is, again, not a surprising result, given the preference for high intensity exercise that this group reported. These results support hypothesis four, and emphasise that even though individuals may have a preference for different intensity exercise this does not affect the overall amount of PA that they perform. This is an important finding because it highlights that those with a preference for low intensity exercise are not less active than those with a preference for high intensity exercise, they just opt to spend more time in light PA than in moderate or vigorous PA. Whilst those individuals reporting a preference for high intensity exercise spent more time in moderate PA than those with a preference for low intensity exercise, the data showed that 87% of participants participated in the recommended 60-minutes of moderate-to-vigorous PA per day over the reported 4-days (calculated by combining both moderate and vigorous PA outputs). However, given the problems with wear-time and compliance it was not possible to determine how many of the individuals participated in the recommended level of PA over each of the 7-days. Future studies should aim to overcome this problem and only include individual's data if they wore the accelerometer for the full 7-days and not the 3-weekdays and 1-weekend day cut off that the current study used. The current study initially aimed to only include participants who had 7-days wear time; however, this resulted in the exclusion of over 50% of the participants. Given the small sample used in the current study this was not deemed appropriate.

Results from the current study reinforce the findings from study 3, where results highlighted the importance of the inclusion of affective associations in to behaviour change theories. The current data indicates that a significant portion of variance of both moderate and vigorous physical activity can be attributed to affective associations. Thus future PA promotions or interventions should aim to improve individuals' affective associations, and make them more positive, in an attempt to encourage increased participation in moderate physical activity. This is an important finding that could contribute significantly to future PA and exercise interventions.

The results from the current study reinforce the importance of taking individual preference in to account when prescribing or promoting PA. The results indicate that we need to understand individual preferences for high or low intensity exercise before prescribing exercise to ensure that individuals are not prescribed an intensity that is too high or too low to elicit positive affective responses and/or physiological benefits. By accounting for individual preference this may have a positive effect on future exercise participation and adherence. Results from the current study support the utility of the PRETIE-Q in predicting the intensity of exercise that an individual chooses, and suggest strong construct validity of this measure.

Strengths and Limitations

The current study sought to overcome some of the limitations of previous studies, the first was by carrying out the exercise sessions in a gym or fitness suite environment. This meant that the results were potentially more generalizable to other gym environments, and not limited to a laboratory setting. This is an important step towards advocating the use of the PRETIE-Q and individual preferences in exercise prescription or promotion. However, generalisability across exercise modes and exercise duration cannot be assumed as all participants exercised on a prescribed treadmill for a given length of time. Future studies should offer individuals the opportunity to choose other pieces of gym equipment and explore whether the current results are transferable across to these other pieces of gym equipment. Future studies should also consider allowing the individuals to choose the duration of their exercise session to determine whether there are differences in the duration chosen between high and low preference groups, as well as to establish whether individuals choose to work for an adequate length of time when given the choice.

Future studies exploring the utility and validity of the adolescent specific PRETIE-Q should focus on some of the limitations of the current study; the most obvious limitation being the nature of the present sample. This population group was chosen specifically given the evidence surrounding declining PA levels in this group. Further research could replicate the current study with other adolescent females, and across to adolescent males also.

The current study only recruited those individuals with a strong preference for high intensity exercise coupled with a weak score for low preference, and those with a strong preference for low intensity exercise coupled with a weak score for high preference. Future studies could recruit 4 types of individuals based on their preference scores; 1) those with strong preference scores for both high and low, 2) those with weak preference scores for both high and low, 3) those with strong scores for high preference and weak scores for low preference, and 4) those individuals who report a strong score for low preference and a weak score for high preference. Future studies should also explore these groups relative to tolerance scores to determine whether particularly strong or weak tolerance scores predict exercise intensity. By exploring the differences between the 4 groups it will give further insight in to the utility of the adolescent-PRETIE-Q and highlight those particular individuals who require the most individually tailored exercise programmes. Ekkekakis et al. (2006) also suggested that the PRETIE-Q may be a useful tool to identify individuals who have a tendency to work too hard or too easy (compared to the ACSM recommended levels) and focus interventions on these specific individuals to ensure they can self-regulate their exercise intensity to ensure they are working within the recommended intensity levels.

Whilst every effort was made to collect baseline PA data prior to the exercise testing sessions, given the availability of school facilities and access to the schools this was not possible. This resulted in PA data being collected post-exercise testing, and this may have resulted in bias or the contamination of data from testing. Future studies should aim to overcome this limitation by collecting baseline PA data.

Conclusion

In conclusion, the current study helped validate the adolescent-specific PRETIE-Q preference scales, highlighting that the preference scales are capable of predicting exercise intensity both above and below VT in individuals with either a particular preference for high or low intensity exercise. The results from the current study also have practical implications. Given that the high and low preference scores from the adolescent-specific PRETIE-Q accounted for 13.4 - 43.3% of the variance in %VO2-at-VT at minutes-5, 10, -15 and -20, beyond that accounted for by age, BMI, VO2 peak and VT, it should be considered as a useful tool for understanding self-selected exercise intensity. The criterion variable was physiologically defined exercise intensity, rather than a self-report measure; these results are even more meaningful. Future research should further explore the utility of the adolescent-specific PRETIE-Q in order to help identify those individuals who choose to self-select exercise intensity that is either too low or too high.

Chapter 9

Study 5b - Acute Affective Responses to Prescribed and Self-Selected Exercise Intensities in Adolescents Girls[5]

[5] Manuscript in preparation for submission to *Medicine and Science in Sport and Exercise*

Abstract:

Objectives: Allowing individuals to self-select exercise intensity has been shown to elicit more positive affective responses than during prescribed intensity sessions. There is conflicting evidence regarding whether individuals choose to work at an intensity that would be adequate to confer physiological benefits.

Methods: Twenty seven females (mean age = 14.6±0.8 years) were recruited. Participants completed three 20-minute exercise sessions (2 self-selected and 1 prescribed) and a graded exercise test. Anticipated affective responses and ratings of perceived exertion (RPE) were recorded prior to each session, with affective responses and RPE also being recorded throughout the exercise sessions. Differences in intensity between prescribed and self-selected sessions were established, with differences in affective responses and RPE during the two sessions also being examined.

Results: There were no significant differences in the intensity between the prescribed and self-selected exercise sessions. Anticipated RPE were significantly higher prior to the prescribed session, with anticipated affective responses being significantly more positive prior to the self-selected session. During the self-selected exercise session affective responses were significantly more positive compared to during the prescribed session, with RPE being higher during the prescribed session compared to the self-selected session. On average participants were working at 70% VO2 peak; an intensity well within the recommended levels by the American College of Sports Medicine.

Conclusion: By allowing individuals to self-select their exercise intensity, instead of prescribing it, affective responses were more positive. Findings support the importance of autonomy and self-paced exercise. Even when the intensity did not differ between the two scenarios, there was a significant impact on the affective experience, highlighting the importance of these findings with regard to future PA promotion.

Introduction

Finding exercise or physical activity (PA) that adolescents enjoy and have positive experiences of is important given the decline in PA that occurs as individuals enter adolescence (Hallal et al., 2012; Troiano et al., 2008) particularly females (Hallal et al., 2012; Nelson et al., 2006). Previous research (Dishman, 2001) has indicated that the exercise experience an individual has can influence future PA behaviour, therefore it is important to understand how an individual experiences exercise. Experiencing positive affect during exercise has an impact upon motivation and behaviour (Parfitt et al. 2006) and recent evidence from studies with adults has indicated that affect may be the first link in the exercise adherence chain and may influence decisions regarding whether or not to repeat the behaviour (Williams et al., 2008). This link between affect and adherence is an important link to explore because 60% of individuals who undertake an exercise programme fail to adhere for longer than 6-months (Dishman, 2001).

When recommending PA for public health, professionals take one of two approaches, the first is based on the participant following a prescription developed by the professional, and the second is an approach based on the participant's own preferences. Previous research has explored the implications of allowing individuals to self-select their own exercise intensity compared to prescribing an intensity (Lind et al., 2008; Vazou-Ekkekakis & Ekkekakis, 2009) to establish whether allowing individuals to self-select their exercise intensity elicits more positive affective responses than when individuals followed a prescribed exercise programme. There is conflicting evidence surrounding the intensity of exercise that individuals choose when self-selecting. Spelman, Pate, Macera and Ward (1993) reported that individuals exercised at an intensity below the levels recommended by the American College of Sports Medicine (ACSM), whereas Ekkekakis (2009) reported that in most cases, self-selected intensity was equal to, or exceeded, the minimum level of the recommended range. The range recommended by the ACSM is between a low of 40-50% of oxygen uptake reserve (VO2R) or heart rate reserve (HRR) or 64-70% of maximum heart rate (HRmax) and a high of 85%VO2R or HRR or 94%HRmax. Lind, Joens-Matre and Ekkekakis (2005) found that, in a group of sedentary women (mean age 43 years) intensity gradually increased from 74% HRmax or 55% VO2max at minute 5 to 83%HRmax or 67%VO2max at minute 20. Results from this study highlighted that when individuals self-selected exercise intensity they chose an intensity that would incur health benefits as recommended by the ACSM. Dishman et al. (1994) also found that when 12 low-active and 11 high-active males (mean age 23 years) self-selected intensity on a cycle ergometer, regardless of group, intensity was approximately 62%VO_2max at the end of the 20-minute exercise session. Rose and Parfitt (2012) found that when 17 sedentary and 15 active women completed 30-minutes exercise on the treadmill, for the first 10 minutes, women chose to exercise at an intensity below their VT, but after the 10-minute point they increased the intensity and exercised just above their VT. However, Stych and Parfitt (2011) and Sheppard and Parfitt (2008a) explored the intensity that adolescents would choose when given the opportunity to self-select their own exercise intensity and results showed that, on average in both studies, participants selected an intensity below VT.

These previous studies have explored the relationships between self-selected exercise and affect, but given the conflicting evidence regarding the intensity chosen many exercise practitioners often prescribe exercise intensities rather than to allow self-selection. This is to ensure that all individuals are working at an intensity that would be beneficial to their health. However, results from the studies by Vazou et al. (2009) and Lind et al. (2008) showed that affect was more negative when the intensity of exercise was prescribed, rather than chosen by the individual; with authors suggesting that this decline in affect may be as a result of loss of autonomy. Cabanac (1986) suggested that the self-selection of intensity is regulated on the basis of affective responses. He went on to suggest that “spontaneous behaviour tends to be optimal in terms of physiological function” (1986; p.843) and that pleasure is the “common currency” people use in making behavioural choices. Sheppard and Parfitt (2008a) showed that during a 15-minute cycle exercise session affective responses became less positive over time in a prescribed, high intensity session compared to in the self-selected session where affective responses became more positive over time. Stych and Parfitt (2011) explored both quantitative and qualitative responses to self-selected exercise and also found that during self-selected exercise sessions, where low-active adolescents reported feeling in control of their intensity, the more positive affective responses were reported compared to prescribed sessions. Dominant themes present in the qualitative findings were ‘choice’ and ‘control’ with individuals reporting that the opportunity to choose what they wanted to do and being in control of it contributed to positive affective responses. These results were consistent with Self-Determination Theory (SDT) (Deci & Ryan, 1987).

Self-Determination Theory focuses on the motivational implications of self-selected (autonomous) and prescribed or dictated (non-autonomous) behaviours. Deci and Ryan (1987) suggest that ‘autonomy’ refers to the degree of freedom that an individual perceives to have to perform the behaviour of his or her own choice. The SDT suggests that the degree of pleasure that an individual experiences when they act autonomously is likely to be higher than that experienced when behaviour is externally controlled. Deci and Ryan (1987; 2000) therefore suggest that under autonomous conditions, positive affect is more likely to occur.

Several studies have supported the theorised link between perceived autonomy and broadly defined positive affect (Black & Deci, 2000; Kasser & Ryan, 1999; Sheldon et al., 1996), with results showing that non-autonomous conditions are typically associated with less positive affective states compared to autonomous conditions. Vazou-Ekkekakis and Ekkekakis (2009) sought to examine whether manipulating an exerciser's perception of autonomy, by allowing or disallowing an individual to set their own exercise pace, could have an impact on affective responses. Results were consistent with the SDT and indicated that the loss of perceived autonomy in setting one's level of exercise intensity can negatively impact affect and thus lessen the enjoyment that the individual derives from the physical activity participation. This previous research suggests that to enhance affect during exercise and ultimately increase adherence to physical activity individuals should be given autonomy over their exercise intensity and be able to self-select the intensity of their own exercise sessions. SDT was not used as a theoretical basis for this study; however it provided a useful framework for understanding the relationships between self-selected and prescribed exercise and affective responses, relating to autonomy.

Two previous studies (Sheppard & Parfitt, 2008; Stych & Parfitt, 2011) explored the effect of allowing adolescents to self-select their exercise intensity rather than prescribe it. Both previous studies have used the cycle ergometer in a laboratory environment, and limited any modifications to the self-selected intensity to minute-5 and minute-10 only. As a result it is important to explore whether these results found in adolescents are generalisable to other modes of exercise, but also to explore whether the protocols used with adult populations elicit different responses. This may have an important impact on the way PA sessions and exercise programmes are promoted to adolescents, and ultimately may contribute to changes in PA participation and adherence.

The primary objective of this study was to explore whether manipulating an exerciser's autonomy over the intensity of an exercise session had an impact on affective responses within an adolescent population. A secondary aim of the research study was to explore whether anticipated affective responses and anticipated ratings of perceived exertion recorded prior to a self-selected or prescribed exercise session would be affected by perceptions of autonomy. The intensity of the self-selected exercise session was also examined.

Hypotheses:

Three hypotheses were made: 1) anticipated affective responses and perceived exertion would be more positive and higher prior to the self-selected intensity session compared to the prescribed intensity session; 2) affective responses would be more positive during the self-selected session than in the prescribed session. RPE would be lower during the self-selected session compared to the prescribed session; and 3) the self-selected intensity would, on average, be within the recommended range of the ACSM.

Data Analysis:

To test hypothesis one and explore whether anticipated affective responses and anticipated ratings of perceived exertion would differ between the prescribed and self-selected a series of repeated measures ANOVAs were run to examine differences between scenario (self-selected, prescribed) on each dependent variable: FS and RPE. Where sphericity was violated, Greenhouse-Geisser was used to adjust the degrees of freedom. Pairwise comparisons and Post-hoc Tukeys tests were performed on any interactions to examine where significant differences occurred.

Hypothesis two was tested by conducting repeated measures ANOVAs to explore differences in affective responses and ratings of perceived exertion across the time points (1, 5, 10, 15, 20, Post, +5) between the self-selected and prescribed exercise sessions on FS and RPE responses.

Hypothesis three was examined by exploring %VO2peak at minutes 1, 5, 10, 15 and 20 of the self-selected exercise session to establish the overall intensity chosen by participants.

Results:

Descriptive anthropometric and physiological data is displayed in Table 20, along with physiological indices utilised for statistical analysis.

	Mean ± St.dev
Height (m)	1.6 ± 0.06
Mass (kg)	54.8 ± 9.1
BMI (kg/m^2)	20.9 ± 3.0
VO2 Peak (ml.min^{-1}.kg^{-1})	42.9 ± 7.7
Ventilatory Threshold (VT) (ml.min^{-1}.kg^{-1})	33.5 ± 5.8

Table 21 Mean descriptive characteristics of Participants

A 2 (intensity condition: self-selected or prescribed) by 5 (time: min1, 5, 10, 15 and 20) repeated measures ANOVA for %±VO2-at-VT showed no significant difference in the intensity participants worked at between the prescribed and self-selected sessions (F (1.00, 26.00) = 0.816, p=.375, η^2=0.03) (figure 1) and no time*condition effect (F 2.8, 74.3 = 1.17, p=.325, η^2 = .04). Results showed a significant increase in intensity across the 20-minute exercise sessions (F (2.35, 61.07) = 28.19, p<.001, η^2 = 0.52). Pairwise comparisons revealed that after a significant increase from minute-1 (M=75.67% of VO2-at-VT ± 2.23) to all time points the intensity of the exercise session (from minute-5 onward) remained relatively stable throughout (see figure 12).

