

**IS VARIETY A SPICE OF (AN ACTIVE) LIFE?: THE EFFECTS OF VARIETY ON
EXERCISE BEHAVIOUR AND EXERCISE-RELATED WELL-BEING**

by

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Abstract

The overall purpose of this dissertation was to examine variety in exercise, and investigate the extent to which the experience of variety in exercise is an additional psychological experience (i.e., when examined alongside satisfaction of the needs for competence, relatedness, and autonomy, embedded within self-determination theory) that has implications for increasing exercise behaviour and exercise-related well-being. The primary purpose of Study 1 was to develop an instrument to measure perceived variety in exercise, and examine whether ratings of perceived variety in exercise prospectively predict unique variance in indices of exercise-related well-being (when examined alongside the three basic psychological needs within self-determination theory, Deci & Ryan, 2002). The results indicate that perceived variety in exercise explains an important amount of variance in indices of exercise-related well-being, in addition to satisfaction of the needs for competence, relatedness, and autonomy. In Study 2 we examined whether perceived variety in exercise complements satisfaction of these three needs by prospectively predicting variance in exercise behaviour, through the mediating role of autonomous and controlled motivation. Results showed that perceived variety, competence, and relatedness were unique indirect positive predictors of exercise behaviour via autonomous motivation, and autonomy was found to negatively predict controlled motivation. Subsequently, we conducted a field-based experimental investigation for Studies 3 and 4 to examine whether the experience of variety in exercise *causally influences* exercise adherence behaviour and exercise-related well-being, respectively. Findings from Study 3 showed that greater exercise-related variety support influenced perceptions of variety in exercise, but not perceptions of competence, relatedness, or autonomy in exercise. Furthermore, greater variety support lead to

improved exercise adherence, and that relationship was explained by perceived variety in exercise. In Study 4, we found evidence that exercise-related variety support led to higher scores on indices of exercise-related well-being, and that these relationships were mediated by perceptions of variety in exercise. Studies 3 and 4 provide evidence for the utility of targeting the experience of variety to influence exercise behaviour and exercise-related well-being. Combined, these investigations further our understanding of the predictive and causal implications that variety in exercise may have for exercise behaviour and exercise-related well-being.

Preface

Study 1 (outlined in chapter 2) was conducted at the University of British Columbia. The manuscript was published in *Psychology and Health* (date of publication: 27 March 2014; copyright Routledge). The citation is as follows: [Sylvester, B. D., Standage, M., Dowd, A. J., Martin, L. J., Sweet, S. N., & Beauchamp, M. R. (2014). Perceived variety, psychological needs satisfaction, and exercise-related well-being. *Psychology & Health*. doi:10.1080/08870446.2014.907900]. Print form is also available through the journal. Ethical approval was granted by the University of British Columbia Research Ethics Board (**H10-02671**). Dr. Martyn Standage, Dr. Justine Dowd, Dr. Luc Martin, Dr. Shane Sweet, and Dr. Mark Beauchamp are co-authors on this manuscript. I was responsible for all aspects of the research such as designing the research question, collecting the data, analyzing and interpreting the data, and manuscript preparation.

Study 2 (outlined in Chapter 3) was also conducted at the University of British Columbia. A version of this manuscript was published in the *Journal of Sport and Exercise Psychology* (date of publication: 30 October 2014; copyright Human Kinetics). The citation is as follows: [Sylvester, B. D., Standage, M., Ark, T., Sweet, S. N., Crocker, P. R. E., Zumbo, B. D., & Beauchamp, M. R. (2014). Is variety a spice of (an active) life?: Perceived variety, exercise behavior, and the mediating role of autonomous motivation. *Journal of Sport & Exercise Psychology*, 36(5), 516-527. doi:10.1123/jsep.2014-0102]. Print form is also available through the journal. Ethical approval was granted by the University of British Columbia Behavioural Research Ethics Board (**H10-02671**). Dr. Martyn Standage, Dr. Tavinder Ark, Dr. Shane Sweet, Dr. Peter Crocker, Dr. Bruno Zumbo and Dr. Mark Beauchamp are co-authors on this manuscript. I was involved in all aspects of this investigation including study design, ethical

application, participant recruitment, data collection, analysis and interpretation of the data, and manuscript preparation.

Study 3 (outlined in Chapter 4) was conducted at the University of British Columbia. A version of this manuscript was published in the *Journal of Behavioral Medicine* (date of online publication: 6 November 2015; copyright Springer). The citation is as follows: [Sylvester, B. D., Standage, M., McEwan, D., Wolf, S. A., Lubans, D. R., Eather, N., Kaulius, M., Ruissen, G. R., Crocker, P. R. E., Zumbo, B. D., & Beauchamp, M. R. (2015). Variety support and exercise adherence behavior: Experimental and mediating effects. *Journal of Behavioral Medicine*. doi: 10.1007/s10865-015-9688-4]. Print form is also available through the journal. Ethical approval was granted by the University of British Columbia Behavioural Research Ethics Board (**H10-02671**). Dr. Martyn Standage, Desmond McEwan, Dr. Svenja Wolf, Dr. David Lubans, Dr. Narelle Eather, Megan Kaulius, GERALYN Ruissen, Dr. Peter Crocker, Dr. Bruno Zumbo and Dr. Mark Beauchamp are co-authors on this manuscript. I led all aspects of this investigation including study design, ethical application, participant recruitment, conducting the intervention, data collection, data analysis and interpretation of the data, and manuscript preparation. Ethical approval was granted by the University of British Columbia Behavioural Research Ethics Board (**H12-02445**).

Study 4 (outlined in Chapter 5) was conducted at the University of British Columbia. A version of this manuscript has been revised and resubmitted for consideration in a peer – reviewed journal. Dr. David Lubans, Dr. Narelle Eather, Dr. Martyn Standage, Dr. Svenja Wolf, Desmond McEwan, GERALYN Ruissen, Megan Kaulius, Dr. Peter Crocker, and Dr. Mark Beauchamp are co-authors on the manuscript. I led all aspects of this investigation including study design, ethical application, participant recruitment, conducting the intervention, data

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List of Abbreviations

ANCOVA- Analysis of Covariance
AVE- Average Variance Extracted
BPNT- Basic Psychological Needs Theory
BREQ- Behavioural Regulations in Exercise Questionnaire
CET- Cognitive Evaluation Theory
CFA- Confirmatory Factor Analysis
CFI- Comparative Fit Index
CI- Confidence Interval
CR- Composite Reliability
DOMS- Delayed-Onset Muscle Soreness
EFA- Exploratory Factor Analysis
GLTEQ- Godin Leisure-Time Exercise Questionnaire
HVS- High Variety Support
ITT- Intention to Treat
LVS- Low Variety Support
LVMANCOVA- Latent Variable Multivariate Analysis of Covariance
LVR- Latent Variable Regression
MCAR- Missing Completely at Random
OIT- Organismic Integration Theory
PARQ+- Physical Activity Readiness Questionnaire for Everyone
PNSE- Psychological Needs Satisfaction in Exercise
PVE- Perceived Variety in Exercise
RMSEA- Root Mean Square Error of Approximation
SDT- Self-determination Theory
SEM- Structural Equation Modelling
SPANES- Scale for Positive And Negative Emotions
SVS- Subjective Vitality Scale
TLI- Tucker-Lewis Index
WLSMV- Weighted Least Squares Means and Variances Adjusted

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Chapter 1: Introduction

1.1 Physical Inactivity and the Promotion of Exercise Behaviour

Physical inactivity is pervasive across the globe (Hallal et al., 2012) and contributes to numerous non-communicable health disorders such as heart disease, obesity, depression, and other chronic conditions (Cooney et al., 2013; Lee et al., 2012). In addition to the human/individual cost of physical inactivity, the economic costs are considerable. For example, in Canada, the economic cost associated with physical inactivity is estimated to be 2.6% of total health care expenses (Katzmarzyk & Janssen, 2004). A wealth of evidence supports the notion that physical activity (which refers to any bodily movement produced by the skeletal muscles that increases the rate of energy expenditure; Bouchard, Blair, & Haskell, 2007) is an effective form of prevention and treatment of many non-communicable diseases (Archer & Blair, 2012) and a modest increase in physical activity levels could greatly reduce health care costs (Katzmarzyk & Janssen, 2004). As such, physical activity has become a public health priority as researchers seek to identify strategies to increase physical activity levels to prevent (and treat) health disorders and reduce the ensuing costs associated with physical inactivity (Pratt et al., 2015).

Multiple approaches have been adopted to address the current state of global physical inactivity, including the use of ecological models (Bauman et al., 2012; Pratt et al., 2015) and interventions that utilize psychological theories of health behaviour (Rothman, 2004). Ecological approaches are thought to be the most comprehensive for addressing physical activity because they incorporate the interaction of influential factors at the individual, interpersonal, and environmental levels (Pratt et al., 2015). Interventions that consider factors at multiple levels

simultaneously are thought to be the most effective at changing physical activity behaviour (Sallis et al., 2008). However, prior to implementing complex multi-level physical activity interventions, it is necessary for researchers to identify evidence-based intervention strategies that are effective at each level of influence. One promising line of investigation for identifying effective intervention strategies involves the psychological factors that are implicated in changing physical activity behaviour (e.g., Rothman, 2004). Psychological factors that are involved in changing physical activity behaviour are integrated and organized within psychological theories of health behaviour which enable researchers to predict/explain physical activity behaviour by specifying relations among relevant variables (Glanz, Lewis, & Rimer, 1997).

Interventions have been found to be more effective at changing behaviour if they target theoretical mechanisms (e.g., causal determinants) of behaviour than if they are atheoretical (e.g., Baranowski et al., 1998). However, when behavioural interventions are based on theory, researchers have shown (only) moderate success at changing physical activity behaviour (cf. Hillsdon, Foster, Thorogood, 2005). For example, in the theory of planned behaviour, Ajzen (1991) suggests is that one's intention to perform a given behaviour is the most proximal determinant of behaviour. However, in a recent meta-analysis to examine experimental evidence regarding the intention-to-behaviour relationship in physical activity contexts, Rhodes and Dickau (2012) found that changes in intentions to engage in physical activity ($d = .45$) did not result in meaningful changes in physical activity behaviour ($d = .15$). This finding has substantial importance for researchers trying to change physical activity behaviour as the theory of planned behaviour may be suitable for understanding and predicting intentions to be

physically active, but is not as useful for changing actual physical activity behaviour (Rhodes, 2013). Another theory that has shown moderate success for explaining physical activity behaviour change is social cognitive theory (Bandura, 1986; 1997). Within social cognitive theory, Bandura (1997) contends that human functioning can be explained by reciprocal causation between personal (e.g., attitudes and beliefs), environmental (e.g., space availability) and behavioural (e.g., choices, and persistence) factors. Self-efficacy (i.e., one's context specific beliefs regarding their capabilities to effectively complete a given behaviour; Bandura, 2000) is a focal construct in social cognitive theory, yet only accounts for a moderate amount of behaviour change and minimal changes in maintenance of physical activity (e.g., Dishman & Buckworth, 1996; Baranowski et al., 1998; Lewis et al., 2002). In a recent meta-analysis, Williams and French (2011) found that changes in self-efficacy are associated with changes in physical activity behaviour, however, interventions that target self-efficacy only produced a small effect on physical activity behaviour (i.e., $d = .21$) and notable unexplained variance in physical activity behaviour remains. Despite the modest utility of using psychological theories for changing physical activity behaviour (cf. Rothman, 2004), researchers have called for innovative advancements to existing theories to improve their utility for influencing physical activity behaviour (cf. Head & Noar, 2014; Noar & Head, 2014).

Self-determination theory (SDT; Deci & Ryan, 1985, 2012; described below) is another theory that provides valuable insight into the psychological factors that are implicated in promoting physical activity behaviour (e.g., Teixeira et al., 2012) and there have been calls for researchers to test the utility of additional psychological factors against those embedded within SDT (e.g., Sheldon, 2011). In this dissertation we examine a psychological factor, namely the

experience of variety, that may have implications for physical activity behaviour, beyond the existing tenets of SDT. Furthermore, in addition to explaining the antecedents of physical activity behaviour, within SDT, Deci and Ryan (1985, 2012) also provide insight into the development of context-specific well-being (i.e., optimal psychological functioning). While well-being is thought to be a worthwhile research pursuit in and of itself (see Diener, 2000), researchers suggest that cultivating positive psychological experiences (i.e., well-being) in physical activity contexts could promote physical activity behaviour and health (Ekkekakis, Hargreaves, & Parfitt, 2013). Given our interest in improving health, we chose to examine well-being, and behaviour in the context of *exercise*, which refers to a subgroup of physical activity characterized by planned, structured, and repetitive movement with the intention of improving or maintaining aspects of health (Nieman, 2011). In the studies presented in this dissertation, our outcome variables were either indices of exercise-related well-being, or exercise behaviour. Since well-being is also a focal outcome within SDT, prior to explaining SDT in greater detail, I first provide an overview of our approach to examining exercise-related well-being.

1.2 Exercise-Related Well-Being

From a psychological and SDT perspective, well-being refers to optimal experiences, and is characterized by the presence of positive feelings, low levels of negative feelings, as well as feeling alert, energized, and vital (Ryan & Deci, 2001). Well-being is comprised of two conceptually related, yet distinct components, namely hedonic (Kahneman, Diener, & Schwarz, 1999) and eudaimonic (Ryan & Deci 2001; Kahneman et al., 1999) well-being. Hedonic well-being refers to the experiences of happiness and pleasure, and is characterized by high positive affect and low negative affect (Ryan & Deci, 2001) whereas eudaimonic well-being refers to

meaning, self-actualization, and the process of living well (Ryan et al., 2008). The differentiated approach to conceptualizing well-being has received empirical support as researchers have found that items representing hedonic and eudaimonic well-being load onto distinct (albeit correlated) factors (cf. Gallagher, Lopez, & Preacher, 2009; Waterman, Schwartz, & Conti, 2008). To advance knowledge regarding the determinants of well-being (e.g., fostering well-being in exercise contexts), researchers should examine both hedonic and eudaimonic components of well-being as focusing on one, at the expense of the other, may restrict progress in identifying the factors that contribute to optimal functioning (Ryan & Deci, 2001; Ryan et al., 2008). SDT has garnered widespread research support for delineating the psychological factors that develop both hedonic and eudaimonic well-being in exercise contexts (and influence exercise behaviour; Ryan & Deci, 2001; 2008; Teixeira et al., 2012).

1.3 Self-Determination Theory

SDT (Deci & Ryan, 1985, 2012) is an organismic dialectic meta-theory of human motivation and personality, in which Deci and Ryan contend that humans have a natural, innate tendency for growth and development. Deci and Ryan (2000) posit that humans are constantly building on their unified sense of self and naturally integrate themselves into their social environment. SDT's framework is comprised of six "mini theories" which include Causality Orientations Theory; Goal Contents Theory; Relationship Motivation Theory; Cognitive Evaluation Theory, (CET); Organismic Integration Theory, (OIT) and Basic Psychological Needs Theory, (BPNT) (Deci & Ryan, 2002, 2012, 2014). Each "mini theory" addresses a facet of motivation or personal functioning, and is integrated to form a unified approach (within the SDT meta-theory) to understanding human growth and development (Deci & Ryan 2012).

However, since our aim was to examine a psychological factor (i.e., the experience of variety) in relation to exercise behaviour and indices of exercise-related well-being, of direct relevance to this dissertation are CET, OIT and BPNT. Specifically, CET addresses intrinsic motivation and how contextual factors (e.g., environmental supports) and subsequent psychological experiences, foster behaviour ‘for its own sake’. Within OIT, Ryan and Deci (2002) consider extrinsic regulations, which refer to reasons to engage in certain behaviours that are independent of the behaviour itself. Ryan and Deci (2002) contend that extrinsic regulations range along a continuum from least to most internalized (which include external, introjected, identified and integrated), and more internalized forms of extrinsic motivation (i.e., more autonomous reasons) are associated with adaptive outcomes such as increased achievement behaviour. Within OIT, Ryan and Deci (2002) further suggest that conditions that support satisfaction of three basic psychological needs for autonomy, competency and relatedness (described below) enhance persistence and behaviour through more internalized forms of motivation. Finally, within BPNT, Ryan and Deci contend that satisfaction of the same three basic psychological needs are also essential to promoting (or thwarting) well-being in a given context (such as exercise; Deci & Ryan, 1985; Ryan & Deci, 2002). Taken together, through these “mini theories”, Ryan and Deci (2002) outline the necessary environmental/social conditions and psychological needs that lead to (a) internalized motivation and subsequent behaviour in a given context (such as exercise), as well as (b) context-specific well-being.

The notion of psychological needs is central to SDT. Psychological needs are theorized to be universal, innate psychosocial experiences that people need to feel to foster ongoing psychological growth, integrity, well-being, and integration into their social environment (Deci

& Ryan, 2000; Ryan & Deci, 2002). Ryan and Deci (2002) propose there are three basic psychological needs for competence, relatedness, and autonomy, which provide a basis for identifying aspects of an experience as positive (or negative) to one's psychological well-being. Competence refers to feeling capable of effectively dealing with challenges in one's social environment (White, 1959; Ryan, & Deci, 2002). Relatedness reflects interacting with others, and feeling connected with them (Baumeister & Leary, 1995; Ryan & Deci, 2002). Finally, autonomy refers to feeling as though one is a self-governing, causal agent of his/her own actions and decisions (DeCharms, 1968; Ryan & Deci, 2002). People tend to experience these essential psychological needs as a result of orienting themselves towards social environments that are personally interesting and important (Deci & Vansteenkiste, 2004). While satisfaction of these basic psychological needs can occur at situational, contextual, and global levels (Diener & Emmons, 1985; Vallerand, 1997), in the studies presented in this dissertation we focus our attention in relation to satisfaction of these needs in the 'context' of exercise.

