A Mixed-Method Examination of the Effects of an Affective Mental Contrasting Intervention on Physical Activity Behaviours

by

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Abstract

University is a vulnerable period for discontinuing regular physical activity, which can have implications for individuals' physical and psychological health (Bray & Born, 2010). Accordingly, it is imperative to find and implement cost and time-effective interventions to mitigate the consequences of this transition. *Mental contrasting* is a self-regulatory strategy that involves imagining the greatest outcome associated with achievement of a desired future goal while considering the aspects of one's present situation that may serve as obstacles for attaining that same goal (Oettingen & Gollwitzer, 2010). Intervention research has shown that mental contrasting can be taught as a metacognitive strategy in a cost- and time-effective way, affecting numerous health behaviours including physical activity (Oettingen, 2012). Drawing from diverse theoretical perspectives (e.g., Bechara, 2005; Lawton, Conner, & McEachan, 2009; Williams, 2010), recent meta-analytic evidence suggests that affective judgements (e.g., enjoyable-unenjoyable) exert greater influence on physical activity behaviours than health-related instrumental judgements (e.g., useful-useless; Rhodes, Fiala, & Conner, 2009). The purpose of this thesis was to utilize mental contrasting as a means of targeting affective judgements, through intervention, in order to bolster physical activity promotion efforts. One hundred and ten inactive, female university students were randomly assigned to an affective, instrumental or standard mental contrasting intervention. Assessments were conducted at baseline, 1-week post intervention and 4-weeks post intervention. Participants in the affective mental contrasting condition displayed higher levels of self-reported MVPA than those in the instrumental or standard comparison conditions, $F(2, 90) = 3.14$, $p < .05$, $\eta_p^2 = 0.065$. Furthermore, results of a moderation analysis provided evidence that when participants were randomized to an affective mental contrasting condition, and highlighted outcome judgements

that were affective in nature, they demonstrated the most pronounced increases in physical activity. Conversely, those randomized to an instrumental condition, who highlighted instrumental outcome judgments, had the lowest physical activity levels. Overall, affective mental contrasting has the potential to represent a low- cost and time-efficient intervention that may help inactive, female students increase activity or attenuate declining levels of MVPA that occurs during university.

Preface

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Introduction

Recent evidence suggests that only 15.4% of Canadian adults accumulate the recommended 150 or more minutes of moderate-to-vigorous physical activity (MVPA) in 10-minute bouts per week (Colley et al., 2011; Tremblay et al., 2011). Overall, the proportion of the population that is sufficiently active decreases with age (Kwan, Cairney, Faulkner, & Pullenayegum, 2012; Zick, Smith, Brown, Fan, & Kowaleski-Jones, 2007). It has been suggested that a cohort with one of the highest rates of decline in physical activity, in the Canadian population, are those in late adolescence or early adulthood (Kwan, et al., 2012). University transitions are a particularly vulnerable period for discontinuing regular physical activity (Bray & Kwan, 2010).

During university, students encounter changes in academic, social, physical, emotional, and even cultural domains of their life (Bray & Born, 2010). Transitions to university life often involve leaving home and moving to a dormitory or shared student residence, dealing with changing familial and societal roles, as well as new challenges associated with increased demands and independence of university coursework (Bray, 2007). Later in university, as students move off-campus, perceived inconvenience and commuting difficulties have been suggested to lead to more pronounced decreases in physical activity (Reed & Phillips, 2005). Moreover, the structured routines established during high school, while living at home with parents, are disrupted (Bray & Born, 2010). This new unstructured environment can result in decreases in both frequency and intensity of physical activity following high school (Bray, 2007; Bray & Born, 2010). This decline in physical activity levels can have implications for students' physical and psychological health (Bray & Kwan, 2010).

There is evidence to suggest a myriad of benefits associated with physical activity (Penedo & Dahn, 2005; Ekkekakis & Backhouse, 2014; Warburton, Katzmarzyk, Rhodes, & Shephard, 2007; Warburton, Nicol, & Bredin, 2006). First, there are long-term health benefits, such as the prevention of chronic conditions including cardiovascular disease, diabetes, cancer, hypertension, obesity, and osteoporosis (Warburton et al., 2006). Physical activity also buffers against the risks associated with being overweight or obese (Gropper, Simmons, Connel & Ulrich, 2012; Penedo & Dahn, 2005) and is associated with better overall cognitive performance, including aspects such as learning and memory (Penedo & Dahn, 2005; Van Praag, 2009).

In contrast to these long-term health benefits, relatively immediate psychosocial benefits are also observed. Improved mood states, resulting from reductions in anger and tension (Penedo & Dahn, 2005), along with reductions in anxiety, depression and stress (Kwan & Bryan, 2010; Penedo & Dahn, 2005; Warburton et al., 2006) have been consistently associated with elevated levels of physical activity. Moreover, this mood management effect (feeling better, not just feeling good) is often overlooked by exercisers (Kwan & Bryan, 2010). Increases in feelings of tranquillity immediately following an exercise bout are also thought to be a particularly important benefit of engaging in physical activity (Kwan & Bryan, 2010). Other short-term benefits reported in the literature include improved body image (Hausenblas & Fallon, 2006), increased energy (Ekkekakis & Backhouse, 2014) and improved feelings of vitality and sleep quality (Leopoldino et al., 2013). Psychological benefits associated with physical activity may be especially valuable to the university population, as university students are at an increased risk for compromised psychological well-being (Adlaf, Gliksman, Demers, & Newton-Taylor, 2001; Bray & Born, 2010).

The health-related benefits of physical activity are generally well known and have been emphasized within the popular media (Bauman & Chau, 2009; Leavy, Bull, Rosenberg, & Bauman, 2011). However, knowledge of these benefits is insufficient to produce a behaviour change; sometimes referred to as the knowledge-behaviour gap (Lavoie & Bacon, 2014). In sum, it is not necessarily that those who are insufficiently active do not know what to do; rather, it is that they do not act in accordance with what they perceive to be best for them. Accordingly, motivational strategies are required to help individuals initiate and maintain physical activity.

Recent reports indicate there are almost a million students enrolled in undergraduate and graduate programs in Canada, approximately 80% of whom are enrolled at the undergraduate level (Statistics Canada and Council of Ministers of Education, 2009). Moreover, enrollment in post-secondary education has been increasing at a rate of 3.1% per year (Statistics Canada, 2009). Furthermore, as early as childhood, females consistently spend less time participating in physical activity than their male counterparts, with this trend continuing into high school and university (Kwan et al., 2012; Trost et al., 2005; Zick et al., 2007). Based on these gender differences in physical activity during university, calls have been made for campus-based physical activity interventions that are tailored on the basis of gender (Kwan et al., 2012). Based on the size and vulnerability of this growing population, it is imperative to find and implement cost and time-effective interventions to mitigate the consequences of this transition. With this in mind, the overall purpose of my Master's thesis research was to develop and test the efficacy of a novel goal-setting intervention (underpinned by mental contrasting) to bolster the improved adoption and maintenance of physical activity behaviours among a sample of inactive, female, undergraduate students.

Setting and Implementing Goals.

Despite the well-known physical, psychological and social benefits of engaging in physical activity, attempts to initiate physical activity are often hindered by distractions, or temptations, and are often in contention with immediately gratifying negative health behaviours (Gollwitzer & Oettingen, 2000). Although many individuals have strong intentions to exercise, only a subset of these individuals are able to translate their intentions into action (e.g., Rhodes, Blanchard, Matheson, 2006; Rhodes & de Bruijn, 2013; Sheeran, 2002; Webb & Sheeran, 2006). Accordingly, self-regulatory strategies are needed in order to help translate these well-meaning intentions into action. Self- regulatory behaviour has been described as occurring in two phases; a motivational phase, and a volitional phase (Heckhausen & Gollwitzer, 1987). In the motivational phase, individuals consider the benefits and barriers of various actions in order to choose which potential goals and behaviours to pursue. Examples of motivational theories include most social-cognitive models and expectancy-value theories (Conner, 2010). The motivational phase is posited to conclude with an intention regarding what goal an individual will pursue (Heckhausen & Gollwitzer, 1987). In the subsequent volitional phase, an individual engages in planning and action directed toward achieving the set goal.

Goal content theories, which focus on the motivational aspects of self-regulation, attempt to explain differences in goal-directed behaviour under the assumption that the content of one's goal is expected to influence goal pursuit (Gollwitzer & Oettingen, 2000). According to Locke and Latham (2002), a goal is the object or aim of an action that provides a source of motivation to attain an outcome, usually within a specified time frame. Overall, meta-analytic evidence regarding the efficacy of goal setting interventions, in the physical activity domain, has demonstrated a medium-sized positive effect (McEwan et al., 2015). Further, it has been shown

that when developing goal-setting interventions, certain principles and guidelines may help to maximize their effectiveness (Shilts, Horowitz, & Townsend, 2004; McEwan et al., 2015). Specifically, parameters that have been suggested to influence the effectiveness of goal-setting include specificity (Latham & Locke, 1991; Shilts et al., 2004), difficulty (Locke & Latham, 1985) and proximity (McEwan et al., 2015). That is, goal-setting will be most effective when goals are specific, challenging (but realistic), and include short-term goals. Further, although it does not matter who prescribes the goal (McEwan et al., 2015), in terms of whether it is self-set or set by an exercise counsellor, goals should be made relevant/important to the individual (Haggar & Chatzisarantis, 2008). On the other hand, although there are factors that can be considered to maximise the efficacy of a goal setting, when implementing goal-setting interventions, it has been demonstrated that neither the delivery mode (e.g., online, face-to-face), nor the length of the intervention moderate the effectiveness of goal-setting on physical activity adherence behaviours (McEwan et al., 2015). Accordingly, goal setting interventions can be a cost- and time-effective way to increase individuals' physical activity behaviour.

In addition to these goal-content theories, self-regulatory theories of goal setting focus on how to overcome goal implementation problems in order to help translate a goal into behaviour (Gollwitzer & Oettingen, 2000). This type of goal setting helps target the volitional stage of self-regulatory behaviour. That is to say, it is not *what* goal you set, but rather *how* you set it that matters (Sheeran, Harris, Vaughan, Oettingen & Gollwitzer, 2013).

Fantasy realization theory. According to fantasy realization theory it is possible to distinguish between two forms of thinking about the future: expectations and free fantasies (Oettingen, 1999). Expectations, Oettingen (2012) notes, are the type of future thought commonly investigated in most social-cognitive models of behaviour (e.g., Ajzen, 1991;

Bandura, 2004). Oettingen (1999) defines expectations as judgments of how likely it is that desirable or undesirable future outcomes or behaviours will occur. Further, expectations are usually based on past experiences, and thus on a person's performance history. Fantasy realization theory differs from other common social-cognitive models, in its consideration of free fantasies about the future (Oettingen, 1999; 2012). Free fantasies about the future, are defined as imagining future outcomes or behaviours, independent of the likelihood that these events will actually occur (Oettingen, 1999). Examples of this type of future thought include daydreams, imagining, mind- wandering, task-unrelated thoughts, or counterfactual thinking (Oettingen, 2012). In free fantasies about the future, individuals can envision a desired future outcome even though they judge the actual occurrence of that event to be unlikely (Oettingen, 1999).

Fantasy realization theory further suggests that a necessity to act is required in order to activate expectations about the future, and that these expectations are used to guide levels of goal commitment (Oettingen, 2000; Oettingen, Pak, & Schnetter, 2001). A necessity to act is defined as the recognition that something needs to be changed in one's present situation in order to reach the desired future (Oettingen, 2000; Oettingen, et al., 2001). In her theory, Oettingen delineates between three routes to goal setting (i.e. indulging, dwelling and mental contrasting**)**, one of which creates a necessity to act (i.e., mental contrasting) and two that do not (i.e., indulging and dwelling). Although both social-cognitive models and fantasy realization theory suggest that an individual's expectations about performing a behaviour, or the outcomes associated with performing a behaviour, influence an individual's motivation and subsequent performance of health-enhancing behaviours, fantasy realization theory uniquely emphasizes a consideration of what expectations need to be considered, as well as in what order. Specifically, Oettingen (2000, 2012) suggests that individuals need to consider both positive outcomes and negative obstacles

of performing a health-enhancing behaviour, and that consideration of outcomes must precede the consideration of obstacles.

Mental contrasting is an expectancy-based form of self-regulatory thought whereby after specifying a goal directed toward changing a person's behaviour (based on principles of goal-content theories addressed above), individuals name and imagine the most positive outcome of successfully changing their behaviour, and name and imagine the most important obstacle that stands in the way of realizing the goal (Oettingen, 2000, 2012; Oettingen, et al., 2001; Oettingen & Gollwitzer, 2010). Oettingen (2012) suggests that imagining the positive future first and then contrasting that with the present obstacle creates a relational construct (Higgins & Chaires, 1980) of the negative reality being an obstacle "standing in the way" of the desired future. It is this relational construct which then creates a necessity to act (Oettingen, 2012).

After a necessity to act is created by mentally contrasting the desired future with the present reality, one's expectations of the desirability and feasibility of goal-achievement are made salient, and are subsequently used to determine commitment to the goal (Oettingen, 2000, 2012; Oettingen et al., 2001). Goal commitment is expected to be strong when expectations of desirability and feasibility are high, and weak when expectations are low (Oettingen, 2000; Oettingen et al., 2001). Other work in the goal setting literature has demonstrated that goal commitment moderates the relationship between a goal and performance (Klein, Wesson, Hollenbeck & Alge, 1999; Locke & Latham, 2002). Accordingly, by employing a mental contrasting strategy an individual will either bolster their commitment (and consequent performance) to a desirable and feasible goal, or disengage from an unrealistic or impossible goal.

The second, expectancy-independent, form of self-regulatory thought is indulging. When individuals engage in indulging thoughts (that is, fantasize about achieving their goal), the desired future can be mentally enjoyed immediately (Oettingen, 2000, Oettingen et al., 2001). Moreover, indulging in a goal prevents an individual from acknowledging that achieving the goal requires exerting substantial effort, overcoming hardships and resisting temptations (Johannessen, Oettingen, & Mayer, 2012). Oettingen theorized that by not considering obstacles that stand in the way of realizing the desired future, a necessity to act is not created, and expectations are also not activated and used to guide levels of goal commitment (Johannessen et al., 2012; Oettingen, 2000, Oettingen et al., 2001).

The final, expectancy-independent form of self-regulatory thought is dwelling. When individuals dwell, they ruminate on the negative aspects of reality that may prevent them from reaching their goals (Oettingen, 2000, 2012; Oettingen et al., 2001). Without anticipating the positive outcomes of achieving their goal, individuals do not experience a necessity to strive for their goal, and thus expectancies of goal-achievement are neither activated nor used to determine goal-commitment or subsequent behaviour.

Oettingen and colleagues (2001) have also examined the impact of reverse contrasting, which is first identifying the biggest obstacle, and then identifying the best outcome associated with being physically active. It was observed that this reverse contrasting does not lead to bolstered goal-commitment or subsequent behaviour. It has been posited that these effects were seen because reverse contrasting prevents the expectancy-dependent relational construct of the present reality standing in the way of the desired future (Kappes, Singmann, & Oettingen, 2012; Oettingen et al., 2001). Without this relational construct, no necessity to act is activated, and thus

expectations of desirability and feasibility do not guide goal-commitment or goal-directed behaviour.

Efficacy of mental contrasting interventions. Evidence regarding the utility of mental contrasting has been found across ages, genders, education levels and socio-economic statuses. In a study of university students, participants in the mental contrasting condition reported consuming fewer calories (eating fewer high-calorie foods and more low-calorie foods), and exercising more, than participants in the indulging and the control conditions over a two week period (Johannessen et al., 2012). In a study of health professionals those in a mental-contrasting condition reported more success in managing their time, completing projects, and making decisions, compared to those in an indulging condition (Oettingen, Mayer, & Brinkmann, 2010). In a print-material mediated intervention (no contact with an interventionist), male, low socio-economic status, inactive recreational fishermen who completed a mental contrasting activity had increases in physical activity at both a 1-month (d = .18) and 7-month (d = .24) follow-up after using intent-to-treat analyses (Sheeran et al., 2013). In the Sheeran et al. (2013) study, although these are relatively small effect sizes, this is a notable finding, particularly considering there was no contact with an interventionist. Moreover, among participants who provided data at all three time points, the difference between groups at the 7-month follow-up revealed a large effect (d = .87).

Mental contrasting interventions have also been conducted with *implementation intentions*, a series of *if…then…* statements whereby one identifies critical cues relating to one's goal and plans a response to that cue, whilst also considering when, where and how that person intends to pursue a goal (Oettingen & Gollwitzer, 2010). Empirical evidence across several diverse samples and contexts suggest that mental contrasting with implementation intentions is

also a promising intervention. For example, in a study with middle-aged women, mental contrasting with implementation intentions increased physical activity compared to an educational condition that provided information regarding the health-benefits of physical activity (Stadler et al., 2009). Further, the medium-sized effects of this intervention remained over time, d = 0.43, 0.47, 0.53, and 0.47 at 1, 4, 8, and 16 weeks after intervention, respectively (Stadler et al., 2009). Additionally, in a study with high school students who used a print-mediated intervention, those in the mental contrasting plus implementation intentions condition completed more than 60% more practice questions in preparation for an upcoming PSAT (university entrance exam) than did students in a placebo control condition during a five month period (May-October; Duckworth, Grant, Loew, Oettingen, & Gollwitzer, 2011).

In summary, mental contrasting interventions are likely to be a highly engaging form of goal setting, whereby participants specify and imagine the idiosyncratic content of their desired future and negative reality (Sheeran et al., 2013). Further, this self-regulatory technique has proven to be valuable in time-limited contexts (Oettigen, 2012; Sheeran et al., 2013). Being cognisant of the negative reality that stands in the way of a desired future is particularly important for inactive individuals, compared to more active populations. Mental contrasting leads to strong goal commitment as long as the expectations of the desirability (expected value) and feasibility (expected success) of the given goal are relatively high (Johannessen et al., 2012). Mental contrasting promotes the realization of goals that are seen as feasible by participants (Oettingen, 2012) and energizes people to overcome obstacles and strive for their desired future (Sheeran et al., 2013). Moreover, the effects of this intervention can be sustained over time, with effects maintained over several months (e.g., Duckwork et al., 2011, Stadler et al., 2009; Sheeran

et al., 2013). However, there exists the opportunity to further bolster the efficacy of this intervention.

Current mental contrasting interventions focus on the idiosyncratic identification of obstacles and outcomes. When thinking about physical activity, individuals can consider either instrumental or affective obstacles and outcomes associated with the target behaviour. Generally, instrumental judgements are understood to be the considerations that an individual has for the utility of a given behaviour; for example, the costs and benefits associated with being physically active (Bellows-Riecken, Mark, & Rhodes, 2013). Alternatively, individuals can consider affective judgements, which are defined as the overall evaluations regarding emotions or feelings one associates with a given behaviour, such as the expected feelings of pleasure/displeasure, or enjoyment perceived in relation to a behaviour (Bellows-Riecken et al., 2013). Current obstacles and outcomes identified in mental contrasting interventions have often focused on instrumental judgements regarding health-enhancing behaviours. For example, content analysis of benefits elicited in a dietary change mental contrasting intervention included predominantly rational, instrumental judgements such as losing weight, looking better, and becoming healthier (Johannessen et al., 2012). As demonstrated in the next section, there is recent work which suggests that affective judgements are better than instrumental judgements in predicting health-enhancing behaviours such as physical activity (e.g. Lawton et al., 2009; Rhodes et al., 2009). Accordingly, there exists the opportunity to bolster the efficacy of mental contrasting interventions, by guiding individuals to focus on affective judgements (outcomes and obstacles) associated with physical activity behaviour.

Operationalizing Physical Activity Judgements

In order for physical activity interventions to be effective in changing behaviour, it has been suggested that researchers and practitioners should opt to implement interventions that are theory-driven (e.g., Gourlan et al., 2013; Michie & Johnston, 2012). Moreover, recent meta-analytic evidence suggests that theory-based interventions are more effective in promoting physical activity (Gourlan et al., 2013). Consequently, physical activity research and intervention initiatives have applied several social-cognitive models of human behaviour that specify the important cognitions that distinguish between those performing and not performing physical activity behaviour (Connor, 2010). Several prominent examples of these social-cognitive models include the transtheoretical model (Prochaska , DiClemente, & Norcross, 1992; Velicer, DiClemente, Prochaska, & Brandenburg, 1985), social cognitive theory (Bandura, 1997), self-determination theory (Ryan & Deci, 2000), and the theory of planned behaviour (Ajzen, 1991). Recently, it also has been suggested that due to the overlap between these theoretical models it may be valuable to integrate them, especially since they include some of the same determinants (Conner, 2010). For example, despite slightly different labels and conceptualisations, many of these theories include constructs involving judgments about physical activity, or the outcomes of physical activity.

The role of physical activity judgements varies slightly across theories. For example, a component of social cognitive theory, self-efficacy theory, focuses on the causal relationships among self-efficacy, outcome expectations (a form of physical activity judgement), and behaviour (Bandura, 1998). Bandura (1997) defined self-efficacy as "the belief in one's capabilities to organize and execute the courses of action required to produce given attainments" (p. 3). Conversely, outcome expectations are defined as expectations that an outcome will follow

a given behaviour (Bandura, 1997; 1998). Traditionally, it has been theorised that self-efficacy beliefs causally influence the outcomes people expect their efforts to produce (Bandura, 1997; 1998; 2004). Specifically, individuals who perceive themselves to possess high levels of self-efficacy expect to accomplish positive outcomes, and individuals with low self-efficacy expect their efforts to result in unfavourable outcomes (Bandura, 2004). Further, three types of outcome expectations have been identified from a social cognitive theory perspective; social, physical, and self-evaluative (Bandura, 1998; 2004). With respect to physical activity, physical outcome expectations reflect expectations about positive and negative physical effects resulting from engaging in physical activity (e.g., exercise will aid in weight control; Wójcicki, White, & McAuley, 2009). Social expectations reflect beliefs about physical activity resulting in increased opportunities for socialization or attaining social approval (e.g., exercise will improve my social standing; Wójcicki et al., 2009). Finally, self-evaluative outcome expectations include judgements regarding the feelings of satisfaction and self-worth associated with involvement in physical activity (e.g., exercise will give me a sense of personal accomplishment; Wójcicki et al., 2009). While Bandura (1997, 1998) contended that outcome expectations depend on an individual's perceptions of their efficacy (Bandura, 1997; 1998), contrary evidence suggests that a bidirectional relationship exists between self-efficacy and outcome expectations, such that outcome expectations can causally influence self-efficacy ratings and subsequent behaviour (Williams, 2010). Specifically, Williams (2010) suggests that, particularly for behaviours that require self-regulation, positive outcome expectations can increase self-efficacy, thus promoting health-enhancing behaviour, whereas negative outcome expectations can decrease self-efficacy, therefore deterring health-enhancing behaviour.

According to Bandura (2004), other social cognitive models of health-enhancing behaviour, were founded on the broader framework of social cognitive theory, and thus contain similar determinants of health behaviours. According to the theory of planned behavior (Ajzen, 1991), individuals engage in health-enhancing behaviour in accordance with their intentions and perceptions of control over the behavior, and that intentions in turn are influenced by an individual's attitudes toward the behavior, subjective norms, and perceptions of behavioral control. Within the theory of planned behaviour physical activity judgements are incorporated into behavioural beliefs, which underlie individuals' attitudes towards the behaviour (Ajzen, 1991). Specifically, an individual's behavioural beliefs associate physical activity behaviour with certain attributes, and an individuals' overall attitude towards physical activity is determined by the subjective values of the behaviour's attributes that interact with the perceived likelihood that these attributes will occur (Ajzen, 2001). In summary, an individual's attitude represents an expectancy-value summary evaluation of a particular health-enhancing behaviour in such attribute dimensions as good-bad, harmful-beneficial, pleasant-unpleasant, and likable-dislikable (Ajzen, 2001). In the context of the theory of planned behaviour, attitudes are an overall evaluation of behaviour, and are not just concerned with outcomes.