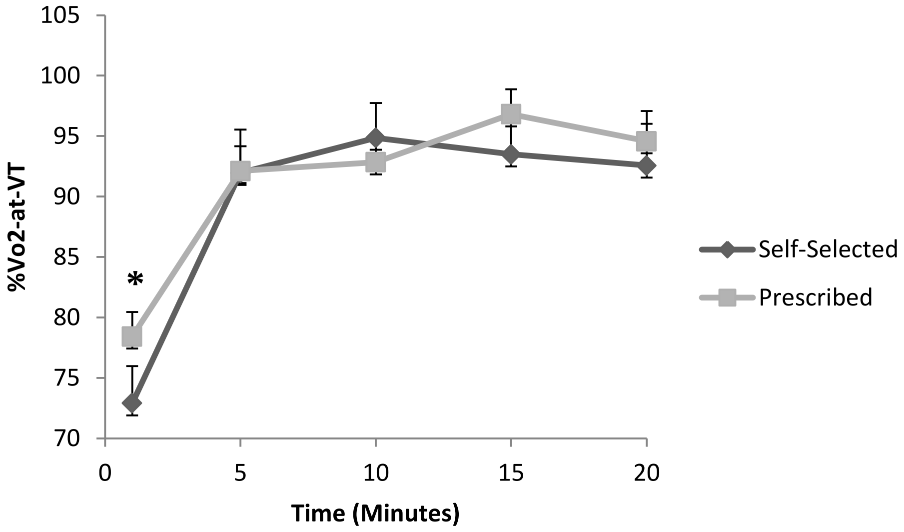

Figure 11 %Vo2-at-VT across time for self-selected and prescribed exercise sessions. *= significantly lower than all other time points (*p*<.001), with error bars.

Ratings of Perceived Exertion: The repeated measures ANOVA revealed a significant main effect for condition ($F_{1.00, 26.00} = 11.1$, $p<.005$, $\eta^2 = .30$). The anticipated rating of perceived exertion was significantly higher in the prescribed condition (M=6.3±0.24) compared to the self-selected condition (M=5.4±0.31) ($p<.001$), suggesting that participants anticipated that they would be working significantly harder in the prescribed intensity session compared to in the self-selected condition.

Affective Responses: The repeated measures ANOVA revealed a significant main effect for condition ($F_{1.00, 26.00} = 26.3$, $p<.001$, $\eta^2 = .50$). The anticipated affective response was significantly more positive in the self-selected condition (M=2.37±0.35) compared to the prescribed condition (M=-0.19±0.43) ($p<.001$) suggesting that participants anticipated that they would feel better and more positive in a self-selected exercise session compared to a prescribed intensity session. On average participants anticipated positive affective responses for the self-selected condition, but negative affective responses for the prescribed condition.

Hypothesis Two:

Affective Responses

A 2 (intensity condition: self-selected or prescribed) by 5 (time points: min1, 5, 10, 15 and 20) ANOVA on FS responses showed a significant main effect for condition ($F_{1.00, 26.00} = 15.87$, $p<.001$, $\eta^2=.38$), and for time ($F_{1.93, 49.74} = 41.48$, $p<.001$, $\eta^2=.615$). Results also revealed a significant condition*time interaction ($F_{2.77, 72.02} = 3.026$, $p<.05$, $\eta^2=.104$. Pairwise comparisons indicated that FS responses were significantly higher at minute-1 compared to all subsequent time points (M=2.93±.338, $p<.001$). Minute-5 responses were also significantly higher than all following time points (M=1.91±.324, $p<.001$). FS responses were reported to be significantly higher at minute-10 (M=1.056±.34, $p<.002$) compared to minute-15 (M=.50±.401) but there was no difference in FS responses between minute-10 and minute-20 (M=.76±.43). Results showed that participants reported significantly higher ($p<.001$), and more positive, affective responses in the self-selected condition (M=1.89 ± .326) compared to the prescribed condition (M=.970±.393). Post-hoc Tukeys test revealed that the condition*time effect occurred as a result of significant differences in affective responses at minute-10 between self-selected and prescribed groups, and significant differences in affective responses at minute-20 between groups, with no differences at other time points between conditions.

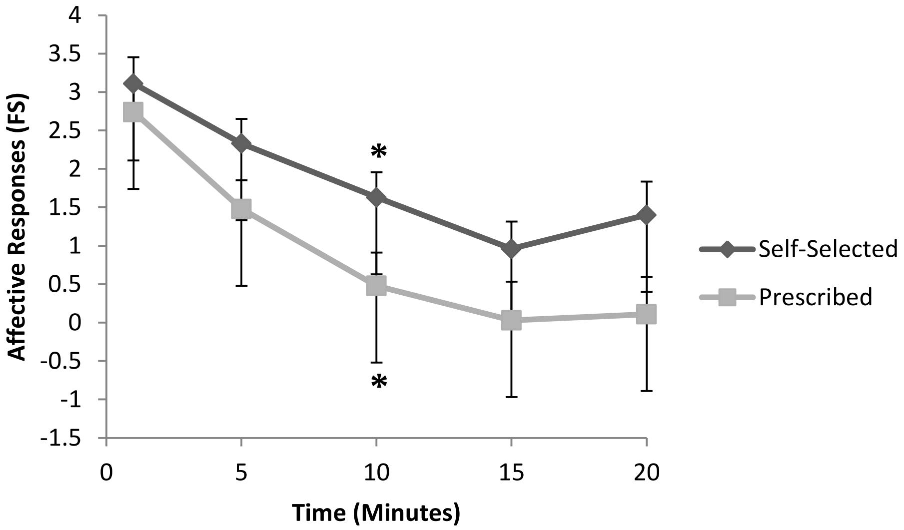

Figure 12 Affective Responses (using the Feeling Scale) across 20-minute exercise sessions, either of self-selected of prescribed intensity. *significant differences in affective responses between self-selected and prescribed groups, with error bars

Ratings of Perceived Exertion

A 2 (condition: self-selected and prescribed) by 5 (time points: minute1, 5, 10, 15 and 20) ANOVA for E-P responses revealed a significant main effect for condition ($F_{(1.00, 26.00)} = 32.2$, $p<.001$, $\eta^2=.553$) and for time ($F_{(1.98, 51.45)} = 41.88$, $p<.001$, $\eta^2=.617$), but no condition*time effect occurred. Results indicated that RPE was significantly higher ($p<.001$) in the prescribed condition (M=4.87±.27) compared to the self-selected condition (M=3.87±.24). Pairwise comparisons also revealed that E-P scores were significantly lower at minutes 1 (M=2.35±.29, $p<.001$) and 5 (M=3.96±.26, $p<.001$) than all subsequent time points. Results also indicated that E-P responses at minute-10 (M=4.6±.27) were significantly lower (p <.001) than responses at minute-15 (M=5.43±.31), but no difference was revealed between minute-10 and minute-20 (M=5.48±.34).

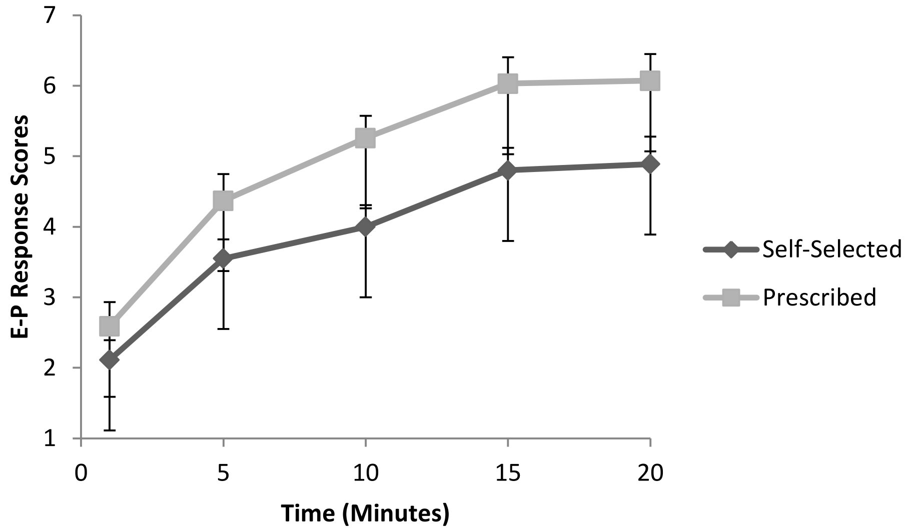

Figure 13 Ratings of Perceived Exertion across time, depending on condition (self-selected or prescribed)

Hypothesis Three:

Hypothesis three was tested by running descriptive statistical analysis on the %VO2peak worked at during the second self-selected exercise session at minutes-1, 5, 10, 15 and 20.

	%VO2 Peak			
Time	Minimum	Maximum	Average	STDev
Minute 1	22.4	76.3	57.5	11.9
Minute 5	46.9	87.5	71.6	10.2
Minute 10	49.2	88.0	73.4	10.9
Minute 15	55.4	91.8	76.2	10.4
Minute 20	60.3	92.8	76.4	11.1

Table 22 Descriptive data showing minimum, maximum, average and standard deviations of %VO2peak in the self-selected condition

Results showed that on average participants worked at 70% of VO2peak; well within the recommended range from the ACSM.

Discussion

The purpose of this study was to explore the effect that the delivery of an exercise session had on affective responses and perceived exertion. The intensity of both the prescribed and self-selected sessions was the same, with no differences between sessions; however there were significant differences in anticipated affective responses, anticipated perceived exertion, actual affective responses and ratings of perceived exertion. As previously stated, according to SDT perceived autonomy, or lack-of, can impact affect. Individuals were told, prior to the prescribed exercise session, that they had no control over the intensity that they were going to exercise at, nor did they know how hard the session was going to be. As a result, they did not know what to expect; this may explain the differences in both anticipated and actual affective responses and ratings of perceived exertion. These results suggest that allowing individuals to self-select exercise intensity elicits a more positive affective response, and given the research to support the relationship between affect and adherence with adults (Williams et al., 2008; Williams et al., 2012) this is an important finding.

When dealing with future behaviours, such as PA, it is appropriate to assess anticipated affective reactions. Anticipated emotions are dynamic responses to real or imagined feedback and occur as a result of a self-regulatory process. Anticipated emotions, such as anticipated affective responses, are dependent on appraisal processes and therefore change dependent on the situation (Bagozzi et al., 2003). Results from the current study reinforce this notion, as anticipated affective responses differed dependent on the situation presented to the individual. Anticipated affective responses to PA represent an understudied class of outcome expectancy (Kirsch, 1995; van der Pligt & de Vries, 1998). Richard et al. (1996) showed that anticipated affective reactions predict a significant portion of variance in self-reported behaviour and can have an effect on future behaviour. These results suggest that it may be preferable to allow individuals to self-select exercise intensity because prior to the session individuals will anticipate positive affective responses. A basic assumption from the few studies that exist, together with the results from the current study, is that the anticipation of affective consequences of behavioural actions could have an impact on decisions about behavioural choices; something that future studies should explore more explicitly. Results from this study support the benefits of allowing individuals to self-select their own exercise intensity, not only does it ensure autonomy, fulfilling the needs of the self-determination theory, but it has the potential to ensure individuals anticipate ‘feeling good’ during their exercise session even before they have begun the session.

Recent evidence implicates affective responses to PA in motivation for future participation (Williams et al., 2012) therefore optimising affective responses should be taken in to account when recommending or prescribing PA to the public. Results from the current study offer evidence in support of incorporating psychological considerations in the prescription of PA guidelines, more specifically, the data offers a strong rationale for the promotion of self-paced PA in the domain of public health in order to achieve more positive affective responses. Data showed that there were no significant differences in exercise intensity between the self-selected and prescribed sessions, suggesting that the differences in affective responses occurred as a result of the nature of the session, i.e. prescribed or self-selected intensity, and not as a result of any differences in intensity. Affective responses were significantly higher and more positive in the exercise session that was self-selected by the individual compared to affective responses reported in the prescribed session, as supported by self-determination theory. It is important to note that the significant difference in affective responses between conditions occurred as a result of significant differences at minute-10. Individuals were informed at minute-10 that they were half way through the exercise session. Affective responses at this point were significantly less positive in the prescribed condition than in the self-selected session, suggesting that the lack of control individuals had over the intensity for the subsequent next 10-minutes of the exercise session contributed to this decline in affective responses. Deci and Ryan (1987; 2000) suggested that the degree of pleasure that individuals experience when they act autonomously will likely be higher than that experienced when behavioural parameters are externally controlled. This supports the current findings, as the autonomous, self-selected session resulted in significantly more positive affective responses than in the externally controlled, prescribed exercise session. In support of the findings from the current study, Black and Deci (2000), Nix, Ryan, Manly et al. (1999), Sheppard and Parfitt (2008a) and Stych and Parfitt (2011) showed that prescribed conditions, or those not under one's autonomy, were associated with less positive affective states compared to autonomous, or self-selected conditions.

Previous studies that have allowed participants to self-select exercise intensity have consistently shown that self-selected intensity is within the recommended range by the ACSM (between 40-50% VO2R and 85%VO2R) in both middle-aged adult participants (Lind et al., 2005; Murtagh, Borcham, & Murphy, 2002; Spelman et al., 1993) and with college-age participants (Dishman et al., 1994; Focht & Hausenblas, 2003; Parfitt et al., 2000; Vazou-Ekkekakis & Ekkekakis, 2009). The current study examined the effects among adolescents. These previous findings have been confirmed by the current study in an adolescent population, with participants on average working at 70%VO2max, well within the recommended ACSM range. The current study, coupled with a growing body of research, suggest that by allowing individuals to self-select their own intensity exercise they will choose to exercise at an intensity that is of a high enough intensity to be beneficial to one's health. It is important that adolescents exercise within the ACSM recommended levels, given the benefits that exercising within this range has been shown to have (Andersen et al., 2006; Ferreira et al., 2007; Hind & Burrows, 2007; Ness et al., 2007).

Results indicate that E-P scores were lower in the self-selected intensity than in the prescribed setting, even though they both put the same metabolic demands on the body. During self-paced exercise, the exercise work rate is regulated by the brain based on the integration of numerous signals from various physiological systems (Tucker, 2009). Borg stated that RPE is the best indicator of physical strain, and as well as being based on the signals from muscles, the cardiovascular system and respiratory functions (Borg, 1982) it also incorporates other mediators, particularly psychological and affective components (Hardy & Rejeski, 1989; Rejeski & Ribisl, 1980). Eston (2009) suggested that perceived exertion involved the interplay of physiological signals from cardiorespiratory, metabolic and thermal stimuli and feed-forward mechanisms to enable individuals to evaluate how hard or easy the task is to them. Eston (2009) went on to state that this is moderated by psychological factors, such as cognition, memory and understanding of the task, as well as situational factors such as knowledge of the duration of the task and temporal characteristics.

The combination of individuals' choosing to work at an intensity well within the recommended range, and the elicitation of more positive affective responses in a self-selected exercise session could contribute to a re-focusing on exercise prescriptions, and move away from prescribed, formalised exercise sessions and towards self-selected sessions. This is of particular relevance to adolescents, given the decline in PA that is evident as individuals enter adolescence. By allowing adolescents to choose the intensity of their exercise session, and giving them autonomy over it, may be a first step in encouraging adolescent females to be more active and promote enjoyable exercise experiences. This is preferable compared to promoting externally controlled, prescribed sessions that have the potential to elicit more negative affective responses, thus reduce adolescents' desire to participate again in the future.

Given the specific age and gender of the group in the current study, the results can contribute significantly to the body of evidence that already exists surrounding the relationship between self-selection of exercise intensity and affective responses. Previous research by Stych and Parfitt (2011) and Sheppard and Parfitt (2008) compared affective responses to self-selected and prescribed exercise sessions and provided similar findings to those of the current study. Both previous studies explored this relationship in male and female adolescents, using a cycle ergometer. The combination of these two previous studies, in conjunction with the current study, provides a significant contribution to this research area. The combination of these three studies suggests that the findings may be generalisable across adolescent populations; male and female, as well as across exercise modes; both treadmill and cycle ergometers. However, none of the three studies allowed participants to choose the duration of the exercise task; something that future studies should aim to do.

Future studies should offer individuals more autonomy over their exercise experience and give the choice of several pieces of exercise equipment, such as the cycle ergometer or rowing ergometer. By allowing individuals to choose their own mode of exercise, autonomy may be further supported, which has the potential to make affective responses more positive and thus contribute to increased adherence to an exercise programme. Following on from the findings in the current study, future studies need to explore the relationship between affect, adherence and self-selection within this specific population in order to fully understand the benefits of allowing individuals to self-select exercise.

In conclusion, the current study showed that by allowing individuals to set their own exercise intensity, instead of prescribing it, it elicited more positive affective responses thus strengthening support for the importance of autonomy and self-paced PA in the public health domain. Even when the intensity does not differ between the self-selected and prescribed sessions, there is a significant impact on the quality of the affective experience, and this may have potential long-term implications for adherence to exercise.