In addition to identifying the conditions necessary to experience well-being in a given context (such as exercise), within SDT, Deci and Ryan (1985, 2012) advocate that the degree to which people experience satisfaction (or thwarting) of the basic psychological needs in any given context, is also associated with subsequent adaptive (or maladaptive) behaviour through autonomous and controlled forms of motivation. Autonomous motivation is a volitional type of motivation that leads to engagement and persistence in activities, whereas controlled motivation refers to acting due to internal, or external constraints, and leads to disengagement and ill-effects (Deci & Ryan, 2002, 2012). In a recent systematic review researchers found support that cultivating satisfaction of the needs for competence, relatedness, and autonomy in exercise

(through contextual supports) leads to exercise behaviour through autonomous motivation (e.g., Teixeira et al., 2012). While this approach has revealed small-moderate effects in explaining exercise behaviour (via autonomous motivation; Teixeira et al., 2012), unexplained variance in exercise behaviour remains, and may be attributable to psychological experiences that are not subsumed within satisfaction of the needs for competence, relatedness, and autonomy (Sheldon, 2011).

Sheldon (2011) noted that the lack of research concerning discriminant validity of psychological experiences (compared to the basic psychological needs) is a main limitation of SDT research. Specifically, Sheldon (2011) argued that in addition to satisfaction of the three basic psychological needs, other positive psychological experiences that explain variance in behaviour and well-being may exist and should be empirically examined from an SDT perspective. As such, SDT is one psychological theory in which additional psychological constructs should be examined within, to potentially enhance researchers' understanding of the causal determinants of exercise behaviour and exercise-related well-being.

1.4 Variety

One such experience that may have implications for how much exercise behaviour people engage in, and how they feel in exercise, is the experience of *variety*. Variety refers to a diversity of novel/alternating activities, behaviours, and opportunities (cf. Dimmock, Jackson, Podlog, & Magaraggia, 2013; Kahn & Ratner, 2005; Sheldon, Boehm, & Lyubomirsky, 2012; Sheldon & Lyubomirsky, 2012). Through the studies presented in this dissertation, we used the SDT framework to comprehensively examine how variety might be related to improved exercise behaviour and exercise-related well-being. Researchers have examined variety as both *variety*

support which refers to the provision of diverse endeavours and opportunities (Lyubomirsky & Layous, 2013) that are expected to facilitate the experience of variety, as well as the *experience of variety* which refers to whether people feel (or felt) like they engage in a range of endeavours and opportunities. Within this dissertation we examined the effects of both exercise-related variety support and the experience of variety in exercise.

1.5 Variety Support

Structuring activities, behaviours and opportunities to elicit (or inhibit) the experience of variety in a given context may influence both actions and feelings within that context. For example, researchers have examined variety as a characteristic of the environment (i.e., variety support; cf. Lyubomirsky & Layous, 2013) and found that the provision of variety support increases behaviour. Interestingly, in terms of food consumption, more is eaten when people are provided with a greater variety of food, than when they have only one option (even when that option is their favourite; Rolls, 1985). While recognizing that in dietary contexts, experiencing greater variety support may have deleterious effects by fostering over consumption (i.e., health-compromising behaviour), it is noteworthy that the provision of context-specific variety support may also act to influence health-enhancing context-specific behaviours (e.g., improved physical activity). Variety support may also have adaptive implications beyond immediate functioning as providing varied, compared to blocked practice schedules of motor skills improves retention and transfer of those skills (Magill & Hall, 1990). That is, engaging in variations of a task (e.g., multiple leg extension strength exercises) in changing sequences, may have a positive influence on learning/performance at a later time, when compared to engaging in the same task (e.g., a single leg extension exercise) in an unchanging, repeated sequence (Magill & Hall, 1990).

Finally, variety support is also associated with how people feel, as presenting people with varied, compared to homogeneous sequences of stimuli, positively influence pleasantness and interestingness (Berlyne, 1970) and thought sequences that are varied, compared to repetitive, produce greater positive affect (Pronin & Jacobs, 2008). Furthermore, Sheldon, Boehm and Lyubomirsky (2012) found that the positive feelings derived from an activity persist when people are instructed to vary the activities over time. For example, consider a person who initiates an exercise program. If their exercise program only includes one exercise, or the same sequence of exercises each exercise session, over time, the initial positive feeling gained from their new endeavour could wane. However, if the exercises are varied (i.e., novel/alternating among familiar behaviours) and unique combinations are presented each time (i.e., varied sequences, varied thoughts), the initial positive feelings would be expected to continue much longer than they otherwise would have.

Few studies on variety have been conducted in exercise contexts. However, researchers have provided exercise-related variety support and found that when people vary their exercise, they enjoy their exercise more, and engage in more exercise behaviour (Glaros & Janelle, 2001; Juvancic-Heltzel, Glickman, & Barkley, 2013). While the direct effects of variety support in exercise contexts are interesting, the authors of these studies took atheoretical approaches which limits insight into how/why exercise-related variety support relates to exercise behaviour and exercise-related well-being.

1.6 The Experience of Variety

One variable that might be implicated in explaining how/why exercise-related variety support promotes exercise behaviour and exercise-related well-being, is the experience of

variety. The experience of variety has received limited research attention, but has been found to prospectively predict indices of well-being (Sheldon & Lyubomirsky, 2012). Sheldon and Lyubomirsky (2012) conducted one of the first empirical examinations of variety as a psychological experience, noting the role that experiencing variety may play in maintaining happiness (akin to well-being; see their Hedonic Adaptation Prevention Model). Furthermore, in exercise contexts the expectation of experiencing variety is related to interest, enjoyment, and an internal perceived locus of causality, which are all indices of intrinsic motivation (i.e., an antecedent of behaviour; Dimmock et al., 2012). However, similar to the studies on variety support, the authors in these studies typically also used atheoretical approaches. By examining the experience of variety within the SDT framework (i.e., alongside satisfaction of the psychological needs for competence, relatedness, and autonomy in exercise), we can determine the extent to which the experience of variety may predict variance in indices of exercise behaviour and exercise-related well-being, and potentially explain how/why exercise-related variety support is associated with both exercise behaviour, and the experience of exercise-related well-being. For the sake of clarity, it is important to note that it was not our intention to test the experience of variety as a basic psychological need in this dissertation as we are cognizant of the fact that to determine whether a psychological experience should be considered a psychological need requires evidence regarding numerous criteria such as being innate and universal across cultures and contexts (cf. Sheldon, 2011) which was beyond the aim of this dissertation.

1.7 Purpose and Structure of this Dissertation

The overall purpose of this dissertation was to examine whether the experience of variety in exercise is an additional psychological experience (i.e., distinct from the basic psychological

needs for competence, autonomy, and relatedness, subsumed within SDT) that has implications for increasing exercise behaviour and exercise-related well-being. To achieve this aim (and in absence of an existing measure of perceived variety in exercise), in the first study of my dissertation (chapter 2), we undertook a substantive instrument development process to create a measure of perceived variety in exercise for use with adults (using validity theory which is discussed below). In that study, we looked at whether perceptions of variety in exercise complement satisfaction of the needs for competence, relatedness, and autonomy in the prospective prediction of indices of exercise-related well-being (i.e., positive and negative affect, as well as subjective vitality, experienced in exercise contexts). After finding that perceived variety, competence, relatedness, and autonomy in exercise, each predicted variance in indices of exercise-related positive affect and subjective vitality, within Study 1 we also sought to examine the extent to which perceptions of variety are empirically distinct from (or subsumed within) perceived competence, relatedness, and autonomy in exercise contexts. Conceptually, the experience of variety in exercise is separate from feelings of competence, relatedness, or autonomy, however, we wanted to test this notion empirically. Confirming our hypothesis, we found that perceived variety was associated, but independent (i.e., empirically distinct) from satisfaction of the three basic psychological needs. From these findings, we inferred that perceived variety in exercise is a unique construct when compared to satisfaction of the three basic needs, and could add a unique element in predicting positive indices of exercise-related well-being. Finally, we concluded that researchers should further examine the complementary role perceived variety in exercise could play in predicting adaptive outcomes in exercise contexts.

Subsequently, in Study 2 (presented in chapter 3), we sought to examine the extent to which perceived variety in exercise (along with satisfaction of the needs for competence, relatedness, and autonomy) predicts the amount of exercise behaviour people engage in over time, and the extent to which that relationship is explained by autonomous and/or controlled motivations for exercise. Perceived variety in exercise was again found to complement satisfaction of the basic psychological needs subsumed within SDT, and along with perceived competence and relatedness, perceived variety in exercise predicted variance in exercise behaviour six-weeks later. Furthermore, the relationship between perceptions of variety in exercise and exercise behaviour was mediated by autonomous motivation. That is, high quality autonomous motivation explained why perceptions of variety in exercise predicted variance in exercise behaviour, over time.

Based on the findings from these observational studies, we then sought to conduct a field-based experimental test to provide a robust examination of whether variety influences exercise behaviour, and exercise-related well-being in people who are physically inactive. In that experiment we randomly allocated one group to receive high variety support, and another group to receive low variety support in exercise contexts, in an attempt to manipulate the experience of variety in exercise. We compared those in each exercise program, and in Study 3 (chapter 4) found that those who received more variety support, better adhered to their exercise program. Furthermore, we found that the provision of variety support influenced perceptions of variety in exercise, but not perceptions of competence, relatedness, or autonomy in exercise. Finally, the degree to which people felt that they experienced variety in exercise was found to be a psychological mechanism that explained why/how variety support influenced exercise behaviour.

In addition to exercise behaviour, in the final study of my dissertation (i.e., Study 4, chapter 5) we sought to examine whether (and the extent to which) the intervention may have also had an effect on indices of exercise-related well-being. We found that for physically inactive people, the provision of high (compared to low) exercise-related variety support influenced how people felt in exercise contexts (i.e., indices of exercise-related positive affect, negative affect and subjective vitality), and the perception of experiencing variety in exercise was a psychological mechanism that explained the effects.

While chapters 2, 3, 4 and 5 can be considered as stand-alone papers (a version of chapter 2 has been published in *Psychology and Health*, a version of chapter 3 has been published in the *Journal of Sport and Exercise Psychology*, a version of chapter 4 has been published in the *Journal of Behavioral Medicine*, and a version of chapter 5 has been re-submitted to a peer-reviewed academic journal), these chapters also form part of a larger program of research, with sequential progression across the chapters. To guide this program of research, we took a validity theory approach (cf. Messick, 1995). Specifically, in light of the absence of an existing measure of perceived variety in exercise, as previously mentioned, in Study 1 (chapter 2) we developed a questionnaire to measure perceived variety in exercise, and throughout this dissertation, used a validity theory perspective to examine the nature of perceived variety in exercise scores. Because our research questions regarding perceived variety in exercise partially originated from contemporary validity theory (i.e., in addition to previous research such as Sheldon, Boehm, and Lyubomirsky (2012), and SDT; Ryan & Deci, 2002), I briefly describe validity theory (i.e., Messick, 1995; Hubley & Zumbo, 2011) and the process of validation that was used to guide this program of research.

1.8 Validity Theory and the Process of Validation

As described in detail in Study 1, following Clark and Watson's (1995) and Messick's (1989; 1995) frameworks, we first provided a thorough conception of perceived variety in exercise, created items, and then began to examine the evidential basis of validity (i.e., assessing the interpretation of perceived variety in exercise scores, and the relevance and utility of our inferences). Messick (1990) presented a unified view of validity that reflected "an integrated evaluative judgment of the degree to which empirical evidence and theoretical rationales support the adequacy and appropriateness of interpretations and actions based on test scores or other modes of assessment" (p. 1). Of particular note is that Messick's (1990) definition focused on inferences based on *test scores*, and *not the test* itself. That is, validity is concerned with evaluating the evidence and theory that support or refute interpretations of the test scores, not the measure per se (American Educational Research Association et al., 1999). As such, throughout this dissertation, validity evidence was gathered with regard to test scores (i.e., the responses) of perceived variety in exercise from each sample.

The initial function of measuring perceptions of variety in exercise is to interpret the responses people provide, and validity evidence is necessary to evaluate the trustworthiness of the responses to accurately reflect the experience of variety in exercise (cf. Hubley & Zumbo, 2011). The interpretation of the perceived variety in exercise scores refers to *construct validity*, which is at the core of Messick's unified view of validity and involves "the evidence and rationales supporting the trustworthiness of score interpretation in terms of explanatory concepts that account for both test performance and score relationships with other variables" (Messick, 1995, p.743). In line with Messick's unified view of validity, in Study 1 we provide evidence of

the content aspect of construct validity through a detailed conception of the construct and examined content relevance and representativeness. In addition to examining the reliability of the scores (to provide an estimation of internal consistency), we examined several sources of construct validity evidence by (a) conducting focus groups with adults to further understand the interpretation/response process of people in our target population (i.e., regarding the substantive aspect of validity), (b) examining the factor structure to determine the internal configuration of the scores, and (c) examining the relationships between perceived variety in exercise and exercise-related well-being to determine the utility of the scores and criterion relevance (i.e., external aspect of construct validity).

Construct validation is an ongoing process that involves developing and testing hypotheses through the collection of data, and making evaluations and inferences based on the evidence (Messick, 1995). Building upon Study 1, we continued to examine reliability and additional sources of validity evidence regarding the properties of the perceived variety in exercise responses. Specifically, in Study 2, we examined the predictive utility of perceived variety in exercise in relation to exercise behaviour, through autonomous and controlled motivation, six-weeks later. Finally, using experimental designs in Studies 3 and 4, we tested whether a proposed antecedent of the experience of variety (i.e., variety support), has an influence on perceptions of variety in exercise, and downstream effects on exercise behaviour, and exercise-related well-being, respectively. This provided a unique opportunity to examine convergence with hypothetically associated constructs (i.e., the contextual factor of variety support and the subsequent psychological experience of variety, as described in Studies 3 and 4), and subject our earlier findings based on observational designs (from Studies 1 and 2) to more

rigorous causal tests. These processes are described in greater detail in the following chapters, and conclude with a discussion in chapter 6 that appraises the overall contributions of the four empirical studies that constitute this dissertation, along with a consideration of implications for theory development and applied practice, and an appraisal of the studies' limitations and future research considerations.

Chapter 2: Perceived Variety, Psychological Needs Satisfaction, and Exercise-Related Well-Being

2.1 Introduction

Across multiple life domains the experience of *well-being* has been consistently found to result in a range of positive and adaptive responses among adults such as more fulfilling relationships, improvements in work success (Lyubomirsky, King, & Diener, 2005), as well as leading longer, healthier lives (Diener & Chan, 2011). Accordingly, it is not surprising that over the past two decades researchers have increasingly sought to better understand psychological factors that are necessary to develop and sustain well-being (Deci & Ryan, 2002). Well-being is characterized by the presence of positive feelings, the absence of negative feelings, and realizing human potentials to be fully functioning (Ryan & Deci, 2001).

One psychosocial experience that has garnered recent attention in the psychological well-being literature is the perception of *variety* (Sheldon, Boehm, & Lyubomirsky, 2012; Sheldon & Lyubomirsky, 2012). Variety refers to the pursuit and experience of diverse activities, behaviours, and opportunities in one's social milieu (cf. Kahn & Ratner, 2005; Sheldon & Lyubomirsky, 2012). While researchers have built support for the prevalence and value of varying one's experiences using various variety-like constructs (e.g., sensation-seeking and experiencing-seeking; Zuckerman, 1994), such constructs refer to personality traits in which one seeks complex, intense, and unconventional experiences in addition to experiences that are varied and novel. In the current study, experiencing variety was conceptualized as a psychological experience that included novel and/or alternating familiar experiences, which could also be simple, mundane, and conventional. Novel experiences stimulate interest (e.g.,

Silvia, 2006) and transiently support persistent behaviour, while alternating among familiar experiences reinforces learning and development (Hebb, 1949; also see McAlister and Pessemier's (1982), review on intrapersonal motives for varied behaviour). For the sake of conceptual clarity it is important to distinguish between the *psychological experience* of variety (i.e., felt variety), and the provisions that allow variety to happen (i.e., variety support). The former corresponds to a person's *perception* of whether he or she has experienced (or currently experiences) variety; whereas the latter corresponds to the range of opportunities that are (objectively) provided in a given social setting. It is the former —*experience of variety*— that forms the basis of enquiry in this paper.

Based on evidence that varied experiences are innately stimulating and rewarding (Berlyne, 1970; Pronin & Jacobs, 2008), researchers have examined perceptions of variety and found them to be instrumental in maintaining positive emotions derived from an activity through a *direct* relationship to well-being (Sheldon et al., 2012; Sheldon & Lyubomirsky, 2012). In their recent paper, Sheldon and colleagues (2012) suggested that through varied experiences well-being is bolstered by virtue of *prolonging the positive emotions* derived from an activity. In support of this contention, Sheldon et al. (2012, Study 2) found that participants who varied their experiences in an activity (i.e., providing varied acts of kindness to others via an experimental manipulation), were able to continue to experience well-being in that activity over time, whereas participants who did the same activity (i.e., routine/similar acts of kindness) in the same way each time, adapted to the positive effect and ceased to derive a boost in well-being from the activity. Although Sheldon et al.'s study specifically concerned acts of kindness, it is

noteworthy that the experience of variety appears to be implicated as an antecedent of the experience of well-being.