The transtheoretical model posits that behaviour change follows a series of stages when initiating a health-enhancing behaviour: pre-contemplation, contemplation, preparation, action, and maintenance (Prochaska et al., 1992). Within the transtheoretical model, physical activity judgements correspond to the decisional balance construct, which involves the weighing of perceived pros and cons of physical activity behaviour, with a positive balance leading to a greater likelihood that individuals will be physically active (Velicer et al., 1985). When applied specifically to physical-activity, pros on the decisional balance have included enhanced

confidence, feeling good about oneself, and having more energy for one's family and friends, whereas cons have included being too tired to exercise, being concerned about bad weather, feeling uncomfortable and out of breath, and not having enough time (Marcus, Rakowski, & Rossi, 1992). The distinguishing feature of the decisional balance approach, compared to other social-cognitive models, is the relative-weighting of importance of potential positive and negative outcomes, rather than just the expectation of those outcomes (Williams et al., 2005).

Although not traditionally considered a social cognitive model, within the physical activity context self-determination theory has been suggested to be complementary with other social-cognitive models, such as self-efficacy theory and the theory of planned behaviour (Haggar & Chatzisarantis, 2009; Sweet, Fortier, Strachan, & Blanchard, 2012). Organismic integration theory is a sub-theory of self-determination theory that posits that motivation is best understood as a continuum of regulations (or reasons to participate in physical activity) that vary based on the degree of self-determination (i.e., the degree to which the behavior is volitional, such that the reasons motivating participation are perceived to be personally important and valuable; Ryan & Deci, 2000). Physical activity judgments can be best understood in self-determination theory through these differing regulations. Specifically, these regulations range on a continuum of amotivation (i.e., no desire or intention to participate in physical activity), external (i.e., participation in physical activity to achieve an external reward or to avoid punishment), introjected (i.e., participation in physical activity to avoid shame or guilt, or to enhance ego or pride), identified (i.e., participation in physical activity due to personally accepting the value, usefulness, or importance of the behaviour), integrated (i.e., participation in physical activity to obtain benefits that are in line with core values and beliefs), and intrinsic

(i.e., participation in physical activity based on an inherent interest, enjoyment, or satisfaction) reasons for initiating behaviour.

Recently, theoretical advances have been made to extend some of these models in terms of the multi-dimensionality of these physical activity judgments (e.g., Lawton et al., 2009; Lowe et al., 2002; Nasuti & Rhodes, 2013; Rhodes et al., 2009). For example, within self-efficacy theory, outcome expectations have been subdivided into affective (e.g. expecting to feel good after exercise) and health-related (e.g. expecting better health through exercise) outcome expectations (Gellert, Ziegelmann, & Schwarzer, 2012). Further attempts have been made to differentiate between affective and instrumental attitudes within the theory of planned behaviour (e.g., Rhodes, Blanchard, & Matheson, 2006; Rhodes & Courneya, 2003). Specifically, instrumental attitudes, which reflect judgements regarding the utility of a given behavior (e.g., important-unimportant) have been differentiated from affective attitudes, which reflect judgments about the overall pleasure/displeasure, enjoyment, and feeling states expected from the target behaviour. Further, the multidimensionality of physical activity judgments is also illustrated within the organismic integration sub-theory of self-determination theory. Specifically, motives for engaging in physical activity behaviour that are more intrinsically regulated could be considered as being more affective in nature (e.g., fun, enjoyable), whereas more externally motivated behaviours can be considered to be more instrumental in nature (e.g., to stay fit or healthy).

In consideration of the various conceptualization of physical activity judgements across health-behaviour theories, in line with previous research (Rhodes et al, 2009; Nasuti & Rhodes, 2013) for the purposes of this study *affective judgments* were operationalized as judgments about the overall pleasure/displeasure, enjoyment, and feeling states expected from being physically

active, including future affective expectations (e.g., physical activity would be enjoyable), affective judgments of past physical activity performances (e.g., physical activity was pleasurable) and the affective experience associated with physical activity (e.g., physical activity makes me happy). In contrast, *instrumental judgements* were operationalized as judgments about the overall benefits/harm, utility, and value expected from being physically active, including future instrumental expectations (e.g., physical activity will help me focus better), instrumental judgments of past physical activity performances (e.g., physical activity helped me lose weight), along with the instrumental experiences associated with current physical activity (e.g., physical activity is good for me). The importance the multi-dimensionality of physical activity judgments in predicting motivation and behaviour is described below.

The Predictive Utility of Affective Versus Instrumental Judgements

Research regarding the distinction between affective and instrumental judgements is a relatively recent topic in the physical activity literature. For example, in a meta-analysis conducted by Rhodes et al. (2009) 90% of studies examined were post year-2000 studies. However, despite the relatively recent attention directed to this topic there is strong evidence that emphasizes the importance of this distinction. For example, results from a meta-analytic review suggest that affective judgements can be considered an independent physical activity predictor, with a summary *r* of .42 (constituting a medium to large effect size) that is robust across theoretical frameworks, measures employed, study quality, population samples and cultural variables (Rhodes et al., 2009). The distinctiveness and predictive power of affective judgements has been found across psychometric, correlational and experimental studies.

Psychometric evidence illustrates that affective and instrumental judgements are distinct constructs (French et al., 2005; Rhodes, Blanchard, & Matheson, 2006; Rhodes & Courneya,

2003). For example, in a population of university students, modelling separate affective and instrumental attitude constructs explained an additional 28% of average item variability compared to modelling a single attitude construct (Rhodes et al., 2006). Furthermore, the two factor model explained an additional 5% of physical activity behaviour than the single attitude factor (Rhodes et al., 2006). These finding have also been supported in general adult populations (aged 35-75 years) where separate instrumental and affective attitude factors provided the best fit to these data compared to a single attitude factor (French et al. 2005).

The majority of evidence for this affective-instrumental distinction comes from observational and correlational data. When examining associations with physical activity intentions, measures of affective attitudes are consistently better predictors than measures of instrumental attitudes (Lawton et al., 2009; Lowe, Eves, Carroll, 2002; French et al., 2005; Richardson, Trafimow, & Madson, 2012). For example, cross-sectional evidence suggests that affective judgements can contribute upwards of 23-29% of the unique variance of intention after controlling for instrumental judgments (Trafimow et al., 2004). These effects remain relatively consistent across studies, with the magnitude of effects being in the medium-large range when predicting intention.

In prospective, longitudinal studies there are also notable differences between the effects of affective and instrumental judgements, as positive changes in affective judgements are more strongly associated with positive changes in physical activity behaviour than instrumental judgements (Rhodes & Pfaeffli, 2010). Moreover, affective attitudes remain significant predictors of physical activity intentions and behaviour for up to 6 months (Lowe et al., 2002). One proposed reason for why affective judgements are able to predict physical activity over time is that intention stability (i.e., the intention–intention relationship) is largely predicted by the

degree to which an individual bases his or her intentions on affective judgements (Keer, Conner, Van den Putte, & Neijens., 2013). Furthermore, the intention–behaviour relationship has been found to be mediated by intention stability (Keer, et al., 2013).

A recent meta-analysis by Rhodes and colleagues (2009) found that affective judgements were better predictors (r =.42) of physical activity behaviours than health-related judgements (r =.25). The effect size for affective judgements was comparable in magnitude to self-efficacy, which is commonly regarded as one of the largest and most reliable correlates of physical activity, and was larger than the effects of the built environment, social, socio-demographic or personality variables found in prior meta-analyses (Rhodes et al., 2009). Other meta-analytic data, using an Action Control framework to predict physical activity, found that successful intenders had higher affective attitudes than unsuccessful intenders, whereas instrumental attitudes could not explain differences between these two groups of individuals (Rhodes & de Bruijn, 2013).

Another notable finding in the literature is that intention is an insufficient mediator of affective evaluations in the exercise domain (Rhodes et al., 2006). Affective attitudes remain a significant predictor of behaviour even after controlling for intention, which suggests that they have additional direct effects on behaviour, unmediated by intentions (Conner, Rhodes, Morris, McEachan, & Lawton, 2011; Lawton et al., 2009). Moreover, it has also been recently suggested that affective attitudes are better predictors of physical activity behaviour than intention (Rhodes & de Bruijn, 2013).

As evidenced above, there is a wealth of research supporting affective judgements as being a valuable predictor of physical activity behaviour; however, evidence is lacking for research examining causal relationships between these constructs. To date, there are only a few

studies that attempt to manipulate the affective or instrumental dimension of an individual's judgements regarding physical activity behaviours. Although there is only preliminary evidence, experimental studies also seem to support the trends found in observational research. In particular, an affective message was more effective than either an instrumental message or a no-message control in increasing levels of self-reported exercise behaviour in two independent studies (Conner, et al., 2011). The evidence for affective messaging was also supported in a sample of inactive adolescents, whereby those who received text-messages about the affective experience of physical activity increased their physical activity more than those receiving messages about the potential health benefits (instrumental benefits; Sirriyeh, Lawton, & Ward, 2010). Finally, in a recent study the manipulation of affective associations with fruits significantly influenced participants' snack choice behaviour, whereby the odds of participants in the positive affective prompting condition selecting a healthy snack was 2.41 times greater than the odds of participants in the neutral condition (Walsh & Kiviniemi, 2014). These findings provide preliminary support for causal relationships between affective judgements and behaviour, which accordingly has implications for targeting affective judgements in health behaviour interventions (Conner et al., 2011; Sirriyeh et al., 2010; Walsh & Kiviniemi, 2014).

This cognitive-instrumental and affective-emotional distinction has been studied extensively in cognitive neuroscience. According to the Somatic Marker Hypothesis, there exist two distinct neural pathways in decision making (Bechara, 2005). The first is a fast and efficient, emotional pathway, referred to as the "hot" pathway, whereas the other is a slower, more deliberate cognitive/rational path, referred to as the "cold" pathway (see Bechara, 2005 for a detailed discussion). When making decisions the "hot" emotional pathway serves as a "cognitive shorthand," allowing people to make decisions more quickly and efficiently (Kiviniemi, Voss-

Humke & Seifert, 2007). That is, emotional/affective influences can guide the decision making process by signaling decision choices without an individual having to rationally work through the instrumental judgements each time a decision is made (Kiviniemi et al., 2007). This evidence further points to the dominance of affective states in guiding decision making.

Further evidence for the dominance of affect from cognitive neuroscience comes from the area of episodic memory. Episodic memory is a special class of memory system that allows one to remember his/her own experiences in an explicit and conscious manner (Tulving & Markowitsch, 1998). It has been well established that for episodic memory, encoding and retrieval for emotionally-valenced experiences is better than for emotionally-neutral experiences (e.g., Stratton, 1919). Further neuroimaging studies have also demonstrated that emotional memories are associated with greater activation of the amygdala and hippocampus, two structures related to the processing of memory, compared to neutral memories (e.g., Richardson, Strange , & Dolan, 2004). As expectations about a given behaviour are usually based on past experiences (Oettingen, 2012), it stands to reason that affective judgements may have a stronger influence on physical activity because they will be more readily accessible than neutrally-valenced instrumental judgements.

In summary, this evidence demonstrates that affective judgements are distinct from instrumental judgements and are better able to predict and explain physical activity behaviour than more rational, instrumental approaches. This trend has been examined across diverse theoretical and methodological perspectives, and all findings seem to converge on a similar conclusion. In consequence, affective judgements are recommended to be an valuable target in the development of physical activity interventions (Rhodes & de Bruijn , 2013).

Combining Affective Judgements with Mental Contrasting

As alluded to earlier, mental contrasting self-regulatory interventions that look to target affective judgements have the potential to foster the improved adoption and maintenance of physical activity behaviour. Increasing the salience of personal, valued, affective judgements (e.g., enjoyment, pleasure, satisfaction), and increasing self-regulatory skills are suggested to be two of the most effective physical activity intervention components (Rhodes & Pfaeffli, 2010). Combining affective judgments and mental contrasting (through contrasting the positive and negative affective experiences of engaging in physical activity) could strengthen the expectations of the feasibility and desirability of participants' goals, thus strengthening their goal commitment. Two primary reasons this is suggested are, (1) by having participants focus on affect, participants will be imagining relatively immediate, outcomes and obstacles associated with engaging in exercise, and (2) considering both affective outcomes and obstacles, through mental contrasting, will attenuate the impact of expectancy-violations (i.e., the actual results of being physically active not meeting previously anticipated expectations) and typical problems that people have in predicting how they will feel in the future (e.g. affective forecasting errors).

Affective outcomes strengthen mental contrasting based on immediate positive and negative factors. As affective judgements of physical activity are more influential in intention formation and predicting behaviour than instrumental judgements (e.g., Lowe et al., 2002), within the context of a mental contrasting intervention the outcomes or obstacles that will have the most pronounced impact on physical activity behaviour should be affective in nature. The influence of affective attitudes appears to be strongest for those behaviours that have a more immediate impact on one's emotional/physiological state (Lawton et al., 2009). One reason this may exist is due to the strong confounds between the affective–instrumental, positive–negative

and the proximal–distal dimensions of physical activity judgements (Williams, 2010). In general, the affective consequences of engaging in physical activity are experienced in the short term, whereas most instrumental consequences are experienced in the long term (Rhodes & Conner, 2010; Keer et al., 2013). Similarly, positive and negative outcomes can be proximal, but there are few, if any, negative distal outcomes of physical activity (Rhodes & Conner, 2010; Williams et al., 2005). Personal affective and instrumental obstacles, such as lack of time, tiredness, muscle soreness and dislike for exercise, are temporally proximal and, have been suggested to be more likely to discourage physical activity (Williams et al., 2005). Similarly, more proximal positive outcomes, such as enjoyment, are more likely to influence physical activity in adults than more distal positive outcomes such as conceiving the potential health benefits associated with physical activity (Williams et al., 2005). Further support for the importance of proximal and distal physical activity judgements comes from a recent study, whereby both the affective-instrumental, and proximal-distal dimensions of physical activity messages were manipulated (Morris, Lawton, McEachan, Hurling, & Conner, 2016). In this study, it was found that participants had higher self-reported physical activity behaviour, compared to baseline, in the group that received a proximal affective message, compared to a distal affective message.

Many health-relevant decisions, such as when to exercise, have long-term consequences and so, ideally, should be made on the basis of long-term preferences (Loewenstein, 2005). However, individuals do not often engage in behaviour that is most adaptive from a cost–benefit perspective (Kahneman & Tversky, 1979; Kiviniemi et al., 2007; Loewenstein, 2005). Temporal discounting is a well-established bias in human decision making that demonstrates that individuals typically prefer immediate rewards over a delayed reward of an equal or greater amount (Ainslie, 1975). Instrumental, health or appearance benefits of physical activity tend to

only occur after repeated performance of the behaviour and are consequently distal in time and, therefore, may not be strong enough to overcome the immediate costs (Keer et al., 2013; Williams et al., 2005). One the other hand, affective outcomes are largely experienced immediately or shortly after engaging in physical activity. Therefore, individuals who base their intentions to perform physical activity on positive affect, thus anticipating such immediate experiences, will find it easier to follow through on intentions, as they are more likely to be instantly rewarded, in the sense that they immediately experience the affective outcomes which led them to intend to perform the behaviour (Keer et al., 2013; Klusmann, Musculus, Sproesser & Renner, 2016; Kwan & Bryan, 2010). This idea has been supported in recent work, whereby the fulfillment of expectations about the positive affective outcomes of physical activity contributed to successfully increasing physical activity over the course of a year (Klusmann et al., 2016). Furthermore, intentions that are strongly based on positive affect are more temporally stable than those that are weakly based on affect; in a recent study, positive affect-intention correlations remained overtime whereas instrumental-intention correlations declined (Keer et al., 2013; Richardson et al., 2012).

As evidence shows affective judgements, but not instrumental judgements, may be able to bind people to their intentions, it has been recommended to target affect in interventions aimed at strengthening the intention–behaviour relationship (Keer et al., 2013). Mental contrasting is one such strategy aimed at strengthening these intentions/goal-commitments. By anticipating and fantasizing about the short-term, affective experiences associated with physical activity, rather than long-term health benefits, it is possible for participants to anticipate immediate gratification for being physically active, which is hypothesized to lead to increases in goal-desirability, and

in-turn goal-commitment, thus increasing the likelihood that those intentions are actually translated into behaviour.

Mental Contrasting may also help resolve the discrepancy over whether negative or positive valenced emotions bolster intentions and behaviour. Many social-cognitive models have attempted to discern whether positively or negatively valenced emotions are better predictors of physical activity behaviour, with mixed findings. Some evidence suggests that anticipated positive, not negative, emotions at baseline predicted future physical activity adoption and maintenance among initially inactive individuals (Dunton & Vaughan, 2008). Other correlational evidence supports the notion that the association between positive affect and physical activity is the best predictor of individuals' self-reported activity behaviour (Kiviniemi, et al., 2007). Finally, in a sample of younger adults, positive affective beliefs in particular, were found to be more important predictors of behaviour than beliefs about the negative feelings one might experience (Lawton, Conner & Parker, 2007). In contrast, other negative affective judgements (e.g., anticipated regret) have been suggested to be the strongest predictor of both health-related intentions and behaviours (Abraham & Sheeran, 2004; Conner, Godin, Sheeran, & Germain, 2013). However, rather than choosing between focusing on either positive or negative outcomes, both can be combined into a single intervention. Interventions targeting positive affective beliefs (e.g., fun, accomplishment, stress relief) with a secondary focus on overcoming negative affective beliefs (e.g., guilt, pain) has been suggested as an effective means of increasing physical activity behaviour (Rhodes & Conner, 2010). Moreover it has been argued that if both the positive and negative affective beliefs are considered, then instrumental beliefs (positive or negative) would yield little value (Rhodes & Conner, 2010).

Mental contrasting helps overcome innate biases of affective forecasting and outcome violations. Regardless of whether they are affective or instrumental in nature, research in social cognitive theory has demonstrated that physical activity judgments (i.e., outcome expectancies) play a larger role in the initiation of physical activity, rather than the maintenance of these behaviours (Williams et al., 2005). Initially high positive outcome expectancies may increase physical activity adoption but may undermine behavioural maintenance if perceived satisfaction with actual outcomes falls short of expected outcomes (Williams et al., 2005). Specifically, when individuals do not get what they expected, the value of the behaviour is reduced, and thus individuals may disengage from physical activity behaviour when faced with competing goals, and/or limited resources (e.g., time, mental/physical effort; Klusmann et al., 2016). It has been suggested that expectancy-violations are better predictors of long-term exercise maintenance than outcome expectancies because outcome expectancies are based only on predictions about future behaviour, whereas expectancy violations include both predictions about future behaviour and actual experiences (Sears & Stanton, 2001). Moreover, individuals generally have unrealistic initial expectations regarding the amount, speed, and ease of change, associated with engaging in physical activity (Polivy & Herman, 2002). Additionally, individuals overestimate the effects that exercising will have on other aspects of one's life (Polivy & Herman, 2002). That is, people often have unrealistic goals regarding how much they can change, they believe they will change more quickly and more easily than is possible, and they believe that making a change will improve their lives more than can reasonably be expected (Polivy & Herman, 2002). These "false-hope beliefs" are particularly prevalent in populations who are insufficiently active, as they have less experience engaging in physical activity (Polivy & Herman, 2002).

Individuals who consider affective outcomes of behaviour are not immune to the impacts of expectancy-violations. In the existing literature on anticipating affective outcomes, it has been suggested that the emotions individuals imagine are often quite different from those that actually occur (Wilson, Wheatley, Meyers, Gilbert, & Axsom, 2000). It has been suggested that humans are inherently biased at representing future events (Gilbert & Wilson, 2007). In an area of research known as *affective forecasting*, it has been demonstrated that individuals overestimate the intensity and duration of their emotional reactions to events, known as the *impact bias* and *durability bias* respectively (Wilson & Gilbert, 2005).

These errors in prediction are hypothesized to occur in situations known as "cold-to-hot" empathy gaps whereby individuals have difficulties anticipating the influence of emotional "hot" states when they are in a "cold" rational, state (Loewenstein, 2005). One suggested reason this occurs is that individuals tend to "zoom in" on a target event, imagining the event largely in isolation from its broader context (Kushlev & Dunn, 2011). Also known as focalism, individuals envision a target emotional event while ignoring the important contextual factors that may moderate/mitigate its emotional impact (Gilbert & Wilson, 2007; Wilson et al., 2000). Specifically, these contextual factors can trigger affective reactions that compete with or nullify the consequences of the anticipated emotion (Wilson et al., 2000). For example, if an individual anticipates that an hour of physical activity will leave her feeling stress-free, she may fail to consider the impact of work-deadlines, interpersonal problems or other stressors. Instead, within the context of the situation it may be more realistic to anticipate the contingency between exercise and mood management (i.e., feeling less-stressed but not absolved of all stress, Kwan & Bryan, 2010).

Despite these reported biases, others suggest that although people may not be completely accurate in their predictions of future emotions, they are reliable in their ability to anticipate their affective reactions (Brown & McConnell, 2011). Additionally, there is evidence to suggest that the impact of focalism and related biases can be attenuated by encouraging individuals to adopt a broader perspective (Wilson et al., 2000; Ruby, Dunn, Perrino, Gillis, & Viel, 2011). By spreading people's attention to both the positive *and* the negative aspects of the workout, researchers have improved participants' intentions and behaviour across university and private gyms, as well as across group and individual exercise (Ruby et al., 2011). In the study by Ruby et al. (2011) improvements were seen in intention to engage in both moderate and challenging workouts, which ranged from yoga and Pilates to aerobic exercise and weight training.

In summary, it has been shown that spreading people's attention to aspects of an experience that they typically overlook can reduce forecasting biases (Ruby et al., 2011; Wilson et al., 2000). Based on its consideration of both obstacles and outcomes, mental contrasting is a self-regulatory intervention that can be harnessed to spread individuals' attention to the positive and negative affective aspects of being physically active. Mental contrasting functions by creating realistic expectations by anticipating the positive benefits of an activity, but also acknowledging negative obstacles that could interfere with the net satisfaction of goal achievement.

Changes in Affective Judgements as a Mediator of the effects of an Affective Mental Contrasting Intervention

As established in the preceding section mental contrasting and affective judgements appear to be complementary approaches to increase physical activity behaviour. Nevertheless, at

present there are no studies that have tried to test the complementarity of these approaches. In order to discern causal conclusions, it is recommended that intervention research should specify the constructs that are hypothesized to affect behaviour, measure these constructs before and after the intervention has been applied, and conduct mediation analyses to determine whether these constructs may have served as the vehicles of change (MacKinnon, Fairchild, & Fritz, 2007; Weinstein, 2007). Accordingly, it was predicted that the affective mental contrasting intervention would function by changing participants' affective judgements about physical activity, and thus influence physical activity behaviour.

For both practical and methodological reasons researchers have stressed the importance of assessing mediation in intervention research (Bauman, Sallis, Dzewaltowski, & Owen, 2002; MacKinnon, et al, 2007; Rhodes & Pfaeffli, 2010; Weinstein, 2007). First, mediation analysis provides a check on whether the intervention produced a change in the construct it was designed to change, sometimes referred to as an action theory link (Mackinnon et al., 2007; Rhodes & Pfaeffli, 2010). Accordingly, mediation analysis results may suggest that certain intervention components need to be strengthened or measurements need to be improved (Mackinnon et al., 2007). For example, if the affective mental contrasting intervention fails to significantly change affective judgments either the intervention was ineffective or the measures of affective judgments were inadequate. Second, mediation analysis tests whether the proposed mediating variable affects the outcome, known as a conceptual theory test (Rhodes & Pfaeffli, 2010). For example, if an affective mental contrasting intervention produces changes in affective judgments, without influencing physical activity, it may suggest that intervention effects on physical activity may emerge later or that the affective judgements are not critical in changing physical activity (Mackinnon et al., 2007). Finally, and most importantly, mediation analysis generates evidence

for how interventions achieved their effects (Mackinnon et al., 2007). Identification of the critical variables can streamline and improve physical activity interventions by focusing on effective components (Mackinnon et al., 2007).

Given the paucity of experimental research manipulating participants' affective judgements, there are even fewer studies that conduct formal mediation analyses (Rhodes & Pfaeffli, 2010). The literature that does exist, however, suggests that changes in affective judgements can mediate the effects of physical activity interventions. In a study on the impact of affective versus instrumental messages, affective attitudes directly impacted physical activity behaviour rather than being mediated by intention (Conner et al., 2011). Furthermore, the effect of the affective message intervention was partially mediated by affective attitudes and was replicated in two separate studies (Conner et al., 2011).