Chapter 10

Discussion

Main Findings

The research studies in this thesis have revealed several important findings in relation to affect with children and adolescents. The six studies provided evidence to support previous research that has been carried out with adults, but also made a unique contribution to the literature regarding affective responses and affective associations of children and adolescents. There were four main aims to this thesis; each addressing more specific research questions regarding the nature of the relationship between affect and PA in this younger population. Of particular importance was i) the applicability of the dual mode theory (DMT) to children and adolescents, ii) the utility of the Preference for, and Tolerance of, exercise intensity questionnaire for predicting self-selected exercise intensity in children and adolescents, iii) the relationship between affective associations and PA behaviour relative to theories of behaviour change, and iv) individual autonomy or loss-of-autonomy relative to affective responses to acute exercise sessions.

The applicability of the dual mode theory to children and adolescents

The premise of study 1 was developed in order to establish whether the DMT (Ekkekakis, 2003) was applicable to male and female children and adolescents. This thesis confirmed the validity and utility of the dual mode theory (DMT) (Ekkekakis, 2003) with children and adolescents, and showed that during continuous exercise affective responses declined after VT. This was the first time that the tenets of the DMT had been tested in both male and female children and adolescents, with affective responses being measured across a GXT. Results supported the previous findings that affective responses are more positive prior to VT than above-VT, however there were significant differences between younger children and adolescents; suggesting that exercise and PA need to be prescribed on a more individual basis rather than grouping children and adolescents together. Affective valence declined significantly from the onset of exercise in children up until the point of VT, whereas it remained relatively stable for adolescents. Exercise above VT brought about significant declines in affective responses in both children and adolescents, but with a more significant decline with adolescents. The results from this study lead to the suggestion that exercise should be prescribed below VT, particularly for young children, to enhance affective experiences. It should be noted; however, that there was large inter-individual variability between participants' affective responses in study 1 which led on to studies 2 and 3; studies focussed on exploring individual differences and factors that contributed to this disparity in affective responses to exercise of the same intensity. These results further enhance the evidence base surrounding the exercise intensity-affect relationship; reinforcing previous findings and extending the research beyond adult populations. These findings indicate that the intensity-affect relationship has an important role with regard to exercise prescription and eliciting positive affective responses across all populations, and should be considered in future exercise promotion and prescription efforts.

The utility of the Preference for, and Tolerance of, exercise intensity questionnaire (PRETIE-Q) for predicting self-selected exercise intensity in children and adolescents

Studies 2 and 4 were interested in exploring the utility of the previously validated PRETIE-Q to determine whether it was appropriate for use with children and adolescents, and whether it was able to predict the intensity of exercise that individuals chose when self-selecting exercise sessions. Study 2 revealed that it was necessary to alter the structure of the original PRETIE-Q, with structural equation modelling results revealing a poor fit with this structure. The structure of the new questionnaire differed significantly from the previously proposed 2-factor model for use with adults. This thesis confirmed that a new structure was more appropriate for children and adolescents and considered that younger people may not be able to clearly identify specific traits given relative inexperience of identifying them, and as a result the new structure dichotomised the traits to make the questionnaire child and adolescent-specific. A follow-up study revealed that the 4-factor structure was appropriate for this age range and reinforced the initial findings. The findings from these studies indicate that future research needs to appreciate the differences between children, adolescent and adults, and take these differences in to account when promoting or prescribing physical activity or exercise.

The development of this new questionnaire led on to study 5a; the exploration of whether preference scores were able to predict the intensity that individuals chose to work at; an area previously unexamined with adolescents. Results showed that a significant amount of the variance in exercise intensity selected by individuals was predicted by high and low preference scores (ranging from 13%-43%); showing the predictive validity of the newly developed questionnaire, as well as reinforcing the utility of the questionnaire in exercise prescription. Results also revealed significant differences in the intensity of exercise that those individuals in the High Preference group chose in comparison to the Low Preference group; with those individuals with preference for high intensity exercise choosing to work, on average, 2.3% above their VT, while those individuals with a preference for low intensity exercise chose to work, on average, 15.1% below their VT. Results did indicate that whilst there were significant differences in the intensity chosen, affective responses were relatively similar, and positive. This is an unsurprising finding, but highlights the need to establish individual preference prior to prescribing exercise in order to elicit the most positive affective responses in order to enhance the exercise experience and encourage future participation. Preference for different exercise intensities is an area of research that has, until now, been neglected in a paediatric population, highlighting the importance of these initial findings. These findings highlight the importance of considering individual differences with regard to exercise prescription. Individuals have preferences for different intensity exercises, and as a result, exercise programmes should be based on individual preferences if eliciting positive affective responses is to be a key component of exercise sessions. Given that many adolescents and children are not sufficiently active, focussing on individual preferences may increase exercise participation and adherence as positive affective responses are more likely to be elicited when sessions are based on individual preferences and personality types. The DMT indicates that personality variables are a key cognitive variable that determine affective responses to exercise. As a result, individual personality type is an important variable to consider when prescribing and promoting exercise.

The relationship between affective associations and PA behaviour relative to theories of behaviour change

The third main finding from this thesis relates to affective associations with PA, and health-related behaviour change. How individuals feel about PA is an important concept to consider when understanding why some individuals are more or less active than others. This thesis explored the relationships between PA and affective associations with male and female children and adolescents. Results indicate that health-related behaviour change models that overlook affective associations may be excluding an important factor that contributes to PA participation as the decision making impact of the TPB constructs on PA were mediated through affective associations, regardless of age or gender. Results also revealed that more positive affective associations significantly predicted greater PA behaviour. These findings are very relevant to children and adolescents as they highlight the importance that one's affective associations with specific health behaviours have with regard to behavioural choices. The relationships between affective associations and PA have been explored relative to adults but no research to date had explored whether affective associations contributed to overall PA with children and adolescents. The findings from this thesis highlight the importance of including affective associations in models of behaviour change. Results from study 5a also supported these findings and found that those individuals with more positive affective associations with PA recorded more PA over a 7-day period than those who had less positive/more negative associations. These findings provide a significant contribution to research exploring affective associations, by reinforcing previous findings (Kiviniemi et al. 2007) and furthering these findings by exploring these relationships in additional populations. The results emphasise the importance of assessing and attempting to enhance affective associations with regard to PA, when trying to increase PA behaviour. By enhancing affective associations with PA, exercise practitioners may well be more successful in attempts to increase PA behaviour. Future research should seek to explore whether manipulating and enhancing affective associations results in increased PA participation, over the short- and long-term.

Individual autonomy or loss-of-autonomy relative to affective responses to acute exercise sessions

The final major finding from this thesis relates to individual autonomy over one's exercise experience. Initial findings from study 4 showed that individuals anticipated higher ratings of perceived exertion during a proposed exercise session that would be prescribed to them compared to a session that they would be able to choose themselves.

These preliminary findings supported previous research exploring exercise autonomy; that removing autonomy from the exerciser potentially reduces affective responses. Following on from this study, study 5b revealed that affective responses were significantly more positive during an acute exercise session where the individual had autonomy over the intensity compared to during the exercise session where the intensity was prescribed, despite the fact that the intensities were identical. Significantly, it was demonstrated that when individuals were given the opportunity to self-select their exercise intensity they chose an intensity that would confer health benefits if maintained in the future, as well as eliciting more positive affective responses in comparison to during the prescribed exercise session of the same intensity.

These results not only reinforce previous research findings regarding autonomy, positive affect and PA, but also further research by not only assessing these relationships with additional populations but also moving from a laboratory environment into a gym environment. By exploring these relationships in an ecological environment the results become more generalisable to exercise environments and more applicable to exercise practitioners. These findings highlight the importance of allowing adolescent girls to self-select their exercise sessions in order to elicit more positive affective responses.

Studies 2-5 stemmed from initial findings from study 1 where there was large inter-individual variability in affective responses to exercise of the same intensity. Studies 2-5 sought to explore potential explanations for these differences and explored individual factors such as personality variables (preference for, and tolerance of, exercise intensity), cognitive beliefs (attitudes (including instrumental and interoceptive attitudes), PBC, subjective norms) and affective associations with particular health behaviours. Results reinforce the idea that exercise and PA needs to be prescribed and delivered on an individual basis as everyone is different and responds affectively to exercise in different ways. This thesis focussed on ways of eliciting positive affective responses in order to increase PA. The results reinforced previous findings suggesting that it is important to consider individual differences and personality types when attempting to elicit positive affective responses which would hopefully result in increased PA behaviour. The findings from this thesis support previous findings, but also extend previous research into different populations; adolescents and younger children. As well as exploring different populations, this thesis also sought to overcome previous limitations by moving from laboratory testing into more ecologically valid, gym-based assessments. This is an important step forward with regard to this area of research. Laboratory-based exercise sessions are not generalisable across to other environments, whereas the results from this thesis from gym-based, naturalistic settings are more applicable to, and representative of, individuals' exercise habits and behaviours.

Limitations of the current research

Despite the frequent use of graded exercise tests (GXT) with children and adolescents, they represent an unnatural exercise experience for children who participate more readily in shorts bursts of sporadic exercise than continuous bouts of exercise (Bailey et al., 1995; Berman et al., 1998; Stone et al., 2009). As a result the affective responses reported may not be representative of affective responses to exercise of similar intensities (i.e. above VT) which are not part of a continuous exercise protocol. However, for the purpose of study one a GXT was deemed the most appropriate way of assessing affective responses across different exercise intensities to enable the identification of the point of decline in affective responses relative to VT.

The data collection for study 3 was limited by the reliance on self-report PA measures, rather than utilising objective measures to get an accurate picture of overall PA. The limitations of self-report measures have been presented extensively (Shephard, 2003), including issues with recall and response bias, however given the practicality and low participant burden of questionnaire measures it was found to be the best method of PA data collection. This limitation was partially overcome in study 5a with the assessment of PA with objective measures to establish relationships between objectively measured PA and affective associations. An oversight, perhaps, was the failure to collect cognitive belief data in study 5 to re-evaluate the relationships between affective associations, cognitive beliefs and PA with the inclusion of objectively measured PA.

Studies 1, 5a and 5b were acute studies that assessed affective responses to exercise, however, the results may not be generalisable across other exercise domains. These studies only allowed individuals to perform exercise on a treadmill; therefore results may not be transferable to other modalities of exercise such as biking or rowing. Given that study 5b sought to enhance individual's feelings of autonomy, an obvious limitation of this study was the lack of autonomy over exercise modality. Future studies should give individuals the opportunity to choose their mode of exercise and explore the effect that this has on affective responses to exercise of identical intensities.

Future Research

In conjunction with previous research (Kiviniemi et al 2007; Williams 2008; Williams et al 2012; Sheppard & Parfitt, 2008a; Stych & Parfitt, 2011) the evidence provided from the studies in this thesis suggest that affective responses and associations are key factors to consider for future PA promotion and prescription. Future research is necessary however to further explore the findings of this thesis. Following on from the findings of the 6 studies within this thesis there is a natural direction for future research to take. Whilst results from the current studies indicated that preference for high or low intensity exercise predicted significant amounts of variance in exercise intensity chosen to work at, longitudinal research needs to be undertaken to establish the long-term benefits of utilising preference scores for exercise prescription and for the development of personal training programmes. Research needs to explore whether, by using preference scores, adherence to training programmes is enhanced. This is an important future study to be undertaken given the current levels of decline in PA levels, particularly in adolescents. Following on from this, future studies could also explore the long-term benefits of allowing individuals to self-select their exercise intensity throughout a training programme to determine whether this also enhances adherence and promotes positive affective responses and prompts increases in affective associations with PA. Exploring ways to improve affective associations may be integral to increasing PA participation, and thus future studies should attempt to change affective associations through eliciting positive affective responses to PA.

It was noted in study 1 that the continuous nature of the GXT, and subsequent continuous bouts of exercise in studies 5a and b, was not representative of children's natural, sporadic PA behaviours. Given the current literature expressing an interest in High Intensity Interval Training this might a more applicable and relevant method of training for children. Future studies should explore affective responses during these short bursts of high intensity exercise to establish whether, despite being above VT, they elicit more positive affective responses than during continuous bouts of exercise.

References

ACSM. (2000). *ACSM's Guidelines for Exercise Testing and Prescription*: Lippincott Williams & Wilkins.

ACSM. (2010). *ACSM's Guidelines for Exercise Testing and Prescription* (Eighth ed.). Philadelphia, PA.: Lippincott Williams & Wilkins.

ACSM. (2011). Quantity and Quality of Exercise for Developing and Maintaining Cardiorespiratory, Musculoskeletal, and Neuromotor Fitness in Apparently Healthy Adults: Guidelines for Prescribing Exercise. *Medicine & Science in Sports & Exercise*. doi: 10.1249/MSS.0b013e318213fefb

Ajzen, I. (1991). The Theory of Planned Behaviour. *Organisational Behaviour and Human Decision Processes, 50*, 179-211.

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

Andersen, L. B., Harro, M., Sardinha, L. B., Froberg, K., Ekelund, U., & Brage, S. (2006). Physical Activity and clustered cardiovascular risk in children: A cross-sectional study. *The Lancet, 368*, 299-304.

Annesi, J. J. (2005). Relations of self-motivation, perceived physical condition, and exercise-induced changes in revitalisation and exhaustion with attendance in women initiating a moderate cardiovascular exercise regimen. *Women Health, 42*(3), 77-93.

Arent, S. M., Landers, D. M., & Etnier, J. L. (2000). The effects of exercise on mood in older adults: A meta-analytic review. *Journal of Aging and Physical Activity, 8*, 416-439.

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

Aylesworth, A. B., Goodstein, R. C., & Kalra, A. (1999). Effect of Archetypal Embeds on Feelings: An Indirect Route to Affecting Attitudes? *Journal of Advertising, 28*(3), 73-81.

Backhouse, S. H., Ekkekakis, O., Biddle, S.J.H., Foskett, A., & Williams, C. (2007). Exercise makes people feel better but people are inactive: Paradox or artifact? *Journal of Sport and Exercise Psychology, 29*, 498-517.

Bagozzi, R. P., Dholakia, U. M., & Basuroy, S. (2003). How Effortful Decisions Get Enacted: The Motivating Role of Decision Processes, Desires, and Anticipated Emotions. *Journal of Behavioural Decision Making, 16*, 273-295.

Bailey, R. C., Olson, J., Pepper, S. L., Porszasz, J., Barstow, T. J., & Cooper, D. M. (1995). The level and tempo of children's physical activities: an observational study. *Medicine & Science in Sports & Exercise, 27*(7), 1033-1041.

Bandura, A. (1986). *Social Foundations of Thought and Action: A Social Cognitive*. NJ: Prentice Hall.

Bandura, A. (1997). *Self Efficacy: The exercise of Control*. New York.

Beaver, W. L., Wasserman, K., & Whipp, B. J. (1986). A new method for detecting the anaerobic threshold by gas exchange. *Journal of Applied Physiology, 60*, 2020-2027.

Bechara A, Damasio H, Damasio AR, & GP, L. (1999). Different contributions of the human amygdala and ventromedial prefrontal cortex to decision-making. *Journal of Neuroscience, 19*, 5473-5481.

Bechara, A., Damasio, H., & Damasio, A. R. (2000). Emotion, decision making and the orbitofrontal cortex. *Cerebral Cortex, 10*, 295-307.

Benjamin, C. C., Rowlands, A. V., & Parfitt, G. (2012). Patterning of Affective Responses During a Graded Exercise Test in Children and Adolescents. *Pediatric Exercise Science, 24*, 275-288.

Bentler, P. M. (1990). Comparative fix indexes in structural models. *Psychological Bulletin*, 238-246.

Bentler, P. M., & Chou, C. P. (1987). Practical Isues in Structural Modeling. *Sociological Methods and Research, 16*, 78-117.

Berger, B. G., & Owen, D. R. (1992). Mood alteration with yoga and swimming: Aerobic exercise may not be necessary. *Perceptual Motor Skills, 75*, 1331-1343.

Berkowitz, L. (1993). *Aggression: Its causes, consequences, and control*. New York: McGraw-Hill.

Berman, N., Bailey, R., Barstow, T. J., & Cooper, D. M. (1998). Spectral and bout detection analysis of physical activity patterns in health, prepubertal boys and girls. *American Journal of Human Biology, 10*, 289-297.