One context that holds particular potential for developing well-being is through exercise (Biddle & Ekkekakis, 2005). Exercise refers to a subgroup of leisure behaviour characterized by repeated bodily movements in planned and structured physical activity with the goal of maintaining or improving physical fitness (Bouchard, Blair, & Haskell, 2007). There is general consensus that participation in exercise is linked with higher levels of well-being (e.g., Netz, Wu, Becker, & Tenenbaum, 2005; Penedo & Dahn, 2005). Experiencing variety may be particularly salient in exercise contexts as the provision of variety has been found to be related to increased enjoyment of exercise (Dimmock, Jackson, Podlong & Magaraggia, 2013; Glaros & Janelle, 2001; Juvancic-Heltzel, Glickman, & Barkley, 2013). For example, Dimmock et al. (2013) found that participants who received messages that emphasized the variety of experiences they could expect in the two halves of their upcoming exercise session (i.e., providing support for variety), reported higher ratings of enjoyment of the exercise session and greater interest and perceived internal locus of causality in repeating the exercise session compared to participants who received messages emphasizing that they could expect to have the same experience in both halves (i.e., absence of variety). It is noteworthy, however, that people in both conditions participated in the same (i.e., non-autonomous) exercise protocol, suggesting that the perception of variety may be particularly important for well-being in exercise.

In their review on variety-seeking behaviour (i.e., the pursuit of varied experiences), Kahn and Ratner (2005) called for researchers to make use of psychological theory to measure the impact of variety-seeking behaviour in relation to a range of outcomes (such as well-being).

One theory that provides insight into the development and maintenance of well-being through psychosocial experiences is SDT (Deci & Ryan, 1985, 2002). SDT is an organismic dialectic meta-theory of human motivation and personality that considers humans to have a natural, innate tendency for growth and development (Deci & Ryan, 1985). This natural propensity is supported (or undermined) by the extent to which social contexts provide support for three basic and universal psychological needs (cf. Vansteenkiste & Ryan, 2013). Indeed, Deci and Ryan (1985, 2000) posit that psychological growth, well-being, and optimal functioning are promoted and fostered by social contexts that satisfy needs for competence, relatedness, and autonomy. Conversely, social-environmental settings that thwart these essential nutrients to well-being and development, frustrate basic need satisfaction and are linked to experiences of ill-being, malfunctioning, and constricted functioning (Vansteenkiste & Ryan, 2013).

The concept and phenomena of basic psychological needs are explicitly addressed within BPNT, which is a mini-theory within the broader SDT framework. Within BPNT, Deci and Ryan (2002) propose that there are (at least) three basic psychological needs (for competence, relatedness, and autonomy) and the degree to which each need is subjectively satisfied provides a basis for categorizing aspects of an experience as positive or negative in relation to one's psychological well-being, integrity, and growth. Competence refers to an individual's perception of their capability to effectively deal with challenges in their social environment (Deci & Ryan, 2002; White, 1959). Relatedness refers to positive interactions with others, and feelings of connectedness by caring for and being cared for by other people (Baumeister & Leary, 1995; Deci & Ryan, 2002). Finally, autonomy refers to feelings of self-governance, and feeling as though one is the causal agent of their own decisions and actions (deCharms, 1968; Deci &

Ryan, 2002). The key principles that define the psychological needs within BPNT are that they are organismic necessities that apply to all people, are not derivatives of other psychological needs, and have fundamental and direct relations to wellness and health (Deci & Ryan, 2002; Standage & Ryan, 2012).

Understanding the role of basic psychological needs satisfaction in exercise contexts in relation to well-being has been a longstanding focus of research in both exercise and health psychology (Fox & Wilson, 2008). Findings from previous studies in which researchers examined psychological needs satisfaction in exercise contexts have generally been consistent with BPNT (Deci & Ryan, 2002) such that people who report feeling greater satisfaction of the need for competence, relatedness, and autonomy also report higher levels of well-being (i.e., small-to-moderate positive relationships; e.g., Edmunds, Ntoumanis, & Duda, 2007; Wilson, Mack, Gunnell, Oster, & Gregson, 2008).

Despite the strong theoretical foundation of the relationships between perceived competence, relatedness, autonomy, and well-being, some scholars have highlighted the potential for other types of positive experiences to explain additional variation in well-being (Sheldon, 2011) and based on recent findings (e.g., Sheldon & Lyubomirsky, 2012), variety could be one such experience. Testing variety alongside the variables presented within BPNT appears warranted as the subjective perception of experiencing variety has also been found to have a *direct* effect on indices of contextual well-being (Sheldon et al., 2012; Sheldon & Lyubomirsky, 2012). While we would expect that experiencing variety would be related to well-being at both *global* and *situational* levels (cf. Vallerand, 1997), we were specifically interested in examining the experience of variety in the context of exercise. In the current investigation, the contextual

experience of variety was examined alongside (i.e., at the same level as) satisfaction of the needs for competence, relatedness, and autonomy because similar to satisfaction of the psychological needs, perceived variety in exercise is conceptualized as (a) a felt experience, (b) a predecessor of both intrinsic motivation (e.g., Dimmock et al., 2013) and well-being, (c) an indicator that helps categorize the extent to which an experience has a positive effect on well-being, and (d) having implications that extend beyond immediate psychological functioning (cf. Sheldon, 2011; Sheldon et al., 2012).

However, the variance in indices of well-being explained by variety may already be explained by satisfaction of the need for competence, relatedness, and autonomy, and perceived variety may have empirical overlap with (i.e., subsumed by) any or all of these psychological experiences. It seems prudent for researchers to investigate whether perceived variety explains unique variance in indices of well-being, in addition to that explained by perceived competence, relatedness, and autonomy and subsequently, whether perceptions of variety are empirically *distinct from* perceptions of competence, relatedness, and autonomy. Despite conceptualizing variety at the same *level* as perceived competence, relatedness, and autonomy, it was not our aim to test variety as a psychological need in the current investigation as we realize there are multiple considerations and criteria such as being *innate*, *universal*, and *necessary for well-being* (see Sheldon, 2011), that must be addressed prior to a construct being considered a psychological need.

The primary purpose of this study was to examine whether perceived variety in exercise predicts unique variance in exercise-related well-being over time, in addition to that explained by satisfaction of the three basic psychological needs embedded within BPNT (i.e., competence,

relatedness, and autonomy). The secondary purpose was to examine whether perceived variety is empirically distinct from perceptions of competence, relatedness, and autonomy in the context of exercise. In order to address the primary and secondary purposes of this study, and in the absence of an established questionnaire to assess perceived variety in exercise, we first sought to develop a measure of this psychological construct.

2.2 Methods

2.2.1 Participants

Participants ($N = 507$) were a community sample of adults (i.e., 18 to 83 years of age). Nine cases were deleted due to missing values (i.e., respondents who failed to provide information regarding perceived variety and satisfaction of the needs for competence, relatedness, and autonomy in the context of exercise). The resulting sample was comprised of 329 females ($M_{age} = 34.02$ years; $SD_{age} = 13.22$ years) and 178 males ($M_{age} = 33.61$ years; $SD_{age} = 13.30$ years). The majority of participants lived in Canada (94.67 %), were single (51.20%), Caucasian (76.20%), had completed at least a college diploma or university degree (72.10%), had full or part-time employment (64.2%), had an annual household income less than \$100,000 (74.70%) and on average, were classified as active at baseline ($M_{moderate-vigorous\ exercise} = 39.19$ units; $SD = 33.21$; Godin Leisure-Time Exercise Questionnaire; Godin, 2011).

2.2.2 Procedure

Following institutional ethical approval (see Appendix A and B), adults over the age of 18 years and able to read and converse in English were recruited online through postings (e.g., a blog) and in person at various events (e.g., recreational walks/runs and hiking areas) for this study. Using a prospective observational design, consenting participants completed the same

online questionnaire (which included a battery of instruments and took approximately 15 minutes) at two time points, six weeks apart. In order to compensate participants for their time, all participants were entered into a draw to win one of six \$50 gift certificates.

2.2.3 Measures

Perceived variety in exercise. We used a three-step process including item development, focus groups, and expert review to develop and refine items that assess perceptions of experiencing variety in exercise (see Appendix A). First, we conducted an extensive literature review of research relating to perceptions of variety with a particular focus on the context of exercise. In their seminal paper on instrument development, Clark and Watson (1995) highlight that developing a precise and detailed conception of the target construct is a critical first step. We defined variety as the pursuit and experience of diverse activities, behaviours, and opportunities in one's social milieu (cf. Kahn & Ratner, 2005; Sheldon & Lyubomirsky, 2012). Using the conceptual framework provided by Kahn and Ratner (2005), Sheldon (2011), and Sheldon and Lyubomirsky (2012) and existing questionnaires measuring variety (e.g., Experience Seeking subscale; Zuckerman, 2007) a comprehensive list of items was generated and refined by the authors, resulting in a preliminary 8-item measure.

Consultation with members of the target population can provide important information regarding the *content* (Messick, 1995; Vogt, King, & King, 2004), and *substantive* aspects of validity (Messick, 1995). Content aspects of validity are concerned with content relevance and representativeness, whereas substantive aspects of validity are concerned with how respondents interpret and make sense of items, and how this might be affected by the structure of the questionnaire (Messick, 1995). Thus, in the second step, focus groups were conducted to further

refine and pre-test the initial items and response options. In total, three focus groups were conducted, ($N = 10$; $M_{age} = 31.3$ years; $SD = 14.37$ years; 3 males, 7 females). A modified ‘retrospective think-aloud’ protocol (Oremus, Cosby, & Wolfson, 2005; Willis, 2005) was used in the focus groups in order to better understand how members of the target population interpret and respond to items. Specifically, participants in the focus groups were instructed to complete a copy of the initial measure independently and following this, a series of questions were used in order to prompt participants to discuss the preliminary measure (e.g., instructions, response format, and wording of items). Questions included (a) “What, in your own words, does the question mean to you?” (b) “Did the answer choices include your answer?” (c) “Did you understand how to answer the questions?” and (d) “Did the questionnaire leave anything out you felt was important?” (Oremus et al., 2005; Willis, 2005). Conversations from the focus groups were transcribed by the first author to conduct a content analysis. We used a constant comparison approach (Strauss & Corbin, 1998) to identify and code sentences and phrases in which participants raised concern with one or more items. The analysis focused on problematic and alternative interpretations of items. This iterative process was repeated following each focus group and revisions were made to the questionnaire until no new suggestions emerged. As a result of the item trimming and instrument refinement process (to the original 8 items), one item was added, five items were reworked, and two items were eliminated, resulting in a 7-item instrument (see Table 2.1).

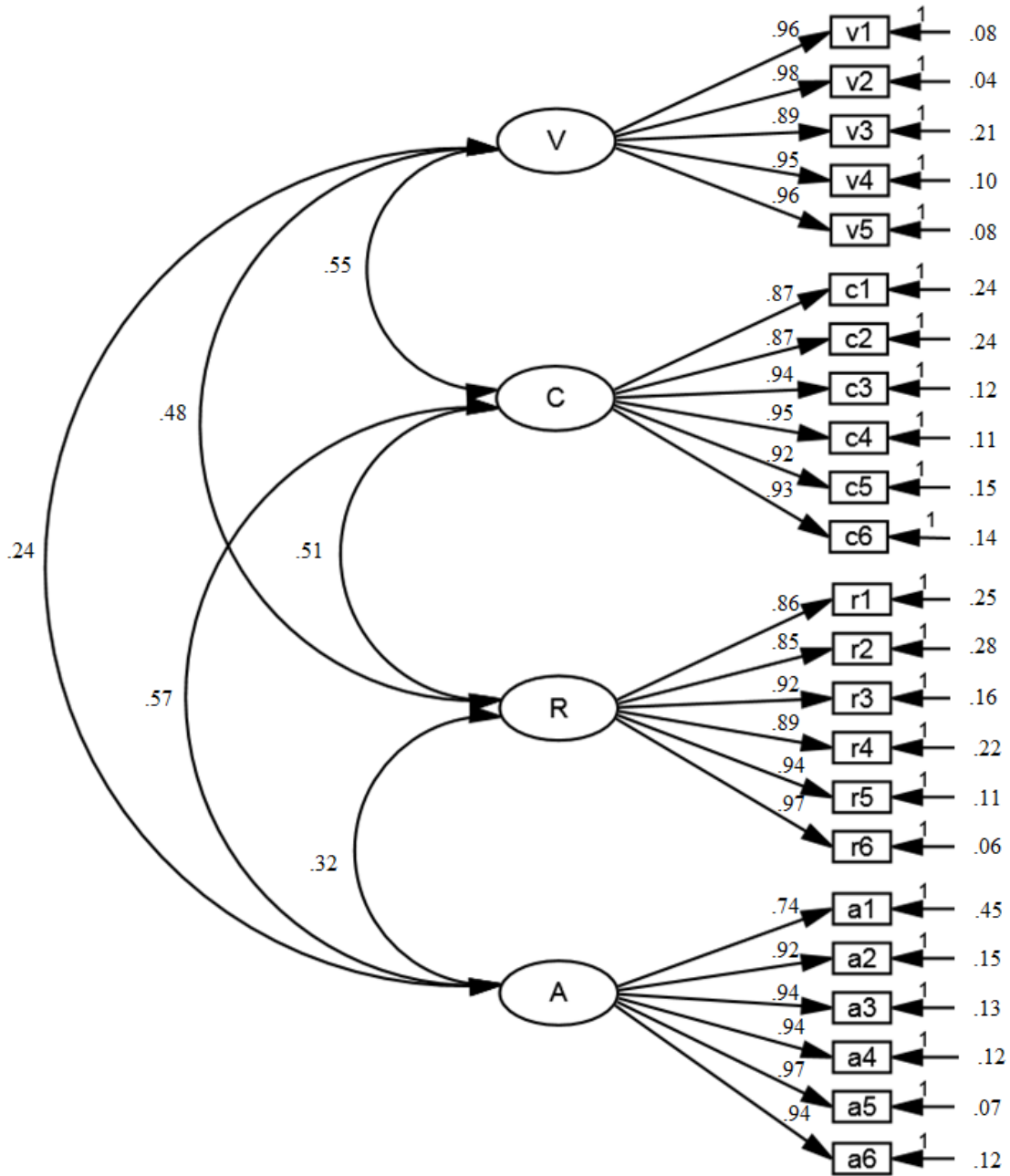
Table 2.1 Findings from the retrospective “think-aloud” focus groups and expert reviewers: Examples of problems and alterations to items.

Concerns	Examples	Action Taken
On the use of ‘when I exercise’	“ ‘when I exercise’... changes it completely for me, the way I answered it, cause I do like a variety but I don’t exercise much.” FG1	Item was retained but the use of “when” was eliminated from all items.
On the use of ‘routine’	“routine [could] be counterintuitive to the notion that the items are trying to measure ‘variety’” ER3 “ if your routine has a lot of variety in it but you still do the same routine, like every week or every amount of time ” FG2	Deleted item
Double barreled item (Clark & Watson, 1995)	The item “I feel like I mix up the types of tasks and exercises that I do”, led participants to multiple interpretations. “it kinda went away from ...to the types of tasks, which means... “ FG1	Reduced the question to a single idea
On redundant items	“avoid being redundant as much as possible. In my opinion, the best 4 of the 7 items might be sufficient” ER2 “There seems to be a fair amount of overlap between this item and item 6” ER3	Eliminated two items
Tapping into the experience of variety	With regards to item #5 “[I took] that question, to be qualitatively different because it was about the internal experience as opposed to the physical activity itself” FG1	Aligned more items with study objectives (e.g., “I feel like...”)
Clarification of Scale	“I say yes or no, it’s more or less what I feel like...” FG1 “one thing I was just thinking with the scale though was it may be helpful to have these blank ones filled in”	Altered the response option based on suggestions for a dichotomous response format. Encouraged to have verbal wording for each response option.

Note: FG = Focus Group; ER = Expert Reviewer.

To ensure that the items were representative of the construct, the trimmed item-pool was subsequently reviewed in the third step by three individuals with expertise in instrument development and exercise psychology. This process resulted in modification to two of the items and omitting two more items due to redundancy (see Table 1). The final set of 5 items—hereafter referred to as the *Perceived Variety in Exercise* (PVE) questionnaire—had a Flesch (1948) Reading Ease score of 75.1, which corresponds to a reading level for those aged 10 and above (D’Alessandro, Kingsley, & Johnson-West, 2001). Items on the PVE questionnaire are anchored on the same 6-point Likert-type rating scale as that used with the Psychological Need Satisfaction in Exercise (PNSE; Wilson, Rogers, Rodgers, & Wild, 2006) questionnaire, with response options of 1 (*False*), 2 (*Mostly False*), 3 (*More False than True*), 4 (*More True than False*), 5 (*Mostly True*), and 6 (*True*; see Table 3 for specific items). Information on the structural properties (e.g., factorial validity) of data derived from the PVE questionnaire in the current study is presented in Figure 2.1 and the results section (see Table 3). Ordinal composite reliability (Zumbo, Gadermann, & Zeisser, 2007) for the variety scores used in the current study was .97.

Figure 2.1. CFA model, interfactor correlations, standardized factor loadings and residuals



Note: $n = 367$. All correlations have $p < .01$. V = Variety, C = Competence, R = Relatedness, A = Autonomy.

Basic psychological needs satisfaction. Satisfaction of the psychological needs for competence, relatedness, and autonomy was measured using the PNSE (Wilson et al., 2006). This instrument includes 6 items that assess each of the three psychological needs (i.e., 18 items in total).

Exemplar items include “I feel that I am able to complete exercises that are personally challenging” (competence), “I feel connected to the people who I interact with while we exercise together” (relatedness), and “I feel free to make my own exercise program decisions” (autonomy). Responses to each item were anchored by 1 (*False*) to 6 (*True*) with higher scores reflecting greater levels of perceived competence, relatedness, and autonomy in exercise. Wilson et al. (2006) reported evidence of structural and criterion validity for scores derived from each subscale of the PNSE. In the current study, ordinal composite reliability for scores from each subscale was .96 for competence, .96 for relatedness, and .95 for autonomy.