Purpose and Hypotheses

Mental contrasting interventions and affective judgments have shown strong evidence of predictive utility across different demographics and contexts; however, research has yet to be done to combine these two complementary approaches. Interventions aimed at improving the appraisal of affective physical activity judgments among undergraduate students are suggested to be useful for increasing physical activity behaviour (Conner et al., 2013; Lawton et al., 2009; Rhodes, Blanchard, & Matheson, 2006). Accordingly, the affective-instrumental distinction suggested by several social cognitive models was manipulated in the current experimental study.

Specifically, the overall purpose of this thesis was to compare an affective mental contrasting intervention with an instrumental mental contrasting intervention and a standard mental contrasting intervention in relation to changes in accelerometry and self-reported exercise behaviour among a sample of inactive, female, undergraduate students. Based on the primacy of affective judgments in predicting the motivation and performance of physical activity behaviour (e.g. Conner et al., 2011; Rhodes et al., 2009), it was hypothesized that participants in the affective mental contrasting intervention condition would display improved adoption and maintenance of physical activity relative to those in the instrumental and standard mental contrasting intervention conditions ***(Hypothesis 1)***.

It has been suggested that the assessment of mediating variables, such as affective judgements, in intervention studies may provide the basis for further insights into how best to change these variables and assess their causal impact on health-enhancing behaviour change (Conner, 2010). There currently exists only limited evidence from affective judgement type constructs as mediators, therefore more work is required in this area (Rhodes & Pfaeffli, 2010). Accordingly, three different variants of the mental contrasting intervention (affective,

instrumental, and standard) were operationalized to see how they influenced affective and instrumental judgements and how changes in these judgements predicted undergraduate students' physical activity behaviour. It was anticipated that the affective mental contrasting intervention would be associated with changes in affective judgments regarding physical activity; however, no changes in affective judgements were expected in the standard and instrumental comparison conditions ***(Hypothesis 2)***. Furthermore, it was hypothesized that changes in affective judgements would mediate the effects of the affective mental contrasting in relation to physical activity behaviour ***(Hypothesis 3)***. Moreover, it was anticipated that changes in instrumental judgments in any of the three experimental conditions would not influence physical activity behaviour ***(Hypothesis 4)***.

Generally, in previous elicitation studies physical activity judgments differed systematically depending on whether they were elicited using affective or instrumental prompts (Bellows-Ricken et al., 2013; French et al., 2005; Sutton et al., 2003). However, it has also been demonstrated that questions posed to elicit affective judgements, may reflect a mixture of both affective and instrumental judgements (Bellows-Ricken et al., 2013). Similarly, it is also possible that questions posed to elicit instrumental judgments could elicit judgments that are more affective in nature. Accordingly, concurrent with testing quantitative indicators of the efficacy of this intervention, qualitative open ended questions explored to what extent participants' responses to their respective mental contrasting intervention aligned with the condition to which participants were randomly assigned ***(Qualitative Research Question 1)****?*

Finally, previous elicitation studies have not differentiated between active and inactive individuals when eliciting positive and negative physical activity judgments (Bellows-Ricken et al., 2013; French et al., 2005; Sutton et al., 2003; Symons Downs, & Hausenblas, 2005).

Moreover, in previous elicitation materials, questions have either been followed by five lines (numbered 1 to 5) for participants to write in their responses (French et al., 2005; Sutton et al., 2003), or participants have not been given a limit to the number of judgments they could list (Bellows-Ricken et al., 2013). This form of elicitation is useful for identifying a variety of different judgments; however it is limited in understanding the context of a given judgment, or what participants' specifically anticipate when they refer to a particular outcome or obstacle. Accordingly, by asking participants to focus on one positive outcome and negative obstacle, as well as having them provide detailed elaboration on their outcomes and obstacles (through the use of the Mental Contrasting activity), it was anticipated that this elaboration would facilitate a clearer understanding of the personal meaning of outcomes and obstacles identified by participants. Further, in response to previously highlighted limitations (Bellows-Ricken et al., 2013) mental contrasting interventions are conducted in a one-on-one setting with a researcher, rather than through a questionnaire. This method of elicitation allows the researcher to probe individuals to provide further explanation if warranted. Thus, building on the work of previous elicitation studies (Bellows-Ricken et al., 2013; French et al., 2005; Sutton et al., 2003; Symons Downs, & Hausenblas, 2005), the secondary purpose of the qualitative component of this study was to use a mental contrasting intervention to elicit affective and instrumental judgements related to physical activity participation, to determine what are the most common outcomes and obstacles to physical activity identified by inactive, female, undergraduate students ***(Qualitative Research Question 2)***, as well as to explore new judgments not otherwise highlighted in previous research.

Method

Research Design

Traditionally, within the field of health psychology the type of methods used varies as a function of the research question being addressed. Specifically, quantitative methods are typically used to address research questions concerned with understanding causality, generalizability, or the magnitude of effects, whereas qualitative methodologies are more often applied to develop a theory (particularly when there is a lack of knowledge of a given phenomenon), or to describe the nature of an individual's experience and the meanings he/she makes of that experience (Fetters, Curry, & Creswell, 2013). Alternatively, mixed-methods research draws upon the strengths of both quantitative and qualitative approaches. Fetters and colleagues (2013) suggest that the integration of qualitative and quantitative data can "dramatically enhance" (p. 2135) the understanding of a phenomenon of interest, and that this integration can be implemented at the design, analysis, and interpretation stages of the research process.

For the purposes of this study, a *concurrent, triangulation, data transformation* mixed-methods design was employed (Creswell & Plano Clark, 2007). Each component of this complex design is disentangled below. *Concurrent* mixed methods intervention designs integrate quantitative and qualitative data collection into the study during the experiment (Creswell, Fetters, Plano Clark, & Morales, 2009). This can be contrasted with sequential designs whereby one phase of the mixed-methods study builds on the other (e.g., collecting and analysing qualitative data before an intervention in order to enhance the quality of the subsequent intervention; Cresswell et al., 2009; Fetters et al., 2013). The qualitative data that is collected during concurrent designs can serve several functions which include: (1) to expand or validate

the quantitative outcomes with qualitative data representing the voices of participants, (2) to check the manipulation and fidelity of the implementation of procedures, and (3) to identify potential mediating and moderating factors (Creswell, Shope, Plano Clark, & Green, 2006).

Within a mixed-methods framework, a *triangulation* design involves collecting both quantitative and qualitative data and then merging the results for a comprehensive understanding of the research problem (Creswell et al., 2009; Creswell & Plano Clark, 2007). This design involves the separate collection and analysis of quantitative and qualitative data sets (see Triangulation in Figure 1a.). Within the context of the present study, triangulation was achieved through conducting a qualitative content analysis regarding participants' physical activity judgments, in addition to the quantitative measures, and then the results were integrated in the discussion for a comprehensive understanding of the research problem.

In tandem, a *data-transformation* component was also embedded within the design. Within data transformation designs the researcher uses procedures to transform one data type into the other data type. Specifically, this design allows the researcher to gather qualitative data, analyze it for codes and themes according to a coding scheme, and then quantify the qualitative data by numerically counting the codes and themes (Creswell, Fetters& Ivankova, 2004). After the transformation, the data can then be integrated during the analysis stage (see Data Transformation in Figure 1b). Within the context of the present study, a data-transformation approach was followed by virtue of data collected through a content analysis being transformed into counts and then subsequently operationalized as a moderator variable in a subsequent quantitative data analysis. This integration (of both triangulation and data transformation designs) allows for qualitative data to assist in the interpretation of the intervention effects, and/or augment the results of an intervention trial (Creswell et al., 2009).

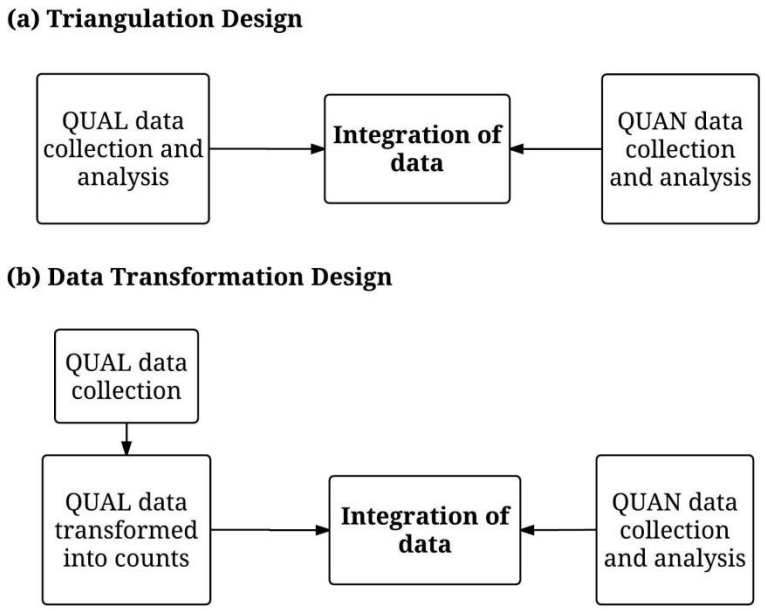

Figure 1. Mixed method intervention designs (adapted from Creswell et al., 2009)

Power Analysis

Based on previous affective/instrumental messaging studies (e.g., Conner et al., 2011; Morris et al., 2016; Sirriyeh et al., 2010), as well as meta-analytic evidence regarding the strength of affective judgements (Rhodes et al., 2009; Nasuti & Rhodes, 2013) medium to large effect sizes have been reported. As such, an *a priori* power analysis, for an ANCOVA with one covariate, using a medium effect size (f = .30, α = .05, 1-β = .80), was conducted prior to recruitment and necessitated that a sample of 111 participants was required to address my primary research question.

Participants

This study involved a sample of 110 female undergraduates from The University of British Columbia (UBC; Mean age = 20.56 years, SD = 2.48). Participants were eligible to participate in the study if they were female, UBC undergraduate students, fluent in English, and were insufficiently active (i.e., engage in moderate-vigorous intensity physical activity for less than 30 minutes, less than three times a week). The screening process also included the online completion of the Physical Activity Readiness Questionnaire for Everyone (PAR-Q+; Bredin, Gledhill, Jamnik, & Warburton, 2013). If participants did not pass the PAR-Q+ they were automatically redirected to the Electronic Physical Activity Readiness Medical Examination (ePARmed-x+; Bredin et al., 2013). If participants did not pass the ePARmed-x+ they were required to obtain their physician's approval before proceeding with the study. All participants completed, and passed, the PAR-Q+. The demographic characteristics of the eligible participants in this sample, including age, year of study, living situation, and hours of commitment in school, work and volunteering, are displayed in Table 1. Overall, the sample was predominantly in their first year of university (52.7%), living on residence (53.6%), unemployed (65.5%), and did not volunteer (60.0%). Baseline comparisons of demographic characteristics were performed using univariate analysis of variance for continuous variables and χ^2 analyses for categorical variables, with no significant differences found between groups.

Table 1

Participant demographic information (N = 110).

	Affect	Instrumental	Standard	Total
Participants	37	36	37	110
Age [*M* (*SD*)]	20.22 (2.24)	20.25 (1.79)	21.21 (3.14)	20.56 (2.48)
Year of Study				
1	21 (56.8%)	19(52.8%)	18(48.6%)	58 (52.7%)
2	7 (18.9%)	7(19.4%)	3 (8.1%)	17(15.5%)
3	4 (10.8%)	7(19.4%)	6(16.2%)	17(15.5%)
4	4(10.8%)%)	1(2.8%)	4 (10.8%)	9 (8.2%)
≥5	1 (2.7%)	2 (5.6%)	6(16.2%)	9 (8.2%)
Living Situation [*n*(%)]				
Residence	21 (56.8%)	18 (50.0%)	20 (54.1%)	59 (53.6%)
Off Campus (Family)	8 (21.6%)	10 (27.8%)	9(24.3%)	27 (24.5%)
Off Campus (Roommates)	5 (13.5%)	7 (19.4%)	6 (16.2%)	18 (16.4%)
Off Campus (Alone)	3 (8.1%)	1 (2.8%)	2 (5.4%)	6 (5.5%)
Hours of Class [*M* (*SD*)]	17.15 (7.95)	15.32 (6.94)	15.53 (6.79)	16.11 (6.92)
Working [*n*(%)]	11 (29.7%)	18 (50.0%)	9 (24.3%)	38 (34.5%)
Hours of Work [*M* (*SD*)]	4.03 (7.65)	5.86 (8.56)	3.76 (8.60)	4.54 (8.26)
Volunteering [*n*(%)]	16(43.2%)	14 (38.9%)	14 (37.8%)	44 (40.0%)
Hours of Volunteering [*M* (*SD*)]	1.93 (3.65)	1.86 (2.98)	1.81 (2.89)	1.87(3.17)

Procedure

Before conducting the study, ethical approval from The University of British Columbia's Behavioural Research Ethics Board was obtained (#H14-02120). Further, this trial was registered with ClinicalTrials.gov (#NCT02615821). Participant recruitment and data collection took place from November 2014 to October 2015. Recruitment was conducted in the form of flyers placed around a university campus and residences, announcements in introductory lectures, information

booths in student residences and through social media. Students were encouraged to email the researcher if they wanted to participate in the study, and as an incentive were offered $15 for their participation. Upon their response to recruitment, participants were briefed about the study through email, and a letter of information was attached for them to review (see Appendix A). After participants read the letter of information, individuals were asked to contact the researcher to arrange a mutually convenient time to come in for the initial lab visit if they wished to participate. After participants were recruited they were randomly allocated to groups according to a computer-generated randomization list. Participants were allocated to one of three groups: (1) mental contrasting intervention with affective prompting, (2) mental contrasting with instrumental prompting, or a (3) standard mental contrasting with no prompting.

Timeline. During this intervention participants were asked to come into the lab at three time-points; once to provide baseline measurements one week before the intervention, once to complete the intervention component of the research, and once to return the accelerometer, complete post-test measures, and receive compensation following the intervention (4-weeks after the intervention). These in-person contacts took approximately 15 minutes, 45 minutes and 15 minutes respectively, cumulating in 1.25 hours of participants' time.

During their initial lab visit participants first went through oral and written informed consent with the researcher. Then, participants completed a series of questionnaires in one of the laboratory's private interview rooms. These questionnaires included demographic information which was completed first, then the physical activity questionnaire, and last, the measures regarding participants' cognitive and affective judgements about physical activity (See Appendix B). After the questionnaires were completed, participants met with the researcher to receive (1) their accelerometer, with oral instructions regarding how to use it, and (2) a validated physical

activity log (Ainsworth et al., 2000; Conway et al., 2002) to track when the accelerometer was worn and record participants' daily activities. During the second visit (and all subsequent interactions) participants were reminded that participation was voluntary and that they could withdraw at any time. Procedures regarding participants' second lab visit are elaborated in greater detail below. During their final lab visit, participants first completed the physical activity questionnaire, followed by measures of participants' cognitive and affective judgements about physical activity. Following the completion of the questionnaires, participants returned their accelerometer in exchange for compensation ($15). Finally, participants were fully debriefed about the purposes of the experiment and the three conditions operationalized within the study.

Between contact sessions participants were asked to wear their accelerometer as per protocols addressed below and were encouraged to practice their respective mental contrasting technique weekly (see below).

Flow of participants through the intervention. Figure 2 shows the flow of participants through the intervention following the Consolidated Standards of Reporting Trial (CONSORT) guidelines (Schulz, Altman, Moher, & the CONSORT group, 2010). Retention for this study was 91.0% (100 of 110). Five participants completed baseline measures, however did not complete the mental contrasting intervention to which they were allocated. Five participants were lost to follow-up. Little's (1988) chi-square test was performed to assess any discernable pattern of missingness in the data. The results from the test indicated that the data were MCAR (Missing Completely at Random), X^2 (36) = 27.503, p = .844.

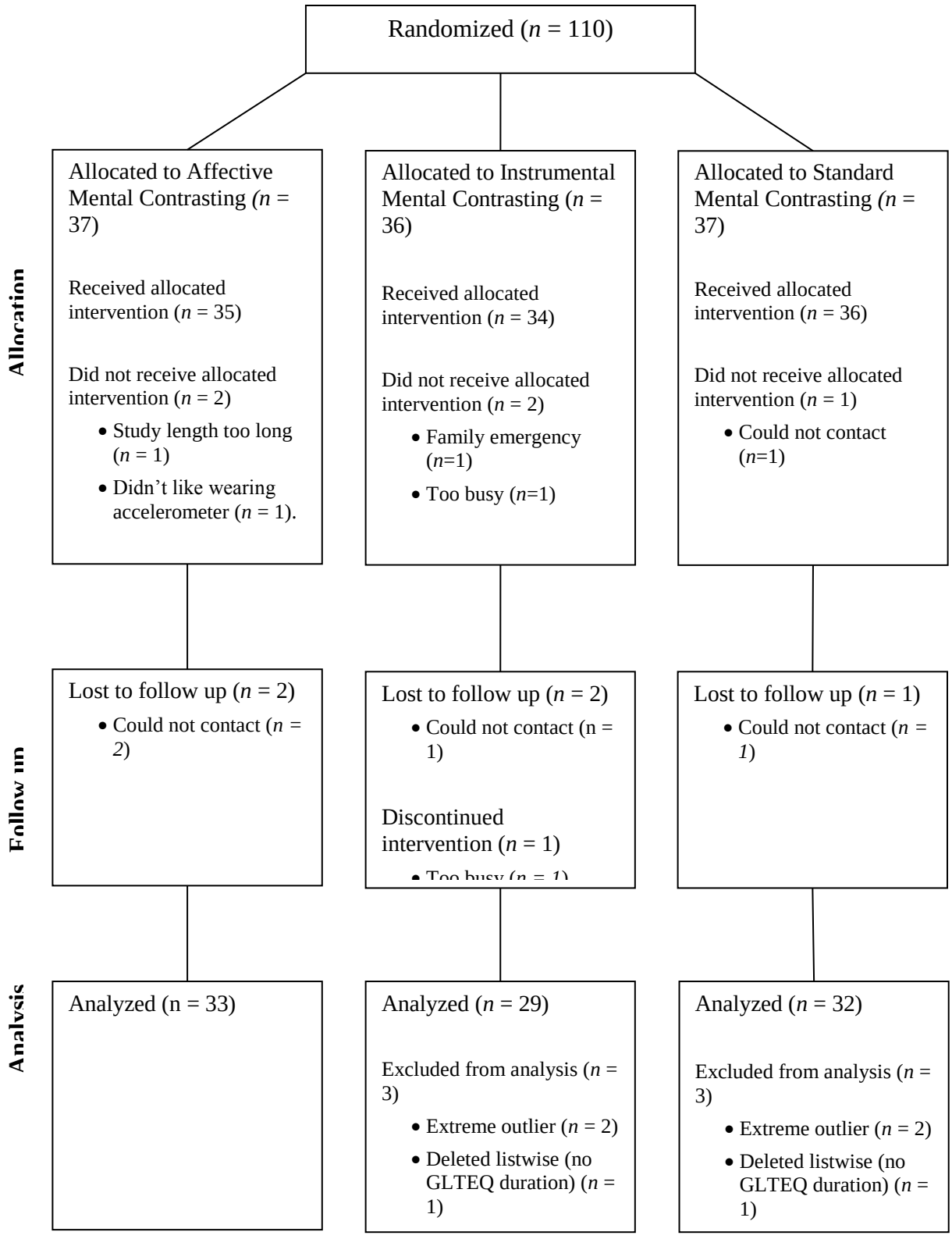

Figure 2. Participant flow chart following CONSORT guidelines.

Intervention. Using procedures adapted from Stadler et al. (2009) and Adriaanse et al. (2010), the Mental Contrasting intervention occurred between female students and a female researcher in one-on-one sessions. During the intervention session, participants learnt and then applied their respective mental contrasting technique using a combination of print-materials and verbal instructions from the researcher. The print-materials consisted of a five-page booklet that contained (a) an exercise prescription, (b) a prompt, and (c) the mental contrasting intervention.

Exercise prescription and prompting. The first two pages of the booklet consisted of information adapted from Bray et al.'s (2011) university transition physical activity brochure (see Appendices C, D, and E). These pages provided basic information related to Canada's physical activity guidelines (Tremblay et al., 2011) and also provided examples of strategies to help participants engage in physical activity during university. Specifically, on this first page, it was explained to participants that adults aged 18-64 years should accumulate at least 150 minutes of moderate-to-vigorous intensity aerobic physical activity per week, in bouts of 10 minutes or more (Tremblay et al., 2011). Specific examples of activities that corresponded to vigorous (e.g., basketball, aerobics, ultimate Frisbee), moderate (e.g., brisk walking, bicycling, skating, rollerblading), and light (e.g., walking, bowling, golf) intensities (based on the 2011 Compendium of Physical Activities; Ainsworth et al., 2011) were also given to participants (Bray et al., 2011). These examples were presented using both text and a contemporary, coloured brochure in order to make the information more visually appealing to the students. On the top-half of the second page of the brochure, specific strategies were given to participants regarding how physical activity could be incorporated into a typical day at school, at home, and while commuting (Bray et al., 2011).

The bottom-half of the second page of the brochure differed depending on the condition to which participants were randomly assigned. In the standard mental contrasting intervention condition, this space was left empty and the exercise prescription and aforementioned examples served as an attention control (see Appendix C; Freedland, Mohr, Davidson, & Schwartz, 2011). In the affective mental contrasting and instrumental mental contrasting interventions this space was used to prompt participants to consider either the affective or instrumental outcomes associated with engaging in physical activity, using procedures adapted from Conner et al. (2011).

Previous research illustrates that messages can be used to target either instrumental or affective beliefs about physical activity (Conner et al., 2011). In the affective mental contrasting condition, participants received information about affective judgements related to exercising (e.g. regular physical activity has been shown to reduce stress, physical activity is enjoyable), and related research support including appropriate references (see Appendix D). In the instrumental message condition, participants received information about the instrumental benefits of exercising (e.g., regular physical activity reduces the risk of developing cancer; regular physical activity prevents osteoporosis, physical activity is an effective weight control strategy) and related research support, again including appropriate references (Conner et al., 2011; see Appendix E).

Goal formation. After reading the exercise prescription and their respective prompt, on the next page of the booklet participants were told that their goal for the next four weeks was to meet the aforementioned physical activity guidelines. Using the preceding examples given in the exercise prescription information, participants worked with the researcher to refine their goal with activities they believed were relevant to them and that they believed were realistic to

achieve. After naming their physical activity goal, participants answered two questions that served as a manipulation check to test whether their goals were both desirable and feasible for them. First, participants were asked about their expectations of achieving their goal ("*Within the next four weeks, how likely is it that you will increase your physical activity to the extent you just indicated*?"; Stadler et al., 2009). Second, participants were asked about the importance of increasing their physical activity ("*Within the next four weeks, how important is it to you to increase your physical activity to the extent you just indicated*?"; Stadler et al., 2009). Responses to both items could range from 1 (not at all) to 7 (very much).

Mental Contrasting. During the mental contrasting component of the intervention (Oettingen, 2012) participants were asked by the researcher to consider the best outcome associated with engaging in physical activity, as well as the biggest obstacle they might encounter while attempting to reach their physical activity goal. In all conditions participants were taught the mental contrasting technique as follows. After being reminded of their goal for the upcoming four weeks, participants were prompted by the researcher to write down responses to two questions on the fourth page of their physical activity booklet. The first question asked participants to name the most positive outcome of realizing their goal (e.g., feeling more awake during classes, weight loss). The second question asked participants to name the most critical obstacle (e.g., feeling tired, rain) to reaching their goal (Adriaanse et al., 2010; Stadler et al., 2009).