Berridge, K. C. (1996). Food Reward: Brain Substrates of wanting and liking. *Neuroscience and Biobehavioural Reviews, 20*, 1-25.

Biddle, S. J. H. (2000). Emotion, mood and physical activity. In S. J. H. Biddle, Fox, K.R., & Boutcher, S.H. (Ed.), *Physical Activity and Psychological Well-Being* (pp. 63-87). London: Routledge.

Biddle, S. J. H., & Mutrie, N. (2008). *Psychology of Physical Activity: Determinants, Well-Being & Interventions* (Second ed.). Oxford: Routledge.

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

Bixby, W. R., Spalding, T. W., & Hatfield, B. D. (2001). Temporal dynamics and dimensional specificity of the affective response to exercise of varying intensity: Differing pathways to a common outcome. *Journal of Sport and Exercise Psychology, 23*(3), 171-190.

Black, D. E., & Deci, E. L. (2000). The effects of instructors' autonomy support and students' autonomous motivation on learning organic chemistry: A self-determination theory perspective. *Science Education*, *84*, 740-756.

Borg, G. (1982). Psychophysical bases of perceived exertion. *Medicine & Science in Sports & Exercise, 14*, 377-381.

Borg, G. (1998). *Borg's Perceived and Pain Scales*. Champaign, IL.: Human Kinetics.

Bowen, D. J., Helmes, A., & Lease, E. (2001). Predicting compliance: How are we doing? In L. E. Burke, & Ockene, I.S. (Ed.), *Compliance in healthcare and research* (pp. 25-41). New York: Futura.

Bradley, M. M., & Lang, P. J. (1994). Measuring emotion: the Self-Assessment Manikin and the Semantic Differential. [Comparative Study

Research Support, U S Gov't, P H S]. *J Behav Ther Exp Psychiatry, 25*(1), 49-59.

Breckler, S. J., & Wiggins, E. C. (1989). Affect versus evaluation in the structure of attitudes. *Journal of Experimental Social Psychology, 25*, 253-271.

Browne, M. W., & Cudeck, R. (1992). Alternative ways of assessing model fit. *Sociological Methods and Research, 21*, 230-258.

Bryan, A., Hutchinson. K.E., Seals, D. R., & Allen, D. L. (2007). A transdisciplinary model integrating genetic, physiological, and psychological correlates of voluntary exercise. *Health Psychology, 26*, 30-39.

Cabanac, M. (1971). Physiological role of pleasure. *Science 173*, 1103-1107.

Cabanac, M. (1979). Sensory Pleasure. *Quarterly Review of Biology, 54*, 1-29.

Cabanac, M. (1986). Performance and perception at various combinations of treadmill speed and slope. *Physiology Behaviour, 38*, 839-843.

Conner M., & P., S. (2005). Theory of planned behaviour and health behaviour. In C. M. & N. P. (Eds.), *Predicting health behaviour* (pp. 170-222). London, England: Open University Press.

Courneya, K. S., Plotnikoff, R. C., Hotz, S. B., & Birkett, N. J. (2000). Social support and the theory of planned behaviour in the exercise domain. *American Journal of Health Behaviour, 24*, 300-308.

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

Crites, S. L., Fabrigar, L. R., & Petty, R. E. (1994). Measuring the Affective and Cognitive Properties of Attitudes: Conceptual and Methodological Issues. *Personality and Social Psychology Bulletin, 20*, 619-634.

Crocker, P., Holowachuk, D., & Kowalski, K. C. (2001). Feasibility of using the Tritrac motion sensor over a 7-day trial with older children. *Pediatric Exercise Science, 13*(1), 70-81.

Crocker, P. R. E., Bailey, D. A., Faulkner, R. A., Kowalski, K. C., & McGrath, R. (1997). Measuring general levels of physical activity: Preliminary evidence for the physical activity questionnaire for older children. *Medicine & Science in Sports & Exercise, 29*(10), 1344-1349.

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

Damasio, A. R. (1994). *Descartes' Error: Emotion, Reason and the Human Brain*. New York: Grosset/Putnam.

Deci, E. L., & Ryan, R. M. (1987). The support of autonomy and the control of behaviour. *Journal of Personality and Social Psychology, 53,* 1024-1037.

Deci, E. L., & Ryan, R. M. (1991). A motivational approach to self: Integration in personality. In R.Dienstbier (Ed.), *Nebraska symposium on motivation* (Vol. 38, pp. 237-288). Lincoln: University of Nebraska Press.

Deci, E. L., & Ryan, R. M. (2000). The "what" and "why" of goal pursuits: Human needs and the self determination of behaviour. *Psychological Inquiry, 11*, 227-268.

Dencker, M. A., L.B. (2008). Health-related aspects of objectively measured daily physical activity in children. *Clinical Physiology Function Imaging*(28), 133-144.

Department of Health, P. A., Health Improvement and Protection. (2011). Start Active, Stay Active: A report on physical activity from the four home countries' Chief Medical Officers. Crown Publishers, London.

Dishman, R. K. (2001). The problem of exercise adherence: fighting sloth in nations with market economies. *Quest, 53,* 279-294.

Dishman, R. K., & Buckworth, J. (1996). Increasing physical activity: A quantitative synthesis. *Medicine & Science in Sports & Exercise, 28*, 706-719.

Dishman, R. K., Farquhar, R. P., & Cureton, K. J. (1994). Responses to preferred intensities of exertion in men differing in activity levels. *Medicine & Science in Sports & Exercise, 26*, 783-790.

Dishman, R. K., Motl, R. W., Saunders, R., Felton, G., Ward, D. S., Dowda, M., & Pate, R. R. (2005). Enjoyment mediates effects of a school-based physical-activity intervention. *Medicine & Science in Sports & Exercise, 37*(3), 478-487.

DofH. (2004). Department of Health, At least five a week: Evidence on the impact of physical activity and its relationship to health. *Chief Medical Officer's Report, Crown Publishers, London*.

Ekkekakis, P. (2003). Pleasure and displeasure from the body: Perspectives from Exercise. *Cognition and Emotion, 17*(2), 213-239.

Ekkekakis, P. (2005b). The Study of Affective Responses to Acute Exercise: The Dual-Mode Model. In R. Stelter, & Roessler, K.K. (Ed.), *New approaches to sport and exercise psychology* (pp. 119-146). Oxford: Meyer & Meyer Sport.

Ekkekakis, P. (2009). Let them roam free? Physiological and psychological evidence for the potential of self-selected exercise intensity in public health. *Sports Medicine, 39*, 857-888.

Ekkekakis, P., & Acevedo, E. O. (2006). Affective Responses to Actue Exercise: Towards a Psychobiological Dose-Response Model. *Psychobiology of Physical Activity, Book*, 91-109.

Ekkekakis, P., Hall, E. E., & Petruzzello, S. J. (1999). Measuring state anxiety in the context of acute exercise using the State Anxiety Inventory: An attempt to resolve the brouhaha. *Journal of Sport and Exercise Psychology, 21*(3), 205-229.

Ekkekakis, P., Hall, E. E., & Petruzzello, S. J. (2004). Practical markers of the transition from aerobic to anaerobic metabolism during exercise: rationale and a case for affect-based exercise prescription. *Preventive Medicine, 38*(2), 149-159.

Ekkekakis, P., Hall, E. E., & Petruzzello, S. J. (2005a). 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*(5), 477-500.

Ekkekakis, P., Hall, E. E., & Petruzzello, S. J. (2005c). Some Like It Vigorous: Measuring Individual Differences in the Preference for and Tolerance of Exercise Intensity. *Journal of Sport and Exercise Psychology, 27*, 350-374.

Ekkekakis, P., Hall, E. E., VanLanduyt, L. M., & Petruzzello, S. J. (2000). Walking in (Affective) Circles: Can Short Walks Enhance Affect? *Journal of Behavioural Medicine, 23*(3), 245-275.

Ekkekakis, P., Hall, E.E., & Petruzzello, S.J. (2008a). The relationship between exercise intensity and affective responses demystified: to crack the 40-year-old nut, replace the 40-year-old nutcracker! *Annals of Behavioural Medicine, 35*, 136-149.

Ekkekakis, P., Lind, E., & Joens-Matre, R. R. (2006). Can Self-Reported Preference for Exercise Intensity Predict Physiologically Defined Self-Selected Exercise Intensity? *Research Quarterly for Exercise and Sport, 77*(1), 81-90.

Ekkekakis, P., Lind, E., & Vazou, S. (2009). Affective Responses to Increasing Levels of Exercise Intensity in Normal-weight, Overweight, and Obese Middle-aged Women. *Obesity, 18*(1), 79-85.

Ekkekakis, P., Parfitt, G., & Petruzzello, S.J. (2011). The Pleasure and Displeasure People Feel When they Exercise at Different Intensities: Decennial Update and Progress towards a Tripartite Rationale for Exercise Intensity Prescription. *Sports Medicine, 41*(8), 641-671.

Ekkekakis, P., & Petruzzello, S. J. (1999). Acute Aerobic Exercise and Affect: Current Status, Problems and Prospects Regarding Dose-Response. *Sports Medicine, 28*, 337-374.

Ekkekakis, P., & Petruzzello, S. J. (2000a). Analysis of the affect measurement conundrum in exercise psychology I. Fundamental Issues. *Psychology of Sport and Exercise, 1*, 71-88.

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, 3,* 35-63.

Ekkekakis, P. T., J., Petruzzello, S.J., & Hall, E.E. (2008). The Preference for and Tolerance of the Intensity of Exercise Questionnaire: A Psychometric evaluation among college women. *Journal of Sports Sciences, 26*(5), 499-510.

Emmons, R. A., & Diener, E. (1986). A goal-affect analysis of everyday situation choices. *Journal of Research in Personality, 20*, 309-326.

Epstein, S. (1993). Emotion and Self-Theory. In M. Lewis, & Haviland, J.M. (Ed.), *Handbook of Emotions* (pp. 313-326). New York: Guildford.

Erdfelder, E., Faul, F., & Buchner, A. (1996). GPOWER: A general power analysis program. *Behavior Research Methods, Instruments, & Computers, 28,* 1-11.

Erikson, E. (1968). *Identity, Youth and Crisis*. New York: Norton.

Eston, R. (2009). What do we really know about children's ability to perceive exertion? Time to consider the bigger picture. *Pediatric Exercise Science, 21*, 377-383.

Eston, R. G., Lambrick, D. M., & Rowlands, A. V. (2009). The Perceptual response to exercise of progressively increasing intensity in children aged 7-8 years: Validation of a pictorial curvilinear ratings of perceived exertion scale. *Psychophysiology, 46*, 843-851.

Ferreira, I., Boreham, C., Twisk, J. W. R., Gallagher, A. M., Young, I. S., & Murray, L. J. (2007). Clustering of metabolic syndrome risk factors and arterial stiffness in young adults: the Northern Ireland Young Hearts Project. *Journal of Hypertension, 25*, 1009-1020.

Focht, B. C., & Hausenblas, H. A. (2003). State anxiety responses to acute exercise in women with high social physique anxiety. *Journal of Sport and Exercise Psychology, 25*, 123-144.

Frederickson, B. L., & Kahneman, D. (1993). Duration neglect in retrospective evaluations of affective episodes. *Journal of Personality and Social Psychology, 65*(1), 45-55.

French, D. P., Sutton, S., Hennings, S. J., Mitchell, J., Wareham, N. J., Griffin, S., . . . Kinmonth, L. (2005). The importance of Affective Beliefs and Attitudes in the Theory of Planned Behaviour: Predicting Intention to Increase Physical Activity. *Journal of Applied Social Psychology, 35*(9), 1824-1848.

Frijda, N. H. (1988). The Laws of Emotions. *American Psychologist, 43*, 349-358.

Gaesser, G. A., & Poole, D. C. (1996). The slow component of oxygen uptake kinetics in humans. *Exercise and Sport Sciences Reviews, 24*, 35-70.

Giner-Sorolla, R. (2004). Is affective material in attitudes more accessible than cognitive material? The moderating role of attitude basis. *European Journal of Social Psychology, 34*(6), 761-780. doi: 10.1002/ejsp.229

Godin, G., and , & Shephard., R. J. (1986). Psychosocial factors influencing intentions to exercise of young students from grades 7 to 9. *Research Quarterly Exercise and Sport, 57*, 41-52.

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

Goldfarb, A. H., Hatfield, B. D., Sforzo, G. A., & Flynn, M. G. (1987). Serum B-endorphin levels during a graded exercise to exhaustion. *Medicine & Science in Sports & Exercise, 19*, 78-82.

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

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

Hallal, P. C., Andersen, L. B., Bull, F. C., Guthold, R., Haskell, W., & Ekelund, U. (2012). Global physical activity levels: surveillance progress, pitfalls, and prospects. *The Lancet*.

Hardman, A. E., & Stensel, D. J. (2009). *Physical Activity and Health: The evidence explained* (Second ed.). Oxford: Routledge.

Hardy, C. J., & Rejeski, W. J. (1989). Not What, But How One Feels: The Measurement of Affect During Exercise. *Journal of Sport & Exercise Psychology, 11*, 304-317.

Harris, J. (2013). afPE's Position on Health. *Physical Education Matters*, *8*(1), 82-87.

Harter, S. (1999). *The construction of the self: A developmental perspective*. New York: Guildford Press.

Hayes, A. F. (2012). PROCESS: A versatile computational tool for observed variable mediation, moderation, and conditional process modeling.

Higgins, E. T. (1997). Beyond pleasure and pain. *American Psychologist, 52*(12), 1280-1300.

Hind, K., & Burrows, M. (2007). Weight-bearing exercise and bone mineral accrual in children and adolescents: A review of controlled trials. *Bone*, *40*, 14-27.

Hoch, S., & Loewenstein, G. (1991). Time-inconsistent preferences and consumer self-control. *Journal of Consumer Research, 17*, 492-507.

Hoffman, M. D., & Hoffman, D.R. (2008). Exercisers Achieve Greater Acute Exercise-induced Mood Enhancement Than Nonexercisers. *Archives of Physical Medicine and Rehabilitation, 89*, 358-363.

Hu, L., & Bentler, P. M. (1995). *Evaluating Model Fit*. London: Sage.

Jiménez-Pavón, D., Kelly, J., & Reilly, J. J. (2010). Associations between objectively measured habitual physical activity and adiposity in children and adolescents: Systematic review. *International Journal of Pediatric Obesity, 5*(1), 3-18. doi: doi:10.3109/17477160903067601

Joreskog, K. G., & Sorbom, D. (1993). *LISREL 8: Structural Equation Modeling with the SIMPLIS command language*: Scientific Software International.

Joreskog, K. G., & Sorbom, D. (1999). LISREL 8: User's Reference Guide. Lincolnwood, IL: Scientific Software International, Inc.

Kahneman, D. (2003). Objective happiness. In D. Kahneman, Diener, E., & Schwarz, N. (Ed.), *Well-being: The Foundations of Hedonic Psychology* (pp. 4-25). New York: Russell-Sage.

Kahneman, D., & Riis, J. (2005). Living, and rhinking about it: Two perspectives on life. In N. B. F.A. Huppert, B. Keverne (Ed.), *The science of well-being* (pp. 285-304). Oxford: Oxford University Press.

Kasser, V. G., & Ryan, R. M. (1999). The relation of psychological needs for autonomy and relatedness to vitality, well-being, and mortality in a nursing home. *Journal of Applied Social Psychology, 29*, 935-954.

Kilpatrick, M., Kraemer, R., Bartholomew, J., Acevedo, E., & Jarreau, D. (2007). Affective responses to exercise are dependent on intensity rather than total work. *Medicine & Science in Sports & Exercise, 39*(8), 1417-1422.

Kimm, S. Y. S., Glynn, N.W., Kriska, A.M., Barton, B.A., Kronsberg, S.S., Daniels, S.R., Crawford, P.B., Sabry, Z.I., & Liu, K. (2002). Decline in Physical Activity in Black Girls and White Girls during Adolescence. *The New England Journal of Medicine, 347*(10), 709-715.

King, A. C., & Martin, J. E. (1993). Exercise adherence and maintenance. In J. L. Durstine, King, A.C., Painter, P.L., Roitman, J.L., & Zwiren, L.D. (Ed.), *ACSM's resource manual for guidelines for exercise testing and prescription* (Vol. 2nd Edition, pp. 443-454). Philadelphia: Lea and Febiger.

Kirkcaldy, B. D., & Shephard, R. J. (1990). Therapeutic implications of exercise. *International Journal of Sport Psychology, 21*(3), 165-184.