Exercise-Related Well-Being. Well-being was measured using two instruments, namely the Scale of Positive and Negative Experience (SPANE; Diener et al., 2010) as well as the Subjective Vitality Scale (SVS; Ryan & Frederick, 1997). The SPANE is a 12-item instrument with six items assessing both positive and negative experiences, respectively. The word ‘exercise’ was added to the original SPANE instructions to refer to well-being in the context of exercise. Participants were asked, “Please think about what exercise you have been doing and experiencing during the past 4 weeks. Then report how much you experienced each of the following feelings, using the scale below.” Items in the SPANE are anchored on a scale ranging from 1 (*Very Rarely or Never*) to 5 (*Very Often or Always*). The positive and negative items are scored separately because of the partial independence of the two types of feelings (Diener & Emmons, 1985). Support for score reliability (e.g., α values of .87 for positive and .81 for negative feelings) and convergent validity (in relation to subjective happiness, satisfaction with life, and positive and negative affect) of measures derived from the SPANE were reported by Diener et al. (2010).

Ordinal composite score reliability in the current study was .91 for positive affect and .86 for negative affect.

The SVS (Ryan & Frederick, 1997) was used to assess the extent to which participants experience feelings of subjective vitality in exercise. Consistent with Bostic, Rubio, and Hood (2000) the instrument was comprised of six items. Following the instructions “Please respond to each of the following statements by indicating the degree to which the statement is true for you when you engage in exercise,” participants were asked to rate each item on a 7-point Likert-type rating scale anchored by 1 (*Not at All True*) to 7 (*Very True*). A sample item used in this study was “I feel alive and vital.” Researchers have found support for the internal consistency of scores derived from this instrument as an index of well-being in exercise contexts (Edmunds et al., 2007). The composite reliability estimate of scores from the SVS in this study was .93.

2.2.4 Data Analysis

First, relationships between perceived variety (along with competence, relatedness, and autonomy) at Time 1 were examined in relation to exercise-related positive affect, negative affect, and subjective vitality six weeks later (Time 2) through use of latent variable regression (LVR) analysis, which is a specific type of confirmatory Structural Equation Model as it only includes latent variables. LVR allows for unique weighting of each item in the construction of unobserved (latent) variables (e.g., variety) from observed variables and simultaneously models the structural (i.e., relationships among latent variables) and measurement (i.e., relationships between a latent variable and its indicators) paths. For this study, LVR analysis is preferable to techniques such as multiple regression analysis, because it is not based on the assumption that measurement of the variables is error-free and therefore we avoid potentially producing biased estimates (Muthén,

2002). Ratings of perceived variety, competence, relatedness, and autonomy in exercise were specified as separate independent latent predictors and each index of exercise-related well-being (i.e., positive affect, negative affect, and subjective vitality) were examined simultaneously as latent dependent variables in a single LVR model.

This analysis was conducted using *Mplus* (Version 6.11) software to account for the ordered categorical nature of the scores. We used WLSMV estimation with a polychoric correlation matrix as it is considered the best option for modeling with ordered categorical data (Beauducel & Herzberg, 2006; Muthén, 1993). Missing data were estimated based on all of the available data, using the WLSMV algorithm within *Mplus*. The χ^2 test was considered for the model, however a non-significant χ^2 statistic is considered unrealistic (Barrett, 2007) so supplementary fit indices were also examined.

To assess the model we compared the χ^2 goodness of fit indices, comparative fit indices (CFI), Tucker-Lewis indices (TLI), and the root mean square error of approximation (RMSEA) for each model. Criterion for evaluating good model-data fit were designated as CFI and TLI values $> .90$, and RMSEA values $< .08$, and excellent fit for CFI and TLI values $> .95$, and RMSEA values $< .06$ (Hu & Bentler, 1998, 1999).

In addition to fit indices, we examined the reliability of the scores and the quality of the individual items through composite reliability and average variance extracted. Composite reliability (CR) is an index of reliability in which scores from each item are individually weighted in the composite load (see Bollen, 1989). Ordinal composite reliability is based on the polychoric correlation matrix and was assessed to account for the Likert-type response formats used in the PNSE and PVE (Zumbo et al., 2007). We measured CR using the formula $CR = \sum$ (standardized

$(\text{std. loadings})^2 / \sum (\text{std. loadings})^2 + \sum (1 - \text{std. loadings}^2)$ (Fornell & Larcker, 1981). Finally, to measure the convergence among the items we calculated the average variance extracted (AVE). To measure AVE we used the formula $\text{AVE} = \sum (\text{std. loadings}^2) / \sum (\text{std. loadings}^2) + \sum (1 - \text{std. loadings}^2)$ (Fornell & Larcker, 1981). To evaluate the CR and AVE values, we used Hair, Black, Babin, and Anderson's (2009) recommendation that values $\geq .70$ provide support for CR and Fornell and Larcker's (1981) recommendation that AVE values that exceed the squared correlation between that and any other construct provides support for convergence among items.

To examine the relative importance of perceived variety in exercise (compared to satisfaction of the psychological needs) in predicting variance in indices of exercise-related well-being, a Relative Pratt Index (RPI; Thomas, Hughes & Zumbo, 1998) was calculated for each outcome variable, which partitions the explained variance into the relative proportion attributable to each independent variable. Zumbo (2007) introduced the RPI for LVR models. The RPI was computed in the following manner: the β weight is multiplied by the simple correlation then the sum is divided by the variance explained in the model (i.e., R^2). An index score less than $1 / (2 \times \text{number of predictor variables})$ classifies the variable as relatively unimportant (Thomas, 1992). The cut-off value was 0.13 (i.e., 13%) for the LVR analyses, indicating that any RPI value below this is considered relatively unimportant (Thomas, 1992).

Second, to examine the extent to which perceived variety in exercise is empirically distinct from perceived competence, relatedness and autonomy in exercise, we conducted an exploratory factor analysis (EFA) using Time 1 data ($N = 507$). Models representing different factor structures were compared to determine the best fit for the data derived from the PVE and PNSE questionnaires. We examined our a priori four-factor model, expecting perceived variety in

exercise to load onto one distinct factor and perceived competence, relatedness, and autonomy to load onto their known factors (Wilson et al., 2006). We also compared the four-factor model to a one and three-factor model to assess how perceived variety in exercise fits alongside the known factors of perceived competence, autonomy, and relatedness (Wilson et al., 2006). Psychological needs satisfaction has at times been operationalized as a single latent variable (e.g., Johnson & Finney, 2010) and so we compared the four-factor model to a one-factor model to examine whether empirically, these conceptualized variables were in fact measuring the same latent factor. A three-factor model was examined to test the extent to which perceived variety in exercise might be empirically synonymous (i.e., lacks discriminant validity) with one or more of the three psychological needs conceptualized within BPNT. Should empirical evidence suggest that perceived variety in exercise is highly correlated with, and undistinguishable from, one or more of the three psychological needs, then this would challenge the contention that perceived variety is a distinct construct from competence, relatedness, and autonomy in the context of exercise.

The EFA analysis was conducted on data derived from the PVE and PNSE using *Mplus* (Version 6.11). We used WLSMV estimation with a polychoric correlation matrix (Beauducel & Herzberg, 2006; Muthén, 1993). Missing data were estimated based on all of the available data, using the WLSMV algorithm within *Mplus*. Geomin rotation (to produce an oblique solution; Tabachnick & Fidell, 2012) was selected based on the small-to-moderate correlations found between perceived variety, competence, relatedness, and autonomy in exercise. To determine which factor structure provided the best overall fit for the data, χ^2 , CFI, TLI, and RMSEA fit indices were examined for each hypothesized model.

Finally, in order to verify the factor structure identified through the EFA, the four-factor measurement model (including perceived variety along with the three needs for competence, relatedness, and autonomy in exercise) was tested through a confirmatory factor analysis (CFA) on the data from Time 2 ($n = 367$). We used WLSMV method of estimation with a polychoric correlation matrix, whereby missing data were again estimated through the WLSMV algorithm. Model fit was assessed using the χ^2 , CFI, TLI, and RMSEA fit indices.

2.3 Results

Overall, the LVR model had good fit ($\chi^2(758) = 1746.98, p < .001, CFI = .974, TLI = .972, RMSEA = .060, 90\% CI [.056-.063]$) and standardized factor loadings ranged from .53 to .97. CR values were calculated for scores of independent and dependent variables and were found to be .97, .96, .96, and .95 for perceived variety, competence, relatedness, and autonomy, and .91, .86, and .93 for positive affect, negative affect and subjective vitality, respectively (Zumbo, et al., 2007). AVE values were also calculated and found to be .87, .79, .79, and .75, for perceived variety, competence, relatedness, and autonomy, and .64, .52, and .69 for positive affect, negative affect, and subjective vitality, respectively. Interfactor correlations between the latent variables are presented in Table 2.2.

Table 2.2 Interfactor correlations

Variable	1	2	3	4	5	6	7
1. Variety-T1	--						
2. Competence-T1	.55*	--					
3. Relatedness-T1	.34*	.53*	--				
4. Autonomy- T1	.17*	.47*	.26*	--			
5. Positive Affect-T2	.42*	.55*	.43*	.40*	--		
6. Negative Affect-T2	-.19*	-.29*	-.23*	-.32*	-.53*	--	
7. Subjective Vitality-T2	.43*	.52*	.41*	.34*	.82*	-.49*	--

Note. T1 = Time 1; T2 = Time 2; * = $p < .01$.

Positive affect. Together, perceived variety, competence, relatedness, and autonomy in exercise explained 37.2% of the variance in exercise-related positive affect. Specifically, perceived variety ($\beta = .175, p < .01$), competence ($\beta = .265, p < .01$), relatedness ($\beta = .181, p < .01$), and autonomy ($\beta = .192, p < .01$) were found to be significant predictors of exercise-related positive affect. The RPI was calculated to determine relative variable importance. Of the 37.2% of variance accounted for by the model, variety, competence, relatedness, and autonomy accounted for 19.76%, 39.18%, 20.92%, and 20.65% respectively.

Negative affect. With regards to exercise-related negative affect, perceived variety in exercise and perceived competence, relatedness, and autonomy explained 13.5% of the variance. Specifically, autonomy ($\beta = -0.236, p < .001$) was found to be the only statistically significant predictor of negative affect. None of the other variables predicted significant variance to the overall

model for exercise-related negative affect. Of the 13.5% of variance accounted for by the model, autonomy accounted for 55.94 %.

Subjective vitality. Finally, perceived variety, competence, relatedness, and autonomy in exercise explained 33.1% of the variance in exercise-related subjective vitality. Specifically, perceived variety ($\beta = .208, p < .001$), competence ($\beta = .240, p < .01$), relatedness ($\beta = .174, p < .01$), and autonomy ($\beta = .143, p < .01$) were found to be significant predictors of exercise-related subjective vitality. The RPIs were calculated and of the 33.1% of variance accounted for by the model, variety accounted for 27.02%, competence accounted for 37.70%, relatedness accounted for 21.55%, and autonomy accounted for 14.69%.

Exploratory Factor Analysis

Using the criteria provided by Hu and Bentler (1998, 1999) to compare the models, we found the four-factor model to be superior to the unidimensional and three-factor models (see Table 2.3 for the fit statistics). In addition to the model fit indices, the interfactor correlations were small-to-moderate which suggests these factors are empirically distinct from each other. The four-factor model was interpretable because factors one through four were comprised of the items measuring feelings of variety, competence, relatedness, and autonomy, respectively (Gorsuch, 1983). Using Thurstone's principle for identifying meaningful cross-loadings of items onto factors (i.e., a pattern coefficient of $|0.30|$ to serve as the lower bound of item meaningfulness per factor; Thurstone, 1947), in the four-factor model we found that none of the perceived variety in exercise items loaded onto the subscales of competence, relatedness, or autonomy (see Table 2.4 for communality estimates, and Geomin rotated pattern coefficients of the four-factor solution). When taken together, the results of the EFA provide preliminary support for the contention that perceived

variety in exercise is empirically distinct from but related to the basic psychological need satisfaction variables in the context of exercise, as evidenced by small-to-moderate correlations between the perceived variety latent factor and the three latent factors representing satisfaction of the basic psychological needs. In sum, empirical support was found for a four-factor measurement model.

Table 2.3 Results of EFA model testing

Fit indices	Exploratory Factor Solution		
	1 Factor	3 Factor	4 Factor
χ^2 (df)	7638.97 (230)	2612.65 (187)	1155.73 (167)
P value	< .01	< .01	< .01
Tucker-Lewis Index (TLI)	0.841	0.936	0.971
Comparative Fit Index (CFI)	0.855	0.953	0.981
Root mean square error of approximation (RMSEA) [90% CI]	0.252 [.25, .26]	0.160 [.16, .17]	0.108 [.10, .11]

Note: $n = 507$. CI = confidence interval.

Table 2.4 EFA communalities and geomin rotated pattern coefficients of the four-factor solution

Scale and Item	h^2	I	II	III	IV
PVE- Variety					
1. I feel like I engage in a variety of exercises.	.88	0.81	0.25	-0.07	0.02
2. I feel like I try a range of exercises.	.91	0.84	0.25	-0.11	0.01
3. I feel like I change the types of exercise that I do.	.74	0.82	0.06	0.02	0.04
4. I feel like my exercise program is varied.	.97	0.98	-0.07	0.13	-0.03
5. I feel like I experience variety in my exercise.	.95	0.95	-0.01	0.12	-0.05
PNSE- Competence					
1. I feel that I am able to complete exercises that are personally challenging	.69	0.09	0.67	0.17	0.06
5. I feel good about the way I am able to complete challenging exercises	.65	0.07	0.58	0.20	0.15
10. I feel confident I can do even the most challenging exercises	.87	-0.04	1.01	0.00	-0.16
12. I feel capable of completing exercises that are challenging to me	.86	0.02	0.85	0.07	0.07
14. I feel confident in my ability to perform exercises that personally challenge me	.80	0.05	0.77	0.08	0.12
17. I feel like I am capable of doing even the most challenging exercises	.92	-0.03	1.05	-0.04	-0.16
PNSE- Relatedness					
2. I feel attached to my exercise companions because they accept me for who I am	.72	-0.03	-0.01	0.87	-0.07
4. I feel close to my exercise companions who appreciate how difficult exercise can be	.73	0.00	-0.05	0.87	-0.00
8. I feel a sense of camaraderie with my exercise companions because we exercise for the same reasons	.81	0.03	-0.03	0.89	0.05
9. I feel like I get along well with other people who I interact with while we exercise together	.81	0.08	0.08	0.83	0.01
15. I feel like I share a common bond with people who are important to me when we exercise together	.83	-0.05	0.10	0.88	0.01
18. I feel connected to the people who I interact with while we exercise together	.92	-0.01	0.12	0.91	-0.01
PNSE- Autonomy					
3. I feel like I am the one who decides what exercises I do	.63	-0.15	0.01	-0.07	0.81
6. I feel free to exercise in my own way	.74	0.04	0.14	-0.05	0.80
7. I feel free to make my own exercise program decisions	.87	-0.05	0.03	-0.04	0.93
11. I feel free to choose which exercises I participate in	.76	0.01	0.08	0.03	0.83
13. I feel like I am in charge of my exercise program decisions	.84	0.04	-0.04	0.05	0.91
16. I feel like I have a say in choosing the exercises that I do	.82	-0.01	-0.06	0.09	0.91

Note: $n = 507$. PVE = Perceived Variety in Exercise; PNSE = Psychological Need Satisfaction in Exercise Scale. h^2 = communality estimates for each item. Pattern coefficients in bold represent primary factor loadings of each item retained in the final solution.

Confirmatory Factor Analysis

The four-factor CFA measurement model based on Time 2 data, included factors representing perceived variety, competence, relatedness, and autonomy. The fit indices for this four-factor measurement model were as follows: $\chi^2 (224) = 859.72, p < .01$, CFI = .986, TLI = .984, and RMSEA = .088, 90% CI [.08, .09]. In addition, the conditions for convergent validity were met (i.e., all factor loadings were significant and ranged from .74 to .98; see Figure 2.1), CR values for perceived variety, competence, relatedness, and autonomy in the context of exercise were .98, .97, .96, and .97 while AVE values were .90, .83, .83, and .82 respectively. Since the four constructs were not highly correlated, (i.e., $.24 \leq r \leq .57$; avoiding multicollinearity issues; see interfactor correlations in Figure 2.1), these findings complement the fit indices of the model and the reliability estimates to provide multiple sources of evidence that perceived variety in exercise is a distinct construct from perceived competence, relatedness, and autonomy in exercise.

2.4 Discussion

In the present study we (a) developed an instrument to measure perceived variety in exercise, (b) examined whether ratings of perceived variety in exercise (compared to satisfaction of the needs for competence, relatedness, and autonomy in exercise) prospectively predicted unique variance in indices of exercise-related well-being over time, (c) examined the extent to which perceived variety in exercise was empirically distinct from satisfaction of the established basic psychological needs for competence, relatedness, and autonomy in the context of exercise, and (d) tested a four-factor measurement model. The current findings are consistent with Sheldon and Lyubomirsky's (2012) conclusions that perceptions of variety directly predict indices of well-being. We extended their work by demonstrating that in the context of exercise, perceived variety complements satisfaction of the three psychological needs incorporated within BPNT in the prediction of indices of exercise-

related well-being. Furthermore, we found that perceived variety in exercise is empirically distinct from (i.e., not subsumed by) perceived competence, relatedness, and autonomy in the context of exercise.