While completing the mental contrasting questions regarding the outcomes and obstacles of physical activity, generally the wording remained similar between the standard, instrumental and affective conditions. In the standard condition, the prompts that were used matched previous mental contrasting interventions (Adriaanse et al., 2010; Stadler et al., 2009). The two prompts

were 3-5 sentences in length and asked participants to name and elaborate upon their obstacles and outcomes (See Appendix C, D, E). In the affective and instrumental conditions the prompts remained the same as the standard condition, with minor variations in the questions in order to elicit either instrumental or affective judgements (Bellows-Riecken, et al., 2013; Sutton et al., 2003; see Appendices 3, 4, 5). Specifically, the affective mental contrasting condition included the additional prompts *"Why might you find exercise to be enjoyable, pleasant, exciting, or fun?"* for eliciting outcomes, and "*Why might you find exercise to be unenjoyable, unpleasant, boring, or miserable?"* for eliciting obstacles (Bellows-Riecken, et al., 2013). In contrast, the instrumental mental contrasting condition included the prompts *"Why might you find exercise to be useful, advantageous, beneficial, or important?"* for eliciting outcomes, and *"Why might you find exercise to be unimportant, useless, inconvenient, or detrimental?"* for eliciting obstacles (Bellows-Riecken, et al., 2013).

Diary. At the end of the intervention session participants were told that they would be e-mailed a link every Sunday evening that could be used to practice the self-regulation technique over the next four weeks (Adriaanse et al., 2010; Stadler et al., 2009). The weekly mental contrasting diary was completed through a web-based local server (http://edudata.educ.ubc.ca/site/home/). The weekly diary consisted of the same instructions given during the lab visit for their respective mental contrasting intervention. The difference was that each week participants were prompted to complete a goal for the upcoming week, rather than for the next 4-weeks (as per the initial lab visit). A reminder e-mail was sent out each week with a link to the diary website.

Measures

Affective and Instrumental Judgements. Although affective judgments are conceptualized within multiple theories, affective and instrumental attitude measurements from the theory of planned behaviour were used in the current study. This was chosen because these measures have been frequently used in the population of interest (e.g., Conner et al., 2011, Courneya et al., 2006; Rhodes & Blanchard, 2006; Rhodes & Conner, 2010; Rhodes et al., 2007) and participants' responses to these measures have demonstrated acceptable variability, as well as acceptable discriminant validity. Additionally, adequate internal consistency has been demonstrated, with previous alpha coefficients for the responses to scales ranging from 0.78 to 0.89 for instrumental attitudes and from 0.85 to 0.93 for affective attitudes (Courneya et al., 2006). Using measures adapted from Conner et al. (2011) instrumental and affective attitudes towards participants' physical activity goals were measured using 7-point semantic differential scales (Ajzen, 2002). Five items were used to tap instrumental judgements (e.g. 'For me, engaging in moderate to vigorous aerobic physical activity for at least 150 minutes a week for the next 6 weeks would be': *useless–useful; unimportant–important; worthless–valuable; not worthwhile–worthwhile; harmful–beneficial*), and five items were used to tap affective judgements (e.g. 'For me, engaging in moderate to vigorous aerobic physical activity for at least 150 minutes a week for the next 6 weeks would be': *unsatisfying–satisfying; unpleasant–pleasant; unenjoyable–enjoyable; boring–exciting; calming-stressful*). A composite score was computed for instrumental and affective measures respectively. In this study, the responses to the affective and instrumental judgment measures demonstrated acceptable reliability, with $\alpha = .865$ and $\alpha = .840$ respectively.

Self-reported Physical Activity. Self-reported MVPA was measured using a modified version of the Leisure Score Index (LSI; Courneya, Jones, Rhodes, & Blanchard, 2004) that has been applied to Godin's Leisure Time Exercise Questionnaire (GLTEQ; Godin & Shepard, 1985). Specifically, participants were asked to report the average number of times per week in the last seven days they had engaged in strenuous (heart beats rapidly, sweating), moderate (not exhausting, light perspiration), and mild (minimal effort, no perspiration) physical activity. Participants also specified the average duration of exercise bouts (minimum of 10 minutes per bout) for each of the three levels of intensity. Despite being interested only in exercise of at least a moderate intensity, the mild intensity category was included so that participants did not "bump up" their mild intensity exercise into the moderate intensity category (Courneya et al., 2004). Total MVPA minutes per week were calculated by multiplying the frequency of exercise bouts (for the moderate and strenuous categories) by the average duration of an exercise bout for the given intensity category. The reliability and validity of measures derived from the LSI have been independently evaluated and found to compare reasonably to nine other measures of objective and self-reported physical activity (Jacobs, Ainsworth, Hartman, & Lean, 1993). Specifically, responses to the LSI have displayed a 1-month test-retest reliability of 0.62 and concurrent validity coefficients (age-sex adjusted correlations) of 0.32 with an accelerometer and 0.56 with maximal oxygen consumption (Jacobs et al., 1993).

Finally, a total metabolic equivalent of task (MET) score was computed by multiplying the weekly minutes of moderate intensity by 4.0 and weekly minutes of strenuous exercise by 7.5, and summing these values together (Brown & Bauman, 2000; Liebreich, Plotnikoff, Courneya, & Boulé, 2009; Plotnikoff et al., 2006). This weighting was done because previous research has demonstrated that, on average, one minute of vigorous physical activity is

equivalent to 1.875 min of moderate activity (7.5/4.0; Brown and Bauman, 2000; Plotnikoff et al., 2006).

Accelerometry. Participants wore an ActiGraph GT3X accelerometer (ActiGraph, LLC, Pensacola, FL) as an objective index of physical activity. The Actigraph accelerometer has been found to be both reliable (intraclass correlation coefficient = 0.97, coefficient of variation= 5.8%, McClain, Sisson, & Tudor-Locke, 2007) and valid (r = 0.85, r = .48, Welk, Blair, Wood, Jones, & Thompson, 2000) when compared with a metabolic cart on a treadmill and in the field respectively. Although as few as 3 and 5 days of monitoring are typically required to reliably estimate physical activity in adult samples, due to inconsistencies in the recommended duration of measurement, a standard 7-day accelerometry monitoring protocol (Trost, McIver, & Pate, 2005; Ward, Evenson, Vaughn, Rodgers, & Troiano, 2005) was used. These measurements were taken at three time periods; baseline, the week immediately following the intervention, and at four-week follow-up. In order to minimize the number of times participants were required to come into the lab, the accelerometry data for both the week immediately following the intervention and the four week follow-up were collected during the participants' third in-lab appointment.

Participants were instructed verbally and via standardized written instructions to start wearing the accelerometer on waking each day, to wear it throughout the day and to remove it on going to bed at night. Participants also removed the accelerometer during participation in water sports, showering and bathing. Accelerometers were asked to be worn close to the body's center of mass, standardized on the hip (Trost, et al., 2005). To calculate moderate to vigorous physical activity, the monitor was programmed to store data at 15 second intervals and was later converted to average counts per minute. Additional considerations for accelerometry data

processing were: (1) data were included as a valid day if the participant wore the accelerometer for at least 10 hours of the day (Trost et al., 2005), and (2) the Freedson equation (Freedson, Melanson, & Sirard, 1998) was used to compute cut-points for light, moderate, and vigorous activities.

As a means to promote compliance, participants also completed three, one-week, physical activity logs corresponding to the three accelerometry periods (see Appendix F). In these logs, participants recorded the time the monitor was worn and removed, in addition to recording all activities performed with or without the monitor. The seven-page physical activity log (a page for each day) contained 29 items per day (including light, moderate, and vigorous intensity activities) organized into transportation, conditioning, sports, and leisure activities (Ainsworth et al., 2000; Conway, Seale, Jacobs, Irwin, & Ainsworth, 2002). Additional spaces were provided for participants to write down any activities not listed. Every evening, participants circled the activities they performed that day and wrote down for each its duration (hours and minutes of actual movement) and the approximate time they began the respective activity that day (Ainsworth et al., 2000). The use of a log-book does not appear to add to the accuracy of estimates from accelerometer data (i.e., results in more misclassification of zeroes, greater underestimation of wear time, and lower precision of physical activity estimates; Peeters, van Gellecum, Ryde, Farías, & Brown, 2013), and accordingly was not used as an additional physical activity measure. To further promote compliance, reminder emails were sent to prompt participants to wear their accelerometer and to complete their physical activity log during the three accelerometry measurement periods, and monetary incentives ($15) were provided for participants (Trost et al., 2005).

Results

Qualitative Analyses

Reponses to the open-ended outcome and obstacle questions from the mental contrasting intervention were transcribed, and categorized by randomization and question. Coding was done by hand, rather than using qualitative software given the small amount of transcribed data. Initially, the data were deductively analyzed (using a directed content analytic approach; Hsieh & Shannon, 2005) in which responses that reflected instrumental and affective judgments were coded with specific reference to previous elicitation studies (Bellows-Riecken et al., 2013; French et al, 2005; Rhodes & Conner, 2010; Sutton et al., 2003; Symons-Downs & Hausenblas, 2005). Specifically, existing theory and prior research were used to develop the initial coding scheme prior to beginning data analysis (Hsieh & Shannon, 2005). Next, in order to identify and categorize all instances of affective and instrumental judgments transcripts were read and all passages were highlighted that on first impression appeared to represent positive or negative physical activity judgments. Following that, all possible highlighted passages were coded using the predetermined codes. In addition to this deductive coding (aligning responses within the dichotomization of instrumental and affective judgements), new higher- and lower-order themes within those judgments, were allowed to inductively emerge (using conventional content analysis; Hsieh & Shannon, 2005) and were collated into common themes. Moreover, when deciding how to categories new themes, the existent literature was referenced wherever possible.

Once the coding scheme was refined to reflect these new themes and categories, the data were iteratively collated and refined to maximize internal homogeneity and external heterogeneity (Braun & Clarke, 2006). That is to say, themes were aggregated when there was an overlap in content, or expanded in order to create themes that were internally cohesive and

mutually exclusive. Following the development of the final coding scheme, a peer-review process was employed whereby a second coder then independently analyzed the data to determine the alignment of the responses with the coding scheme. Although there was high initial agreement (91.4%), discrepancies were discussed to refine the themes and coding rules. All disagreements regarding what theme a response should be categorized to were resolved through discussion.

Frequency counts of the responses associated with each code were then tabulated, yielding a total number of responses for each theme. Each participant could contribute only one outcome and one obstacle count for a given theme. For example, in the quote "After exercising, I feel more *calm*, can breathe more deeply, am *no longer thinking about stressful things* like schoolwork" would only be coded once under the *Stress Release* theme. Additionally, themes were only created when a judgement was represented across two or more participants. This was done to provide an overall representation of the most salient themes. This approach is consistent with Miles and Huberman (1994) who suggested that researchers identify recurring themes and "lay aside the more tenuous ones until other informants and observations give them better empirical grounding" (p. 70).

Emergent Physical Activity Judgement Themes.

The data analytic procedures resulted in the identification of three types of physical activity judgments. These included affective and instrumental judgments which were conceptualized *a priori*, as well as a third type of judgment that emerged which was defined as 'unclassifiable judgements'. Each of these three types of judgments included both positive outcome judgments and negative obstacle judgments. Accordingly, all of the emergent lower-order themes regarding participants' physical activity judgments were categorized into one of the

following higher-order themes: (1) *affective outcome judgments*, (2*) affective obstacle judgments*, (3) *instrumental outcome judgments*, (4) *instrumental obstacle judgments*, (5) *unclassifiable outcome judgments* and (6) *unclassifiable obstacle judgments*. The frequency counts of these judgments, and their respective lower-order themes, are displayed in Table 2. For the purposes of discussion, the number of participants who mentioned a particular lower-order theme will be discussed regardless of their assigned condition, however a partitioning of the frequency counts by experimental condition is provided in Table 2.

Table 2

Frequency of emergent outcomes and obstacles discussed across conditions

	Number of Participants				Initial Agreement Rate
	Affect	Instrumental	Standard	Total	
Affect					
Positive Outcome					
Stress-Relief	22	10	5	37	100%
Invigorating	17	5	2	24	96.00%
Esteem	11	3	6	20	90.91%
General Positive Affect	11	2	4	17	100%
Enjoyment	7	2	1	10	100%
Social Involvement	6	2	0	8	100%
Negative Obstacle					
Stressful	14	2	5	21	100%
Unenjoyable	8	3	7	18	95.23%
Guilt	14	0	1	15	100%
Physical Discomfort	3	1	1	5	100%
Fear	3	1	1	5	100%
Lacking Esteem	3	2	0	5	100%
General Negative Affect	2	0	1	3	100%

	Number of Participants				Initial Agreement Rate
	Affect	Instrumental	Standard	Total	
Instrumental					
Positive Outcome					
Increased Efficiency	8	18	19	45	100%
General Health	2	16	15	33	97.06%
Improved Fitness	2	12	14	28	100%
Develop Healthy Lifestyle	2	12	9	23	100%
Encourage Other Healthy Habits	3	6	11	20	100%
Injury/Disease Prevention	1	8	7	16	100%
Improved Ability (PA)	1	6	7	14	100%
Weight/Appearance	3	3	7	13	100%
Improved Mental Health	1	1	3	5	100%
Socially Desirable	1	1	2	4	80%
Other	0	2	0	2	100%
Negative Obstacle					
School	7	18	19	44	NEW
Time Management	10	13	9	32	68.08%
Other Priorities	2	12	9	23	47.92%
Inconvenient	3	10	3	16	100%
Exercise Conditions	2	4	6	12	100%
No Results/Incentives	3	4	3	10	100%
Difficulty Developing Habit	1	4	4	9	100%
Interferes with Sleep	0	4	2	6	66.67%
Social Conflicts/Distractions	0	3	2	5	100%
Unclassifiable					
Positive Outcome					
Energy	3	7	9	17	100%
Avoiding Negative Emotions	6	3	3	12	100%
Pursuit of Happiness	1	5	5	11	100%
Contingent Esteem	3	5	3	11	84.62%
Stress Resilience	0	4	2	6	100%
Increased Motivation	1	2	2	5	NEW
Change of Pace	2	0	1	3	NEW
Negative Obstacle					
Lack of motivation	9	12	16	37	100%
Exhaustion	11	4	7	22	100%
Lack of Social Support	2	1	1	4	100%
Total	211	233	234	676	
Agreement rate over all 676 codes					91.4%

Note. "NEW" refers to lower-order themes that emerged after discussion with the second coder.

Affective outcome judgments. Six lower-order themes were subsumed within the affective outcome judgment higher-order theme (See Table 2). The most common affective outcome lower-order theme was *Stress-Relief,* which was identified by 37 participants. This theme included descriptions of participants feeling more relaxed, using physical activity as a means to vent, or as a distraction/escape from stress. For example, one participant described, "I see myself jogging around an empty block cold air surrounding me while fast/upbeat music rushes through my ears. I'm only focusing on my breathing, the beat, and my footsteps. Everything I worry about is left at the door until I come back home and need to deal with it". Similarly, another participant explained, "when I exercise (especially when I play an intense game of badminton or run hard) I don't have to think very much. It is kind of like meditation where I can just push all the negative thoughts out of my mind and not think about my grade, careers, and other 'dark' stuff".

Invigorating was the second most common affective outcome judgment identified, being described by 24 participants. This theme included descriptions of physiological and/or emotional sensations associated with having more energy or being more mentally alert, during or immediately following physical activity. For example, one participant noted, "I love how when I work out and am active I have more energy. I feel like I smile more often and more genuinely, I can appreciate little things around me like nice weather or a happy song and having more energy directly relates to my work ethic and how I perform at school. When I think of energy I think of bright colours escaping in every direction and brightness to life." The next judgement, identified by 20 participants was that physical activity brought about feelings of *Esteem*. This esteem theme included descriptions of how physical activity contributed to improving participants' perceptions of their self-esteem, including feelings of mastery, improved body image, or feelings

of accomplishment that occurred during or following exercise. For example, one participant explained “When I have completed a dance class or a work out I feel relieved and happy because I achieved a goal I set for myself. I also feel over all good because I know that I spent the past hour doing something that is good and proactive rather than spending that hour sitting down and playing on my phone or staring into space. I also feel accomplished because I am taking control of my wellbeing…when it comes to dance classes I am proud of myself that I am pushing through and improving my skills. When the class is over I walk out of the studio feeling great because I learned something new and didn't give up when it got difficult."

The final three themes identified in this higher-order theme were *General Positive Affect, Enjoyment, and Social Involvement,* described by 17, 10 and 8 participants respectively. General positive affect included descriptions of how participants would “feel better”, “happier”, or have “an improved mood” *immediately following* physical activity. Similarly, enjoyment described the inherent fun and enjoyment that participants experienced *during* physical activity, as well as specific aspects of physical activity that participants enjoy (e.g., getting out into nature). Finally, the social involvement theme reflected participants’ perceptions that physical activity established or strengthened social connections, by emphasizing notions such as “having fun with friends” and “building friendships.”

Affective obstacle judgments. Seven lower-order themes were subsumed within the affective obstacle judgment higher-order theme (See Table 2). The most common affective obstacle, identified by 21 participants, was that physical activity was *Stressful*. This theme also included feelings that physical activity led participants to being frustrated or overwhelmed. These sensations of stress were commonly associated with a perceived lack of time or difficulty balancing multiple demands. For example, one participant explained “not having adequate and

ample time to be active stress[es] me out. As someone who is easily stressed, when I work out and can't enjoy myself I feel as if I am not benefitting from a work out as I normally should be. I hate being on a machine or out running and having a constantly check the time to make sure I'm not late or behind in my day. If I am pressed for time I find I get into a cycle of rushing, not being prepared and still constantly feeling stressed throughout the rest of the day." Similarly, another participant described "the idea that I wouldn't be able to focus on exercising when I'm stressed about homework and feeling even more stressed while exercising".

Eighteen participants associated physical activity with being something that is *Unenjoyable*. This included common evaluations of participants finding physical activity to be something that it is "boring", not liking the activity, or an obligation that had to be "endured", as well as participants citing previous negative experiences or burnout as the reason that they did not enjoy physical activity. A final idea that emerged under the unenjoyable lower-order theme was that physical activity was relatively unenjoyable, in which participants compared physical activity to other activities that they judged to be "more appealing". For example, one participant indicated that she "want[ed] to spend my free time doing something I enjoy rather than working out".

Fifteen participants described *Guilt* as an affective obstacle to being more physically active. This sensation commonly occurred when managing multiple demands, such as family or school. With regards to family demands, one participant explained "when it comes to guilt, I know I have many things to do or my family needs help with something so it feels like I should spend my time more wisely and be with my family, or play with my dog, hang out with friends, be with my boyfriend, or all those different little things I should want to do in my time outside of work or studying than wanting to exercise". An example of where school was the source of guilt

was illustrated when another participant explained, "most of the time, I do feel guilty because sometimes when there is such a huge workload that day or there is an assignment that the due date is just few hours away, its hard to actually encounter that feeling. So, when I did the exercise I would feel bad because I have to sacrifice my study time in order to be able to go to the gym".

The final four lower-order themes were *Physical Discomfort, Fear, Lacking Esteem,* and *General Negative Affect*, identified by 5, 5, 5, and 3, participants respectively. Physical discomfort referred to physical sensations that acted as an obstacle for physical activity, such as pain, soreness, injury, intensity, feeling cold/wet, or hot/sweaty. Fear was a unique theme that emerged, which included fear of falling behind in school, fear of missing out on something while exercising, or safety concerns. For example, one participant explained that she was afraid of "exercising outdoors at night for fear of assault". Lack of esteem included a feeling of being judged by others, negatively critiquing themselves, or being self-conscious. Finally, general negative affect, included responses that couldn't be classified into the remaining themes, such as being "emotionally sad".

Instrumental outcome judgments. Ten distinct themes emerged in the instrumental outcome judgments higher-order theme (See Table 2). The most common instrumental outcome judgment identified was *Increased Efficiency or Productivity*. This theme included a variety of cognitive benefits (such as better memory or ability to focus), better time management, and an overall ability to aid in schoolwork and/or daily errands/chores. For example, one participant believed that being physically active "influences my day to day tasks and improves concentration. As a result I would be more efficient in everything I engage in." Similarly,

another participant commented that by being physically active she would experience "having more things to do in a day [which will] make me manage my time better and more efficiently."

General Health was the second most common instrumental outcome, which was identified by 33 participants. This theme included participants' judgments that physical activity would lead them to have better "overall health" or "feel collectively healthier." Twenty-five participants indicated that *Improved Fitness* would be an outcome that they associate with being physically active. This theme included a myriad of fitness benefits such as, increasing muscle tone, increasing flexibility, getting stronger, or increased endurance/stamina. Twenty-three participants identified *Adopting a Long-Term Physical Activity Habit/Lifestyle* as an outcome that was important to them. For example, one participant indicated that it would be beneficial to "form good exercise habits now for the future", and another participant thought that being physically active now "promotes long-term exercise plans". On a similar, but distinct note, twenty-one participants indicated that a positive outcome associated with being more physically active was that it would *Encourage Other Healthy Habits*. These healthy habits included increasing/decreasing their appetites, eating healthier, snacking less, and/or improving their sleep quality/quantity. For example, one participant thought physical activity would "probably help my sleep schedule become consistent" while another indicated "when I'm more physically active I'm more inclined to eat healthier."

In the *Disease/Injury Prevention or Management* theme, twenty-one participants mentioned a decreased risk of disease, managing a pre-existing condition, rehabilitating from a previous injury, or living longer. Many of the participants identified what could be considered typical responses to this theme (e.g., "I will be at decreased risk for heart disease and other illnesses later in life"); however, a unique sub-theme emerged within this lower-order theme

which was *Managing Mental Health*. In this sub-theme, five participants identified physical activity as a means to manage a clinically diagnosed condition, such as depression or anxiety. For example one participant noted "my psychiatrist recommended me to exercise more to help with my depression".

The remaining four lower-order themes were (1) *Improved Ability (specific to physical activity),* (2) *Weight Management/ Improved Appearance,* (3) *Socially Desirable* or (4) *Other*. For improving ability at specific physical activities (identified by 14 participants), exemplar responses included, "increasing the likelihood of running a marathon within 5-7 years", "I can go hiking on more intense terrain" or a "shorter time on the Grouse Grind" (a well-known hiking trail). In the weight management/improved appearance theme (identified by 13 participants), responses were included if they concerned topics such as "weight loss", "avoiding the freshmen 15", "clothes fitting better", or "looking more attractive". On the other hand, the socially desirable theme (identified by four participants) was less concerned about physical appearance, but rather participants believed being physically active was a valued/desirable characteristic in society. For example, one participant wanted to show "other people that I'm just not about academics, but rather I can be sporty too", and another thought being physically active was a good "conv[ersation] starter, [that could] help with [her] career". The *Other* lower-order theme included two unique responses, which could not be classified into any of the above themes, but were worth highlighting. One participant identified safety as being the best outcome that she associated with being physically active, predicting she would be able to "outrun an attacker" or during natural disasters she could "flee quickly even with obstacles in the way." In the second unique response, a participant cited saving money as a valued outcome of being physically active, which she associated as a consequence of being healthier.

Instrumental obstacle judgments. Nine themes comprised the instrumental obstacle judgments higher-order theme (See Table 2). The most common instrumental obstacle judgment, cited by 44 participants was *School*. The School theme was not originally coded as a lower-order theme, a but rather emerged after discussion with the second coder, as responses within this theme had previously been subdivided between the *Time Management* and *Other Priorities* themes. However, it was agreed that the previous subdivision created redundancy between themes. Accordingly, elements that were included in this theme consisted of references to class/homework/studying taking precedence over all other activities (particularly at exams/midterms), heavy time involvement based on class schedule/study time, and the potential of physical activity to negatively impact school performance. For example, one participant stated "too little time [because] exams, papers, deadlines must be met [therefore] exercising not longer [sic] a priority". Similarly, another participant explained "when I have been studying for a long time, I often think that I should take and break and get some exercise like go for a walk or go to yoga but then I look at my to do list and often see that I won't have time to get school work done". When participants cited school as an obstacle, it was also sometimes described as something to accept, rather than overcome. For example one participant explained "although school may seem like the obstacle holding me back from exercise and a social life, it is the main reason why I am at UBC."