Kirsch, I. (1995). Self-Efficacy and outcome expectancies: A concluding commentary. In J. E. Maddux (Ed.), *Self-Efficacy, Adaptation, and Adjustment: Theory Research and Application* (pp. 331-345). New York: Plenum.

Kiviniemi, M. T., Voss-Humke, A. M., & Seifert, A. L. (2007). How Do I Feel About the Behaviour? The Interplay of Affective Associations With Behaviour and Cognitive Beliefs as Influences on Physical Activity Behaviour. *Health Psychology, 26*(2), 152-158.

Kowalski, K. C., Crocker, P. R. E., & Faulkner, R. A. (1997). Validation of the Physical Activity Questionnaire for Older Children. *Pediatric Exercise Science, 9*, 174-186.

Kwan, B. M., & Bryan, A. (2010). In-Task and post-task affective response to exercise: Translating exercise intentions into behaviour. *British Journal of Health Psychology, 15*, 115-131.

Kwan, B. M., & Bryan, A. D. (2010a). Affective response to exercise as a component of exercise motivation: Attitudes, norms, self-efficacy, and temporal stability of intentions. *Psychology of Sport and Exercise, In Press, Corrected Proof.*

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

Lang, P. J. (1980). Behavioural treatment and bio-behavioural assessment: Computer applications. *J.B. Sodowski, J.H. Johnson, & T.A. Williams (Eds), Technology in mental health care delivery systems, Norwood. NJ: Ablex*, 119-137.

Larsen, R. J., & Frederickson, B. L. (1999). Measurement issues in emotion research. In E. D. D. Kahneman, N. Schwarz (Ed.), *Well-being: Foundations of Hedonic Psychology* (pp. 40-60). New York: Russel Sage.

Laverie, D. A. (1998). Motivations for ongoing participation in a fitness activity. *Leisure Sciences, 20*, 277-302.

Lenroot, R. K., & Giedd, J. N. (2006). Brain development in children and adolescents: Insights from anatomical magnetic resonance imaging. *Neuroscience & Biobehavioral Reviews, 30*(6), 718-729. doi: 10.1016/j.neubiorev.2006.06.001

Leventhal, H. (1984). A Perceptual-Motor Theory of Emotion. In L. Berkowitz (Ed.), *Advances in Experimental Social Psychology* (Vol. 17, pp. 118-182). Orlando, FL:: Academic Press.

Lind, E., Joens-Matre, R. R., & Ekkekakis, P. (2005). What intensity of physical activity do previously sedentary middle-aged women select? Evidence of a coherent pattern from physiological, perceptual, and affective markers. *Preventive Medicine, 40*(4), 407-419.

Lind, E., Vazou, S., & Ekkekakis, P. (2008). The affective impact of exercise intensity that slightly exceeds the preferred level. *Journal of Health Psychology, 13*, 458-462.

Lloyd, L., Langley-Evans, S., & McMullen, S. (2010). Childhood obesity and adult cardiovascular disease risk: a systematic review. *International Journal of Obesity, 34*(1), 18-28.

Lobstein, T., Baur, L., & Uauy, R. (2004). Obesity in children and young people: a crisis in public health. *Obesity Reviews, 5*(s1), 4-85.

Lox, C. L., Jackson, S., Tuholski, S. W., Wasley, D., & Treasure, D. C. (2000). Revisiting the measurement of exercise-induced feeling states: The Physical Activity Affect Scale (PAAS). *Measurement in Physical Education and Exercise Science, 4*, 79-95.

Macera, C. A., Hootman, J. M., & Sniezek, J. E. (2003). Major Public Health Benefits of Physical Activity. *Arthritis & Rheumatism (Arthritis Care & Research), 49*(1), 122-128.

McAuley, E., & Courneya, K. S. (1992). Self-efficacy relationships with affective and exertion responses to exercise. *Journal of Applied Social Psychology, 22*(4), 312-326.

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

McAuley, E., Jerome, G. J., Elavsky, S., Marquez, D. X., & Ramsey, S. N. (2003). Predicting long-term maintenance of physical activity in older adults. *Preventive Medicine: An International Journal Devoted to Practice and Theory, 37*, 110-118.

McEachan, R. R. C., Conner, M., Taylor, N. J., & Lawton, R. J. (2011). Prospective prediction of health-related behaviours with the Theory of Planned Behaviour: a meta-analysis. *Health Psychology Review, 5*(2), 97-144. doi: 10.1080/17437199.2010.521684

McLaughlin, J. E., King, G. A., Howley, E. R., Bassett, J., D.R., , & Ainsworth, B. E. (2001). Validation of the COSMED K4 b2 Portable Metabolic System. *Int J Sports Med, 22*, 280-284.

McMurray, R. G., Guoin, W. K., Ainsworth, B. E., & Harrell, S. J. (1998). Predicting aerobic power in children. *Journal of Sports Medicine and Physical Fitness, 38*, 227-233.

Metcalf, B., Henley, W., & Wilkin, T. (2012). Effectiveness of intervention on physical activity of children: systematic review and meta-analysis of controlled trials with objectively measured outcomes (EarlyBird 54). *BMJ, 345*. doi: 10.1136/bmj.e5888

Michie, S., & Abraham, C. (2004). Identifying techniques that promote health behaviour change: Evidence based or evidence inspired? *Psychology and Health, 19*, 29-49.

Miller, B. M., Bartholomew, J.B., & Springer, B.A. (2005). Post-Exercise Affect: The Effect of Mode Preference. *Journal of Applied Sports Psychology, 17*(4), 263-272.

Monge, R. H. (1973). Developmental trends in factors of adolescent self-concept. *Development Psychology, 8*, 382-393.

Mummery, W. K., Spence, J. C., & Hudec, J. C. (2000). Understanding physical activity intention in Canadian school children and youth: an application of the theory of planned behavior. *Res Q Exerc Sport, 71*(2), 116-124.

Murtagh, E. M., Borcham, C. A. G., & Murphy, M. H. (2002). Speed and exercise intensity of recreational walkers. *Preventive Medicine, 35*, 397-400.

Nader, P. R., Bradley, R. H., Houts, R. M., McRitchie, S. L., & O'Brien, M. (2008). Moderate-to-Vigorous Physical Activity From Ages 9 to 15 Years. *JAMA: The Journal of the American Medical Association, 300*(3), 295-305. doi: 10.1001/jama.300.3.295

Nelson, M. C., Neumark-Stzainer, D., P.J., H., Sirard, J. R., & Story, M. (2006). Longitudinal and secular trends in physical activity and sedentary behaviour during adolescence. *Pediatrics, 118*(6), 1627-1634.

Ness, A. R., Leary, S. D., Mattocks, C., Blair, S. N., Reilly, J. J., Wells, J., . . . Riddoch, C. (2007). Objectively Measured Physical Activity and Fat Mass in a Large Cohort of Children. *PLoS Medicine, 4*(3).

Nix, G. A., Ryan, R. M., Manly, J. B., & Deci, E. L. (1999). Revitalisation through self-regulation: The effects of autonomous and controlled motivation on happiness and vitality. *Journal of Experimental Social Psychology, 35*, 266-284.

Nunnally, J. (1978). *Psychometric Theory* (2nd ed.). New York: McGraw-Hill.

Ojanen, M. (1994). Can the true effects of exercise on psychological variables be separated from placebo effects? *International Journal of Sport Psychology, 25*, 63-80.

PAGAC. (2008). Physical Activity Guidelines Advisory Report. Washington, DC: Department of Health and Human Sciences.

Panksepp, J. (1998). *Affective neuroscience: The foundations of human and animal emotions*. New York: Oxford University Press.

Parfitt, G., & Gledhill, C. (2004). The effect of choice of exercise mode on psychological responses. *Psychology of Sport and Exercise, 5*, 111-117.

Parfitt, G., Alrumh, A., & Rowlands, A. V. (2012). Affect-regulated exercise intensity: Does training at an intensity that feels 'good' improve physical health? *Journal of Science and Medicine in Sport*.

Parfitt, G., Blissett, A., Rose, E. A., & Eston, R. (2012). Physiological and perceptual responses to affect-regulated exercise in healthy young women. *Psychophysiology, 49*(1), 104-110.

Parfitt, G., Eston, R., & Connolly, D. (1996). Psychological affect at different ratings of perceived exertion in high- and low-active weomen: a study using a production protocol. *Perceptual Motor Skills, 82*, 1035-1042.

Parfitt, G., & Hughes, S. (2009). The Exercise Intensity-Affect Relationship: Evidence and Implications for Exercise Behaviour. *J Exerc Sci Fit, 7*(2(suppl)), s34-s41.

Parfitt, G., Rose, E. A., & Burgess, W. M. (2006). The psychological and physiological responses of sedentary individuals to prescribed and preferred intensity exercise. *British Journal of Health Psychology, 11*, 39-53.

Parfitt, G., Rose, E. A., & Markland, D. (2000). The Effect of Prescribed and Preferred Intensity Exercise on Psychological Affect and the Influence of Baseline Measures of Affect *J Health Psychol 2000, 5*(2), 231-240.

Parker, D., Manstead, A. S. R., & Stradling, S. G. (1995). Extending the theory of planned behaviour: The role of personal norm. *British Journal of Social Psychology, 34*, 127-137.

Pechmann, C., & Stewart, D. (1989). The multidimensionality of persuasive communications: Theoretical and empirical foundations. In P. T. Cafferata, A. (Ed.), *Cognitive and affective responses to advertising* (pp. 31-65). Boston: Lexington.

Penedo, F. J., & Dahn, J.R. (2005). Exercise and well-being: A review of mental and physical health benefits associated with physical activity. *Current Opinion in Psychiatry, 18*, 189-193.

Petruzzello, S. J., Landers, D. M., Hatfield, B. D., Kubitz, K. A., & Salazar, W. (1991). A meta analysis on the anxiety-reducing effects of acute and chronic exercise. *Sports Medicine, 11*, 143-182.

Phillips, L. R. S., Parfitt, G., & Rowlands, A. V. (2012). Calibration of the GENEA accelerometer for assessment of physical activity intensity in children. *Journal of Science and Medicine in Sport*.

Povey, R., Conner, M., Sparks, P., James, R., & Shepherd, R. (2000). The Theory of Planned Behaviour and Healthy Eating: Examining Additive and Moderating Effects of Social Influence Variables. *Psychology and Health, 14,* 991-1006.

Pronk, N. P., Crouse, S. F., & Rohack, J. J. (1995). Maximal Exercise and Acute Mood Response in Women. *Physiology and Behaviour, 57*(1), 1-4.

Quine, L., Rutter, D. R., & Arnold, L. (2000). Comparing the theory of planned behaviour and the health belief model: The example of helmet use among schoolboy cyclists. In P. Norman, Abraham, C., & Conner, M. (Ed.), *Understanding and changing health behaviour: From health beliefs to self-regulation* (pp. 73-98). Amsterdam: Harwood.

Raedeke, T. D. (2007). The Relationship Between Enjoyment and Affective Responses to Exercise. *Journal of Applied Social Psychology, 19*, 105-115.

Reed, J., & Ones, D. (2006). The effect of acute aerobic exercise on positive activated affect: A meta-analysis. *Psychology of Sport and Exercise, 7*(5), 477-514.

Reichert, F., Baptista Menezes, A., Wells, J. et al. (2009). Physical Activity as a predictor of adolescent body fatness: a systematic review. *Sports Medicine*(39), 279-294.

Reilly, J. J., Kelly, L., Montgomery, C., Williamson, A., Fisher, A., McColl, J. H., . . . Grant, S. (2006). Physical activity to prevent obesity in young children: cluster randomised controlled trial. *BMJ, 333*(7577), 1041. doi: 10.1136/bmj.38979.623773.55

Rejeski, W. J. (1994). Dose-response issues from a psychosocial perspective. In C. Bouchard, Shepard, R.J., T. Stephens (Ed.), *Physical activity, fitness, and health: International proceedings and consensus statement* (pp. 1040-1055). Champaign, IL: Human Kinetics.

Rejeski, W. J., & Ribisl, P. M. (1980). Expected task duration and perceived effort: an attributional analysis. *Journal of Sport Psychology, 39*, 249-254.

Rhodes. R., Fiala, B., & Conner, M. (2009). A review and meta-analysis of affective judgements and physical activity in adult populations. *Annals of Behavioural Medicine, 38*, 180-204.

Richard, R., van der Plight, J., & De Vries, N. (1996). Anticipated Affect and Behavioural Choice. *Basic and Applied Social Psychology, 18*(2), 111-129.

Robertson, R. J., Goss, F. L., Dube, J., Rutkowski, J., Dupain, M., Brennan, C., & Andreacci, J. (2004). Validation of the adult OMNI scale of perceived exertion for cycle ergometer exercise. *Medicine & Science in Sports & Exercise, 36*(1), 102-108.

Robertson, R. J., & Noble, B. J. (1997). 15 Perception of Physical Exertion: Methods, Mediators, and Applications. *Exercise and Sport Sciences Reviews, 25*(1), 407-452.

Rodgers, W. M., & Gauvin, L. (1998). Heterogeneity of incentives for physical activity and self-efficacy in highly active and moderately active women exercisers. *Journal of Applied Social Psychology, 28*(11), 1016-1029.

Rose, E. A., & Parfitt, G. (2008). Can the Feeling Scale Be Used to Regulate Exercise Intensity. *Medicine & Science in Sports & Exercise, 40*(10), 1852-1860.

Rose, E. A., & Parfitt, G. (2010a). Exercise experience influences affective and motivational outcomes of prescribed and self-selected intensity exercise. *Scandinavian Journal of Medicine & Science in Sports*.

Rose, E. A., & Parfitt, G. (2012). Exercise experience influences affective and motivational outcomes of prescribed and self-selected intensity exercise. *Scandinavian Journal of Medicine & Science in Sports, 22*, 265-277.

Rose, E. A., & Parfitt, G. (2007). A Quantitative Analysis and Qualitative Explanation of the Individual Differences in Affective Responses to Prescribed and Self-Selected Exercise Intensities. *Journal of Sport & Exercise Psychology, 29*, 281-309.

Rowland, T. (2007). Promoting Physical Activity for Children's Health: Rationale and Strategies. *Sports medicine (Auckland, NZ), 37*(11), 929-936.

Rozin, P. (2003). Preadaptation and the Puzzles and Properties of Pleasure. In D. Kahneman, Diener, E., & Schwarz, N. (Ed.), *Well-Being: The Foundations of Hedonic Psychology* (pp. 109-133). New York: Russell Sage Foundation.

Russell, J. A. (1980). A circumplex model of affect. *Journal of Personality and Social Psychology, 39*(6), 1161-1178.

Russell, J. A. (2009). Emotion, core affect, and psychological construction. *Cognition & Emotion, 23*(7), 1259-1283. doi: 10.1080/02699930902809375

Russell, J. A., & Carroll, J. M. (1999). On the bipolarity of positive and negative affect. *Psychological Bulletin, 125*(1), 3-30.

Russell, J. A., Weiss, A., & Mendelsohn, G. A. (1989). Affect Grid: A single-item scale of pleasure and arousal. *Journal of Personality and Social Psychology, 57*, 493-502.

Sallis, J., Prochaska, J. J., Taylor, W. C., Hill, J. O., & Geraci, J. C. (1999). Correlates of Physical Activity in a National Sample of Girls and Boys in Grades 4 through 12. *Health Psychology, 18*(4), 410-415.

Sallis, J. F., Prochaska, J.J., & Taylor, W.C. (2000). A review of correlates of physical activity of children and adolescents. *Medicine & Science in Sports & Exercise, 32*(5), 963-975.

Salmon, J., Booth, M. L., Phongsavan, P., Murphy, N., & Timperio, A. (2007). Promoting physical activity participation among children and adolescents. *Epidemiology Review, 29*, 144-159.

Saunders, R., Pate, R. R., Felton, G., Dowda, M., Weinrich, M. C., Ward, D. S., . . . Baranowski, T. (1997). Development of Questionnaires to Measure Psychosocial Influences on Children's Physical Activity. *Preventive Medicine, 26*, 241-247.

Beliefs, values and normative changes related to continuation and noncontinuation in an exercise program (1986).

Schneider, M., & Cooper, D. M. (2011). Enjoyment of exercise moderates the impact of a school-based physical activity intervention. *International Journal of Behavioural Nutrition and Physical Activity, 20*(8).

Schneider, M., Dunn, A., & Cooper, D. (2009). Affect, Exercise, and Physical Activity Among Healthy Adolescents. *Journal of Sport and Exercise Psychology, 31*(6), 706-723.