Conceptualized within BPNT, Deci and Ryan (2002) contend that satisfaction of the needs for competence, relatedness, and autonomy is associated with higher scores of well-being. Results from the present investigation are consistent with BPNT (Deci & Ryan, 2002) and offer the construct of perceived variety in exercise as a potential complementary psychological experience that explains an important amount of variance (as evidenced by the Pratt indices) in exercise-related positive affect and subjective vitality. Based on the Pratt indices, perceived variety in exercise was found to predict a relatively equal amount of variance to that of relatedness and autonomy in predicting exercise-related positive affect, and explained a greater relative amount of variance than relatedness and autonomy in predicting scores of exercise-related subjective vitality. However, the Pratt indices also indicated that perceived variety in exercise accounted for less relative variance in exercise-related positive affect and subjective vitality than perceived competence. Although the experience of variety in exercise was found to be related to both exercise-related positive affect and subjective vitality, it was unrelated to exercise-related negative affect (see Diener & Emmons, 1985). Therefore, perceived variety in exercise may be more related to the promotion of exercise-related well-being than buffering against the experience of negative affect.

In addition to our predictive analyses, we examined and found support for perceived variety in exercise as a unique factor separate from the three basic psychological needs conceptualized within BPNT. From a discriminant validity perspective, the results demonstrated that perceived variety in exercise was positively related yet empirically distinct from perceived competence, relatedness and autonomy in the context of exercise. From the perspective of SDT, this finding was not surprising as

the experience of different behaviours and activities (i.e., manifested as felt variety) is conceptually distinct from feeling effective (i.e., competent), connected to others (i.e., relatedness) and volitional/self-governed (i.e., autonomous). The present findings support the notion that perceived variety in exercise is worthy of additional research attention as it appears to be a psychosocial variable that provides additional explanatory power to the satisfaction of competence, relatedness, and autonomy in the prediction of exercise-related well-being indices.

Balanced against the potential contributions of the present study, we recognize that limitations should also be noted. First, although a prospective observational design was utilized to examine the relations between perceived variety in exercise (and perceived competence, relatedness, and autonomy) and indices of exercise-related well-being over time, the non-experimental nature of the design used in this study still precludes any inferences of causality. Experimental designs will be necessary in future research to examine the extent to which *changes (and frustration) in the experience of variety in exercise* relates to changes in exercise-related well-being (and ill-being) outcomes. A second limitation of the study corresponds to the *contextual* level through which we operationalized assessments of perceived variety. Specifically, in this study we were interested in how varied experiences with regard to exercise are prospectively related to subsequent experiences of exercise-related well-being. Regardless, we are acutely aware that both basic psychological needs and the experience of well-being operate and exist at both *episodic/situational* and *global* levels, as well as at the contextual level (e.g., Diener & Emmons, 1985; Vallerand, 1997). Specifically, although we would certainly expect that experiencing variety in the context of exercise would be related to various adaptive outcomes, the results of the study do not provide insight into the *acute effects* of perceived variety on the immediate/episodic experience of well-being, or any *global effects* of experiencing variety within life in general. Future investigations are required that test the effects

of perceived variety at these different levels. A final limitation corresponds to the use of the same sample to verify the factor structure (albeit at different time points) and results should be interpreted with caution.

In spite of these limitations, the results of this study provide conceptual foundations and preliminary evidence for the construct validity of scores derived from the PVE in a sample of adults. Based on the present findings, we suggest that researchers start examining the determinants of the perception of experienced/felt variety in exercise to understand how to foster this potentially adaptive psychological construct. Research in this area provides exciting opportunities to test the external validity of experiencing variety in relation to well-being across other contexts (e.g., variety with regard to dietary behaviours, work/employment opportunities, and interpersonal relationships) and to further examine whether understanding feelings of variety may complement the constructs embedded within SDT.

Chapter 3: Is Variety a Spice of (an Active) Life?: Perceived Variety, Exercise Behaviour, and the Mediating Role of Autonomous Motivation

3.1 Introduction

Participating in regular exercise is highly beneficial for psychological and physical functioning (Warburton, Charlesworth, Ivey, Nettlefold, & Bredin, 2010; World Health Organization, 2010). However, recent evidence indicates that as little as 15% of Canadian adults meet current physical activity guidelines (Colley et al., 2011). As such, understanding exercise behaviour and the mechanisms that predict involvement in exercise is a critical issue. A prominent line of enquiry for advancing our understanding of the amount of exercise people engage in has involved investigation of the psychosocial factors they experience in exercise contexts (Teixeira, Carraça, Markland, Silva, & Ryan, 2012).

One factor that has recently garnered attention for understanding individuals' exercise behaviour is *variety* (e.g., Juvancic-Heltzel, Glickman, & Barkley, 2013). The experience of variety (i.e., felt variety) refers to a person's *perception* of whether they have experienced (or currently experience) variety, and is characterized by feeling as though one pursues and experiences diverse (i.e., novel or alternating among familiar) activities, behaviours, and opportunities in their social environment (cf. Kahn & Ratner, 2005; Sheldon & Lyubomirsky, 2012). Varied experiences stimulate interest (via novelty; Silvia, 2006) and reinforce learning and development (via alternation among familiar experiences; e.g., Magill & Hall, 1990). Variety has been previously examined as a feature of the activity or environment (e.g., Lyubomirsky & Layous, 2013), however the *experience* of variety is conceptually distinct from the provisions that facilitate the experience of variety (i.e., variety support). The experience of variety in one's social environment refers to the subjective assessment of one's felt experience whereas variety support refers to one's subjective perception(s)

of the way that activities, behaviours and opportunities are structured to promote (or thwart) the experience of variety in a given social setting. The *experience of variety* (i.e., one's felt experience) is the focus of investigation in the present paper.

In the context of exercise, researchers have found that when people experience variety, this prospectively predicts their subsequent behaviour (Glaros & Janelle, 2001; Juvancic-Heltzel et al., 2013). For example, in Glaros and Janelle's (2001) study, when people varied the type of aerobic exercise that they engaged in every two weeks, they had greater adherence to their exercise sessions than people who did the same aerobic exercise each session. Furthermore, Juvancic-Heltzel and colleagues (2013) found that providing people with the opportunity to experience more variety (i.e., ten versus two options of equipment to use) resulted in longer duration of time spent exercising and a greater amount of repetitions performed.

In terms of *how* and *why* varied experiences may be related to behaviour, it is noteworthy that the experience of variety has been found to be innately stimulating and rewarding in and of itself (i.e., intrinsically gratifying; Berlyne, 1970; Kahn & Ratner, 2005; Pronin & Jacobs, 2008), and people volitionally engage in meaningful behaviours they find to be personally interesting and enjoyable (Ryan & Deci, 2002; Kahneman, 1999). Conceptualizing variety as an antecedent of intrinsic motivation has been highlighted by researchers in organizational psychology through the job characteristics model described by Hackman and Oldham (1976). Hackman and Oldham illustrated that the extent to which a person experiences different activities and uses multiple skills and talents at work, leads to a psychological state of 'meaningfulness', which subsequently supports intrinsic motivation. In support of the link between variety and intrinsic motivation, the appraisal of something (e.g., an experience) as being new, unfamiliar, and diverse is one of the main appraisals upon which interest is built (e.g., Silvia, 2006). In the exercise psychology literature the provision of

opportunities for people to experience variety has been found to be related to their enjoyment and intrinsic motivation (Silva et al., 2010). Moreover, emphasizing that one can expect variety has also been found to be positively related to a greater internal perceived locus of causality in exercise settings (Dimmock, Jackson, Podlong, & Magaraggia, 2013), which includes both intrinsic motivation *and* internalized forms of extrinsic behavioural regulation (Ryan & Deci, 2000). Along with interest and enjoyment, the extent to which someone has an internal perceived locus of causality broadly describes their autonomous motivation in a given context (Ryan & Deci, 2002; Dimmock et al., 2013), which is theorized to be a high quality and volitional type of motivation that leads to engagement and persistence in activities (Ryan & Deci, 2002). Indeed, autonomous motivation could be an important mechanism (i.e., reason) that explains how and why the experience of variety is related to behaviour.

In their review on the pursuit of varied experiences, Kahn and Ratner (2005) called for researchers to move beyond piecemeal atheoretical approaches, by drawing from theory to examine the effect of variety in relation to a range of salient outcomes, including motivation and behaviour. One theory that may provide insight regarding whether experiencing variety develops and maintains autonomous motivation and exercise behaviour is SDT (Deci & Ryan, 1985; Ryan & Deci, 2002). Within SDT, Deci and Ryan (1985, 2008) contend that the degree to which people experience satisfaction of the basic psychological needs for competence, relatedness, and autonomy, supports (or restricts) subsequent autonomous motivation and persistence in behaviour. However, Sheldon (2011) highlighted that the three basic psychological needs advanced within SDT are perhaps an incomplete subset of psychosocial experiences that may explain variance in salient outcomes such as motivation and behaviour. By examining the experience of variety concurrently with satisfaction of the psychological needs proposed within SDT, we can gain insight into any potential novel

contributions that experiencing variety may offer in the prediction of autonomous motivation and behaviour.

Conceptually, the experience of variety (i.e., feeling as though one pursues and experiences diverse activities, behaviours, and opportunities in their social environment) is unique from satisfaction of each of the basic psychological needs as competence refers to an individual's perception of their ability to be effective in their social environment (Ryan & Deci, 2002; White, 1959), relatedness refers to feelings of attachment, companionship, and connectedness with other people (Baumeister & Leary, 1995; Ryan & Deci, 2002), and autonomy refers to feelings of choice, volition, and feeling in charge of one's decisions and actions (deCharms, 1968; Ryan & Deci, 2002). For example, a participant in an exercise class may feel as though s/he experiences variety (via performing novel exercises or alternating among familiar exercises) without feeling competent in their performance, related to those with whom they exercise, or autonomous in the exercises they perform. In a recent study, Sylvester et al. (2014b) found that in the context of exercise, perceived variety in exercise is an empirically distinct psychological experience from the satisfaction of the needs for competence, relatedness, and autonomy. More specifically, the authors found that perceived variety in exercise (along with perceptions of competence, relatedness, and autonomy) predicted unique variance in indices of exercise-related well-being and, through the use of factor analyses, the variance in perceived variety in exercise was not subsumed by satisfaction of the basic psychological needs.

In addition to supporting exercise-related well-being, perceived variety in exercise may further complement perceptions of competence, relatedness, and autonomy in exercise by explaining unique variance in autonomous (internalized) exercise motivation. As previously discussed, perceived variety in exercise may promote autonomous motivation through interest, enjoyment and

an internal perceived locus of causality (Dimmock et al., 2013). Beyond autonomous motivation, Ryan and Deci (2002) also emphasize the importance of considering controlled motivation, which has yet to be examined in relation to perceived variety. Controlled motivation is characterized by partial internalization of a value without fully accepting it as one's own, and being motivated by external rewards and punishments (Ryan & Deci, 2002). For example, people who exercise to avoid feelings of guilt and/or to attain accolades are acting out of controlled motivation. Overall, autonomous motivation involves a higher degree of internalization than controlled motivation; Ryan and Deci (2002) postulate that autonomous (but not controlled) forms of motivation will result in increased behavioural outcomes such as greater performance and sustained persistence over time (Ryan, Frederick, Lepes, Rubio, & Sheldon, 1997; Ryan, Williams, Patrick, & Deci, 2009).

Evidence supporting the relationships between satisfaction of the needs for competence, relatedness, and autonomy, autonomous motivation, and exercise behaviour has been tested and supported in exercise settings (Teixeira et al., 2012). Furthermore, satisfaction of the three psychological needs in exercise settings has been found to positively predict exercise behaviour, and autonomous (but not controlled) motivation has been found to mediate that relationship (e.g., Barbeau, Sweet, & Fortier, 2009; Silva et al., 2010).

Experiencing variety in exercise may be a unique predictor (when examined alongside satisfaction of the needs for competence, relatedness and autonomy) of autonomous motivation and exercise behaviour because (a) the expectation (but not the experience) of variety in exercise has been found to be related to indices of autonomous motivation (Dimmock et al., 2013), (b) variety support has been found to explain variance in exercise behaviour (Glaros & Janelle, 2001; Juvancic-Heltzel et al., 2013), and (c) the experience of variety has been found to be empirically distinct from perceptions of competence, relatedness, and autonomy in the context of exercise (Sylvester et al.,

2014b). However, the extent to which the experience of variety in exercise explains unique variance (alongside perceptions of competence, relatedness, and autonomy) in exercise behaviour via autonomous motivation has not yet been examined. In the present study, the experience of variety in exercise was examined at the same *level* as satisfaction of the needs for competence, relatedness, and autonomy because perceived variety in exercise is also conceptualized as a felt experience that precedes both autonomous motivation (e.g., Dimmock et al., 2013) and exercise behaviour (e.g., Glaros & Janelle, 2001), has enduring effects on psychological functioning (Sheldon, Boehm, & Lyubomirsky, 2012), and has affective consequences (cf. Sheldon, 2011; Sylvester et al., 2014b). It is also noteworthy that it was not our aim to test variety as a basic psychological need in the present work as there are numerous criteria that must be established before a construct can be considered a psychological need (e.g., psychological needs are universal, apply across cultures, and are not necessarily consciously valued; Ryan & Deci, 2002).

The purpose of the present study was to examine whether perceived variety in exercise (along with perceptions of competence, relatedness, and autonomy) prospectively predicts unique variance in exercise behaviour over time, and whether autonomous and controlled motivation mediate that relationship in the context of exercise. Based on previous research (e.g., Dimmock et al., 2013; Glaros & Janelle, 2001; Juvancic-Heltzel et al., 2013; Sylvester et al., 2014b) and SDT (Ryan & Deci, 2002), we expected that perceived variety in exercise (along with satisfaction of the needs for competence, relatedness, and autonomy) would explain unique variance in autonomous motivation and exercise behaviour over a 6 week period, and that variance in exercise behaviour would be explained (i.e., mediated) by autonomous motivation. In a test of discriminant validity, we expected that in the context of exercise, perceived variety (along with satisfaction of the needs for competence, relatedness, and autonomy), would have a negative or non-significant effect on

controlled motivation and controlled motivation would have a negative or non-significant effect on exercise behaviour (Ryan & Deci, 2002; Teixeira et al, 2012; see Figure 3.1 for the path diagram of the relationships examined).

3.2 Methods

3.2.1 Participants

Participants ($N = 363$) were a community sample of adults (i.e., 18 to 83 years of age)

¹. ¹Eight cases were deleted due to missing values (i.e., respondents failed to provide any information regarding their behavioural regulations in exercise). The ensuing sample included 246 females ($M_{age} = 35.43$ years; $SD_{age} = 13.90$ years) and 117 males ($M_{age} = 35.58$ years; $SD_{age} = 14.81$ years). At the first time point, 47.7% of participants were single while 46.8% were married; the majority were Caucasian (79.9%), and residents of Canada (95.6 %). Most participants had completed at least a college diploma or university degree (73%), had full or part-time employment (64.7%), and had an annual household income less than \$100,000 (73.3%).

3.2.2 Procedure

Once ethical approval for this study was obtained from the University of British Columbia institutional review board (see Appendix B), adults (i.e., at least 18 years of age) able to read and converse in English were invited to contact the first author (via e-mail) through posters in the community (e.g., community centers), online postings (e.g., a blog), and in person (e.g., at

¹ The data reported in the present study is part of a larger program of research designed to examine the effects of perceived variety in exercise contexts. Research on item development, and reliability and validity evidence of scores derived from the PVE questionnaire was previously published in Sylvester et al. (2014b) and included data on perceived variety, competence, relatedness, and autonomy in exercise collected at Time 1 and data on exercise-related well-being at Time 2. In the present study, we examined Time 1 scores of perceived variety, competence, relatedness, and autonomy in exercise, in relation to Time 2 (i.e., 6 week later) scores of autonomous and controlled motivation in exercise, and exercise behaviour.

recreational events) to obtain more information or express their interest in participating. We used a prospective observational design, and e-mailed an online questionnaire to consenting participants on two occasions, six weeks apart. Demographic information, perceived variety in exercise, and basic psychological needs satisfaction were measured at Time 1, while autonomous and controlled motivation, and exercise behaviour were measured at Time 2. The questionnaires took approximately 15 minutes for participants to complete. To thank participants for their time, they were entered into a draw to win one of six \$50 gift certificates.

3.2.3 Measures

Perceived variety in exercise. The PVE questionnaire (Sylvester et al., 2014b) was used to assess participants' perceived variety in exercise. An example item includes "I feel like I experience variety in my exercise". Items on the PVE questionnaire were anchored on a 6-point Likert-type rating scale with responses ranging from 1 (False) to 6 (True). Higher scores reflect greater levels of perceived variety in exercise. Sylvester et al. provided evidence for the factorial validity of scores derived from the PVE questionnaire whereby (a) support was found for a four-factor measurement model (including perceived variety in exercise, and satisfaction of the needs for competence, relatedness, and autonomy in exercise), and (b) perceived variety in exercise was found to be empirically distinct from perceptions of competence, relatedness, and autonomy. The ordinal composite reliability (Zumbo, Gadermann, & Zeisser, 2007) estimate for the perceived variety in exercise scores used in the current study was .97.

Basic psychological needs satisfaction. The PNSE questionnaire (Wilson, Rogers, Rodgers, & Wild, 2006) was used to measure satisfaction of the psychological needs for competence, relatedness, and autonomy in the context of exercise. Examples of items that characterized each of the psychological needs include "I feel capable of completing exercises that are challenging to me"

(perceived competence; 6 items), “I feel connected to the people who I interact with while we exercise together” (perceived relatedness; 6 items) and “I feel free to exercise in my own way” (perceived autonomy; 6 items). Responses to each item were anchored on a scale that ranged from 1 (False) to 6 (True). Higher scores reflect greater levels of psychological needs satisfaction in exercise. In the current study, the scores were integrated to create a latent variable for each unique construct. Ordinal composite reliability (Zumbo et al., 2007) estimates for scores from each need satisfaction subscale were .96 for competence, .96 for relatedness, and .95 for autonomy.