The revised *Time Management* theme included responses for 32 participants, and was distinct from the *School* theme as it was largely focused on problems with time management or procrastination. For example, one participant noted that the reason she was not physically active was that "I lose track of time; hence, I missed out on a yoga session or working out in the gym before it closes." Similarly, another participant commented on how procrastination was a

problem because “I often end up procrastinating for the same about of time that I could have been exercising, which gives me even less time to exercise.” Similarly, the revised *Other Priorities* theme (cited by 23 participants) was also distinct from the *School* theme as participants either made vague comments about other priorities, such as “being in a situation to do something else instead of the physical activity”, or cited other priorities such as work, errands or other plans as taking precedence over physical activity. This is highlighted in the quote “[my] job [is] time consuming [so I] often feel need to complete other errands or spend time [with] friends rather than work[out] when I have time off.”

Inconvenience was another theme that emerged (cited by 16 participants). In this theme participants described aspects such as lacking access to facilities (too far from facility, facility hours, lacking transportation), the inconvenience of active transportation, or how physical activity interferes with their daily routine. For example, one participant noted “car transport [is] more convenient/faster than walking/biking to supermarket”. Other participants described physical activity becoming “an ‘event’ that doesn’t fit into my day because of having to change clothing, getting all sweaty and having to be somewhere right afterward” or that they were “going out of my way to exercise.” Finally, another participant described how her preferred physical activity facility was “too far away from home. I have to bus 40 min to get there.”

The theme of *Exercise Conditions*, cited by 12 participants, described conditions such as weather, hours of daylight, or problems with their chosen physical activity facilities as reasons for not exercising. For example, one participant described “I work out at home and doing various stretches/exercises require[s] more room. Sometimes I’d have to wait for family members to clear out (go to work/school) before I can lay out my mat.” In the *No Results/Incentives* theme ten participants described either how the benefits of physical activity are too far into the future or

how they would not be rewarded for being physically active because they engaged in other unhealthy habits (e.g., binge eating, smoking, drinking) that would attenuate the health-enhancing effects of physical activity. For example one participant stated "to get into healthy lifestyle, it is a constant and long term goal, no[t] something that can be achieved in just one week. [I have trouble] getting over that 'short term pain, long term gain' mindset" whereas another participant indicated that "smoking makes me feel like achieving a healthy and happy body is impossible". Alternatively, participants described how there was no one/nothing holding them accountable to a physical activity goal or a general lack of incentives. A similar theme, identified by nine participants was *Difficultly Maintaining a Habit*. In this theme participants described struggles involved with getting into a physical activity habit or routine, which usually involved forgetting to do the activity. For example, it was explained by one participant that "often times, I do not exercise because I do not think of it", while another participant anticipated "difficulty getting into a habit; forgetting to do an activity."

Interfering with Sleep was a unique theme that emerged whereby participants explained how physical activity was something that could have a detrimental effect on their overall sleep quality/quantify (particularly when exercising at night). For example, it was explained by one participant that "since exercising at night is usually not the most ideal (people tell me that there are scientific findings that shows night-time exercise…can be detrimental to the quality of subsequent sleep received), this means that I will have to find time in my mornings or afternoons to exercise," similarly another participant expressed that she had "concern about not being able to fall asleep so [I] skip scheduled exercise at night time." The final instrumental obstacle that emerged (identified by five participants) was the *Social Conflicts* theme. This theme inductively emerged, and was coded, when participants mentioned family members or friends actively

preventing participants from being physically active. For example, one participant explained "my parents would prefer me to stay at home instead", while another wrote about "being convinced not to be physically active by a friend/someone to do something else".

Unclassifiable outcome judgments. During the data coding and analysis, a third type of physical activity judgments emerged. Specifically, when responses did not clearly align with either affective or instrumental judgments they were coded as *Unclassifiable* judgements. Within the unclassifiable outcome judgments higher-order theme there were two distinct response patterns. The first response pattern, entitled 'insufficient information', corresponded to a set of lower-order themes that after discussion with the second coder, and consulting the relevant literature, provided insufficient information to definitively categorize the given response as being instrumental or affective in nature. The second response pattern, entitled 'instrumental-affective', corresponded to lower-order themes that were both instrumental and affective in nature , as affective states were anticipated as a distal consequence of meeting an instrumental goal.

Within the 'insufficient information' pattern of responses *Energy* was the most commonly identified unclassifiable outcome associated with being more physically active, identified by 17 participants. *Energy* was differentiated from the *Invigorating* lower-order theme within affective outcome judgments as it was a more diffuse description of global, long-term energy levels, such as "waking up with more energy", "being more energetic in life". Furthermore, within this theme the expected increase in energy was not specifically attributable to being physically active, but rather was a distal outcome anticipated as a result of an instrumental outcome such as improved health or improved sleep quality. The final two lower-order themes within the 'insufficient information' response pattern, were that physical activity lead to *Increased Motivation* (cited by five participants), and was a *Change of Pace* (cited by

three participants). Responses within the increased motivation theme described how physical activity improved global motivation levels (i.e., "increased motivation" not specific to any activity), or that being physically active would motivate future physical activity. For example, one participant explained how being physically active would help "maintain enthusiasm for future physical activity." With regards to the change of pace theme, participants described how physical activity was, for example, "a switch of activities to help focus on schoolwork," or that it "adds variety to my daily activities". On the basis that both coders were unable to differentiate between whether variety was being discussed as a description of the utility of physical activity, or as something that participants found to be enjoyable these responses were coded as unclassifiable.

Within the second pattern of responses, entitled 'instrumental-affective', these responses were categorized as unclassifiable judgments, as opposed to affective judgements, as participants did not note anything enjoyable or pleasant about physical activity itself, but rather their speculated positive affect was a result of another instrumental outcome associated with being physically active. The first lower-order theme that reflected this type of response pattern was *Avoiding Negative Emotions* (cited by 12 participants). Within this theme, twelve participants indicated being physically active for reasons such as, feeling "less judgemental of myself", "less guilt in engaging in unhealthy eating habits", "less stress about maintaining my former fitness level", or "discard the feeling of guilt that I associated with being physically inactive". This theme was categorized as an unclassified judgment, as opposed to an affective judgement, as it seemed to mirror Ryan and Deci's (2000) introjected regulation, a type of extrinsic motivation, whereby people engage in an activity to comply with internal pressure, including the avoidance of feelings of guilt and shame. Moreover, the role of self-conscious emotions associated with

non-performance of a health-enhancing behaviour (such as anticipated regret) has been studied within theory of planned behaviour (e.g., Conner, McEachan, Taylor, O'Hara & Lawton, 2015; Conner et al., 2013). These emotions, referred to as *anticipated affective reactions*, are conceptually distinct from affective attitudes as evidenced by good discriminant validity between responses to measures of affective attitudes and anticipated affective reactions (Conner et al., 2013, 2015). In summary, since participants did not indicate that there was anything inherently enjoyable about being physically active, and instead suggested that being physically active was useful in avoiding unpleasant sensations, there was insufficient evidence to clearly categorize the theme of avoiding negative emotions with either instrumental or affective judgments.

In the *Pursuit of Happiness* theme, eleven participants described achieving happiness after first experiencing weight-loss, or better health. For example, one participant described how "after a week or so I would hope to get in a routine [and] by increasing physical activity [I] could gain a better quality of night sleep [and] feel happier and refreshed by my lifestyle choices by the end." Responses to the pursuit of happiness theme were coded as unclassified, instead of as affective outcomes, because participants were not indicating that there was anything inherently enjoyable/pleasant about being physically active, but rather that the affect was a distal outcome that they predicted they would feel after first achieving an instrumental outcome (such as improved sleep quality described above).

Contingent Esteem (also identified by 10 participants) was similar to the *Pursuit of Happiness* theme in that participants' anticipated that would have better body-image, confidence or self-esteem, after noticing a tangible change in their weight or fitness levels. For example, one participant described how she would be "happier with [her] body when there is a noticeable change" while another participant explained "cardiovascular power, strengthening core [and]

growing taller, which are my ultimate goals for doing exercises… keeping me in shape [sic], would help increase my self-confidence and self-esteem." Responses to the contingent esteem theme were coded as unclassified, instead of as affective or instrumental outcomes, as elements of both affective and instrumental judgments were evident in the responses. Specifically, the anticipated affect (i.e., improved esteem or body image) was a distal outcome that was contingent on first achieving an instrumental outcome (such as improved appearance or increased fitness described above).

Stress Resiliency was another unique theme that emerged and was identified by six participants, and was differentiated from *Stress-Relief* as it was described as a long-term outcome that was an element of an overall lifestyle change. For example one participant explained stress resiliency in the context of other health outcomes, "exercise in general increases physical health and fitness, making a variety of diseases less likely and allowing a person to endure more stress from future physically-challenging environments". In spite of both instrumental (e.g., improved health) and affective (e.g., stress-relief) elements being present in this theme, participants provided insufficient information to clearly align responses in this theme as being purely affective or purely instrumental.

Unclassifiable obstacle judgments. Three themes emerged within the unclassifiable obstacle judgments higher-order theme, *Lack of Motivation, Exhaustion*, and *Lack of Social Support*. All themes in this higher-order theme were categorized as unclassified because after discussion with the second coder, and consulting the relevant literature, participants provided insufficient information to clearly categorize the response as being either instrumental or affective in nature. The most common lower-order theme within unclassifiable obstacle judgments was *Lack of Motivation*, which was identified by 38 participants. Although there was

a lot of initial discussion regarding whether to classify this theme as an affective judgment, ultimately it was decided to leave it as unclassified, with reference to Ryan and Deci's (2000) conceptualization of amotivation. Specifically, Ryan and Deci (2000) explain that amotivation is a lack of intention or willingness to engage in physical activity. Accordingly, it is not that participants judge physical activity as being either unenjoyable or unimportant but rather it is the absence of any salient participation motives (affective or instrumental) that precludes an individual from being physically active. Generally, this theme included responses where the participant identified "laziness", "feeling unmotivated", that physical activity was "too much effort", feeling discouraged or that they were lacking the discipline required to be physically active. The second theme that was included within the unclassified obstacles higher-order theme 'insufficient information' was *Exhaustion.* Within the literature, there is a lack of consensus on how to attribute concepts such as exhaustion/ fatigue. For example, although fatigue/exhaustion is a known symptom of underlying medical/psychiatric conditions (e.g., flu, cold, anxiety, depression, chronic fatigue syndrome; Jason, Evans, Brown & Porter, 2010), it is also a symptom of lifestyle or situational factors, such as lack of sleep or stress (Jason et al., 2010), and it has also been suggested to be an 'excuse' confounded with constructs such as lack of motivation (Rhodes et al., 2014). However, in the present study participants provided insufficient information for the coders to definitely categorize these attributions as being affective or instrumental in nature. Specifically, it was not clear that participants judged physical activity as being either unenjoyable or unimportant, because participants did not describe physical activity as being exhausting, but rather they described it as a preexisting state (that could be due to other reasons unrelated to physical activity) that influenced their decision not to be physically active. For example, participants would note "exhaustion", "fatigue", "tiredness", without providing

much information regarding the source of their exhaustion. Furthermore, previous elicitation studies also could not distinguish whether these types of judgements were instrumental or affective in nature (French et al., 2005; Sutton et al., 2003). *Lack of Social Support* was the final theme to be included within the unclassifiable obstacle higher-order theme. The multidimensionality of social support has been a concept that has previously been addressed in the literature (Cohen, Mermelstein, Kamarck, & Hoberman, 1985; Siceloff, Wilson, & Van Horn, 2014). Specifically, it has been suggested that social support can been subdivided into facets such as *instrumental support* (i.e., supplying behavioral or material assistance that facilitates an individual to become more physically active), and *emotional support* (e.g., motivating or encouraging individuals to participate in physical activity; Siceloff, et al., 2014). Accordingly, after discussion with the second coder, it was determined that participants had provided insufficient information to elucidate whether this perceived lack of social support was more instrumental (i.e., lacking resources, external pressures or incentives), or affective (i.e., boring/unenjoyable) in nature. For example, one participant explained how having "no one to exercise with [lead to] no commitment", while another participant described how "I lose motivation half way through due to the fact that no one is keeping me accountable".

Adherence to the Intervention Materials

As alluded to previously, the qualitative component of the intervention was also used as a manipulation check to identify what proportion of participants elicited obstacles and outcomes that matched their randomized condition. This was done by examining the participants' responses to the outcome and obstacle questions as a whole, rather than partitioning the response into multiple lower-order themes. Specifically, despite only prompting for one obstacle and outcome, some participants explained additional physical activity judgements within their

description of their outcomes and obstacles. For example, in her description of being healthier as being the best outcome she associated with being physical active, one participant indicated that "exercising will help me feel less stressed and better about myself. I will be at decreased risk for heart disease and other illnesses later in life. I will feel more fit and capable of things like running quickly for a longer period of time in a soccer game. I'll feel more on top of things if I can accomplish my goal, and I'll be able to focus more easily on schoolwork if I don't feel restless due to a lack of exercise." As there was a mixture of affective and instrumental lower-order themes within this response, the response as a whole was coded as being unclassified, as agreed upon by both coders. When considering the responses as a whole, and not considering the separate lower-order themes, there was a high initial agreement (88.57%), and discrepancies were discussed until both coders reached consensus on the categorization of the outcomes and obstacles. Tables 3 and 4 provide the results of the manipulation check conducted on the mental contrasting intervention, for the outcomes and obstacles respectively.

Overall, a chi-square test of goodness-of-fit was performed to determine whether the patterns of responding were equivalent across randomized conditions for both outcomes and obstacles. Results of these tests indicated that, generally, more participants indicated outcomes and obstacles that aligned with their randomized condition, compared to outcomes and obstacles that did not align. For outcomes it was demonstrated that patterns of responding were not equivalent across conditions, χ^2 (4, N = 105) = 35.47, $p < .001$. Specifically, it was found that those randomized to the affective condition cited affective outcomes significantly ($p < .05$) more than instrumental or unclassifiable outcomes, and participants also cited unclassifiable outcomes significantly more than instrumental outcomes. For those randomized to the instrumental condition, participants cited significantly less affective outcomes ($p < .05$) compared to

instrumental or unclassified outcomes, however there were no significant differences between the frequencies of those who reported instrumental or unclassifiable outcomes. For those randomized to the standard mental contrasting condition the frequency of affective outcomes was significantly less ($p < .05$) than instrumental or unclassifiable outcomes, but there was no difference in the frequency of instrumental or unclassifiable outcomes.

Table 3

Frequencies (and percentages) regarding the type of outcome judgment identified in the manipulation check by randomized condition.

		Outcome Identified in the Manipulation Check			Total
		Affective	Instrumental	Unclassified	
Randomization	Affect	23_a (65.7%)	4_b (11.4%)	8_c (22.9%)	35
	Instrumental	6_a (17.6%)	19_b (55.9%)	$9_{a,b}$ (26.5%)	34
	Standard	3_a (8.3%)	24_b (66.7%)	$9_{a,b}$ (25.0%)	36
Total		32 (30.5%)	47 (44.8%)	26 (24.8%)	105

Note. Subscript letters indicate significant differences: if frequencies within a row are labelled with different subscripts, they were significantly different ($p < .05$); and if they share subscripts, they did not differ.

For obstacles it was demonstrated that patterns of responding were also not equivalent across conditions, χ^2 (4, N = 105) = 57.84, $p < .001$. Specifically, it was found that those randomized to the affective condition cited significantly more ($p < .05$) affective obstacles compared to instrumental or unclassifiable outcomes, and participants also cited unclassifiable obstacles significantly more ($p < .05$) than instrumental obstacles. For those randomized to the instrumental condition, participants cited instrumental obstacles significantly($p < .05$) more than

affective or unclassifiable outcomes, however there were no significant differences in the frequency of unclassifiable obstacles, compared to affective obstacles. For those randomized to the standard condition, the frequency of affective obstacles was significantly less ($p < .05$) than instrumental or unclassifiable outcomes, but there was no difference in the frequency of instrumental or unclassifiable outcomes.

Table 4

Frequencies (and percentages) regarding the type of obstacle judgment identified in the manipulation check by randomized condition.

		Obstacle Identified in the Manipulation Check			Total
		Affective	Instrumental	Unclassified	
Randomization	Affect	22_a (62.9%)	2_b (5.6%)	11_c (31.4%)	35
	Instrumental	1_a (2.9%)	26_b (76.5%)	7_a (20.6%)	34
	Standard	2_a (5.6%)	17_b (47.2%)	17_b (47.2%)	36
Total		31 (31.0%)	45 (35.0%)	35 (33.3%)	105

Note. Subscript letters indicate significant differences: if frequencies within a row are labelled with different subscripts, they were significantly different ($p < .05$); and if they share subscripts, they did not differ.

Although the majority of participants that cited outcomes and obstacles that were congruent with their respective experimental condition, there was also a substantive proportion of participants whose responses were incongruent with their assigned condition. With regards to outcomes, it was demonstrated that 65.7% of participants that were randomized to the affective mental contrasting intervention condition identified outcomes that were affective in nature, whereas 22.9% were coded as being unclassifiable responses and 11.4% of participant responses were coded as instrumental. The observed proportion of participants randomized to the affective

mental contrasting intervention that described outcomes that aligned with their experimental condition differed significantly from the expected proportions (i.e., all participants randomized to the affective experimental condition citing affective outcomes; two-tailed Fisher's Exact test, $p < 0.001$). With regards to obstacles, for those randomized to the affective mental contrasting condition, 62.9% of obstacles identified were affective in nature, 31.4% were unclassifiable, and 5.7% were instrumental in nature. Again, the observed proportion of participants randomized to the affective mental contrasting intervention that described obstacles that aligned with their experimental condition differed significantly from the expected proportions (i.e., all participants randomized to the affective experimental condition citing affective obstacles; two-tailed Fisher's Exact test, $p < 0.001$).

For those who were randomized to the instrumental mental contrasting condition, it was found that only 55.9% of participants' outcomes were purely instrumental in nature, 26.5% were unclassifiable, and 17.6% of outcomes identified were affective in nature. The observed proportion of participants randomized to the instrumental mental contrasting intervention that described outcomes that aligned with their experimental condition differed significantly from the expected proportions (i.e., all participants randomized to the instrumental experimental condition citing instrumental outcomes; two-tailed (Fisher's Exact test, $p < 0.001$). With regards to the obstacles mentioned by participants randomized to the instrumental mental contrasting condition, 76.5% of the obstacles identified were instrumental, 20.6% were unclassifiable and 2.9% were affective in nature. Again, the observed proportion of participants randomized to the instrumental mental contrasting intervention that described obstacles that aligned with their experimental condition differed significantly from the expected proportions (i.e., all participants randomized to

the instrumental experimental condition citing instrumental obstacles; two-tailed Fisher's Exact test, $p < 0.001$).

Finally, in the standard condition (whereby participants identified idiosyncratic obstacles and outcomes, and were not prompted) it was found that, 66.7% of participants identified instrumental outcomes, 25.0% identified unclassifiable outcomes, and 8.3% of participants identified affective outcomes. With regard to obstacles, 47.2% of participants randomized to the standard mental contrasting intervention identified unclassifiable obstacles and 47.2% of randomized participants identified instrumental obstacles, and the remaining 5.6% identified affective obstacles. Fishers exact tests were not performed for those randomized to the standard mental contrasting condition, as the nature of outcomes and obstacles were not prompted.

In summary, based on the results of the Fishers Exact tests and the Chi- Square goodness of fit analyses it was determined that although the majority of participants' responses aligned with the condition to which they were randomized (i.e., 65.7% and 55.9% for the affective and instrumental conditions respectively), a substantial proportion of participants provided responses that were incongruent with their experimental conditions. Accordingly, the congruency of participant's responses to their experimental condition was explored as a moderator in the subsequent quantitative analyses.

Quantitative Analyses

Preliminary Analyses

Data were entered into SPSS (Version 21), and screened for any potential entry errors through double-checking hard-copy questionnaires. Initial normality assumptions were assessed through examining skewness and kurtosis values for all eligible participants ($N = 110$). Both baseline and 4-week post-test, self-reported, MET minutes of physical activity variables were

extremely skewed and kurtotic. Outliers were detected through the examination of box-plots and Z-scores. Participants with a Z-score of +/- 3.29 (n = 5) were identified as potential univariate outliers (Tabachnick & Fidell, 2001). These participants were removed because their responses appeared to be atypical (e.g., three participants who passed initial inactivity screening reported over 500 minutes of MVPA at baseline, and two participants reported 580 mins and 650 minutes of MVPA respectively at 4-week post-test). As can be seen in Table 1 and Table 5, the demographics remained largely unchanged after the removal of the five participants, with the exception of the dichotomous employment measure. After the removal of outliers, significantly more participants in the instrumental mental contrasting condition reported being employed, compared to the affective and standard conditions, χ^2 (2, N = 105) = 6.72, p < .05. However, although more participants in the instrumental condition reported being employed, there were no significant differences between the three conditions in the average number of hours of employment each week (p = .428).

Table 5

Participant demographic information (N = 105)

	Affect	Instrumental	Standard	Total
Participants	37	33	35	105
Age [*M*(*SD*)]	20.22 (2.24)	20.18 (1.65)	21.23(3.22)	20.54 (2.49)
Year of Study [*n*(%)]				
1	21 (56.8%)	16(48.5.8%)	17(48.6%)	54 (51.4%)
2	7 (18.9%)	7(21.2%)	3 (8.6%)	17(16.2%)
3	4 (10.8%)	7(21.2%)	6(17.1%)	17(16.2%)
4	4(10.8%)%)	1(3.0%)	4 (11.4%)	9(8.6%)
≥5	1 (2.7%)	2 (6.1%)	5(14.3%)	8(7.6%)
Living Situation [*n*(%)]				
Residence	21 (56.8%)	15 (45.5%)	19 (54.3%)	55 (52.4%)
Off Campus (Family)	8 (21.6%)	10 (30.3%)	8(22.9%)	25 (24.8%)
Off Campus (Roommates)	5 (13.5%)	7 (21.2%)	6 (17.1%)	18 (17.1%)
Off Campus (Alone)	3 (8.1%)	1 (3.0%)	2 (5.7%)	6 (5.7%)
Hours of Class [*M*(*SD*)]	17.15 (7.95)	14.75 (6.09)	15.86 (6.01)	15.98 (6.79)
Working [*n*(%)]	11 (29.7%)	17 (51.5%)	8(22.9%)	36 (34.3%)
Hours of Work [*M*(*SD*)]	4.03 (7.65)	6.15 (8.82)	3.69 (8.76)	4.58 (8.39)
Volunteering [*n*(%)]	16(43.2%)	13 (39.4%)	13 (37.1%)	42 (40.0%)
Hours of Volunteering [*M*(*SD*)]	1.93 (3.65)	2.00 (3.08)	1.74 (2.87)	1.89(3.20)

Descriptive Statistics

Descriptive statistics and bivariate correlations for all continuous measures were computed and are presented in Table 6 and Table 7. As can be seen from the descriptive statistics in Table 6, and confirmed by the Kolmogrov-Smirnov test, there was evidence of a significant positive skew for baseline and post-intervention self-reported physical activity data, $D(92) = 0.167$, $p < .001$, and $D(92) = 0.146$, $p < .001$ respectively. This is unsurprising; given the high prevalence in physical activity research of having continuous data with a lower bound of zero and a positive skew (Baldwin, Fellingham, & Baldwin, 2016). These conditions are particularly prevalent in interventions to increase physical activity among previously inactive individuals where the outcome is time spent per week engaging in physical activity. However, despite its pervasiveness in the field, assuming a normal distribution for this type of data can be problematic and can lead to misleading results (Baldwin et al., 20016). As this was a randomized design, in line with methods described by Vickers (2005a; 2005b) the distributions and group sizes indicated ANCOVA to be the preferred method of comparison for running the primary analyses. Further, given the substantial proportion of zero values and violations in non-normality, confidence intervals were constructed via a bias-corrected and accelerated (BC*a*) bootstrapping method (Field, 2013; Kelley, 2005). The BC*a* bootstrapping method was chosen because it has been suggested to provide a more robust assessment of physical activity behaviour, when parametric assumptions of normality or homogeneity of variance are violated (Kelley, 2005). Violations in normality were also observed across all three time points for the instrumental judgment measures, as well as for the affective judgments measure at four-week post-test. These problems with the physical activity judgement measures will be further elucidated in the Item-Analysis section.

Table 6

Summary of descriptive statistics.