Schneider, M., & Graham, D. (2009). Personality, physical fitness, and affective responses to exercise among adolescents. *Medicine & Science in Sports & Exercise, 41*(4), 947-955.

Schuettler, D., & Kiviniemi, T. M. (2006). The effect of positive and negative affect when considering chronic illness diagnoses. *Journal of Applied Psychology*.

Schumacker, R. E., & Lomax, R. G. (2004). *A Beginner's Guide to Structural Equation Modeling* (2nd ed.). Mahwah, NJ.: Lawrence Erlbaum Associates, Inc.

Services, U. S. D. o. H. a. H. (1996). Physical Activity and Health: A Report of the Surgeon General (pp. 234-235). Atlanta, GA: Department of Health and Human Services, Centers for Disease Control and Prevention, National Centre for Chronic Disease Prevention and Health Promotion.

Sheldon, K. M., Ryan, R. M., & Reis, H. T. (1996). What makes for a good day? Competence and autonomy in the dat and in the person. *Personality and Social Psychology Bulletin, 22*, 1270-1279.

Sheppard, K. E. (2008). *Affective Responses to Acute Exercise.* PhD, University of Exeter, Exeter.

Sheppard, K. E., & Parfitt, G. (2008). Patterning of Physiological and Affective Responses During A Graded Exercise Test in Sedentary Men and Boys. *Journal of Exercise Science and Fitness, 6*(2), 121-129.

Sheppard, K. E., & Parfitt, G. (2008a). Acute Affective Responses to Prescribed and Self-Selected Exercise Intensities in Young Adolescent Boys and Girls. *Pediatric Exercise Science, 20*(2), 129-141.

Shiv, B., & Fedorikhin, A. (1999). Heart and Mind in Conflict: The Interplay of Affect and Cognition in Consumer Decision Making. *The Journal of Consumer Research, 26*(3), 278-292.

Simmons, R. G., Rosenberg, F., & Rosenberg, M. (1973). Disturbance in the self-image at adolescence. *American Sociological Review, 38*, 533-568.

Simons, J., & Carey, K. B. (1998). A structural analysis of attitudes toward alcohol and marijuana use. *Personality and Social Psychology Bulletin, 24*, 727-735.

Simonson, I. (1992). The influence of anticipating regret and responsibility on purchase decisions. *Journal of Consumer Research, 19*, 105-118.

Sothern, M. S., Loftin, M., Suskind, R. M., Udall, J. N., & Blecker, U. (1998). The health benefits of physical activity in children and adolescents: implications for chronic disease. *European Journal of Pediatrics, 158*(4), 271-274.

Spelman, C. C., Pate, R. R., Macera, C. A., & Ward, D. S. (1993). Self-Selected exercise intensity of habitual walkers. *Medicine & Science in Sports & Exercise, 25*, 1174-1179.

Steinberg, L. (2005). Cognitive and affective development in adolescence. *TRENDS in Cognitive Sciences, 9*(2), 69-74.

Stone, M. R., Rowlands, A. V., Middlebrook, A. R., Jawis, M. N., & Eston, R. G. (2009). The pattern of physical activity in relation to health outcomes in boys. *International Journal of Pediatric Obesity*, 1-10.

Strauss, R. S., Rodzilsky, D., Burack, G., & Colin, M., . (2001). Psychosocial Correlates of Physical Activity in Healthy Children. *Archives of Pediatric Adolescent Medicine, 155*, 897-902.

Strong, W. B., Malina, R. M., & Blimkie, C. J. R. e. a. (2005). Evidence based physical activity for school-age youth. *Journal of Paediatrics, 146*(6), 732-737.

Stych, K., & Parfitt, G. (2011). Exploring Affective Responses to Different Exercise Intensities in Low-Active Young Adolescents. *Journal of Sport and Exercise Psychology, 33*, 548-568.

Sutton, S., French, D., Hennings, S., Mitchell, J., Wareham, N., Griffin, S., . . . Kinmonth, A. (2003). Eliciting salient beliefs in research on the theory of planned behaviour: The effect of question wording. *Current Psychology, 22*(3), 234-251. doi: 10.1007/s12144-003-1019-1

Svebak, S., & Murgatroyd, S. (1985). Metamotivational dominance: a multi-method validation of reversal theory constructs. *Journal of Personality and Social Psychology, 48*, 107-116.

The NHS Information Centre, L. S. (2012). *Statistics on obesity, physical activity and diet: England, 2012*.

Trafimov, D., & Sheeran, P. (1998). Some tests of the distinction between cognitive and affective beliefs. *Journal of Experimental Social Psychology, 34*, 378-397.

Troiano, R. P., Berrigan, D., Dodd, K. W., Masse, L. C., Tilert, T., & McDowell, M. (2008). Physical Activity in the U.S. measured by accelerometer. *Medicine & Science in Sports & Exercise, 40*, 181-188.

Trost, S., Pate, R., Freedson, P., Sallis, J., & Taylor, W. (2000). Using Objective physical activity measures with youth: How many days of monitoring are needed? *Medicine & Science in Sports & Exercise, 32*, 426-431.

Tucker, R. (2009). The anticipatory regulation of performance: the physiological basis for pacing strategies and the development of a perception-based model for exercise performance. *British Journal of Sports Medicine, 43*, 392-400.

Vallerand, R. J., & Rousseau, F. (2001). Intrinsic and extrinsic motivation in sport and exercise: a review using the hierarchical model of intrinsic and extrinsic motivation. In R. N. Singer, Hausenblas, H.A., Janelle, C.M. (Ed.), *Handbook of Sport Psychology* (pp. 264-280). New York: John Wiley & Sons.

van der Pligt, & de Vries, N. K. (1998). Expectancy-value models of health behaviour: The role of salience and anticipated affect. *Psychology and Health, 13*, 289-305.

Van Der Pligt, J., Zeelenberg, M., Van Dijk, W. W., De Vries, N., & Richard, R. (1998). Affect, attitudes, and decisions: Let's be more specific. *European Review of Social Psychology, 8*, 33-66.

Van Landuyt, L. M., Ekkekakis, P., Hall, E. E., & Petruzzello, S. J. (2000). Throwing the mountains into the lakes: On the perils of nomothetic conceptions of the exercise-affect relationship. *Journal of Sport and Exercise Psychology, 22*(3), 208-234.

VanSluijs, E. M. F., McMinn, A. M., & Griffin, S. J. (2007). Effectiveness of interventions to promote physical activity in children and adolescents: systematic review of controlled trials. *BMJ, 335*(7622), 703. doi: 10.1136/bmj.39320.843947.BE

Vara, L. S., & Epstein, L.H. (1993). Laboratory assessment of choice between exercise or sedentary behaviours. *Research Quarterly for Exercise and Sport, 64*(3), 356-360.

Vazou-Ekkekakis, S., & Ekkekakis, P. (2009). Affective consequences of imposing the intensity of physical activity: does the loss of perceived autonomy matter? *Hellenic Journal of Psychology, 6*, 125-144.

Watson, D., & Clark, L. A. (1997). Measurement and mismeasurement of mood: Recurrent and emergent issues. *Journal of Personality and Social Psychology, 62*, 489-505.

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, 47*, 1063-1070.

Welch, A. S., Hulley, A., Ferguson, C., & Beauchamp, M. R. (2007). Affective responses of inactive women to a maximal incremental exercise test: A test of the dual-mode model. *Psychology of Sport and Exercise, 8*(4), 401-423.

WHO. (2011). *Global status report on noncommunicable diseases 2010. Description of the global burden of NCDs, their risk factors and determinants.* Geneva.

Williams, D. M. (2008a). Exercise, Affect, and Adherence: An integrated Model and a Case for Self-Paced Exercise. *Journal of Sport and Exercise Psychology, 30*(8), 471-496.

Williams, D. M., Dunsiger, S., Ciccolo, J. T., Lewis, B. A., Albrecht, A. E., & Marcus, B. H. (2008). Acute affective response to a moderate-intensity exercise stimulus predicts physical activity participation 6 and 12 months later. *Psychology of Sport and Exercise, 9*, 231-245.

Williams, D. M., Dunsiger, S., Jennings, E. G., & Marcus, B. H. (2012). Does Affective Valence During and Immediately Following a 10-Min Walk Predict Concurrent and Future Physical Activity? *Annals of Behavioural Medicine*. doi: 10.1007/s12160-012-9362-9

Zajonc, R. B. (1980). Feeling and Thinking: Preferences Need No Inferences. *American Psychologist, 35*, 151-175.

Zuckerman, M., & Lubin, B. (1965). Manual for the Multiple Affect Adjective Check List San Diego, CA:: Education and Industrial Testing Service.

Zuckerman, M., Lubin, B., & Rinck, C. M. (1983). Construction of new scales for the Multiple Affect Adjective Check List. *Journal of psychopathology and behavioural assessment, 5*(2), 119-129.

Appendix 1a

School of Sport and Health Sciences
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October 2009

Information Sheet

Dear School/ Parent/ Guardian,

We are inviting the participation of 60 children, both male and female, aged 8 - 14 years to participate in a Physical Activity and Health research study. We welcome all activity levels from sedentary to very active and all fitness levels as well.

What is the purpose of the study?
An accurate measure of physical activity is necessary for determining the impact of physical activity on health. The main purpose of the study is to test how well a newly designed activity monitor performs when measuring various forms of physical activity. The new activity monitor will be compared to a variety of existing devices.

What will my son/daughter be asked to do?
When your child arrives at the laboratory a researcher will record the following details:

1) Full name
2) Date of birth
3) Sex
4) Handedness (left or right)
5) Contact information (address, phone number(s), email(s) if applicable)

Next, he/she will be asked to complete two short questionnaires about:

a) His/her physical activity level
b) His/her readiness for physical activity

Next, the researcher will take some key body measurements:

1) Height
2) Seated height
3) Weight
4) Waist size

Next, your child will be fitted with a series of activity monitors on the wrists, waist, and ankle as well as a heart rate monitor and face mask to measure the air breathed. Then they will be briefed about the physical activity testing protocol which includes up to 11 of the following semi-structured activities: Next your son/daughter will be asked to do the following activities; lying down, watching a DVD, playing a computer game, walking at a slow pace (on a running machine), walking at a fast pace, and then running at two different speeds. Each activity will last for three minutes, apart from lying down (which is for 10) and there will be chance to rest between each activity. The last thing we would like your son/daughter to do is a running test to establish their level of fitness. This is a maximal test where your son/daughter will run on a treadmill on a gradient until they cannot run anymore. It is a hard test and they may sweat a lot, their heart rate will increase and they will feel tired at the end.

Some participants may be asked to come back to the university to do a few more outdoor activities. If your son/daughter is asked to come back some of the activities they may do will include walking outside, running on the field and kicking a ball around. As with the first session they will be asked to wear the same equipment again (activity monitors, heart rate monitor and the face mask).

Finally, your child's health information will be summarized and returned to you at a later date.

Who can take part?
Due to the nature of the study your son/daughter must be 'apparently healthy' without muscular-skeletal injury.

Can I stay with my son/daughter?
Yes. You are more than welcome to remain with your child throughout the study. However, trained individuals will be present at all times, all of whom have full CRB checks.

What will happen with the information?
All information obtained will be stored on computer in coded form and individual results will be confidential to the participant and the research team. Results of this study may be published but any data included will in no way be linked to any specific participant. It is important to note that you may withdraw your child's participation in the study at any time without any disadvantage to you of any kind. The data will be stored for up to five years so that we can gain as much information from the results as possible. After this time all data will be destroyed.

If you, or your child, have any further queries regarding the above study please do not hesitate to contact us.

The Ethics Committee of the School of Sport and Health Sciences has reviewed and approved this study.

Yours Sincerely,

Charlotte Benjamin and Lisa Phillips

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Appendix 1b

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Information Sheet

Dear Pupil,

Thank you for showing an interest in taking part in this study. This sheet will tell you a bit more about the study and what we would like you to do. If you decide not to take part it will not change your relationship with the research team or your school.

What is the project about?

We are inviting the participation of 60 volunteers, both male and female, aged 8 - 14 years to take part in a Physical Activity and Health research study. Everyone is welcome to take part in the study whether you do lots of activities and exercise or not much at all.

What do we want to find out?

We have two new measuring devices that can be used to measure how much activity you do and we want your help to see how well they work.

What do I have to do?
When you arrive at the laboratory at the University a researcher will ask you the following details:

a) Full name
b) Date of birth
c) Handedness (whether you write with your left or right hand)
d) Any contact information you may have (address, phone number(s), email(s) if you have one)

Next, you will be asked to complete two short questionnaires about:

a) Your physical activity level
b) Your readiness for physical activity

Next, the researcher will take some key body measurements:

1 Height
2 Seated height
3 Weight
4 Waist size

After we've got this information from you, you will be fitted with some activity monitors. These will be put on your waist and wrists. As well as wearing these we will ask you to wear a heart rate monitor and a face mask to measure the air you breathe out.

Next you'll be asked to do the following activities; lying down, watching a DVD, playing a computer game, walking at a slow pace (on a running machine), walking at a fast pace, and then running at two different speeds. Each activity will last for three minutes, apart from lying down (which is for 10) and there will be chance to rest between each activity.

The last thing we will ask you to do is a running test to see how fit you are. This is called a maximal test and we are going to see how long you can run on a treadmill for before you get too tired to carry on. It is a hard test and you may find that you sweat a lot during it, your heart will beat faster and you will feel tired at the end of it. But this will be followed by a rest period.

Some of you may be asked to come back to the university to do a few more outdoor activities. If you are asked to come back, some of the activities you may do will include walking outside, running on the field and kicking a ball around. As with the first session you will be asked to wear the same equipment again (activity monitors, heart rate monitor and the face mask).

As a thank you for taking part we will provide you with a certificate with a photograph of you in all the gear!

Who can take part?

Because part of the study involves being able to run for quite a long time on a treadmill you must be able to run for at least ten minutes otherwise we won't be able to work out your fitness level properly. So if you think you can run for that long and don't mind getting a bit sweaty and tired then you can definitely take part!

Can I change my mind?

Yes! You can stop the study at any time without having to give a reason.

What will we do with the information?

All the information collected will be stored on a computer and the results will be confidential to the University research team. We will keep the results we get from you for up to five years so that we can use as many of your results as possible to find out new and interesting things.

What if I have any questions?

If you have any questions then please feel free to ask any of the researchers listed below at any time.

What do I have to do next?

If you have read and understood everything that we want you to do and are happy to take part please sign the consent form, which is attached to this sheet. Your parent/guardian must also sign the form we have given to them.

The Ethics Committee of the School of Sport and Health Sciences has reviewed and approved this study.

Thank you,

Charlotte Benjamin and Lisa Phillips

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Appendix 1c

UNIVERSITY OF EXETER

Consent Form for Parents

Please complete and sign if you **DO** wish your child to take part in this study.

I have read the information sheet concerning this study and understand what it is about. All my questions have been answered to my satisfaction. I understand my child will have their general health assessed and their physical activity measured during specific activities of daily living. I understand that I am free to request further information at any stage.

I know that:

1. My son/daughters' participation in the study is entirely voluntary.

2. My son/daughter will be required to perform various activities of daily living while wearing:
    a. a heart rate monitor
    b. a series of activity monitors on their wrist, waist, and ankle
    c. a face mask to allow the measurement of air breathed

3. My son/daughter will be required to have his/her weight, height, sitting height, waist size, and body composition measured

4. My son/daughter is free to withdraw from the study at any time without giving reason.

5. The results will be stored on computer in coded form and individual results will be confidential.

6. The results of the study may be published but my son/daughter's anonymity will be preserved.

If you **DO** wish to take part in this study please sign below and return this form to the researcher.

Signed Parent/ Guardian / care giver…………………………………………………..…

Date………………………..
Name Child (please print)…………………………...………

Name parent/ guardian/ care giver ……………………………….

Contact telephone number(s)………………………………………………………
Contact email(s)………………………………………………………

This study has been reviewed and approved by the Ethics Committee of the School of Sport and Health Sciences.

Do we have your permission to contact you in the future for follow-up research?
YES NO

I understand that my son/daughter may be asked to return for further testing at a later date?
YES NO

I give permission for my son/daughter's photograph to be taken for the production of a certificate?
YES NO

Appendix 1d

Consent Form for Child

Please complete and sign if you **DO** wish to take part in this study.