Autonomous and controlled motivation. The Behavioural Regulations in Exercise Questionnaire-2R (BREQ-2R; Wilson, Rodgers, Loitz & Scime, 2006) was used to assess current behavioural regulations in exercise. The BREQ-2R is a 23-item self-report instrument that was developed to measure the quality of one’s exercise motivation along a continuum of internalization (Wilson et al., 2006). The BREQ-2R includes the following subscales: (a) Intrinsic regulation (e.g., “I enjoy my exercise sessions”; 4 items); (b) Integrated regulation (e.g., “I consider exercise a fundamental part of who I am”; 4 items); (c) Identified regulation (e.g., “I consider exercise consistent with my values”; 4 items); (d) Introjected regulation (e.g., “I feel guilty when I don’t exercise”; 3 items); (e) External regulation (e.g., “I exercise because other people say I should”; 4 items); (f) Amotivation (e.g., “I think exercising is a waste of time”; 4 items). Each item was rated on a 5-point Likert scale anchored from 0 (Not true for me), to 4 (Very true for me). Previous research has supported the internal consistency (i.e., Cronbach’s α) of scores for each of the subscales of the BREQ-2; Longbottom, Grove, & Dimmock, 2012).

Scores from the items were used to form latent variables reflecting autonomous and controlled motivation. Consistent with tenets of SDT (Deci & Ryan, 2008), and previous research in this area (e.g., Barbeau et al., 2009), the latent variable of autonomous motivation, was comprised of

items reflecting intrinsic, integrated, and identified regulations, and the latent variable of controlled motivation included items reflecting introjected and external regulations. Amotivation was excluded from analyses because it is theorized to reflect a lack of motivation, which was not of interest in this particular study. Ordinal composite reliability (Zumbo et al., 2007) estimates for the scores used in each latent variable were .96 for autonomous motivation and .88 for controlled motivation.

Exercise behaviour. Exercise behaviour was assessed using the Godin Leisure Time Exercise Questionnaire (GLTEQ; Godin & Shephard, 1985). The GLTEQ is comprised of 3-items regarding leisure-time exercise and asks participants about the frequency (on average) of mild (e.g., minimal effort), moderate (e.g., not exhausting) and strenuous (e.g., heart beats rapidly) exercise lasting at least 15 minutes per session during a typical 7-day period at that point in time. To examine exercise behaviour that was conducive to promoting psychological and physical functioning, mild activities were not included in the analysis as Godin (2011) suggested that only moderate and strenuous activities (i.e., not mild activities) contribute to health. A score was calculated using the formula $[(\text{Moderate} \times 5) + (\text{Strenuous} \times 9)]$ to produce typical weekly estimates of leisure-time exercise with higher scores reflecting higher levels of energy expenditure (Godin, 2011). Supporting the validity evidence of GLTEQ scores, Godin and Shephard (1985) found higher scores to have positive correlations with estimates of cardiorespiratory fitness (i.e., VO_2max) and negative correlations with high body fat scores. Score stability has been examined through test-retest reliability coefficients, which have been found to range from .24 to .96 (Godin & Shephard, 1985; Jacobs, Ainsworth, Hartman, & Leon, 1993).

3.2.4 Data Analysis

In the present study, the hypothesized model (see Figure 3.1) was tested using *Mplus* 6.11 software to account for the ordered categorical nature of the Likert-type response scale scores. A

WLSMV method of estimation was used because the data were ordinal (Finney & DiStefano, 2006). When data are treated as ordinal, a polychoric correlation matrix is modeled in the analyses and is the best option for modeling Likert-type responses when the number of response categories are less than seven (Beauducel & Herzberg, 2006; Muthén, 1993). We used multiple categorical items to construct latent variables for perceived variety (five items), satisfaction of the needs for competence (six items), relatedness (six items), and autonomy (six items), as well as autonomous motivation (twelve items) and controlled motivation (seven items). The outcome variable of exercise behaviour was operationalized as an observed variable. In addition, participants' gender was included as a covariate in relation to exercise behaviour to control for potential differences in exercise behaviour between men and women (cf. Colley et al., 2011).

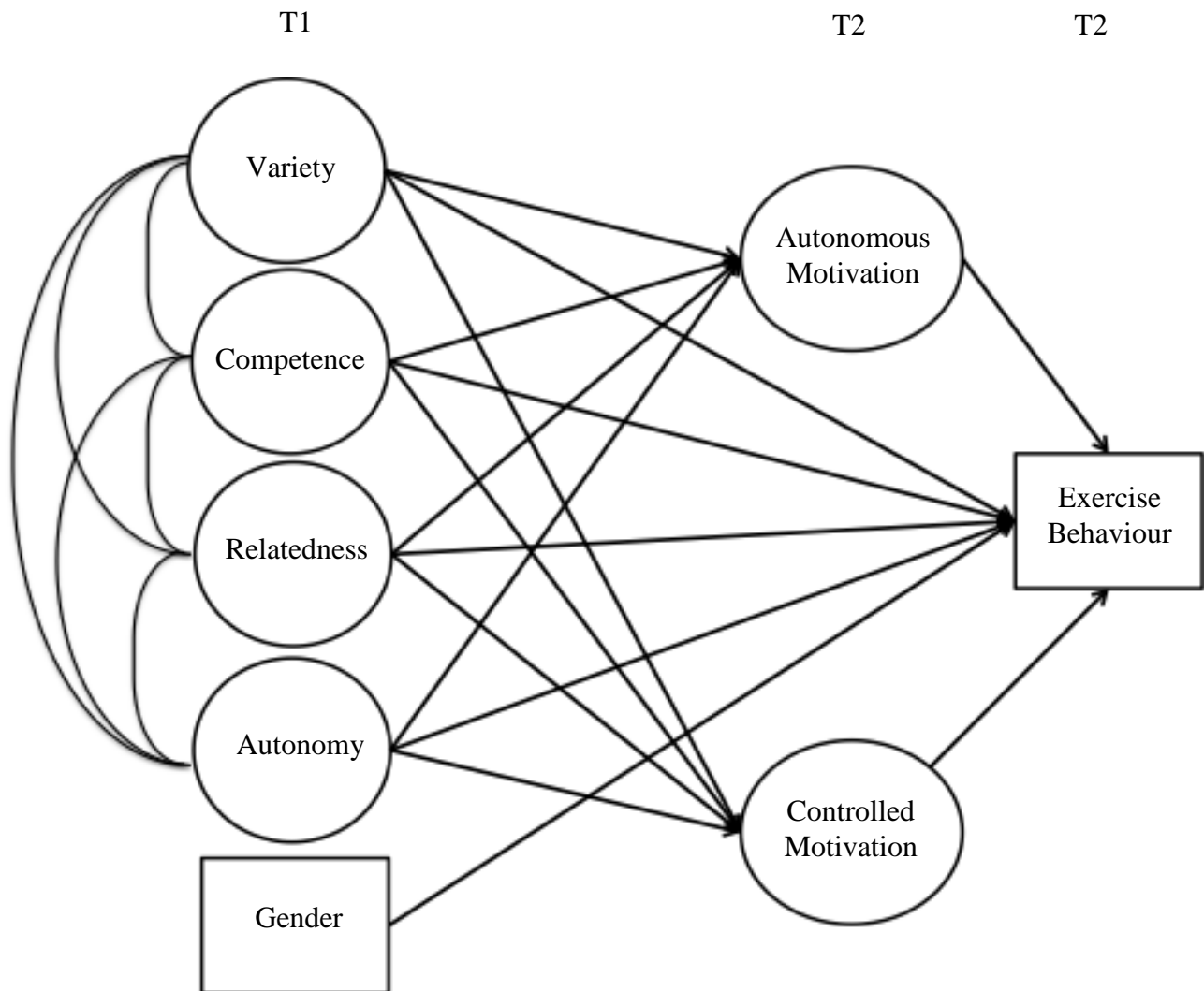


Figure 3.1 Path Diagram of the relationships examined between perceived variety, competence, relatedness, and autonomy in exercise at Time 1 (T1), and autonomous motivation, controlled motivation and exercise behaviour at Time 2 (T2). Gender was included as a covariate of exercise behaviour.

To assess the measurement reliability of the scores, we used CR in which each item is individually weighted in the composite load (see Bollen, 1989). Ordinal composite reliability is based on the polychoric correlation matrix and was assessed to account for the Likert-type response formats used in the PVE, PNSE, and BREQ-2R (Zumbo, Gadermann, & Zeisser, 2007). We measured CR using the formula $CR = \frac{\sum (\text{std. loadings})^2}{\sum (\text{std. loadings})^2 + \sum (1 - \text{std. loadings})^2}$ (Fornell & Larcker, 1981). The structural model included tests of correlations as well as direct and indirect predictive pathways between perceived variety, competence, relatedness, and autonomy at

Time 1, and autonomous and controlled motivation, and exercise behaviour at Time 2 (see Figure 3.1). To assess the fit of the model to the data, we examined the χ^2 goodness of fit index, along with the CFI, TLI, and the RMSEA (Brown, 2006; Hu & Bentler, 1999; Marsh, Hau, & Wen, 2004). Acceptable model-data fit was designated as CFI and TLI values $> .90$, and RMSEA values $< .08$, and excellent fit was designated as CFI and TLI values $> .95$ and RMSEA values $< .06$ (Brown, 2006; Hu & Bentler, 1998, 1999; Marsh et al., 2004). Although we recognize that there has been considerable debate in terms of what constitutes acceptable cut-off values for approximate fit indexes (e.g., CFI, RMSEA), or whether fit indices can even be used to supplement the chi-square statistic (e.g., Barrett, 2007; McIntosh, 2007), our approach aligns with that presented by Brown (2006) and Marsh et al. (2004) who recommend providing multiple sources of information to guide model evaluation.

In line with Baron and Kenny's (1986) conceptual approach to describing mediation, we estimated the relationships between the predictors (i.e., perceived variety, competence, relatedness, and autonomy in exercise) and the mediators (i.e., autonomous and controlled motivation), the effects of the mediator variables on the outcome variable (i.e., exercise behaviour), and the direct effect of the predictors on the outcome variable after controlling for the mediators. Consistent with contemporary approaches to testing mediation (i.e., Rucker, Preacher, Tormala, & Petty, 2011) the main outcome of interest was the indirect effects of perceived variety, competence, relatedness, and autonomy on exercise behaviour through autonomous and controlled motivation which were calculated via Preacher and Hayes' (2007; 2008) bootstrapping procedure ($k = 5000$ samples) to produce bias corrected confidence intervals. In line with Preacher and Hayes (2008), we used bias corrected bootstrapped confidence intervals within a structural equation modeling framework to

allow for covariation of autonomous and controlled motivation (i.e., latent mediators), reduce the likelihood of Type 1 error, and increase statistical power.

3.3 Results

Descriptive statistics for the (observed) outcome variable, exercise behaviour, were as follows: $M_{\text{moderate-vigorous exercise}} = 38.23$ units; $SD = 23.24$; skewness = .671 (SE = .128); kurtosis = .475 (SE = .255). The fit indices for the model were: $\chi^2(883) = 2662.59$, $p < .001$, CFI = .96, TLI = .95; RMSEA = .075, 90% CI [.071, .078]. Interfactor correlations between all study variables ranged from -.14 to .61 (see Table 3.1). With regards to the structural relations, perceived variety ($\beta = .227$, $p < .001$), and satisfaction of the needs for competence ($\beta = .315$, $p < .001$) and relatedness ($\beta = .267$, $p < .001$) positively predicted autonomous motivation, while satisfaction of the need for autonomy ($\beta = -.203$, $p < .01$) negatively predicted controlled motivation over a six week period (see Table 3.2). Furthermore, autonomous motivation positively predicted exercise behaviour ($\beta = .254$, $p < .001$), and controlled motivation was not a significant predictor of exercise behaviour ($\beta = .011$, $p > .05$). Additionally, gender ($\beta = -.165$, $p < .01$) directly predicted exercise behaviour (see Figure 3.2) with men reporting more exercise behaviour than women.

Table 3.1 Interfactor correlations

Variable	1	2	3	4	5	6	7
1. Variety-T1	--						
2. Competence-T1	.56*	--					
3. Relatedness-T1	.35*	.54*	--				
4. Autonomy- T1	.16*	.46*	.26*	--			
5. Autonomous Motivation-T2	.50*	.61*	.53*	.31*	--		
6. Controlled Motivation-T2	-.22*	-.33*	-.20*	-.30*	-.22*	--	
7. Exercise Behaviour-T2	.30*	.36*	.26*	.26*	.40*	-.14*	--

Note. T1 = Time 1; T2 = Time 2; * = $p < .01$.

Table 3.2 Direct effects of predictors and mediators

Variables	Standardized Estimates	Unstandardized Estimates	Standard Errors	<i>p</i> -values
<i>Predictors on Autonomous Motivation</i>				
Variety	.227	.204	.048	< .001
Competence	.315	.314	.069	< .001
Relatedness	.267	.280	.050	< .001
Autonomy	.062	.075	.072	.298
<i>Predictors on Controlled Motivation</i>				
Variety	-.083	-.074	.069	.283
Competence	-.167	-.165	.095	.081
Relatedness	-.033	-.034	.073	.640
Autonomy	-.203	-.242	.089	.007
<i>Predictors and Mediators on Exercise Behaviour</i>				
Variety	.102	2.521	1.772	.155
Competence	.081	2.213	2.605	.396
Relatedness	.019	0.533	1.809	.768
Autonomy	.123	4.092	2.185	.061
Gender	-.165	-7.386	2.345	.002
Autonomous Motivation	.254	6.974	1.994	< .001
Controlled Motivation	.011	0.317	1.840	.863

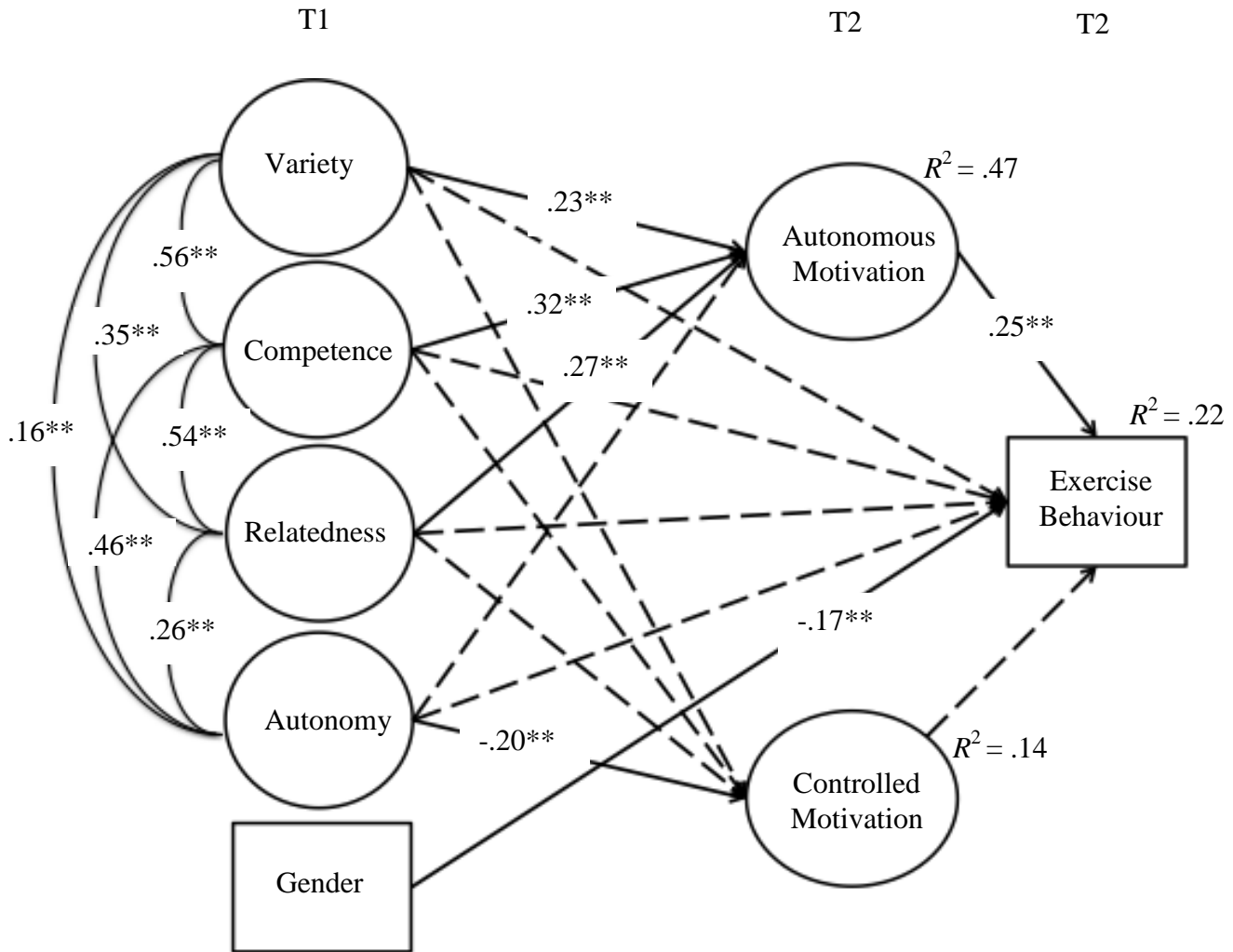


Figure 3.2 Path diagram of the relationships between perceived variety, competence, relatedness, and autonomy in exercise at Time 1 (T1), and autonomous motivation, controlled motivation and exercise behaviour at Time 2 (T2). Gender was included as a covariate of exercise behaviour. Solid lines represent (standardized) significant path coefficients and dashed lines represent non-significant path coefficients. * $p < .05$, ** $p < .01$.