	Range	M(SD)	Skewness	SE	Kurtosis	SE	Alpha
Time 1							
Affective Judgments	29.00	25.6(5.49)	-.61	.24	.71	.47	.87
Instrumental Judgements	18.00	31.51(3.30)	-1.12	.24	2.24	.47	.84
MET LTPA	2280.00	433.28(448.93)	1.72	.24	3.73	.47	
Time 2							
Goal Feasibility	3.00	5.47(0.83)	.10	.24	-.49	.48	
Goal Desirability	6.00	5.86(1.03)	-1.12	.24	3.42	.48	
Affective Judgments	20.00	26.30(4.23)	-.38	.24	-.18	.48	.78
Instrumental Judgements	10.00	32.06(2.76)	-.67	.24	-.58	.48	.82
Time 3							
Affective Judgments	29.00	26.48(5.53)	-.88	.25	1.49	.49	.87
Instrumental Judgements	23.00	30.72(3.91)	-1.34	.25	4.21	.49	.86
MET LTPA	2940.00	788.69(648.94)	1.25	.25	1.28	.49	

Note. LTPA = leisure time physical activity, MET = metabolic equivalent of task .

Table 7

Bivariate correlations among study variables.

	1	2	3	4	5	6	7	8	9	10
Time 1										
Affective Judgments	-	.621**	.420**	.333**	.368**	.688**	.333**	.681**	.428**	.202
Instrumental Judgements		-	.231*	.294**	.404**	.452**	.580**	.342**	.453**	.109
MET LTPA			-	.232**	.102	.301**	.038	.307**	.120	.367**
Time 2										
Goal Feasibility				-	.410**	.411**	.381**	.381**	.335**	.316**
Goal Desirability					-	.345**	.549**	.347**	.374**	.216*
Affective Judgments						-	.559**	.748**	.562**	.201
Instrumental Judgements							-	.351**	.589**	.154
Time 3										
Affective Judgments								-	.636**	.298**
Instrumental Judgements									-	.295**
MET LTPA										-

Note. LTPA = leisure time physical activity, MET = metabolic equivalent of task. ** $p < 0.01$, * $p < 0.05$

Item Analysis. Item-level response descriptive statistics were used to evaluate whether the item response categories were being used appropriately for the Affective and Instrumental Judgment measures. Specifically, item means, standard deviations and skew were evaluated. It has been established that relatively high variance is desirable, as limited variance does not discriminate among individuals with different levels of the construct being measured (DeVellis, 2003). Similarly, having a mean closer to the center of the range of possible scores is also desirable, otherwise the item might fail to detect certain values of the construct. Further, when examining item-response distributions it is important to identify and eliminate items that are highly skewed (Clark & Watson, 1995). These unbalanced item-distributions are undesirable because when most respondents answer similarly, items convey little information (Clark & Watson, 1995). Moreover, items with extremely unbalanced distributions can produce highly unstable correlational results (Clark & Watson, 1995).

Results from the item-level response descriptives suggest that there may be non-trivial problems with the Affective and Instrumental Judgement measurements. Specifically, most items demonstrated a ceiling effect with a very high negative skew, high item means and low standard deviations (See Appendix G). These problems were also reflected in the composite scores of the Affective and Instrumental Judgements across time points, specifically a restricted range, high scale means and limited variability were observed. These factors provide an indication that the data were likely right censored, also known as a ceiling effect (Wang & Zang, 2011). With right censored data, the true attitudes of those individuals who obtain the maximum score cannot be determined, and thus the reliability and validity of the measurement is potential compromised. Further, this right censored data has important implications on conducting mediation analyses. Specifically, when there are censored data on the hypothetical mediator, the mediation effects

will either tend to be underestimated or overestimated (Wang & Zang, 2011). Moreover, as baseline judgments for physical activity were already very high, if mental contrasting did increase participants' physical activity judgements, it is likely that these changes would not be detected. Accordingly, based on the limited variability and right censored nature of the hypothetical mediators, the proposed mediation analyses were unable to be conducted.

Accelerometry. Tables 8-9 show the frequency counts for physical activity measured through accelerometry. Despite using multiple strategies to wear accelerometers, such as providing reminder e-mails, incentives and monitoring logs (Trost et al., 2005) compliance to wearing the physical activity monitors was very low (see Table 8). Compliance was highest at baseline, with 29.5% of participants wearing the accelerometer for seven days, and 27.6% of participants had data for less than 3 valid days. At one-week post-test, 22.9% of participants wore the accelerometer for seven days, and 34.3 % of participants had data for less than 3 valid days. At the 4-week post-test 93.3% of participants were missing at least one day of accelerometry, and 48.6% of participants had data for less than 3 valid days.

There are no set standards regarding the minimum number of valid days required to for the data to be used in subsequent analyses, although 3 to 5 valid days are typically recommended (Eslinger, Copeland, Barnes & Tremblay, 2005; Trost et al., 2005). However, due to differences in physical activity patterns between weekday and weekend activities, it has been suggested that accelerometry data should include at least one valid weekend day (Eslinger et al., 2005; Trost et al., 2005). In the current study, 76.19%, 60.00%, and 40.95% of participants had at least one valid weekend day at baseline, one-week post-test and 4-week post-test respectively (see Table 9). When considering whether to perform imputation for this missing data, recent results show that varying the minimum number of valid days can introduce a bias and affect the

representativeness of the sample (Catellier et al., 2005; Lee, 2015). Specifically, stringent criteria (i.e., requiring more valid days) lowers the effective sample size, whereas lenient criteria increase the instability of the estimation (Lee, 2015). Longitudinal studies using accelerometers are even more vulnerable to such a bias, as data are collected at multiple time points and bias could be introduced at all time points (Lee, 2015).

Table 8.

Number of valid days measured by accelerometers

	Number of Valid Days	Frequency	Percent (%)
Time 1	0	17	16.2
	1	5	4.8
	2	1	1.0
	3	6	5.7
	4	8	7.6
	5	14	13.3
	6	23	21.9
	7	31	29.5
Time 2	0	24	22.9
	1	5	4.8
	2	7	6.7
	3	6	5.7
	4	9	8.6
	5	16	15.2
	6	14	13.3
	7	24	22.9
Time 3	0	39	37.1
	1	7	6.7
	2	5	4.8
	3	10	9.5
	4	6	5.7
	5	18	17.1
	6	13	12.4
	7	7	6.7

Table 9.

Number of valid weekend days measured by accelerometers.

	Number of Valid Days	Frequency	Percent
Time 1	0	25	23.8
	1	29	27.6
	2	51	48.6
Time 2	0	42	40.0
	1	25	23.8
	2	38	36.2
Time 3	0	62	59.0
	1	17	16.2
	2	26	24.8

In addition, the missing accelerometer data were not missing completely at random as indicated by a significant Little's (1988) chi square test, $\chi 2 = 134.85$, $p < .001$. When looking at this further it was found that the number of valid days of accelerometer data and average number of minutes per valid day were significantly correlated at all three time points. At baseline and one-week post-test, the number of valid days of accelerometer data and average number of minutes per valid day were moderately positively correlated, $r(92) = .269$, $p < .01$ and $r(87) = .276$, $p < .01$ respectively. At the 4-week post-test the number of valid days of accelerometer data and average number of minutes per valid day were strongly positively correlated, $r(79) = .528$, $p < .001$. Accordingly, it appears that the participants who wore their accelerometer more often were also more physically active, and that the data were not missing at random (NMAR). Based on the high proportions of missing data and that the data were NMAR, conducting imputation for the missing data is not recommended (Catellier et al., 2005; Scheffer, 2002; Sterne et al., 2009).

Furthermore, despite previous research that indicates that most self-report measures result in a gross overestimation of physical activity (Sallis & Saelens, 2000), in this study the self-report measures had more conservative estimates of physical activity compared to the accelerometers. For example, at the four-week post-test Godin's LTPAQ recoded average MVPA to be 114.14 minutes per week (*SD* = 116.35), whereas accelerometer reports recorded average MVPA to be 186.69 minutes per week (*SD* = 192.16). Furthermore, as the purpose of this study was to compare across conditions, as opposed to describing the state of physical activity levels among participants, it is likely that there would be no differences in the prevalence of self-report bias across randomized groups, thus would likely not influence the overall pattern of results. In summary, due to the magnitude of missing date, the non-randomness of those missing data, and the relative strength of self-report data, no further analyses were conducted with the accelerometry data.

Goal feasibility and desirability. One-way ANOVAs were conducted to examine whether there were any differences in participants' ratings of how desirable and useful they perceived their physical activity goal to be, prior to conducting the mental contrasting intervention across groups. Ratings of both goal desirability and goal feasibility were high (see Table 6), and there were no differences in how desirable ($F(2, 98) = 0.421$, $p = 0.658$), or feasible ($F(2,98) = 0.324$, $p = 0.724$) participants' goals were appraised to be across the three mental contrasting conditions.

Primary Analyses

Self –Reported MVPA. A one-way ANCOVA was performed to examine whether those in the affective mental contrasting condition reported being more physically active compared to the instrumental and standard mental contrasting conditions at four-week post-test, with mental

contrasting condition as the between-subjects variable, and baseline physical activity as a covariate**.** As illustrated in Figure 3, the ANCOVA yielded a significant effect for both the baseline physical activity covariate, $F(1, 90) = 15.40$, $p < .001$, $\eta_p^2 = .146$ and the randomization condition, $F(2, 90) = 3.14$, $p < .05$, $\eta_p^2 = 0.065$. *Post hoc* comparisons, using BC*a* 95% confidence intervals (Kelley et al., 2005), indicated that those randomized to the affective mental contrasting condition (adjusted $M = 995.80$, $SE = 123.80$, BCa 95% CI [756.72, 1235.95]), had higher 4-week post-test self-reported MET minutes of MVPA, compared to the instrumental mental contrasting (adjusted $M = 699.54$, $SE = 92.27$, BCa 95% CI [534.50,841.89]) and the standard mental contrasting (adjusted $M = 655.90$, $SE = 91.79$, BCa 95% CI [485.18, 878.26]) conditions when controlling for baseline MET minutes of MVPA. This was evidenced by BC*a* 95% confidence intervals of mean differences not overlapping zero. Specifically, the, BC*a* 95% confidence interval of mean differences between the affective and standard mental contrasting conditions, and the affective and instrumental conditions were [46.09, 628.80], and [10.38,602.93], respectively. The p-values of these differences provided secondary support for these effects, as the difference between the affective and standard mental contrasting conditions was statistically significant ($p < .05$), and the difference between the affective and instrumental conditions approached statistical significance ($p = .062$*).* No significant differences were found between the standard and instrumental conditions ($p = .72$, BC*a* 95% CI of mean difference [-271.92, 201.43]).

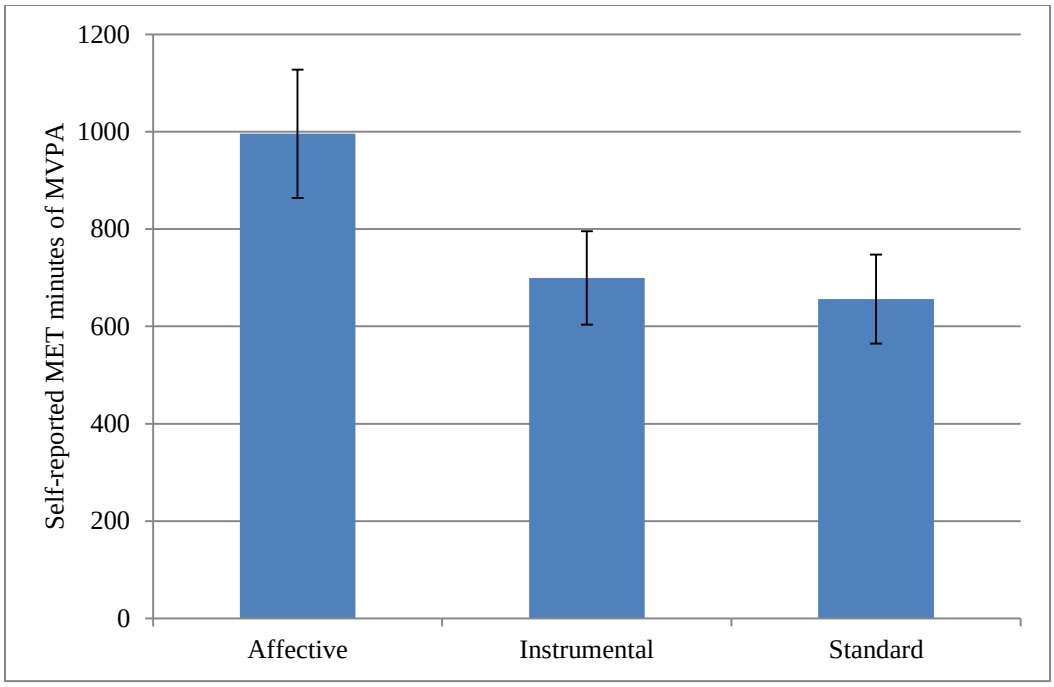

Figure 3. The effect of the mental contrasting intervention condition on self-reported MET minutes of MVPA at 4-weeks post intervention, controlling for baseline MVPA. Bars represent adjusted marginal means and error bars represent BC*a* standard errors.

Exploratory Moderation Analyses

Fidelity to weekly goal setting. As a manipulation check, the number of times that participants used the online weekly goal setting activity were counted and evaluated. Overall, 93 of the 105 participants who completed the intervention used the online goal setting activity at least once, and overall fidelity (to a maximum of three of the weekly goal setting activities) was moderate (M = 1.98, SD = 1.13*)* . A one-way ANOVA was also conducted to examine whether there were any differences in participants' use of the online goal setting across intervention conditions, and no differences were found, $F(2, 102) = 0.05$, $p = .950$.

Adherence to intervention materials. Based on the results from the qualitative manipulation check, exploratory moderation analyses were performed. Specifically, because the questions posed in the affective mental contrasting intervention elicited a mixture of affective, instrumental, and unclassifiable judgements, and that mental contrasting intervention materials

posed to elicit instrumental judgments also elicited judgments that were affective or unclassifiable in nature, we sought to test whether participants' adherence to the intervention materials moderated the strength of the mental contrasting intervention. To do this, participants' responses to both outcomes and obstacles were dummy coded as either aligning or not aligning with their assigned intervention (to note, as the standard mental contrasting condition received neither affective nor instrumental prompting it was not included in this exploratory analysis). Next, a two-way ANCOVA was performed to determine whether those whose responses to the outcome component of the mental contrasting intervention aligned with their randomized condition (affective or instrumental) reported different physically active levels compared to those whose responses did not align with their randomized condition at the four-week post-test, controlling for baseline physical activity.

The ANCOVA yielded a significant effect for the baseline physical activity covariate, $F(1, 57) = 7.38$, $p < .001$, $\eta_p^2 = .115$, no significant main effects for either randomization condition, or alignment to manipulation, however a randomization by alignment interaction approached statistical significance, $F(1, 57) = 3.80$, $p = .056$, $\eta_p^2 = 0.062$. The interaction is presented in Figure 4. Simple effects tests were performed and results suggest that those randomized to the affective mental contrasting condition and whose outcome responses aligned with their condition (adjusted $M = 1144.94$, $SE = 174.31$) demonstrated the highest physical activity levels at four-week post-test, and had significantly higher physical activity levels than those randomized to the instrumental condition whose responses aligned with their randomization (adjusted $M = 584.83$, $SE = 82.56$; $p < .05$, BC*a* 95% CI of mean difference [179.89, 976.65]). However, there were no differences in physical activity levels between the

instrumental and affect conditions when their responses did not align with their randomized condition (BC*a* 95% CI of mean difference [-488.64, 333.43], p = .742).

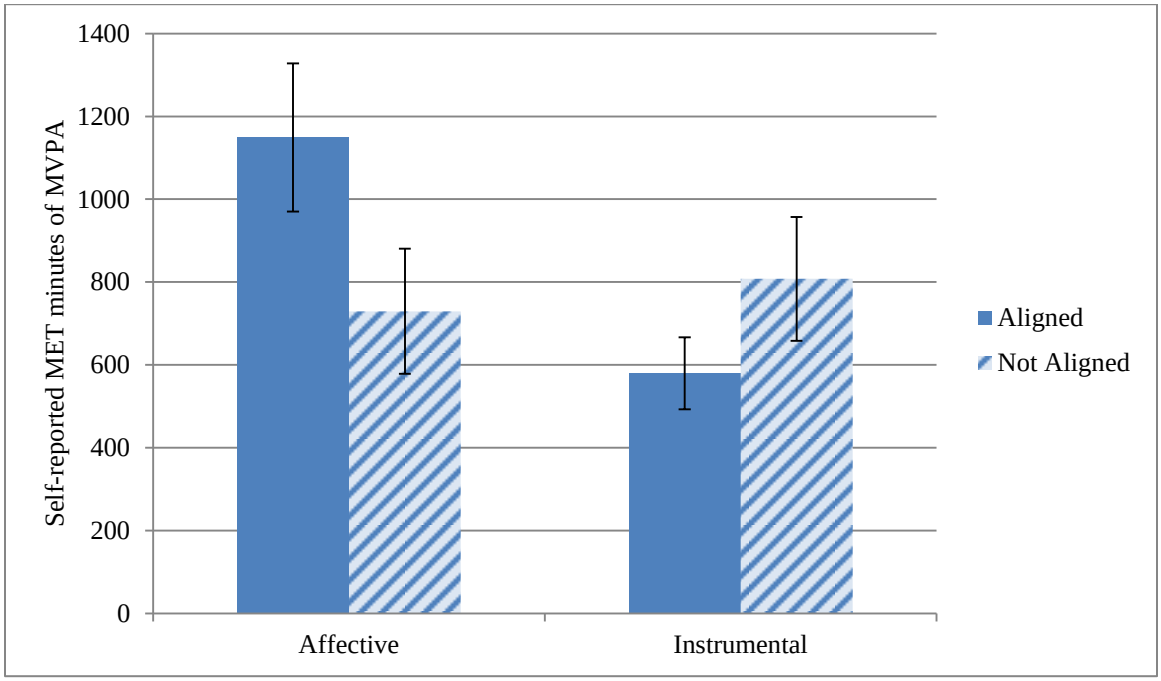

Figure 4. The moderating effect of adherence to intervention randomization on self-reported MET minutes of MVPA at 4-weeks post intervention, controlling for baseline MVPA. Bars represent adjusted marginal means and error bars represent BC*a* standard errors.

A two-way factorial ANCOVA was also performed to determine whether those whose responses to the obstacle component of the mental contrasting intervention aligned with their randomized condition (affective or instrumental) reported different physically active levels compared to those whose responses did not align with their randomized condition at the four-week post-test, controlling for baseline physical activity. The ANCOVA yielded a significant effect for baseline physical activity, $F(1, 57) = 5.76$, $p < .05$, $\eta_p^2 = .092$, however no significant main effects for either randomization condition (p = .139), or alignment to manipulation (p = .862), and there was also no randomization by alignment interaction (p = .997).

Discussion

The present study was designed to use a combination of qualitative and quantitative methods to assess the efficacy of an affective mental contrasting intervention, compared to an instrumental and standard mental contrasting intervention, in relation to changes in accelerometry and self-reported moderate- to- vigorous physical activity among a sample of inactive, female, undergraduate students. It was predicted that participants in the affective mental contrasting intervention condition would display improved adoption and maintenance of physical activity relative to those in the instrumental and standard mental contrasting conditions. With respect to this first hypothesis, the results suggest that an affective mental contrasting intervention was more effective than either instrumental or standard mental contrasting conditions in increasing levels of self-reported physical activity behaviour. Furthermore, no differences were found in self-reported physical activity between the instrumental and standard mental contrasting conditions four weeks following the intervention. Accordingly, it appears that a mental contrasting intervention that was adapted to target participants' affective judgments could bolster changes in health-enhancing behaviour beyond an already efficacious standard mental contrasting protocol (e.g., Sheeran et al., 2013; Stadler et al., 2009). Moreover, a mental contrasting intervention that was adapted to target participants' instrumental judgments showed no improvements over the standard control condition.

These results seem to be consistent with other research which found that brief goal-setting protocols, such as mental contrasting, can be a time- and cost-effective technique to increase physical activity behaviour (Sheeran et al., 2013; Stadler et al., 2009). These findings are also consistent with prior findings that affective judgements are a valuable target in health-enhancing behaviour change interventions, that are conceptually distinct from more rational,

instrumental judgements (e.g., Lawton et al., 2009; Lowe et al., 2002; Nasuti & Rhodes, 2013; Rhodes et al., 2009). Moreover, these results are consistent with recent, experimental, messaging studies that have demonstrated that participants who are prompted to think about affective judgments of physical activity, demonstrate increased physical activity behaviour compared to instrumental judgments (Conner et al., 2011: Morris et al., 2015; Sirriyeh et al., 2011). The lack of difference between the instrumental and standard mental contrasting conditions is likely due to standard mental contrasting interventions frequently eliciting instrumental judgements regarding health-enhancing behaviours. For example, content analysis of benefits elicited in a dietary change mental contrasting intervention included predominantly rational, instrumental judgements such as losing weight, looking better, and becoming healthier (Johannessen et al., 2012). The results of the current study also support this notion, as the qualitative manipulation check demonstrated that 55.9 % of participants randomized to the instrumental condition cited instrumental judgement outcomes, whereas 66.7 % of participants randomized to the standard condition cited outcomes that were instrumental in nature.

A secondary purpose of this mixed-methods study was to explore to what extent participants' responses to their respective mental contrasting intervention align with the condition to which participants were randomized. With respect to this qualitative research question, it was found that there was substantial variation in the types of outcomes and obstacles participants identified, and participants' responses to their respective mental contrasting intervention did not always align with the condition that participants were randomized. Further, the results of the *post hoc*, exploratory, moderation analyses that examined the effect of alignment of participants' responses to their respective mental contrasting intervention indicated that participants demonstrated the most pronounced increase in self-reported physical activity

levels at the four-week follow-up when they were randomized to the affective condition, and the outcome that they cited was affective in nature. Conversely, participants had the lowest physical activity levels when they were randomized to the instrumental condition and the outcome they cited was instrumental in nature. When participants' responses did not align with their randomized intervention, they demonstrated intermediate levels of physical activity, which did not differ significantly from each other. Additionally, when examining the moderating effect of alignment related to participants' cited obstacles, no significant differences in follow-up physical activity levels were found.

As a possible explanation for why the alignment of outcomes, but not obstacles, moderated the efficacy of the intervention, Rhodes and Conner (2010) suggested that positive outcomes of physical activity can be both proximal and distal, but there are few, if any, negative distal outcomes of physical activity. Specifically, as both affective and instrumental obstacles associated with being physically active are experienced within a similar timeframe (i.e., immediately prior to, during, or following a physical activity bout), participants may perceive both as being equally relevant in guiding behaviour. A further explanation for why there was a stronger effect on self-reported physical activity levels, when participants' responses were congruent with their experimental condition for outcomes, compared to obstacles, originates from research regarding the phenomenological characteristic associated with re-imagining or pre-imagining an event. Specifically, it has been demonstrated that when individuals were asked to remember or anticipate pleasant and unpleasant (i.e., non-traumatic) autobiographical events, mental representations of positive events contained more sensorial details (e.g., visual details, sounds, and smell/taste), contained more details concerning the context of the event (i.e., time of the day), and were associated with a greater feeling of re-experiencing (or pre-experiencing) an

event, compared to mental representations of negative events (D'Argembeau, Comblain, & Van der Linden, 2003; D'Argembeau, & Van der Linden, 2004). A suggested reason for this asymmetry in representations is that self-enhancement goals favour access to positive, rather than negative, self-relevant information, therefore enhancing the richness of representations for positive events, both when remembering the past and imagining the future (D'Argembeau, & Van Der Linden, 2004). Accordingly, within the context of a mental contrasting intervention, when participants imagine possible future outcomes and obstacles associated with being physically active, they may access information concerning outcomes more easily than obstacles, therefore enabling them to construct richer representations of their anticipated outcome.