I have read the information sheet concerning this study and understand what it is about. All my questions have been answered to my satisfaction. I understand that I will have my general health assessed and my physical activity measured during specific activities of daily living. I understand that I am free to request further information at any stage.

I know that:

1. My participation in the study is entirely voluntary.

2. I will be required to perform various activities of daily living while wearing:
   a. a heart rate monitor
   b. a series of activity monitors on my wrist, waist, and ankles
   c. a face mask to allow the measurement of expired air

3. I will be required to have my weight, height, sitting height, waist size, and body composition measured

4. I am free to withdraw from the study at any time without giving reason.

5. The results will be stored on computer in coded form and individual results will be confidential

6. The results of the study may be published but my anonymity will be preserved.

If you **DO** wish to take part in this study please sign below and return this form to the researcher.

Signed ……………………………………..

Date………………………..

Name (please print)………………………………..………

Contact telephone number(s)…………………………………………………………

This study has been reviewed and approved by the Ethics Committee of the School of Sport and Health Sciences.

Do we have your permission to contact you in the future for follow-up research? YES NO

I understand that I may be asked to complete a further session at a later date. YES NO

Please tick the box if you would like to receive a certificate with your photograph on ☐

Appendix 2a

School of Sport and Health Sciences
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Information and Consent Form for Parents

Dear Parents/Guardian,

We are inviting the participation of 11-16 year olds, both male and female, in a physical activity and health research study. We welcome all activity levels from sedentary to very active and all fitness levels as well. This sheet will tell you a bit more about what the study and what it will involve.

What is the purpose of the study?

This study is interested in exploring whether there are links between individual personality characteristics, physical activity levels and how people feel about exercise.

What is involved?

First we will ask your child to fill out some personal details regarding age, gender, school year, postcode of their home address and a short assessment of how much physical activity they do. Your child will then be required to fill out several questionnaires assessing personality traits and looking at thoughts and feelings about exercise. These will take about 20 minutes to complete. 4-weeks after the initial questionnaires we will return and ask your child to answer the same questions again to see how or if their answers have changed.

What will happen with the information?

All information obtained will be stored on computer in coded form and individual results will be confidential to you, your child and the research team. Results of this study may be published but any data included will in no way be linked to any specific child. It is important to note that you may withdraw your child's participation in the study at any time without any disadvantage to you or your child of any kind.

What next?

As the children in this study are below the age of 18 we are writing to gain consent from parents/guardians of care givers. If you do not wish for your child to participate we would be grateful if you could return the attached form below. If, however, you are happy for your child to fill out the questionnaires there is no need to return this form.

Any questions can be directed to a member of the research team listed below.

Thank you for your time,

Yours Sincerely,

Charlotte Benjamin (PhD Student) ccb204@ex.ac.uk

Charlotte Slaney (BSc Student) cs327@ex.ac.uk

Associate Professor Gaynor Parfitt (Supervisor) c.g.parfitt@ex.ac.uk

---

Thank you for requesting my consent. I would, however, request that my child does not participate in the project.

Print Name ………………………………………………

Signed………………………………………………………

Name of child……………………………………….

Date………………………………………………………….

Appendix 2b

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Information Sheet for Participants

Thank you for showing an interest in taking part in this study. This sheet will tell you a bit more about the study and what we would like you to do. Please read it carefully before you decide whether or not you would like to take part. If you decide not to take part then this will not change your relationship with the research team or your school or camp. If you have any questions about the study or would like some more information then just ask.

What is the project about?

We are interested in investigating how exercise makes young people feel and seeing if this is related to the type of personality that you have and your current level of physical activity.

Who can take part?

We are inviting anyone, boys and girls, aged 11-16 to take part in the study. Everyone is welcome to **take part** whether you do lots of activities and exercise or not.

What will I have to do?

First of all we would like you to fill out some information sheets for us about yourself; how old you are, whether you are male or female, what school you go to, what your postcode is and then a short question to see how much physical activity you do. Once we've taken this information from you we would like you to fill out several questionnaires for us which look at the type of personality that you have and how exercise makes you feel.
About **four** weeks after we've been to see you we will come back and ask you the same questions again to see if your answers to the questions have changed.

Can I change my mind?

Yes! You can stop the study at any time without having to give a reason.

What will we do with the information?

All the information that we collect will be stored on a computer and the results will be confidential to the University research team.

What do I have to do next?

If you have read and understood everything that we want you to do and are happy to take part then please sign the consent form, which is attached to this sheet.

The Ethics Committee of the School of Sport and Health Sciences has reviewed and approved this study.

If you have any additional questions then please do not hesitate to contact any of the research team.

Thank You

Charlotte Benjamin (PhD Student) ccb204@exeter.ac.uk
Charlotte Slaney (BSc Student) cs327@exeter.ac.uk
Associate Professor Gaynor Parfitt (Supervisor) c.g.parfitt@exeter.ac.uk

Appendix 2c

Assent form for Participants

I have read the Information Sheet about this project and understand what it is about. All my questions have been answered to my satisfaction. I understand that I will have to answer some questions about how I feel about physical activity and how much physical activity I do. I understand that I am free to ask for more information at any stage.

I know that:

1. My participation in this project is entirely voluntary
2. I am free to withdraw from the project at any time without giving a reason
3. I will be required to answer several questionnaires about physical activity and exercise.
4. The results will be stored on a computer in coded form and individual results will be confidential
5. The results of the study may be published but my anonymity will be preserved

If you **DO** wish to take part in this study please sign below and return this form to the researcher.

Signed………………………………………….

Date…………………………………………….

Name (please print)…………………………….

Contact telephone number(s)……………………

This study has been reviewed and approved by the Ethics Committee of the School of Sport and Health Sciences.

Do we have your permission to contact you in the future for follow-up research?
YES NO

I understand that I may be asked to complete further questionnaires at a later date.
YES NO

Appendix 3a

College of Life and Environmental Sciences
Sport and Health Sciences
University of Exeter
St Luke's Campus
Heavitree Road
Exeter, EX1 2LU
General Office +44 (0)1392 722896

Information Sheet

Dear School/ Parent/ Guardian,

We are inviting the participation of girls, aged 13-15 years to participate in a Physical Activity and Health research study. We welcome all activity levels from sedentary to very active and all fitness levels as well.

What is the purpose of the study?

Understanding why some people take part in more physical activity and exercise than others is important so that we can develop new ideas and methods of getting all children more active. This study will investigate how exercise makes young people feel, and we will see if this is related to what they are like. We will also be exploring whether what they are like is linked to how hard young people like to work when they are exercising.

What will the study involve?

Your daughter will be asked to come to the gym on 4 separate occasions. The first time they come in a researcher will record your daughter's name, age and some contact details. Their readiness for physical activity will also be recorded. A researcher will also measure their height and weight.

Next we will fit your daughter with a heart rate monitor and a face mask so that we can measure the air they breathe in and out.

Your daughter will then be asked to run or walk on the treadmill for 20-minutes at a speed that they choose themselves. After they have finished this session they will be asked to wear an activity monitor on their wrist to measure how much they move during the week. They will wear this for a **week.**

There will be 2 more 20-minute exercise sessions following the first one on separate days; one where they choose the speed or level that they want to work at and another where the speed is chosen for them.

The final session will involve a running test on the treadmill to see how fit they are. This will be a continuous, strenuous exercise test, and they will be running on the treadmill for as long as they possibly can. Feedback will be given to your daughter about the type of personality they have, and health-related information will also be given.

What will happen with the information?

All information obtained will be stored on computer in coded form and individual results will be confidential to the participant and the research team. Results of this study may be published but any data included will in no way be linked to any specific

participant. We will provide you and your child with feedback about their overall fitness and health.
It is important to note that you may withdraw your child's participation in the study at any time without any disadvantage to you of any kind.
If you, or your child, have any further queries regarding the above study please do not hesitate to contact us.

The Ethics Committee of the School of Sport and Health Sciences has reviewed and approved this study.

Yours sincerely,

Charlotte Benjamin, PhD Researcher
College of Life and Environmental Sciences
School of Sport and Health Sciences
University of Exeter
St. Luke's Campus
Heavitree Road
Exeter, EX1 2LU
07748 282923
ccb204@exeter.ac.uk

Professor Adrian Taylor
College of Life and Environmental Sciences
School of Sport and Health Sciences
University of Exeter
St. Luke's Campus
Heavitree Road
EX1 2LU
01392 724747
A.H.Taylor@ex.ac.uk

Appendix 3b

Sport and Health Sciences
College of Life and Environmental Sciences
University of Exeter
St Luke's Campus
Heavitree Road
Exeter, EX1 2LU
01392 722896

<u>Information Sheet for Participants</u>

Thank you for taking your time to fill out our questionnaire for us that looked at what type of exercise you prefer. Following on from this we would like you to take part in the next stage of our study. Below is some more information about what is involved and a form to sign if you do wish to take part.

What is the project about?

We are looking at how exercise makes people feel and we are looking at whether this is related to what you are like as a person. We are also interested in exploring whether your personality is linked to how hard you like to work when exercising.

What will I have to do?

You will be asked to come to the gym on 4 separate occasions. The first time you come in a researcher will record your name, age and some contact details from you. You will also have your height and weight measured.
Next we will fit you with a heart rate monitor and a face mask so that we can measure the air you breathe in and out.
We will then ask you to run or walk on the treadmill for 20-minutes at a speed that you can choose yourself. After you have finished this session we will ask you to wear an activity monitor on your wrist to measure how much you move during the week. You will wear this for a **<u>week.</u>**
There will be 2 more 20-minute exercise sessions following the first one on separate days; one where you choose the speed or level that you want to work at and another where we will choose the speed for you.
The final session will involve a running test on the treadmill to see how fit you are. You will be running for as long as you possibly can on the treadmill, so this will be a strenuous test and you may feel out of breath at the end and your heart will beat faster.

Can I change my mind?

Yes! You can stop the study at any time without having to give a reason.

What will we do with the information?

All the information will be stored on a computer and the results will only be seen by the University research team. We will provide you with feedback about your overall health and fitness.

What if I have any questions?

If you have any questions then please feel free to ask any of the researchers listed below.

What do I have to do next?

If you have read and understood everything and are happy to take part then please sign the assent form, which is attached to this sheet. Your parent/guardian must also sign the form we have given them.
The Ethics Committee of the School of Sport and Health Sciences has reviewed and approved this study.
Thank you,

Charlotte Benjamin
Email: ccb204@ex.ac.uk
A.H.Taylor@ex.ac.uk
Tel: 07748 282923
School of Sport and Health Sciences
College of Life and Environmental Sciences
University of Exeter
St Luke’s Campus
Heavitree Road
Exeter, EX1 2LU

Professor Adrian Taylor
Email:

Tel: 01392 724747

Appendix 3c

Consent Form for parents

Please complete and sign if you **DO** wish your child to take part in this study.

I have read the information sheet concerning this study and understand what it is about. All my questions have been answered to my satisfaction. I understand my child will answer some questionnaires and have their general health assessed. I understand that my child will be required to return to the gym on 4 separate occasions. I understand that my daughter will have to wear an activity monitor for a week. I understand that I am free to request further information at any stage.

I know that:

1. My daughters' participation in the study is entirely voluntary.

2. My daughter will be required to come back to the gym on 4 separate occasions.

3. My daughter will be required to exercise on a treadmill while wearing:
    a. a heart rate monitor
    b. a face mask to allow the measurement of air breathed

4. My daughter will be required to have her weight, height and body composition measured

5. My daughter is free to withdraw from the study at any time without giving reason.

6. The results will be stored on computer in coded form and individual results will be confidential.

7. The results of the study may be published but my daughter's anonymity will be preserved.

If you **DO** wish for your child to take part in this study please sign over leaf and return this form to the school.

Signed Parent/ Guardian / care giver…………………………………………………..…

Date………………………..

Name Child (please print)…………………………………..………

Name parent/ guardian/ care giver ……………………………….

Contact telephone number(s)……………………………………………………

Contact email(s)………………………………………………………….

This study has been reviewed and approved by the Ethics Committee of the School of Sport and Health Sciences.

Do we have your permission to contact you in the future for follow-up research? YES NO

I understand that my daughter may be asked to return for further testing at a later date? YES NO

Appendix 3d

Assent form for Participants

Please complete and sign if you **DO** wish to take part in this study.

I have read the information sheet about this study and understand what it is about. All my questions have been answered to my satisfaction. I understand that I will have to answer some questionnaires about myself and that my general health will be measured.
I understand that I will be required to return to the lab on 4 separate occasions. I understand that I will have to wear an activity monitor for a week. I understand that I will have to answer questions about physical activity and exercise and I understand that I am free to request further information at any stage.

I know that:

1. My participation in the study is entirely voluntary.

2. I will be asked to come back in **FOUR** times

3. I will be required to exercise on a treadmill wearing:
   a. a heart rate monitor
   b. a face mask to allow the measurement of expired air

4. I will be required to have my weight, height and body composition measured

5. I will have to wear an activity monitor on my wrist for a week

6. I am free to withdraw from the study at any time without giving reason.

7. The results will be stored on computer in coded form and individual results will be confidential.

If you **DO** wish to take part in this study please sign below and return this form to the PE Department or your form tutor.

Signed ……………………………………..

Date………………………..

Name (please print)………………………………..………

Contact telephone number(s)…………………………………………………………

This study has been reviewed and approved by the Ethics Committee of the School of Sport and Health Sciences.

Do we have your permission to contact you in the future for follow-up research? YES NO

I understand that I may be asked to complete further sessions at a later date. YES NO

Appendix 3e

School of Sport and Health Sciences
St Luke's Campus
Heavitree Road
EXETER, EX1 2LU
General Office +44 (0)1392 262896
Fax +44 (0)1392 264706

Information Sheet for Participants

Thank you for showing an interest in taking part in this study. This sheet will tell you a bit more about the study and what we would like you to do. Please read it carefully before you decide whether or not you would like to take part. If you decide not to take part then this will not change your relationship with the research team or your school or camp. If you have any questions about the study or would like some more information then just ask.

What is the project about?

We are interested in investigating how exercise makes young people feel and seeing if this is related to the type of personality that you have and your current level of physical activity.

Who can take part?

We are inviting anyone, boys and girls, aged 11-15 to take part in the study. Everyone is welcome to take part whether you do lots of activities and exercise or not.

What will I have to do?

First of all we would like you to fill out some information sheets for us about yourself; how old you are, whether you are male or female, what school you go to, what your postcode is and then a short question to see how much physical activity you do. Once we've taken this information from you we would like you to fill out several questionnaires for us which look at the type of personality that you have and how exercise makes you feel.

About four weeks after we've been to see you we will come back and ask you the same questions again to see if your answers to the questions have changed.

Can I change my mind?

Yes! You can stop the study at any time without having to give a reason.

What will we do with the information?

All the information that we collect will be stored on a computer and the results will be confidential to the University research team.

What do I have to do next?

If you have read and understood everything that we want you to do and are happy to take part then please sign the bottom of this form.

The Ethics Committee of the School of Sport and Health Sciences has reviewed and approved this study.

If you have any additional questions then please do not hesitate to contact any of the research team.

Thank You

Charlotte Benjamin (PhD Student) ccb204@exeter.ac.uk
Charlotte Slaney (BSc Student) cs327@exeter.ac.uk
Associate Professor Gaynor Parfitt (Supervisor) c.g.parfitt@exeter.ac.uk

Appendix 4a

HEALTH SCREEN FOR CHILD VOLUNTEERS (PARENTAL FORM)

Name: ....…………………

It is important that volunteers participating in research studies are currently in good health and have had no significant medical problems in the past. This is:

(i) To ensure their own continuing well-being
(ii) To avoid the possibility of individual health issues confounding study outcomes.

Your answers to the questions in this questionnaire, on behalf of your child, are **strictly confidential**.

Please complete this brief questionnaire to confirm your child's fitness to participate:

1. **At present,** does your child have any health problem for which they are:

(a) On medication, prescribed or otherwise...................Yes No
(b) Attending a general practitioner................................Yes No
(c) On a hospital waiting list..Yes No

2. **In the past two years,** has your child had any illness that required them to:

(a) Consult your family GP ....Yes No
(b) Attend a hospital outpatient department...................Yes No
(c) Be admitted to hospital ....Yes No

3. **Has your child ever** had any of the following:

(a) Convulsions/epilepsy..Yes No
(b) Asthma..Yes No
(c) Eczema..Yes No
(d) Diabetes..Yes No
(e) A blood disorder..Yes No
(f) Head injury...Yes No
(g) Digestive problems...Yes No
(h) Heart problems...Yes No
(i) Lung problems..Yes No
(j) Problems with bones or joints....................................Yes No
(k) Disturbance of balance/coordination.........................Yes No
(l) Numbness in hands or feet..Yes No
(m) Disturbance of vision...Yes No
(n) Ear / hearing problems...Yes No

(o) Thyroid problems..Yes No
(p) Kidney or liver problems...Yes No
(q) Allergy to nuts...Yes No
(r) Eating disorder ……………………………………… Yes No

4. Do you know of **any other reason** why your child should not engage in physical activity?

Yes No

If YES to any question, please describe briefly (for example, to confirm problem was/is short-lived, insignificant or well controlled.)
A member of our research team may contact you if we have any further questions.