With regard to the main findings, total indirect effects were found to be significant for the relationships between perceived variety ($\beta = .057, p < .05$), competence ($\beta = .078, p < .05$), and relatedness ($\beta = .067, p < .01$) on exercise behaviour (see Table 3.3). More specifically, perceived variety ($\beta = .058, p < .01$), competence ($\beta = .080, p < .05$), and relatedness ($\beta = .068, p < .01$) had unique indirect effects on exercise behaviour through autonomous motivation. After statistically controlling for the effects of autonomous and controlled motivation (i.e., mediators), the direct effects (see Table 3.2) for perceived variety ($\beta = .102, p = .155$), competence ($\beta = .081,$

$p = .396$), and relatedness ($\beta = .019, p = .768$) in relation to exercise behaviour were non-significant, which provides evidence of the mediating effects of these variables.

Table 3.3. Indirect effects of perceived variety, and satisfaction of the needs for competence, relatedness, and autonomy on exercise behaviour, through autonomous and controlled motivation

Variables	Estimate	SE	<i>p</i> -Value	Bias Corrected Bootstrapped 95% Confidence Interval
<i>Variety to Exercise Behaviour</i>				
Total Indirect Effects	.057	.025	.025	.007 – .106
Specific Indirect Effects				
Autonomous Motivation	.058	.021	.007	.016 – .099
Controlled Motivation	-.001	.010	.925	-.021 – .019
<i>Competence to Exercise Behaviour</i>				
Total Indirect Effects	.078	.035	.027	.009 – .147
Specific Indirect Effects				
Autonomous Motivation	.080	.031	.011	.019 – .141
Controlled Motivation	-.002	.013	.887	-.028 – .024
<i>Relatedness to Exercise Behaviour</i>				
Total Indirect Effects	.067	.023	.004	.022 – .113
Specific Indirect Effects				
Autonomous Motivation	.068	.022	.002	.025 – .110
Controlled Motivation	.000	.006	.951	-.012 – .012
<i>Autonomy to Exercise Behaviour</i>				
Total Indirect Effects	.013	.023	.551	-.031 – .058
Specific Indirect Effects				
Autonomous Motivation	.016	.016	.313	-.015 – .046
Controlled Motivation	-.002	.015	.874	-.031 – .026

Note. Standardized beta coefficients are reported.

3.4 Discussion

The purpose of this study was to examine the extent to which perceived variety in exercise (along with satisfaction of the needs for competence, relatedness, and autonomy in exercise) prospectively predicts exercise behaviour, and the extent to which that relationship is mediated by autonomous and controlled motivation in the context of exercise. The results of this study revealed that perceived variety in exercise was a unique indirect positive predictor of exercise behaviour, and autonomous motivation mediated that relationship. Furthermore, satisfaction of the needs for competence and relatedness also positively predicted exercise behaviour indirectly through autonomous motivation, while satisfaction of the need for autonomy was a negative predictor of controlled motivation.

The results regarding perceived variety in exercise are consistent with past work that has found exercise-related variety support to predict exercise behaviour (Glaros & Janelle, 2001; Juvancic-Heltzel et al., 2013). These results are also consistent with those of Dimmock et al. (2013) who reported that expectations of variety in exercise were related to autonomous (i.e., internalized) motivation. We extended their work by testing and finding support for a theoretical mediator (i.e., autonomous motivation) that explains the relationship between perceived variety and behaviour in exercise. Overall, perceived variety in exercise was found to complement satisfaction of the needs for competence, relatedness, and autonomy by explaining unique variance in the prospective prediction of autonomous motivation and (indirectly) exercise behaviour.

Consistent with SDT (Ryan & Deci, 2002), in the current study satisfaction of the needs for competence and relatedness were positively related to exercise behaviour, and those relationships were mediated by autonomous motivation. Contrary to our a priori theorizing,

satisfaction of the need for autonomy was not a significant predictor of either autonomous motivation or exercise behaviour. Unfortunately, our data do not provide insight into the possible reasons for why the satisfaction of the need for autonomy in exercise did not explain variance in these variables. However, as a potential explanation, some researchers have found that in the context of exercise, when statistically controlling for satisfaction of the needs for relatedness and competence, satisfaction of the need for autonomy no longer predicts autonomous motivation (e.g., Sweet, Fortier, Strachan, & Blanchard, 2012; Wilson & Rogers, 2008). With regards to controlled motivation, our results indicated that satisfaction of the need for autonomy in exercise was a negative predictor, which is also consistent with previous research (e.g., Silva et al., 2010).

Since the experience of variety in exercise was found to be related to both autonomous motivation and indirectly to exercise behaviour, but unrelated to controlled motivation, perceived variety may be more related to the *promotion* of autonomous motivation and exercise behaviour than protecting against the experience of controlled motivation. This finding is in line with the notion that experiencing variety in exercise may promote interest and enjoyment in exercise and facilitate the internalization of exercise behaviour (Dimmock et al., 2013). In light of the finding that the experience of variety was able to explain unique variance in autonomous motivation, the results of this study lend weight to Sheldon's (2011) contention that satisfaction of the three basic psychological needs subsumed within SDT (i.e., competence, relatedness, and autonomy) may be an incomplete subset of the types of positive experiences that are involved in supporting autonomous motivation. Although this study was restricted to the context of exercise, it would seem worthwhile to examine the extent to which the experience of variety is able to account for

unique variance in autonomous motivation and relevant behaviours in other contexts of human functioning such as eating/diet, friendship interactions, and work experiences.

Despite the theoretical and empirical contributions of the present study, limitations should also be acknowledged. While using a broad community sample for this study holds merit, participants were a convenience sample (e.g., those interested in a study about exercise), which restricts the external validity of the conclusions. While administering questionnaires online for this study reduced participant burden and study costs, an exclusive reliance on self-report data limits our conclusions, as complementary objective measures of exercise behaviour (e.g., the use of accelerometers) would have provided data for an additional (more robust) test of predictive utility. By using a prospective observational design, we were able to draw conclusions regarding the relationships between exercise-related perceived variety, satisfaction of the needs for competence, relatedness, autonomy, motivation and exercise behaviour over time. However, the observational (i.e., non-experimental) design prevents inferences of causality. In future research, experimental designs are encouraged to examine the social contextual supports that give rise to perceived variety in exercise as well as the potential causal link between perceived variety, autonomous motivation and behaviour in exercise contexts.

Consistent with the tenets within SDT (Ryan & Deci, 2002), Vallerand (1997) suggested that in given contexts (e.g., exercise, sport, leisure) the way in which the social context is structured and the interpersonal interactions experienced within serve to either satisfy or frustrate particular psychological experiences (e.g., within SDT ‘basic psychological needs’; Ryan & Deci, 2002). That is, need-supportive social contexts are hypothesized to satisfy a person’s basic psychological needs and subsequently promote autonomous motivation and behaviour (Standage & Vallerand, 2014). In contrast, need-thwarting social contexts are assumed to frustrate an

individuals basic psychological needs and lead to controlling forms of motivation and/or passive engagement in activities (Standage & Vallerand, 2014). Of direct relevance to the current discussion is that in future an important line of inquiry would be to examine the extent to which the provision of variety within the social context (i.e., exercise-related variety support) is related to the perception of exercise-related variety (i.e., felt variety), as well as downstream measures of autonomous motivation toward exercise and exercise behaviour. By examining these relationships experimentally and/or in a mediation model (i.e., exercise-related variety support → perceived variety in exercise → autonomous motivation toward exercise → exercise behaviour), researchers can gain insight into the extent to which the provision/availability of exercise-related variety support (i.e., opportunity), results in the felt experience of variety (i.e., perceived variety in exercise) independent of, or (possibly) in combination with, the satisfaction of the needs for competence, relatedness, and autonomy in exercise. Such an endeavour would also shed light on the extent to which variety support is related to subsequent exercise behaviour, as well as a more comprehensive analysis of the different mechanisms (i.e., mediational pathways) that might explain that relationship. In line with SDT (Ryan & Deci, 2002) and Vallerand's (1997) hierarchical conceptualization of these tenets, we would hypothesize that exercise-related variety support would best predict an individuals' perceived variety in exercise (i.e., as when compared with the satisfaction of the needs for competence, relatedness, or autonomy in exercise), which would in turn explain variance in exercise behaviour (mediated through autonomous motivation toward exercise). We encourage researchers to test this hypothesis. Should research provide evidence for such an effect, this would point to the utility of targeting exercise-related variety support through intervention as a means of bolstering autonomous motivation and exercise behaviour.

In conclusion, the results of this study provide insight into how/why perceived variety in exercise relates to exercise behaviour. That is, when examined alongside satisfaction of the needs for competence, relatedness, and autonomy, perceived variety in exercise explained unique variance in exercise behaviour via autonomous motivation. As such, we suggest that researchers examine the antecedents of the perception of variety in exercise to understand how to facilitate this potentially beneficial psychosocial experience. With regards to external validity, examining perceived variety in relation to motivation and behaviour in other contexts (e.g., perceived variety with regard to sport training or educational/learning opportunities) would be an insightful line of enquiry. Researchers should continue to examine potential theoretical and applied implications that perceived variety may hold.

Chapter 4: Variety Support and Exercise Adherence Behaviour:

Experimental and Mediating Effects

4.1 Introduction

Researchers and public health agencies have consistently identified that the vast majority of North American adults are physically inactive (i.e., Centers for Disease Control and Prevention, 2014; Colley et al., 2011) and that physical inactivity is linked to an increased risk for numerous causes of morbidity (and mortality) such as cardiovascular disease and some types of cancer (World Health Organization [WHO], 2009). To address the public health concern ensuing from this global physical inactivity pandemic (Hallal et al., 2012), there have been calls to develop efficacious exercise intervention strategies (Mâsse et al., 2011; WHO, 2007).

One intervention strategy that holds potential for influencing individuals' exercise behaviour relates to the provision of variety (e.g., Juvancic-Heltzel et al., 2013). Variety refers to the experience of an assortment or alternation of (novel and familiar) tasks, actions, and opportunities (cf. Juvancic-Heltzel et al., 2013; Sheldon & Lyubomirsky, 2012; Sylvester et al., 2014a). Variety has been examined as both a feature of an activity or environment (i.e., *variety support*; e.g., Lyubomirsky & Layous, 2013), and as an experience (i.e., one's *felt experience*; e.g., Sylvester et al., 2014b). Variety support refers to the manner in which activities, behaviours, and opportunities are structured to facilitate (or thwart) the experience of variety, whereas the experience of variety refers to the extent to which a person feels as though they experience an assortment of tasks, actions, and opportunities. In the present investigation, we focus on both variety support and the experience of variety in the context of exercise.

In previous work, Glaros and Janelle (2001) found that participants who varied their use of aerobic exercise equipment every fortnight for eight weeks adhered to their exercise program

more so than participants who did the same aerobic exercise each session. In addition, Juvancic-Heltzel and colleagues (2013) found that participants who encountered greater variety support in a single bout of exercise (i.e., the opportunity to use ten versus two pieces of equipment) spent more time exercising and performed a greater number of repetitions. In these studies the authors structured exercise-related variety support by prescribing variation both between sessions (i.e., changing the mode of exercise from one session to another; Glaros & Janelle, 2001) and within a session (i.e., offering a greater number of exercises in a single bout; Juvancic-Heltzel et al., 2013). Furthermore, Dimmock Jackson, Podlog, and Magaraggia (2013) provided variety support within a single exercise by instructing participants that the second half of a cycling task would require different resources and would be experienced differently than in the first half. Although these studies provide insight in terms of how to structure exercise-related variety support (e.g., Dimmock et al., 2013), and the subsequent effect on exercise behaviour (i.e., Glaros & Janelle, 2001; Juvancic-Heltzel et al., 2013), these studies examined exercise-related variety support using atheoretical approaches which limits researchers understanding of the process through which (i.e., why/how) interventionists can change exercise behaviour (Rothman, 2004).

One theory that provides insight in terms of the extent to which (and manner through which) various contextual factors lead to exercise behaviour (i.e., through psychological experiences) is SDT (Deci & Ryan, 1985; Ryan & Deci, 2002). Embedded within SDT, Ryan and Deci (2002) posit that people have universal and innate basic psychological needs for competence, relatedness, and autonomy, and the extent to which these needs are supported in one's social environment leads to subsequent behaviour (through the intermediary role of autonomous motivation). Competence refers to feeling capable and effective in one's

environment (Ryan & Deci, 2002; White, 1959), relatedness refers to feeling connected to others (Baumeister & Leary, 1995; Ryan & Deci, 2002), and autonomy refers to feelings of self-governance, and volition in one's choices and behaviours (deCharms, 1968; Ryan & Deci, 2002).

In their conception of SDT, Ryan and Deci (2002) theorized that in any given context, the way in which that context is structured will influence downstream psychological variables and subsequent behaviour. While there is mounting empirical evidence supporting the notion that fostering satisfaction of the needs for competence, relatedness, and autonomy in exercise (through social support) leads to exercise behaviour (e.g., Teixeira et al., 2012), Sheldon (2011) noted that a lack of research examining alternative/additional psychological experiences that may support adaptive behaviour (in addition to satisfaction of the needs for competence, relatedness and autonomy advanced within SDT) is a limitation in the extant SDT literature, and one that should be empirically examined.

The experience of variety may operate as a salient and unique psychological experience worth investigating from an SDT perspective. In the context of exercise, previous work has found that perceived variety is empirically distinct from perceptions of competence, relatedness, and autonomy (Sylvester et al., 2014b). Moreover, perceptions of variety (in addition to satisfaction of basic psychological needs for competence, autonomy, and relatedness) predict variance in indices of exercise-related well-being (e.g., Sylvester et al., 2014b), motivation and exercise behaviour (Sylvester et al., 2014a). One of the notable limitations of the studies by Sylvester and colleagues (2014a, 2014b), however, is that they used observational (i.e., non-experimental) designs, which substantively limits inferences of causality. Drawing from the work of Sylvester et al. (2014a, 2014b), theorizing from the perspective of SDT (Ryan & Deci, 2002), as well as observations by Sheldon (2011), the diversity (or invariance) of exercises that

one engages in (i.e., exercise-related variety support), may act to facilitate the subsequent experience of variety in exercise, which in turn could have substantive implications for exercise behaviour.

Thus, in the present study, we sought to examine the effects of experimentally manipulated variety support in a resistance exercise program in relation to exercise adherence behaviour, while first examining the extent to which variety support is differentially related to the experience of variety, when considered in comparison to perceptions of competence, relatedness, and autonomy. This initial step was designed to provide evidence of discriminant validity, whereby we hypothesized that the provision of variety support in the context of exercise would result in changes in perceived variety, but not in perceived competence, relatedness, and autonomy. Beyond this manipulation check, the main purpose of the study was to examine the effects of variety support in relation to exercise behaviour and whether the experience of variety in exercise mediates those effects. This line of enquiry was designed to shed light on whether perceived variety acts as a psychological experience (cf. Sheldon, 2011) that influences (and explains the relationship between variety support and) exercise behaviour. Based on Ryan and Deci's (2002) conceptual framework and previous research (e.g., Glaros & Janelle, 2001; Juvancic-Heltzel et al., 2013; Sylvester et al., 2014a, 2014b), we hypothesized that exercise-related variety support would foster perceptions of variety (but not satisfaction of the needs for competence, relatedness, and autonomy) in exercise, as well as exercise adherence behaviour. Furthermore, we hypothesized that the relationship between variety support and exercise adherence behaviour would be mediated through perceived variety.

4.2 Methods

4.2.1 Participants

Following ethical approval from the first author's institutional research ethics board (see Appendix C), a sample of university students ($n = 144$) between the ages of 17 and 38 years old were recruited to participate in the study. To be eligible, participants had to (a) be currently enrolled as a university student, (b) be between the ages of 17 and 40 years old, (c) be able to read and converse in English, (d) report no health risks that would interfere with exercise (as identified by responses to the Physical Activity Readiness Questionnaire for Everyone; PARQ+, Warburton et al., 2011), and (e) be classified as physically inactive (i.e., report two or fewer bouts, of at least 20 minutes, of moderate to vigorous exercise in a typical week; cf. Wilcox et al., 1999).

The final sample ($N = 121$) was comprised of 87 females ($M_{age} = 20.87$ years; $SD_{age} = 3.09$ years) and 34 males ($M_{age} = 21.88$ years; $SD_{age} = 3.57$ years). The sample was ethnically diverse, as most participants self-identified as Chinese ($n = 43$; 35.5%), White ($n = 32$; 26.4%), multi-racial ($n = 17$; 14.1%), or Korean ($n = 9$; 7.4%). Most participants lived on their own off-campus ($n = 43$; 35.5%), in an on-campus residence ($n = 38$; 31.4%), or with family ($n = 35$; 28.9%) and reported being in their third ($n = 36$; 29.8%), first ($n = 32$; 26.4%), second ($n = 28$; 23.1%), or fourth ($n = 20$; 16.5%) year of university.

4.2.2 Procedure

This study was conducted at a university fitness centre in British Columbia, Canada. Participants attended an introductory session where they were briefed on the study protocol (e.g., that they could drop-in to complete the exercise program at their convenience) and asked to provide written informed consent. They subsequently provided baseline data and were then

randomly assigned (through a random number generator) to either a HVS or LVS exercise program (i.e., condition). Participants were blinded to the program conditions. Trained research assistants and employees (i.e., Certified Personal Trainers) at the fitness centre supervised the exercise sessions and monitored participants for safety and technique.