In this study it was hypothesized *a priori* that the effect of the affective mental contrasting intervention in relation to physical activity behaviour would be mediated by changing participants' affective judgements about physical activity. Further, it was hypothesized that changes in instrumental judgments would not influence physical activity behaviour. Unfortunately, mediational analyses could not be performed due to the lack of adequate measures of affective and instrumental judgments (as per the Results section). It has been suggested that using inadequate measures of mediating variables can result in the absence of mediating effects even when the proposed mediator is actually a mediator of an intervention outcome, and even when the intervention is actually able to significantly change the potential mediator (Maric, Wiers, & Prins, 2012). Within the current study, the lack of variability and negative skew in responses to both the affective and instrumental judgment measures, across all three time points, provided an indication of a ceiling effect. With ceiling effects, the true attitudes of those individuals who obtained the maximum score cannot be determined, and thus the reliability and validity of the measures are compromised. Furthermore, as baseline measures

of affective and instrumental judgments were already very high, if mental contrasting did increase participants' physical activity judgements, it is likely that the measurement would not have been sensitive to these changes.

An additional objective of the present study was to test the efficacy of affective mental contrasting interventions through the use of hip-worn, tri-axial accelerometers. Unfortunately, this study was unable to corroborate the results of the self-reported Godin's Leisure Score Index (Coureyna et al., 2004) with these objective physical activity measures. It has been suggested that results from experimental studies that use self-report measures of physical activity may be attenuated due to increased measurement error (Rhodes & Pfaeffli, 2010). Despite attempts to obtain objective indicators of participants' physical activity level, through the use of accelerometers, consistent with previous research there were substantial difficulties in promoting compliance to wearing traditional waist-worn accelerometers in the young adult population (Lee, 2015). Furthermore, based on the magnitude of missing data and the non-randomness of those missing data, it was impossible perform inferential analysis with the data that were obtained.

Although accelerometers are suggested to provide slightly more reliable and valid estimates of physical activity compared to self-report measures (Pedisic, & Bauman, 2015), there are several issues that undermine their use. In a recent review, Pedisic and Bauman (2015) identified several key issues regarding the suitability of accelerometry-based physical activity measurements which included: (1) accelerometry-based estimates may not be generalizable to the target population, as only those who adhere to the rigorous measurement requirements will provide usable data; (2) accelerometers may underestimate total physical activity levels; (3) accelerometers are unable to capture common activities such as cycling, aquatic activities (for non-waterproof accelerometers), resistance/ static exercise, or carrying loads; (4) accelerometry-

based measurements cannot account for domain-specific physical activity levels (i.e., partitioning physical activity levels between work, transport, domestic and leisure-time activities); (5) accelerometry-based estimates of physical activity are sometimes influenced by participants (e.g., through intentional non-wearing, altering habitual behaviour, changing the position or shaking the device); (6) accelerometry-based measurements are largely dependent on the choice of cut-off points; and (7) meaningful between-study comparisons are sometimes limited, because accelerometer data collection and processing methods are not standardised. Based on these issues, it is questionable whether the reported improvements in the reliability and validity of accelerometry-based physical activity measurements, over self-report measures, are substantive.

Strengths

In addition to providing preliminary evidence regarding the efficacy of an affective mental contrasting intervention in promoting the adoption and maintenance of physical activity behaviour, this mixed-method study had several notable strengths. First, this study through the use of a concurrent, triangulation, data transformation design, examined how the congruence between the assigned intervention and participants' responses to their respective intervention moderated the efficacy of the affective mental contrasting intervention. Specifically, through the use of a manipulation check there was an opportunity to observe how participants' physical activity behaviour varied when participants' responses to the intervention materials aligned with the intended intervention, compared to when they did not. The degree to which a physical activity intervention is experienced by the participant as intended has been suggested to be a valuable, and often over-looked, moderator of the relationship between interventions and their outcomes (Carroll et al., 2007). Accordingly, it has been suggested that intervention research

should involve an evaluation of implementation fidelity in order to discern the true effects of an intervention (Carroll et al., 2007). Moreover, data associated with implementation fidelity can provide valuable insights regarding the potential for inconsistencies in implementation of an intervention within the real world. Within the context of the present study, it was observed that message prompting and questions posed to elicit affective judgements, reflected a mixture of both affective and instrumental judgements. When examining the moderating effect between intended and observed outcome judgments it was found that those who completed the affective mental contrasting activity as intended displayed increased levels of physical activity compared to those who did not, thus lending support to the efficacy of promoting affective mental contrasting. There would therefore seem to be a definite need for future research to continue to measure whether affective mental contrasting interventions target affective judgements as intended, as well as examine whether factors such as question wording or intervention delivery can be manipulated to better enhance fidelity to the intervention.

Another notable strength of this study was an increased understanding of what participants specifically anticipate when they refer to particular outcomes or obstacles in elicitation studies. Specifically, by asking participants to focus on one positive outcome and one negative obstacle, as well as having them provide a detailed elaboration of their outcomes and obstacles (through the use of the Mental Contrasting activity), a more in-depth understanding of the context (e.g., timeframe) surrounding these physical activity judgments was provided, as well as greater insights into participants' interpretation of the outcomes and obstacles they identified. Based on this additional information, it was discovered that trying to dichotomize physical activity judgements as either affective or instrumental may sometimes result is an oversimplification of a participant's true beliefs. For example, previous elicitation studies have

consistently considered anticipated outcomes of physical activity, such as stress-relief, happiness and esteem, to be affective outcome judgments (e.g., Bellows-Riecken et al., 2013; Rhodes & Conner, 2010; Symons Downs, & Hausenblas, 2005). However, in the current study a proportion of participants who referred to these types of physical activity judgements actually explained these phenomena as being more instrumental in nature. Specifically, some participants would describe a causal chain whereby the anticipated affective response (e.g., happiness, esteem) was mediated by attaining an instrumental outcome (e.g., weight loss, increased health). Accordingly, future researchers should carefully consider whether affective judgments identified by participants are attributable to being physically active, or whether the affective judgement is attributed to realising an instrumental outcome. This finding has potential implications due to the confounds that exist between the affective-instrumental and proximal-distal dimensions of physical activity judgements (Rhodes & Conner, 2010; Keer et al., 2013; Morris et al., 2016; Williams et al., 2005). For example, as Morris and colleagues (2016) demonstrated, distal affective messages result in losing the sense of immediate relevance of being physically active, as thus do not result in similar improvements in physical activity behaviour as seen with proximal affective messages.

Furthermore, the results derived from the qualitative content-analysis associated with this intervention suggest the need to tailor interventions to target participants' idiosyncratic affective outcomes and obstacles. Within the current study it was found that one participant's best outcome was another's biggest obstacle. For example, in the current study the most common affective outcome identified among participants was *stress-relief*. Conversely, the most commonly anticipated affective obstacle was that physical activity was *stressful*. In addition, many participants described the invigorating effects of physical activity, whereas others thought

that those invigorating effects were detrimental to their quality of sleep. Within the context of mental contrasting, Oettingen (2000; 2012) suggests that goal commitment is expected to be strong when expectations of desirability and feasibility are high. On the other hand, goal-commitment is expected to be weak when these expectations are low. Accordingly, a one-size-fits-all messaging approach may not work as strongly as having individuals identify their own outcomes and obstacles, as affective outcomes identified within a physical activity message may contradict an individual's personal experiences with, or judgments about, physical activity. This contradiction could result in reductions to an individual's expectations of the desirability or feasibility of their goal. For example, if an individual is given a message regarding the stress-reduction effects of physical activity that he/she could anticipate experiencing, but the individual's own physical activity experiences have been very stress-inducing, then the individual may perceive the message to be less credible, thus resulting in reductions in expectations regarding the feasibility and/or desirability of being physically active.

Limitations

Although the present study offers some promising evidence that a theory-driven, affective mental contrasting intervention can bolster female, undergraduate students' adoption and maintenance of moderate-to-vigorous physical activity during transition to university, there are several limitations to acknowledge. One limitation of this research is the reliance on a student samples. Although physical activity judgments do not appear to differ by gender or age (Rhodes, Blanchard, & Blacklock, 2008; Rhodes et al., 2009), and mental contrasting has been shown to be an effective technique to increase physical activity in diverse populations (e.g., middle aged women and overweight, middle-aged, low socio-economic-status fishermen; Sheeran et al., 2013; Stadler et al., 2009), the efficacy of affective mental contrasting interventions should be

formally tested in diverse demographic samples to provide further justification of the utility of this novel intervention. For example there are other major life transitions such as entering the workforce, getting married or having a child that can result in substantive declines in individuals' physical activity levels. For example, mothers are about half as likely to engage in regular physical activity compared to otherwise similar non-mothers (Zick et al., 2007). Accordingly, future research could test whether the findings from this intervention could extend to other female, young-adult populations who could be at an even greater risk of discontinuing physical activity than university students. Furthermore, further work could also be done to evaluate the efficacy of affective mental contrasting interventions to promote physical activity in cohorts of the population who bear the highest burden of chronic disease related to physical inactivity, such as clinical populations or very sedentary individuals (Waters, Galichet, Owen, & Eakin, 2011). Specifically, these sub-groups of the population may be less likely to anticipate affective outcomes, or have more intense affective obstacles (e.g., extreme physical discomfort), that may preclude them from being more physically active.

Additionally, the sample in the current study may differ from the general population in terms of motivation levels. Recruitment of participants was done primarily via posters and advertisements; therefore, the study may have recruited students with a pre-existing interest in changing their physical activity levels begin with. Furthermore, based on the longitudinal nature of the design and the use of accelerometers, this study required a substantial time commitment, and thus only those who had a significant interest in wanting to be more active would have volunteered to participate.

Another limitation of the study is that the moderating effect of historical physical activity levels was not considered. Although only insufficiently active participants were recruited for this

study (i.e., those who engaged in moderate-vigorous intensity physical activity for less than 30 minutes, less than three times a week during the week preceding recruitment), the study did not measure or control for physical activity levels that extended further back than the point of initial recruitment, for example activity levels that preceded the university transition. The consequences of measuring more distal past physical activity levels were demonstrated in a recent study. Specifically, among first-year university students, it was found that physical activity levels during the 8-months preceding the university transition were the only significant predictor of physical activity levels during students' first semester of university (Kwan, Bray, & Martin Ginis, 2010). Bandura (1997) posited that *mastery experiences* (i.e., experiences of successfully completing a behaviour in the past) are a critical determinant in developing an individual's self-efficacy to perform a health-enhancing behaviour. Moreover, these mastery experiences provide observable proof of outcomes one can expect through accomplishing a goal. Accordingly, the affective mental contrasting intervention may be more relevant for individuals who have recently relapsed into physical inactivity, compared to intenders who have never concertedly engaged in physical activity in the recent past. If individuals have recently discontinued physical activity, and thus have recent physical activity experience, they may remember why they used to enjoy being physically active. On the other hand, individuals with a longstanding history of physical inactivity may have a more difficult time with this type of intervention as they will be asked to speculate/imagine why they may enjoy physical activity.

Further support for the importance of previous physical activity experiences has been demonstrated within the field of cognitive psychology. According to the *constructive episodic simulation hypothesis*, episodic memory primarily exists as a means to simulate future events by drawing on past experience in a manner that flexibly extracts and re-combines elements of

previous experiences (Addis, Wong, & Schacter, 2007; Schacter, & Addis, 2007). Support for this hypothesis has been demonstrated in fMRI studies, whereby considerable overlap has be found in the activation of brain structures associated with re-imagining past experiences and pre-imagining future experiences (Addis et al., 2007). It is therefore likely that such connections exist between individuals past affective experiences with physical activity, and the efficacy of interventions tailored to change affective judgments regarding physical activity. Specifically, this type of intervention may well be more successful with individuals who have had previous positive affective experiences, compared to those who have never had those experiences.

Additionally, the extent to which past physical activity behaviour moderates the efficacy of affective mental contrasting interventions may be further influenced by how recently individuals discontinued physical activity. Specifically, the temporal proximity of a memory impacts the phenomenological characteristics of the remembered event (D'Argembeau, & Van Der Linden, 2004). For example, it been demonstrated that individuals who recalled personal memories that were more temporally proximal (i.e., memories for events that occurred within the past year), reported that their memories contained more sensorial details, were associated with a clearer representation of contextual information (i.e., location, time of day), and generated a stronger feeling of re-experiencing, compared to temporally distal memories (i.e., memories for events that were 5–10 years old; D'Argembeau, & Van der Linden, 2004). Accordingly, the more recent the affective memory of being physically active, the more readily available these phenomenological characteristics will be for individuals to draw on when anticipating a future affective outcome associated with being physically active. Further studies, which take these considerations into account, will need to be undertaken.

Conclusion

To conclude, this study demonstrated that providing female, inactive, undergraduate university students with a novel, theory-driven, affective mental contrasting intervention resulted in greater levels of moderate-to-vigorous-physical activity during a four-week intervention follow-up compared to those in the instrumental and standard mental contrasting intervention groups. These findings provide preliminary support for the efficacy of affective mental contrasting as a cost- and time-effective strategy to increase physical activity behaviour. Moreover, the present study complements and adds to existing correlational (e.g., Lawton et al., 2009) and experimental (e.g., Conner et al., 2011) research in highlighting the importance of affective judgments as determinants of health-enhancing physical activity behaviour. Further research exploring the role of previous physical activity experience as a moderating factor of the efficacy of affective mental contrasting interventions, and research exploring the efficacy of affective mental contrasting interventions within other populations is warranted.

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Psychology of Exercise, Health, and Physical Activity Lab-
School of Kinesiology
The University of British Columbia

Appendix A: Letter of Information

Letter of Information

Mental Contrasting Physical Activity Study

Principal Investigator:
Mark R. Beauchamp, Ph.D.
School of Kinesiology
University of British Columbia

Co-Investigator:
Geralyn Ruissen, BSc
School of Kinesiology
University of British Columbia

Purpose: The purpose of this study is to test a novel goal setting strategy for maintaining or increasing exercise during students' time at university.

The following criteria will be used to determine participant eligibility for this study:

1. Female
2. Studying as an undergraduate at the University of British Columbia
3. Able to read and converse in English.
4. Was physically active less than three times for more than 30 minutes in the past seven-days.

Involvement: Should you choose to participate, we will ask you to come into the lab at three time points. During your first lab visit, you will fill out a short questionnaire and receive an accelerometer to wear and a log-book to complete for the upcoming week. An accelerometer is a small device worn on your hip that tracks the frequency, duration and intensity of physical activity that you engage in. Your participation for the first lab visit will take approximately 30 minutes. During the second lab visit you will learn a novel goal setting activity one-on-one with a female research assistant and complete a second questionnaire. Your participation for the second lab visit will take approximately one hour. During the final lab visit, you will hand back your accelerometer, complete a final questionnaire and receive your compensation. Your participation for the final lab visit will take approximately 30 minutes. Outside of the lab, you will be asked to wear a small accelerometer on your hip for three weeks throughout the next 6 week period, and complete a log book each night during those three weeks which will take 5 minutes nightly. Additionally, you will be asked to practice your goal setting strategy once a week for four weeks, which will take approximately 10 minutes per week.

Benefits: In this study, you will have the opportunity to learn a new, evidence-based, goal setting strategy. In addition, you will be given $15 for your participation. Compensation will be prorated for those that choose to withdraw before the end of the study (i.e. participants will accumulate $5 for each in lab session they complete.)

Confidentiality: Any information that is provided by participants will remain confidential and access to all information will be limited to members of the research team named above. There is no identifying information (e.g., name, home address) recorded on your surveys or other materials relating to the study. All data files will be kept on a secured password-protected computer in the Psychology of Exercise, Health, and Physical Activity Lab (Room 122, War Memorial Gym).

Participation: Participation in this study is voluntary and individuals may decline to answer any question(s) that they choose. There are no known psychological or physical risks associated with participation. You may choose to decline or withdraw your participation at any time throughout the course of the study.

Sponsorship: This project is funded by a new faculty grant awarded to Mark Beauchamp by the UBC School of Kinesiology.

If for ANY reason, you do not want to take part in this study that's fine, you don't have to. It is up to you if you want to take part or not. You are also free to withdraw at any time without having to give any reason. If you drop out you will not experience ANY negative consequences at all.

Should you have any further questions concerning the study please feel free to contact either Geralyn Ruissen, or Dr. Mark Beauchamp.

If you have any concerns or complaints about your rights as a research participant and/or your experiences while participating in the study, please contact the Research Participant Complaint Line in the UBC Office of Research Services.

Thank you for your help,

Mark Beauchamp, PhD Geralyn Ruissen, BSc Hons

Appendix B: Demographic Information

Psychology of Exercise, Health, and Physical Activity Lab-
School of Kinesiology
The University of British Columbia

Questionnaire
Mental Contrasting Study

Participant Identifier

What are the first 3 letters of your first name? _____ _____ _____

What are the first 3 letters of your last name? _____ _____ _____

Date of Birth: _____ (Day) _____ (Month) _____ (Year)

PART A: Background Information

A1. In what Faculty, School or Centre are you registered?

- ○ Faculty of Applied Science (Engineering)
- ○ Faculty of Agricultural and Environmental Sciences
- ○ Faculty of Arts
- ○ Faculty of Education
- ○ Faculty of Forestry
- ○ Faculty of Pharmaceutical Sciences
- ○ Faculty of Religious Studies
- ○ Faculty of Science
- ○ School of Kinesiology
- ○ School of Music
- ○ Undeclared
- ○ Other_____

A2. Which year of study are you currently in?

○ First ○ Second ○ Third ○ Fourth ○ Fifth upwards

A3. What describes your current living status?

○ In residence ○ With parents, guardians or family

○ Off campus (with roommates) ○ Off campus (alone)

A4. How many hours do you estimate that you spend each week in class (including labs and tutorial hours)? _____

A5. Are you currently employed? If so, how many hours a week are you currently working?

○Yes ○No

I currently work _____ hours per week.

A6. Do you currently volunteer? If so, how many hours a week are you currently volunteering?

○Yes ○No

I currently volunteer _____ hours per week.

PART B: ***Leisure time physical activity***

1. Considering the past **7-day period** (last week), how many times did you do the following kinds of exercise for **more than 10 minutes** during your free time (write in each square the appropriate number).

TIMES PER WEEK

A. STRENUOUS EXERCISE
(HEART BEAT RAPIDLY)
(i.e. running, jogging, hockey, football, soccer, squash, basketball, netball, judo vigorous swimming, vigorous long distance, cycling, roller skating)

How many minutes was each strenuous intensity exercise session (approximately)? _____ minutes

MODERATE EXERCISE
(NOT EXHAUSTING)
(i.e. fast walking, baseball, tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, dancing)

How many minutes was each moderate intensity exercise session (approximately)?
_____ minutes

MILD EXERCISE
(MINIMAL EFFORT)
(i.e. yoga, archery, bowling, golf, fishing from river bank, easy walking)

How many minutes was each mild intensity exercise session (approximately)?
_____ minutes.

2. Considering the past 7-day period (last week), during your leisure-time, how often did you engage in any regular exercise long enough to work up a sweat (heart beats rapidly)?

OFTEN SOMETIMES NEVER/RARELY

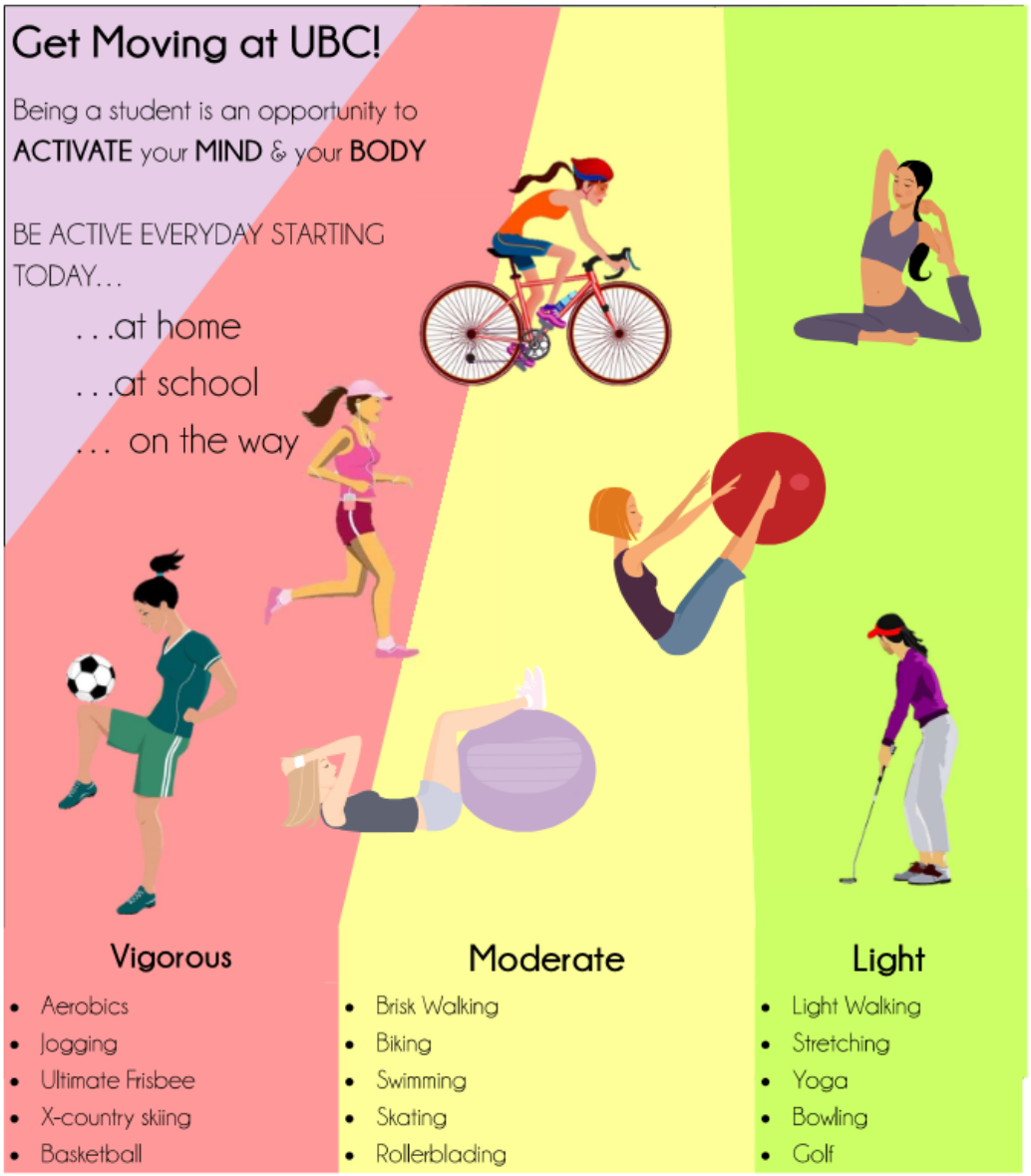
PART C: ***Thoughts about physical activity.***

For me, engaging in moderate to vigorous aerobic physical activity for at least 150 minutes a week for the next 6 weeks would be:

unsatisfying	○	○	○	○	○	○	○	satisfying
useless	○	○	○	○	○	○	○	useful
unimportant	○	○	○	○	○	○	○	important
unpleasant	○	○	○	○	○	○	○	pleasant
unenjoyable	○	○	○	○	○	○	○	enjoyable
worthless	○	○	○	○	○	○	○	valuable
not worthwhile	○	○	○	○	○	○	○	worthwhile
boring	○	○	○	○	○	○	○	exciting
harmful	○	○	○	○	○	○	○	beneficial
calming	○	○	○	○	○	○	○	stressful

Appendix C: Standard Mental Contrasting Intervention

Adapted with permission from Bray et al. (2011).



According to the Canadian Physical Activity Guidelines adults aged 18-64 years should accumulate at least **150 minutes of moderate- to vigorous-intensity aerobic physical activity** per week, in bouts of **10 minutes or more** . Depending on the intensity of the activity, you can vary the amount of time you are active. Accumulating activity is easy if you try to ***BE ACTIVE WHENEVER POSSIBLE***!

Achieving 150 minutes of physical activity per week is easier than you think!