Thank you for your cooperation!

Signed:

Date:

Appendix 5a

School of Sport and Health Sciences
St Luke's Campus
Heavitree Road
EXETER, EX1 2LU
General Office +44 (0)1392 262896
Fax +44 (0)1392 264706

Information Sheet for Participants

Thank you for showing an interest in taking part in this study. This sheet will tell you a bit more about the study and what we would like you to do. Please read it carefully before you decide whether or not you would like to take part. If you decide not to take part then this will not change your relationship with the research team or your school or camp. If you have any questions about the study or would like some more information then just ask.

What is the project about?

We are interested in investigating how exercise makes young people feel and seeing if this is related to the type of personality that you have and your current level of physical activity.

Who can take part?

We are inviting anyone, boys and girls, aged 11-15 to take part in the study. Everyone is welcome to take part whether you do lots of activities and exercise or not.

What will I have to do?

First of all we would like you to fill out some information sheets for us about yourself; how old you are, whether you are male or female, what school you go to, what your postcode is and then a short question to see how much physical activity you do. Once we've taken this information from you we would like you to fill out several questionnaires for us which look at the type of personality that you have and how exercise makes you feel.

About four weeks after we've been to see you we will come back and ask you the same questions again to see if your answers to the questions have changed.

Can I change my mind?

Yes! You can stop the study at any time without having to give a reason.

What will we do with the information?

All the information that we collect will be stored on a computer and the results will be confidential to the University research team.

What do I have to do next?

If you have read and understood everything that we want you to do and are happy to take part then please sign the bottom of this form.

The Ethics Committee of the School of Sport and Health Sciences has reviewed and approved this study.

If you have any additional questions then please do not hesitate to contact any of the research team.

Thank You

Charlotte Benjamin (PhD Student) ccb204@exeter.ac.uk

Charlotte Slaney (BSc Student) cs327@exeter.ac.uk

Associate Professor Gaynor Parfitt (Supervisor) c.g.parfitt@exeter.ac.uk

Before you begin answering the questionnaires please fill in the following details about yourself.

Age:___________________________

Gender: Male

Female

School:_________________________

School Year:_____________________

Address or postcode of where you live at home:_____________________

If you do not know your address then please write the town or village that you live in_____________

Thank you. Now please take your time to fill out the questionnaires that follow.

Physical Activity Questionnaire

Name: ________________________ Age: ________

Sex: M______ F______ Year: ________

We are trying to find out about your level of physical activity from *the* ***last 7 days*** (in the last week). This includes sports or dance that make you sweat or make your legs feel tired, or games that make you breathe hard, like tag, skipping, running, climbing, and others.

Remember:

1. There are no right and wrong answers – this is not a test.
2. Please answer all questions as honestly and accurately as you can – this is very important.

---

1. Physical activity in your spare time: Have you done any of the following activities in the past 7 days (last week)? If yes, how many times? (Mark only one circle per row.)

	No	1-2	3-4	5-6	7 times or more
Skipping	○	○	○	○	○
Rowing/Canoeing	○	○	○	○	○
In-line skating	○	○	○	○	○
Tag	○	○	○	○	○
Walking for Exercise	○	○	○	○	○
Bicycling	○	○	○	○	○
Jogging or running	○	○	○	○	○
Aerobics	○	○	○	○	○
Swimming	○	○	○	○	○
Baseball, rounders	○	○	○	○	○
Dance	○	○	○	○	○
Football	○	○	○	○	○

Badminton	O	O	O	O	O
Skateboarding	O	O	O	O	O
Rugby	O	O	O	O	O
Tennis	O	O	O	O	O
Volleyball	O	O	O	O	O
Hockey	O	O	O	O	O
Basketball	O	O	O	O	O
Ice Skating	O	O	O	O	O
Cricket	O	O	O	O	O
Netball	O	O	O	O	O
Other:___________________	O	O	O	O	O
________________________	O	O	O	O	O

2. In the last 7 days, during your physical education (PE) classes, how often were you very active (playing hard, running, jumping, throwing)? (Check one only.)

I don't do PE………………………………………………………… O

Hardly ever ………………………………………………………… O

Sometimes ………………………………………………………… O

Quite Often ……………………………………………………….. O

Always ……………………………………………………………….. O

3. In the last 7 days, what did you do most of at ***morning break***? (Check one only.)

Sat down (talking, reading, doing school work)………. O

Stood around or walked around …………………………….. O

Ran or played a little bit ……………………………………… O

Ran around and played quite a bit ………………………… O

Ran and played hard most of the time …………………. O

4. In the last 7 days, what did you normally do at ***lunch*** (besides eating lunch)? (Check one only.)

Sat down (talking, reading, doing school work)………. O

Stood around or walked around …………………………….. O

Ran or played a little bit ……………………………………… O

Ran around and played quite a bit ………………………… O
Ran and played hard most of the time …………………. O

5. In the last 7 days, on how many days ***right after school,*** did you do sports, dance, or play games in which you were active? (Check one only.)

None ……………………………………………………………… O

1 time last week ………………………………………………. O

2 or 3 times last week …………………………………….. O

4 times last week …………………………………….. O

5 times last week …………………………………….. O

6. In the last 7 days, on how many ***evenings*** did you do sports, dance, or play games in which you were active? (Check one only.)

None ……………………………………………………………… O

One time last week ………………………………………………. O

2 or 3 times last week …………………………………….. O

4 or 5 times last week …………………………………….. O

6 or 7 times last week ………………………………….. O

1 ***On the last weekend,*** how many times did you do sports, dance, or play games in which you were very active? (Check one only.)

None ………………………………………………………………… O

One time ……………..………………………………………………. O

2- 3 times ………………...…………………………………….. O

4- 5 times ……………………………………………………….. O

6 or more times …….…………………………………….. O

1 Which ***one*** of the following describes you best for the last 7 days? Read ***all five*** statements before deciding on the ***one*** answers that describes you.

A. All or most of my free time was spent doing things that involve little physical effort O

B. I sometimes (1 -2 times last week) did physical things in my free time (e.g. played sports, went running, swimming, bike riding, did aerobics O

C. I often (3 – 4 times last week) did physical things in my free time O

D. I quite often (5 – 6 times last week) did physical things in my free time O

E. I very often (7 or more times last week) did physical things in my free time O

2 In the last 7 days, on how many ***evenings*** did you do sports, dance, or play games in which you were active? (Check one only.)

	None	Little bit	Medium	Often	Very Often
Monday	○	○	○	○	○
Tuesday	○	○	○	○	○
Wednesday	○	○	○	○	○
Thursday	○	○	○	○	○
Friday	○	○	○	○	○

3 Were you sick last week, or did anything prevent you from doing your normal physical activities? (Check one.)

Yes ………………………………………………….. O

No ………………………………………………….. O

If Yes, what prevented you? ____________________________

Exercise Associated Adjectives:

Thinking about exercise and physical activity, how does each of these words make you feel? Circle the number which best shows this.

	Very Bad		Bad		Fairly Bad	Neutral	Fairly Good		Good		Very Good
Sweating	0	1	2	3	4	5	6	7	8	9	10
Legs Aching	0	1	2	3	4	5	6	7	8	9	10
Breathing Heavily	0	1	2	3	4	5	6	7	8	9	10
Heart Racing	0	1	2	3	4	5	6	7	8	9	10
Muscles Aching	0	1	2	3	4	5	6	7	8	9	10
Hot	0	1	2	3	4	5	6	7	8	9	10
Hurting	0	1	2	3	4	5	6	7	8	9	10
Red	0	1	2	3	4	5	6	7	8	9	10
Sticky	0	1	2	3	4	5	6	7	8	9	10

Preference for and Tolerance of Exercise Questionnaire

Please read each of the following statements and then use the response scale below to indicate whether you agree or disagree with it. There are no right or wrong answers. Work quickly and mark the answer that best describes what you believe and how you feel. Make sure you respond to all the questions.

1= I totally disagree 2= I disagree 3= I neither agree nor disagree 4= I agree 5= I totally agree

1.	Feeling tired during exercise is my signal to slow down or stop	1	2	3	4	5
2.	I would rather work out at low intensity levels for a long duration than at high-intensity levels for a short duration	1	2	3	4	5
3.	During exercise, if my muscles begin to burn excessively or if I find myself breathing very hard, it is time for me to ease off	1	2	3	4	5
4.	I'd rather go slow during my exercise, even if that means taking more time.	1	2	3	4	5
5.	While exercising, I try to keep going even after I am exhausted	1	2	3	4	5
6.	I would rather have a short, intense workout than a long, low intensity workout	1	2	3	4	5
7.	I block out the feeling of fatigue when exercising	1	2	3	4	5
8.	When I exercise, I usually prefer a slow, steady pace	1	2	3	4	5
9.	I'd rather slow down or stop when a workout starts to get too tough	1	2	3	4	5
10.	Exercising at a low intensity does not appeal to me at all	1	2	3	4	5
11.	Fatigue is the last thing that affects me when I stop a workout; I have a goal and stop only when I reach it	1	2	3	4	5

12.	While exercising, I prefer activities that are slow-paced and do not require much exertion	1	2	3	4	5
13. 14.	When my muscles start burning during exercise, I usually ease off some	1	2	3	4	5
15.	The faster and harder the workout, the more pleasant I feel	1	2	3	4	5
16.	I always push through muscle soreness and fatigue when working out	1	2	3	4	5
17.	Low-intensity exercise is boring	1	2	3	4	5
18.	Feeling tired during exercise does not make me stop	1	2	3	4	5
19.	I only stop exercising once I have reached my goals	1	2	3	4	5
20. 21.	I always try to keep going even if my muscles are sore and I feel tired	1	2	3	4	5
22.	Low intensity exercise appeals to me	1	2	3	4	5
23.	When a workload intensity gets too tough I slow down or stop	1	2	3	4	5
24.	I prefer high intensity exercise than low intensity exercise	1	2	3	4	5

For each item below circle the number on the continuum that best describes how you feel when considering physical activity:

Sad	1	2	3	4	5	6	7	Happy
Tense	1	2	3	4	5	6	7	Calm
Bored	1	2	3	4	5	6	7	Excited
Bad	1	2	3	4	5	6	7	Good
Sorrow	1	2	3	4	5	6	7	Joy

Overall I think that physical activity is;

Enjoyable	1	2	3	4	5	6	7	Unenjoyable
Good	1	2	3	4	5	6	7	Bad
Pleasant	1	2	3	4	5	6	7	Unpleasant
Favourable	1	2	3	4	5	6	7	Unfavourable

How confident are you that you could do physical activity if you wanted to?

Not at all confident	1	2	3	4	5	6	7	Extremely Confident

How much control do you feel you have over doing physical activity?

No Control	1	2	3	4	5	6	7	Complete Control

To what extent is it up to you whether you do physical activity?

Not at all	1	2	3	4	5	6	7	A great amount

How easy or difficult do you think it would be for you to do physical activity?

Very Difficult	1	2	3	4	5	6	7	Very Easy

People who are important to me think I should do physical activity

Strongly Agree	7	6	5	4	3	2	1	Strongly Disagree

People I know well think physical activity is

A very good idea	7	6	5	4	3	2	1	A very bad idea

If I were to be physically active on most days it would:

	Strongly Agree 1	2	3	4	5	6	Strongly Disagree 7
Make me tired	1	2	3	4	5	6	7
Give me energy	1	2	3	4	5	6	7
Be fun	1	2	3	4	5	6	7
Be boring	1	2	3	4	5	6	7
Get or keep me in shape	1	2	3	4	5	6	7
Make me better in sports	1	2	3	4	5	6	7
Help me be healthy	1	2	3	4	5	6	7
Help me control my weight	1	2	3	4	5	6	7
Make me embarrassed in front of others	1	2	3	4	5	6	7
Cause pain and muscle soreness	1	2	3	4	5	6	7
Help me look good to others	1	2	3	4	5	6	7
Help me make new friends	1	2	3	4	5	6	7
Make me more attractive to the opposite sex	1	2	3	4	5	6	7
Help me work out my anger	1	2	3	4	5	6	7
Help me spend more time with my friends	1	2	3	4	5	6	7
Make me get hurt	1	2	3	4	5	6	7

Please read the scenario below and imagine that you are the exerciser. You will then be asked to complete the scales and questions below. Feel free to re-read the scenario if you need to.

You are exercising at an intensity that has been **selected for you.**

"You have been running on the treadmill at a given level. You are beginning to feel your body warming up and you notice that you are breathing more heavily. Your heart rate has increased and your legs are beginning to feel tired. You are beginning to struggle but you have to keep the treadmill at the same speed. You can still feel your body working".

What is your rating of perceived exertion? This feeling should reflect your total amount of exertion and fatigue, combining all sensation and feeling of physical stress, effort and fatigue. Don't concern yourself with any one factor but try to concentrate on your total, inner feeling of exertion. Try not to overestimate your feeling of exertion; be as accurate as you can.

6	
7	Very, very light
8	
9	Very light
10	
11	Fairly light
12	
13	Somewhat hard
14	
15	Hard
16	
17	Very Hard
18	
19	Very, very hard
20	

Estimate here how aroused you actually feel. Do this by circling the appropriate number. The term 'arousal' here refers to how worked up you might feel. High arousal might be experienced as excitement or anxiety or anger. Low arousal might be experienced as relation or boredom or calmness.

1	Low arousal
2	
3	
4	
5	
6	High arousal

While participating in exercise, it is common to experience changes in mood. Some individuals find exercise pleasurable, whereas others find it to be unpleasurable. Additionally feeling may fluctuate over time, that is one might feel good and bad a number of times during exercise. How does the above scenario make you feel?

+5	Very good
+4	
+3	Good
+2	
+1	Fairly good
0	Neutral
-1	Fairly Bad
-2	
-3	Bad
-4	
-5	Very bad

Do you think feeling like this will influence you exercising or being physically active in the future?

Yes No

If YES, would it influence you to do MORE or LESS exercise and physical activity?

1 2 3 4 5 6 7 8 9 10

You have now finished your exercise session. Your legs are no longer tired and your heart rate and breathing have returned to normal. Please now complete the scales below.

What is your rating of perceived exertion? This feeling should reflect your total amount of exertion and fatigue, combining all sensation and feeling of physical stress, effort and fatigue. Don't concern yourself with any one factor but try to concentrate on your total, inner feeling of exertion. Try not to overestimate your feeling of exertion; be as accurate as you can.

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Do you think feeling like this will influence you exercising or being physically active in the future?

Yes No

If YES, would it influence you to do MORE or LESS exercise and physical activity?

1 2 3 4 5 6 7 8 9 10

Please read the scenario below and imagine that you are the exerciser. You will then be asked to complete the scales and questions below. Feel free to re-read the scenario if you need to.

You are exercising at an intensity you have **selected yourself.**

"You have been running on the treadmill at a level you have chosen. You are beginning to feel your body warming up and you notice that you are breathing more heavily. Your heart rate has increased and your legs are beginning to feel tired. You are beginning to struggle and but you can change the speed of the treadmill to one you prefer. You can still feel your body working".

What is your rating of perceived exertion? This feeling should reflect your total amount of exertion and fatigue, combining all sensation and feeling of physical stress, effort and fatigue. Don't concern yourself with any one factor but try to concentrate on your total, inner feeling of exertion. Try not to overestimate your feeling of exertion; be as accurate as you can.

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Do you think feeling like this will influence you exercising or being physically active in the future?

Yes No

If YES, would it influence you to do MORE or LESS exercise and physical activity?

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You have now finished your exercise session. Your legs are no longer tired and your heart rate and breathing have returned to normal. Please now complete the scales below.

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Do you think feeling like this will influence you exercising or being physically active in the future?

Yes No

If YES, would it influence you to do MORE or LESS exercise and physical activity?

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Thank you for taking your time to answer the questions. This is the last page and you have reached the end of the questionnaires.