During your time in residence**, being physically active doesn't have to be hard**. Here are some examples of how you can include physical activities into your daily routine:

At home...	☐	Establish a morning or evening activity routine (e.g., wake up with a light jog or swim)
	☐	Include variety into your routine by alternating the activities you do!
	☐	Take a 5-minute stretch break during periods of inactivity (e.g., studying, watching
At school...	☐	Take advantage of fitness consultations at the campus gym and sign-up for a physical activity class (e.g., yoga, cycling, dance) – take a friend along and start together
	☐	Take a brisk walk between classes – explore the campus and get to know your classmates better.
On the way...	☐	Walk across campus and grab your morning coffee from the furthest café
	☐	Walk, blade, board, or cycle to school
	☐	Walk a couple of blocks before you hop on the bus.

Of course these are only a few suggestions that can help guide you along the road to a physically active lifestyle. Remember that a little activation can go a long way…**start paving your pathway today!**

Step 1: Set your goal

As mentioned previously, according to the Canadian Physical Activity Guidelines adults aged 18-64 years should accumulate at least **150 minutes of moderate- to vigorous-intensity aerobic physical activity per week, in bouts of 10 minutes or more**. **Your goal for the next six weeks is to meet these guidelines!** Look back to the examples given on the previous two pages. What is a specific physical activity that you want to start or continue that will help you reach these guidelines (e.g., biking 25 minutes to and from school three times a week)? Try to choose an activity that is appealing to you and will be possible to implement in the next 6-weeks.

Goal:

_____

_____

_____

Within the next six weeks, how likely is it that you will increase your physical activity to the extent you just indicated?

Not at all Very Much

○ ○ ○ ○ ○ ○ ○

Within the next six weeks, how important is it to you to increase your physical activity to the extent you just indicated?

Not at all Very Much

○ ○ ○ ○ ○ ○ ○

Step 2: What are your benefits and barriers?

Please consider the most positive outcome you associate with achieving your goal and write it down in one keyword. Now imagine the events and experiences that you associate with this outcome. Try to describe this outcome as vividly as possible! Take as much time and space as you need to write down what you are thinking. If you need more space to write, please use the back of the page.

_____

_____

_____

_____

_____

_____

_____

_____

Sometimes, despite your best intentions, you may encounter distractions, temptations or difficulties that prevent you from achieving your goal. What situations could make it hard for you to become physically active? Think about which is the most important obstacle to being physically active for you personally and write it down in one keyword. Now imagine the events and experiences that you associate with this obstacle. Try to describe this obstacle as vividly as possible! Take as much time and space as you need to write down what you are thinking. If you need more space to write, please use the back of the page.

_____

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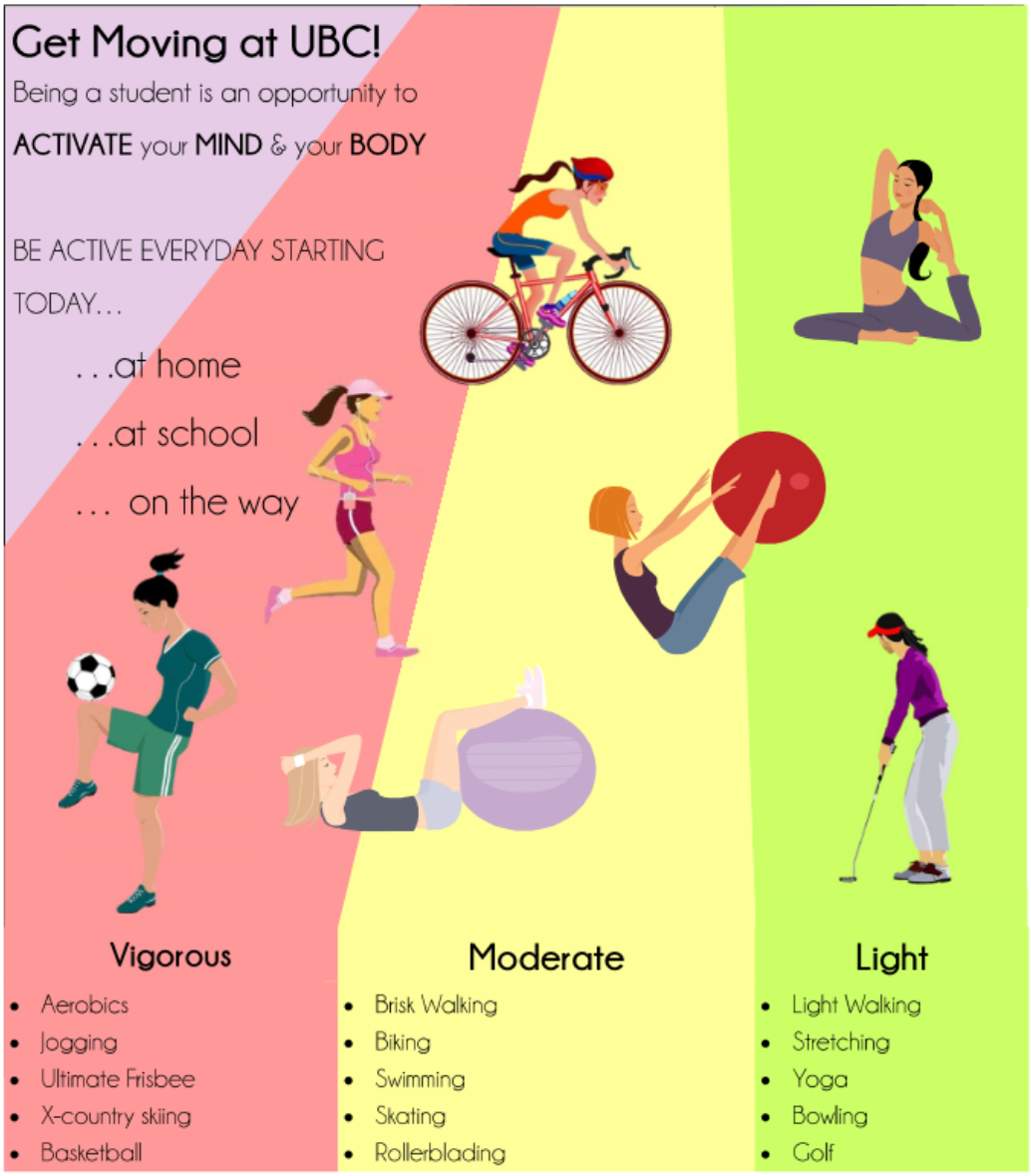
Appendix D: Affective Mental Contrasting Intervention

Adapted with permission from Bray et al. (2011).



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Achieving 150 minutes of physical activity per week is easier than you think!

During your time in residence**, being physically active doesn't have to be hard**. Here are some examples of how you can include physical activities into your daily routine:

At home...	☐	Establish a morning or evening activity routine (e.g., wake up with a light jog or swim)
	☐	Include variety into your routine by alternating the activities you do!
	☐	Take a 5-minute stretch break during periods of inactivity (e.g., studying, watching
At school...	☐	Take advantage of fitness consultations at the campus gym and sign-up for a physical activity class (e.g., yoga, cycling, dance) – take a friend along and start together
	☐	Take a brisk walk between classes – explore the campus and get to know your classmates better.
On the way...	☐	Walk across campus and grab your morning coffee from the furthest café
	☐	Walk, blade, board, or cycle to school
	☐	Walk a couple of blocks before you hop on the bus.

Of course these are only a few suggestions that can help guide you along the road to a physically active lifestyle. Remember that a little activation can go a long way…**start paving your pathway today!**

DID YOU KNOW?

Physical activity is not only good for your health, it also make you feel good too! Immediately after exercising the following effects have been observed;

⇒ Improved mood states, resulting from reductions in anger and tension (Penedo, & Dahn, 2005), or reductions in anxiety, depression and stress (Kwan, & Bryan, 2010; Penedo, & Dahn, 2005; Warburton et al., 2006).
⇒ Increases in feelings of tranquillity (Kwan, & Bryan, 2010).
⇒ Improved body image (Hausenblas, & Fallon, 2006).
⇒ Increased energy (Ekkekakis, & Backhouse, 2014)
⇒ Improved feelings of vitality and sleep quality (Leopoldino et al., 2013).

These benefits associated with physical activity may be especially valuable during university, as university students may be at an increased risk for compromised psychological well-being (Adlaf, et al., 2001; Bray & Born, 2010).

Step 1: Set your goal

As mentioned previously, according to the Canadian Physical Activity Guidelines adults aged 18-64 years should accumulate at least **150 minutes of moderate- to vigorous-intensity aerobic physical activity per week, in bouts of 10 minutes or more**. **Your goal for the next six weeks is to meet these guidelines!** Look back to the examples given on the previous two pages. What is a specific physical activity that you want to start or continue that will help you reach these guidelines (e.g., biking 25 minutes to and from school three times a week)? Try to choose an activity that is appealing to you and will be possible to implement in the next 6-weeks.

Goal:

_____

_____

_____

Within the next six weeks, how likely is it that you will increase your physical activity to the extent you just indicated?

Not at all						Very Much
○	○	○	○	○	○	○

Within the next six weeks, how important is it to you to increase your physical activity to the extent you just indicated?

Not at all						Very Much
○	○	○	○	○	○	○

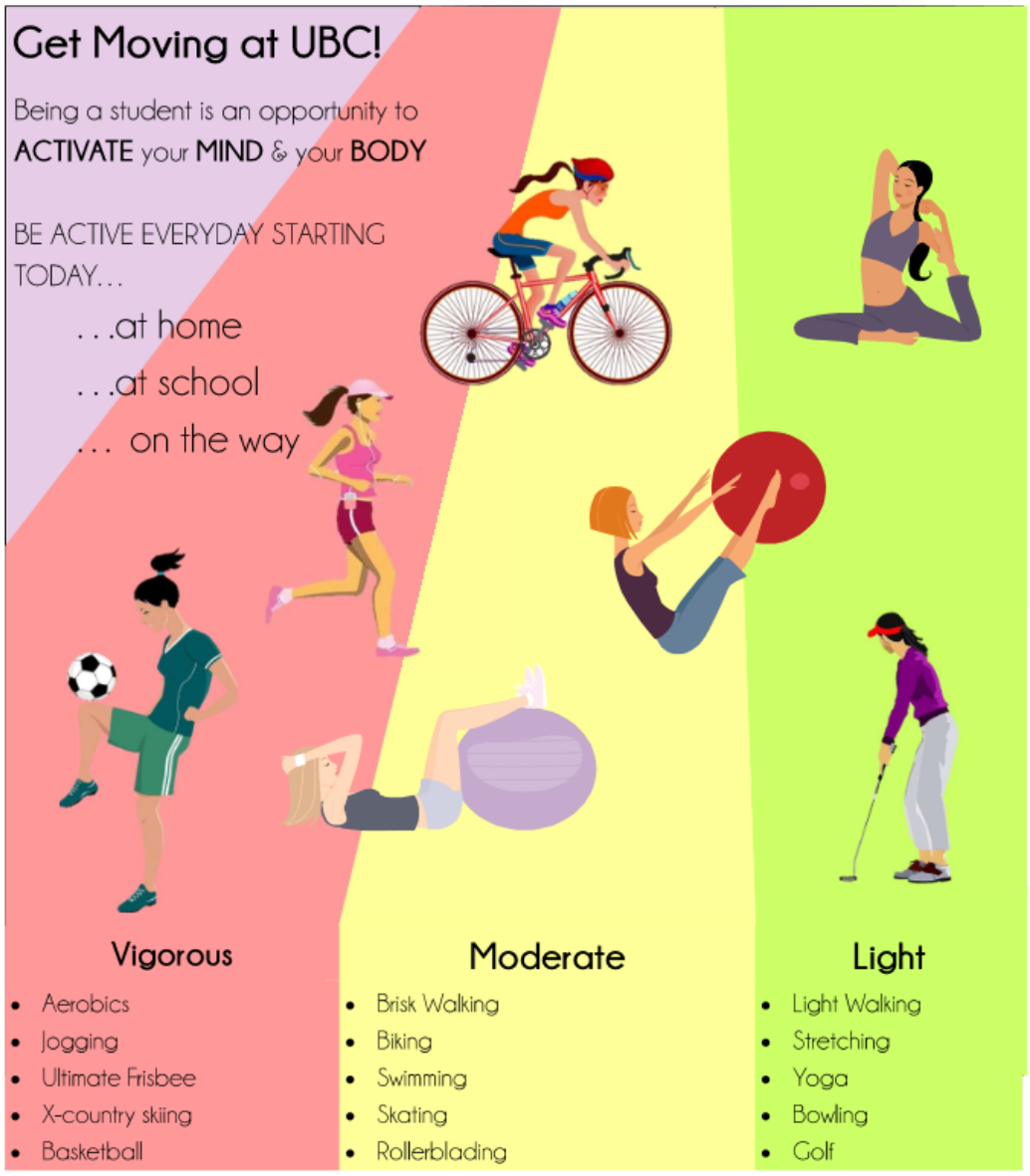
Step 2: What are your benefits and barriers?

Please consider the most positive outcome you associate with achieving your goal and write it down in one keyword. **Why might you find exercise to be enjoyable, pleasant, exciting, or fun?** Now imagine the events and experiences that you associate with this outcome. Try to describe this outcome as vividly as possible! Take as much time and space as you need to write down what you are thinking. If you need more space to write, please use the back of the page.

Sometimes, despite your best intentions, you may encounter distractions, temptations or difficulties that prevent you from achieving your goal. **Why might you find exercise activities to be unenjoyable, unpleasant, boring, or miserable?** Think about which is the most important obstacle to being physically active for you personally and write it down in one keyword. Now imagine the events and experiences that you associate with this obstacle. Try to describe this obstacle as vividly as possible! Take as much time and space as you need to write down what you are thinking. If you need more space to write, please use the back of the page.

Appendix E: Instrumental Mental Contrasting Intervention

Adapted with permission from Bray et al. (2011).



According to the Canadian Physical Activity Guidelines adults aged 18-64 years should accumulate at least **150 minutes of moderate- to vigorous-intensity aerobic physical activity** per week, in bouts of **10 minutes or more** . Depending on the intensity of the activity, you can vary the amount of time you are active. Accumulating activity is easy if you try to ***BE ACTIVE WHENEVER POSSIBLE***!

Achieving 150 minutes of physical activity per week is easier than you think!

During your time in residence**, being physically active doesn't have to be hard**. Here are some examples of how you can include physical activities into your daily routine:

At home…	☐	Establish a morning or evening activity routine (e.g., wake up with a light jog or swim)
	☐	Include variety into your routine by alternating the activities you do!
	☐	Take a 5-minute stretch break during periods of inactivity (e.g., studying, watching TV).
At school…	☐	Take advantage of fitness consultations at the campus gym and sign-up for a physical activity class (e.g., yoga, cycling, dance) – take a friend along and start together
	☐	Take a brisk walk between classes – explore the campus and get to know your classmates better.
On the way…	☐	Walk across campus and grab your morning coffee from the furthest café
	☐	Walk, blade, board, or cycle to school
	☐	Walk a couple of blocks before you hop on the bus.

Of course these are only a few suggestions that can help guide you along the road to a physically active lifestyle. Remember that a little activation can go a long way…**start paving your pathway today!**

DID YOU KNOW?

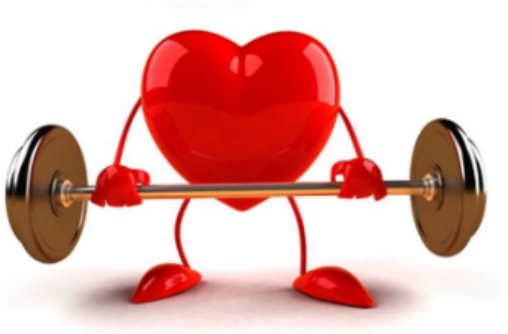
Help yourself stay healthy this year by exercising! Being physically active has lots of long-term health benefits, such as;

⇒ Decreases the risk of heart disease and hypertension (Warburton et al., 2006, 2007).

⇒ Helps you lose weight, or keep weight off (Gropper, Simmons, Connel & Ulrich, 2012; Penedo, & Dahn, 2005)

⇒ Decreases the risk diabetes, cancer, and osteoporosis (Warburton et al., 2006, 2007).

⇒ Helps increase cognitive performance, including improved learning and memory (Penedo, & Dahn, 2005; Van Praag, 2009).



Continuing to be physically active in university is critical because a decline in physical activity during the first few months of university may lead to a pattern of inactivity that persists through- out one's university years and beyond (Bray & Born, 2010).

Step 1: Set your goal

As mentioned previously, according to the Canadian Physical Activity Guidelines adults aged 18-64 years should accumulate at least **150 minutes of moderate- to vigorous-intensity aerobic physical activity per week, in bouts of 10 minutes or more**. **Your goal for the next six weeks is to meet these guidelines!** Look back to the examples given on the previous two pages. What is a specific physical activity that you want to start or continue that will help you reach these guidelines (e.g., biking 25 minutes to and from school three times a week)? Try to choose an activity that is appealing to you and will be possible to implement in the next 6-weeks.

Goal:

_____

_____

_____

Within the next six weeks, how likely is it that you will increase your physical activity to the extent you just indicated?

Not at all Very Much

○ ○ ○ ○ ○ ○ ○

Within the next six weeks, how important is it to you to increase your physical activity to the extent you just indicated?

Not at all Very Much

○ ○ ○ ○ ○ ○ ○

Step 2: What are your benefits and barriers?

Please consider the most positive outcome you associate with achieving your goal and write it down in one keyword. **Why might you find exercise to be useful, advantageous, beneficial, or important?** Now imagine the events and experiences that you associate with this outcome. Try to describe this outcome as vividly as possible! Take as much time and space as you need to write down what you are thinking. If you need more space to write, please use the back of the page.

Sometimes, despite your best intentions, you may encounter distractions, temptations or difficulties that prevent you from achieving your goal. **Why might you find exercise activities to be unimportant, useless, inconvenient, or detrimental** ? Think about which is the most important obstacle to being physically active for you personally and write it down in one keyword. Now imagine the events and experiences that you associate with this obstacle. Try to describe this obstacle as vividly as possible! Take as much time and space as you need to write down what you are thinking. If you need more space to write, please use the back of the page.

Appendix F: Daily physical activity log to complement accelerometers

Instructions: Fill this page out at the end of the day. For each activity, circle *yes* if you did the activity and *no* if you did not do the activity. For each activity you did, write down the number of hours and/or minutes you were actually moving and the time you began the activity (am or pm). If you did an activity many times during the day, write down the total time you did that activity during the day. If you did many activities that are not on the list, please write them on the line labeled 'other', circle yes and write in the hours and/or minutes. **Remember to record only the hours and/or minutes you were actively engaged in the activity and only include activities that were longer than 10 minutes in duration.**

Day of the Week: M T W Th F Sa Su

Did you do this activity today?	Yes	No	How long?		Time Started activity (AM or PM)
	(Circle one)		Hours	Minutes	
Transportation (to and from)					
Walk to work, school, shopping	Yes	No	_____	:_____	_____
Bicycle to work, school shopping	Yes	No	_____	:_____	_____
Other_____	Yes	No	_____	:_____	_____
Conditioning Activities					
Aerobic exercise, Aerobic dance	Yes	No	_____	:_____	_____
Bicycling	Yes	No	_____	:_____	_____
Calisthenics or Gymnastics	Yes	No	_____	:_____	_____
Jogging or Running	Yes	No	_____	:_____	_____
Hiking with Pack or in Mountains	Yes	No	_____	:_____	_____
Martial Arts (judo, karate, tai chi)	Yes	No	_____	:_____	_____
Rowing a boat, canoeing	Yes	No	_____	:_____	_____
Swimming	Yes	No	_____	:_____	_____
Walking for Exercise	Yes	No	_____	:_____	_____
Weight Lifting, Body Building	Yes	No	_____	:_____	_____
Other_____	Yes	No	_____	:_____	_____
Other_____	Yes	No	_____	:_____	_____
Sports Activities					
Baseball or Softball	Yes	No	_____	:_____	_____
Basketball	Yes	No	_____	:_____	_____
Surfing	Yes	No	_____	:_____	_____
Cross-country Skiing	Yes	No	_____	:_____	_____
Downhill Skiing	Yes	No	_____	:_____	_____
Racquetball, or Squash	Yes	No	_____	:_____	_____
Ice or Roller Skating, Ice Hockey	Yes	No	_____	:_____	_____

Rugby, Football	Yes	No	_____	:_____	_____
Soccer	Yes	No	_____	:_____	_____
Tennis	Yes	No	_____	:_____	_____
Volleyball	Yes	No	_____	:_____	_____
Other_____	Yes	No	_____	:_____	_____
Other_____	Yes	No	_____	:_____	_____
Leisure Activities					
Bowling	Yes	No	_____	:_____	_____
General Dancing	Yes	No	_____	:_____	_____
Golf	Yes	No	_____	:_____	_____
Table Tennis	Yes	No	_____	:_____	_____
Walking for Pleasure of Social	Yes	No	_____	:_____	_____
Yoga	Yes	No	_____	:_____	_____
Other_____	Yes	No	_____	:_____	_____
Other_____	Yes	No	_____	:_____	_____

Please record the time you put on your motion detectors *on in the morning* and the time you take them *off at night.*

Time *on* in the morning _____ Time *off* at night _____

Appendix G: Item Level Descriptive Statistics

Descriptive Statistics

	N	Range	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
T1UnSatisfyingSatisfying	105	6.00	6.0000	1.16850	-1.401	.236	2.539	.467
T1UselessUseful	105	4.00	6.4286	.77033	-1.557	.236	3.216	.467
T1UnimportantImportant	105	5.00	5.9238	1.08038	-.965	.236	.918	.467
T1UnpleasantPleasant	105	6.00	5.0381	1.43396	-.607	.236	.063	.467
T1UnenjoyableEnjoyable	105	6.00	5.1714	1.34777	-.799	.236	.788	.467
T1WorthlessValuable	105	2.00	6.3619	.73542	-.691	.236	-.839	.467
T1NotWorthwileWorthwile	104	4.00	6.1635	.93591	-1.059	.237	.985	.469
T1BoringExciting	105	5.00	4.9048	1.39728	-.301	.236	-.542	.467
T1HarmfulBeneficial	105	3.00	6.6571	.64790	-2.121	.236	4.717	.467
T1_RC_CalmingStressful	105	6.00	4.4857	1.48786	.028	.236	-.518	.467
T2UnSatisfyingSatisfying	101	3.00	6.1386	.91684	-.758	.240	-.387	.476
T2UselessUseful	101	3.00	6.4158	.76508	-1.146	.240	.623	.476
T2UnimportantImportant	101	4.00	6.1881	.86848	-.845	.240	.411	.476
T2UnpleasantPleasant	101	4.00	5.3465	1.08107	-.296	.240	-.401	.476
T2UnenjoyableEnjoyable	101	5.00	5.4158	1.11595	-.533	.240	.102	.476
T2WorthlessValuable	101	2.00	6.4851	.64209	-.869	.240	-.286	.476
T2NotWorthwileWorthwile	100	3.00	6.3000	.74536	-.702	.241	-.335	.478
T2BoringExciting	101	5.00	5.0990	1.03446	-.202	.240	-.066	.476
T2HarmfulBeneficial	101	3.00	6.6931	.57866	-2.066	.240	4.767	.476
T2_RC_CalmingStressful	101	6.00	4.2970	1.57191	.203	.240	-.969	.476
T3UnSatisfyingSatisfying	96	6.00	6.0417	1.14171	-1.860	.246	4.727	.488
T3UselessUseful	96	5.00	6.1458	.88233	-1.419	.246	3.996	.488
T3UnimportantImportant	96	6.00	5.8438	1.24248	-1.580	.246	2.997	.488
T3UnpleasantPleasant	96	6.00	5.3542	1.33755	-1.001	.246	1.304	.488
T3UnenjoyableEnjoyable	96	6.00	5.5000	1.24816	-.995	.246	1.356	.488
T3WorthlessValuable	96	4.00	6.2500	.78136	-1.014	.246	1.682	.488
T3NotWorthwileWorthwile	96	5.00	5.9896	1.07110	-1.239	.246	1.665	.488
T3BoringExciting	96	5.00	5.1146	1.25547	-.384	.246	.006	.488
T3HarmfulBeneficial	96	5.00	6.4896	.79465	-2.536	.246	10.260	.488
T3_RC_CalmingStressful	96	6.00	4.4688	1.78268	-.113	.246	-1.077	.488
Valid N (listwise)	94							