All participants were given the same exercise protocol instructions with regard to exercise frequency, duration, and intensity (e.g., three 1-hour training sessions per week) and both exercise programs were designed to target upper and lower body muscle groups (e.g., chest, legs). To control for volume and intensity, following a warm-up consisting of aerobic exercise, dynamic stretching, and a light set for each exercise, participants were instructed to perform sets of 10 repetitions (of each prescribed exercise) at a selected weight such that a consecutive repetition (i.e., >10) would not be possible without compromising proper technique. As such, to maintain the same relative intensity between participants, the absolute resistance for each given exercise was individually tailored. Participants were provided with an exercise booklet (available from the first author upon request) that had a printed copy of their exercise program as well as information about the study protocol and exercise techniques. The booklet remained at the exercise facility throughout the study for participants to follow their assigned program and record their attendance. Participants were asked to abstain from other strength-training exercise programs over the course of the study (to avoid compromising internal validity). Finally, participants in both conditions completed measures of exercise-related perceived variety and the psychological needs at two time points (i.e., at baseline prior to commencing the exercise program, and at the end of week three (Time 2)) as part of the experimental pretest-midtest-posttest control group design. Those who received LVS served as the control group in this study.

4.2.3 Intervention

The exercise programs were designed to be as identical as possible with the exception of the level of variety support that was provided. Participants in each condition performed the same number of exercise sets and repetitions, at the same relative intensity. The volume of exercise (i.e., 160 total repetitions) was equal for both conditions and was consistent with procedures developed by Sparkes and Behm (2010) who outlined the provision of resistance exercise programs for previously inactive adults within a university setting. The rest intervals (i.e., one-minute) between exercises and sets were also identical for each group. In the HVS condition, however, participants completed varied resistance-based exercises (using machine weights, free weights, and one's own body weight) during each session, while participants in the LVS condition completed the same exercises each session. To foster the experience of variety in exercise, participants in the HVS group engaged in an exercise program designed to (a) alternate exercises between sessions (cf. Glaros & Janelle, 2001), (b) include more diverse exercises within each session (while holding the total number of sets and repetitions in each session equal with the LVS group; cf. Juvancic-Heltzel et al., 2013), and (c) vary within individual exercises by incorporating modifications (cf. Dimmock et al., 2013). Those in the HVS condition had unique combinations of eight exercises to perform each session (two sets of each exercise), which was expected to consistently support the experience of variety throughout the study, while those in the LVS condition repeated the same four exercises each session (four sets of each exercise).

4.2.4 Sample Size Determination

G*Power 3 (Faul, Erdfelder, Lang, & Buchner, 2007) software was used to conduct an a priori power analysis to determine the total sample size necessary for this study. The sample size

was selected based on our primary research question regarding the extent to which experimentally manipulated variety support in the context of a resistance exercise program leads to exercise adherence behaviour in a sample of physically inactive adults. We used G*power (Faul et al., 2007) to determine that an analysis of covariance (ANCOVA) with $\alpha = .05$, a moderate effect size ($\eta^2 = .06$) based on Glaros and Janelle (2001) and Juvancic-Heltzel et al. (2013), and a conservative power estimate ($\beta = .80$) requires a sample of $N = 128$. To answer our second research question regarding the extent to which the experience of variety mediates that relationship, we used a single mediation model with a latent variable of the mediator (with the independent variable operationalized as an observed variable reflecting the two experimental conditions and the dependent variable as an observed measure of attendance). For structural equation modelling (SEM), several researchers suggest at least 5 or 10 observations per estimated parameter (Bentler & Chou, 1987; Bollen, 1989); 10 parameters were estimated in our mediation model (i.e., using a conservative approach based on these recommendations, a sample of 100 was required). Others have provided more omnibus recommendations for sample size estimates with SEM, such as suggesting samples of at least 200 (Kline, 2005). However, sample size depends on many factors such as the size of the model (e.g., number of parameters) and the estimated size of effects, with researchers also recently advocating that sample size estimates for SEM models can be smaller in instances with less measurement error (e.g., Wolf, Harrington, Clark, & Miller, 2013). We reduced the risk of Type 1 error by creating a latent variable (to reduce measurement error) and used bootstrapping procedures to estimate indirect effects (Preacher & Hayes, 2008). Bootstrapping analysis is recommended to test for mediation with small sample sizes (e.g., Fritz & MacKinnon, 2007; Shrout & Bolger, 2002). When taken together, our a priori sample of $n = 144$ was deemed appropriate to address both our primary

(effects of variety support on physical activity) and secondary (mediation) research questions, while accounting for modest attrition (final sample $n = 121$).

4.2.5 Measures

Perceived variety in exercise. Perceived variety in exercise was assessed using the five-item PVE questionnaire (Sylvester et al., 2014b). Items on the PVE questionnaire are anchored on a six-point Likert-type rating scale with responses ranging from 1 (*False*) to 6 (*True*). Higher scores reflect greater levels of perceived variety in exercise. In their original instrument development work, Sylvester et al. (2014b) reported ordinal composite reliability (Zumbo et al., 2007) of PVE scores to be .97. In the current study, ordinal composite reliability of the PVE scores was .91 at Time 1 and .94 at Time 2.

Basic psychological needs satisfaction. The PNSE questionnaire (Wilson et al., 2006) was used to measure the satisfaction of the needs for competence, relatedness, and autonomy in the context of exercise. The PNSE is an 18-item instrument with each of the three psychological needs measured using six items. Responses to each item are anchored on a scale that ranges from 1 (*False*) to 6 (*True*). Higher scores reflect greater satisfaction of the needs for (perceived) competence, relatedness, and autonomy in exercise. Structural and criterion validity of scores derived from an adult population regarding each subscale of the PNSE was initially reported by Wilson et al. (2006). In the current study, ordinal composite reliability was found to be $\geq .87$ for each of the psychological needs at both Time 1 and Time 2 (see Table 4.1).

Exercise behaviour. Exercise behaviour was operationalized as the percentage of recorded adherence to the exercise program over the six-week period. For each exercise session the participants attended (up to 18 sessions over six-weeks), they recorded whether they completed the prescribed exercises in their exercise booklets. Adherence was calculated as a

percentage of sessions completed (i.e., total number of sessions completed, divided by the maximum number of sessions (i.e., 18), and multiplied by 100). This variable was used as the dependent measure of exercise behaviour.

Exercise behaviour at baseline (i.e., Time 1) was measured using the GLTEQ (Godin & Shephard, 1985). The GLTEQ is comprised of 3-items that assess the frequency of mild, moderate, and strenuous leisure-time exercise behaviour enduring at least 15 minutes per session in a typical week. A score was calculated using the formula [(Mild \times 3) + (Moderate \times 5) + (Strenuous \times 9)] to produce weekly estimates of leisure-time exercise, with higher scores reflecting higher levels of energy expenditure (Godin, 2011). Godin and Shephard (1985) reported support for the validity evidence of adult's GLTEQ scores in the form of positive correlations with estimates of cardiorespiratory fitness (i.e., $VO_2\text{max}$) and negative correlations with body fat scores. Score stability has been examined through test-retest reliability coefficients, which have been found to range from .24 to .96 (Godin & Shephard, 1985; Jacobs et al., 1993).

4.2.6 Data Analysis

In line with our study objective to examine the efficacy of exercise-related variety support on exercise program adherence, participants who attended at least one exercise session (i.e., received the variety support) were included in the analysis. Prior to the main analyses, descriptive data were obtained and Little's chi-square test (Little, 1988) was conducted to examine any potential patterns of missing data using.

Next, to examine whether exercise-related variety support differentially leads to the experience of variety, and/or satisfaction of the needs for competence, relatedness, and autonomy in exercise, we examined a latent variable multivariate analysis of covariance (LVMANCOVA)

using *Mplus* 6.11 software. The latent model was utilized to (a) treat the PVE and PNSE data as ordinal, (b) reduce potential bias from measurement error, (c) estimate the model simultaneously and therefore reduce the risk of Type 1 error, and (d) provide sufficient degrees of freedom in the model. WLSMV method of estimation was used to account for the ordered categorical nature of the Likert-type response scale scores (Finney & DiStefano, 2006). To model ordinal data, a polychoric correlation matrix is considered to be the best option when there are less than seven response options (cf. Beauducel & Herzberg, 2006). Missing data were estimated using all of the available data via the WLSMV algorithm within *Mplus* 6.11.

Based on recommendations by Brown (2006), Hu and Bentler (1999), and Marsh, Hau, and Wen (2004), goodness of fit for the model was assessed using the χ^2 goodness of fit index, the CFI, TLI, and the RMSEA. CFI and TLI values greater than .90, and RMSEA values less than .08 were considered to indicate good model-data fit, whereas CFI and TLI values greater than .95, and RMSEA values less than .06 were considered to indicate excellent fit (cf. Hu & Bentler, 1998, 1999). In addition to fit indices, we examined the reliability of the scores through CR where scores from each item are individually weighted in the composite load (see Bollen, 1989; Fornell & Larcker, 1981). Ordinal composite reliability is based on the polychoric correlation matrix and was assessed to account for the Likert-type response format used in the PVE and PNSE measures (Zumbo et al., 2007).

The LVMANCOVA was used to examine whether exercise-related variety support influenced perceptions of variety, competence, relatedness, and/or autonomy in exercise at Time 2, controlling for within-person (baseline) scores of perceived variety, competence, relatedness, and autonomy in exercise at Time 1. The experimental condition was the independent variable, while latent variables were constructed using multiple categorical items regarding perceived

variety (five items), satisfaction of the needs for competence (six items), relatedness (six items), and autonomy (six items). Time 2 scores of perceived variety, competence, relatedness, and autonomy in exercise were the dependent variables, and baseline scores of those variables at Time 1 were specified as covariates.

On the basis of the finding that the intervention resulted in changes in perceived variety, but not the three psychological needs (see Results section), we subsequently conducted an ANCOVA to assess whether there were differences in adherence to the exercise program based on the provision of (high or low) exercise-related variety support. To examine this research question, the experimental condition was specified as the independent variable, scores of exercise program adherence over the six-week intervention was specified as the dependent variable, and gender and baseline scores of exercise behaviour at Time 1 were specified as covariates. Exercise adherence behaviour was operationalized as an observed variable.

Finally, through a structural equation model we examined whether receiving exercise-related variety support explains variance in adherence to the six-week exercise program, through the mediating role of perceived variety in exercise (measured at Time 2). To examine the full range of adherence scores, we included participants who either completed or dropped out of the intervention at any time (i.e., before or after Time 2 data collection). For those participants who had dropped out of the study before we measured their perceived variety in exercise at Time 2, we imputed the last value obtained from those participants as a conservative estimate (i.e., no manipulation) of the participant's perceived variety in exercise (cf. intention-to-treat analysis recommendations; Unnebrink, & Windeler, 2001). Specifically, we used scores of perceived variety in exercise available from Time 2 ($n = 88$) as the mediator, but if the participant had

dropped out of the study by this point, we carried forward their score from Time 1 ($n = 33$; $n_{HVS} = 13$; $n_{LVS} = 20$) to retain their adherence data in the model.

In line with Rucker, Preacher, Tormala, and Petty's (2011) recommendations for testing mediation, the main outcome of interest was the indirect effect of exercise-related variety support on exercise program adherence through perceived variety in exercise. The indirect effect was estimated using Preacher and Hayes' (2008) bootstrapping procedure ($k = 5000$ samples) to construct bias corrected 95% confidence intervals (CIs). Bootstrapping is a non-parametric resampling procedure recommended for estimating indirect effects and CIs, and to optimize statistical power (Preacher & Hayes, 2008).

4.3 Results

Of the 144 people who attended the baseline appointment, 121 participants received the exercise-related variety support manipulation (i.e., $n_{HVS} = 58$; $n_{LVS} = 63$) by attending at least one exercise session, and were subsequently included in the analyses. Examination of Little's (1988) test indicated that missing data were Missing Completely at Random (MCAR), $\chi^2(502) = 519.20, p = .289$.

Descriptive statistics for exercise adherence were as follows: $M = 56.80\%$; $SD = 30.71$; skewness = $-.144$ ($SE = .220$); kurtosis = -1.304 ($SE = .437$). Results from the LVMANCOVA showed that overall, the model had good fit, $\chi^2(1015) = 1292.24, p < .00$, CFI = .96, TLI = .96, RMSEA = .06. Correlations and CR values for the study variables are presented in Table 4.1. In the LVMANCOVA (see Table 4.2), after statistically controlling for baseline scores of exercise-related perceived variety, competence, relatedness, and autonomy, there was a statistically significant intervention effect on perceived variety ($\beta = .47, p < .001$), but not perceived

competence ($\beta = .05, p > .05$), relatedness ($\beta = -.04, p > .05$), or autonomy ($\beta = .03, p > .05$) at Time 2.

Table 4.1. Correlations and reliability estimates of study variables

Variable	CR	1	2	3	4	5	6	7	8	9	10	11
1. Variety Support		--										
2. Variety-T1	.91	-.02	--									
3. Competence-T1	.94	-.08	.67*	--								
4. Relatedness-T1	.92	-.11	.49*	.54*	--							
5. Autonomy-T1	.87	-.09	.52*	.59*	.47*	--						
6. Variety-T2	.94	.42*	.56*	.37*	.27*	.29*	--					
7. Competence-T2	.94	.05	.46*	.68*	.37*	.40*	.60*	--				
8. Relatedness-T2	.95	-.03	.20	.21	.40*	.19	.23	.40*	--			
9. Autonomy-T2	.94	.03	.36*	.41*	.33*	.69*	.58*	.64*	.17	--		
10. Exercise Behaviour-T1		-.12	.11	.09	-.07	.17	-.08	.06	.07	-.04	--	
11. Exercise Adherence		.20*	.02	.01	.02	.13	.39*	.19*	.25*	.01	-.05	--

Note. CR = composite reliability; T1 = Time 1; T2 = Time 2. * $p < .05$.

Table 4.2. Intervention effects on perceived variety, competence, relatedness, and autonomy

Variables	Standardized Estimates	Unstandardized Estimates	SE	Bootstrapped 95% Confidence Interval
<i>Effects of Variety Support on:</i>				
Perceived Variety (T2)	.474	.897	.177	 [.668, 1.338]
Competence (T2)	.053	.085	.179	[-.228, .458]
Relatedness (T2)	-.036	-.056	.161	[-.341, .321]
Autonomy (T2)	.028	.034	.128	[-.233, .282]

Note: Boldface confidence intervals do not contain 0. T2 = Time 2.

An ANCOVA was then conducted to examine potential differences between exercise-related variety support conditions with regard to exercise program adherence, after statistically controlling for gender and baseline scores of exercise behaviour as covariates. There was a significant intervention effect on adherence to the program $F(1, 116) = 5.55, p = .02, \eta_p^2 = .05$, after statistically controlling for gender $F(1, 116) = 0.01, p > .05, \eta_p^2 = .00$, and exercise behaviour at Time 1 $F(1, 116) = 0.05, p > .05, \eta_p^2 = .00$. Participants who received high variety support had greater exercise adherence than those who received low variety support, $M_{HVS} = 64.22\%, SD = 30.99; M_{LVS} = 50.89\%, SD = 28.80$ (see Figure 4.1). That is, on average participants in the high variety support group completed 11.56 exercise sessions, whereas participants in the low variety support group completed only 9.16 exercise sessions, on average (out of 18).

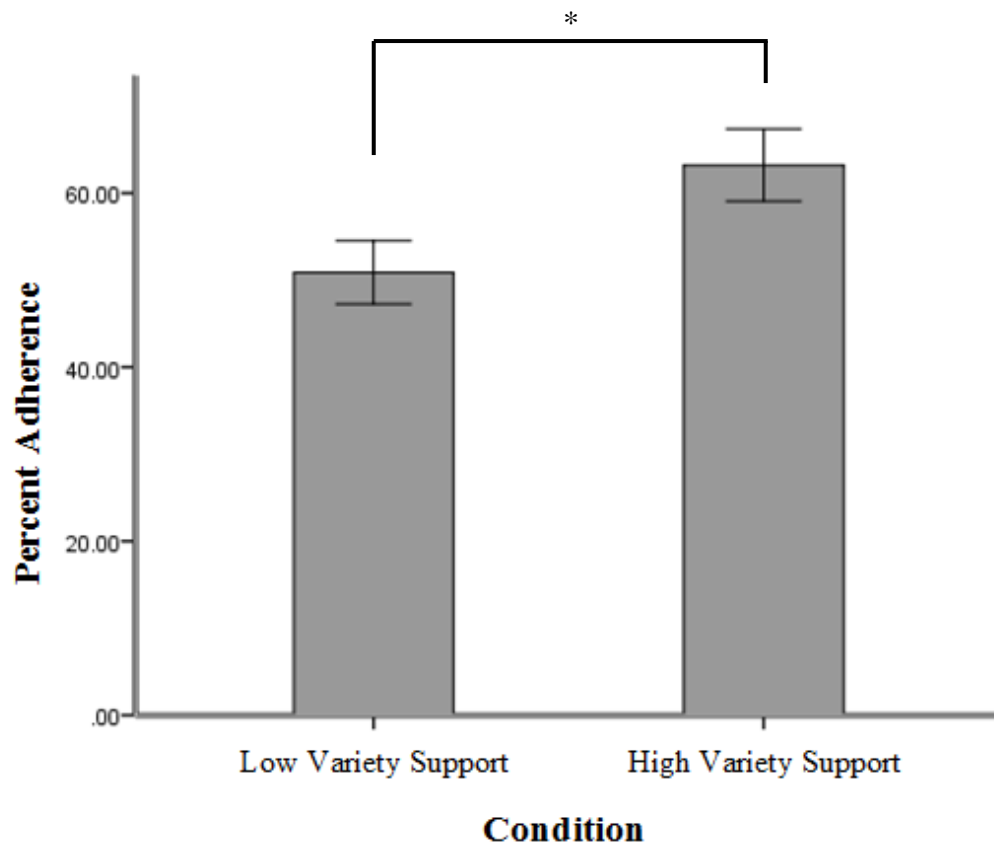


Figure 4.1 Dependent variable scores after controlling for gender and exercise behaviour at Time 1. Estimated marginal means are reported (i.e., the mean values at post-test include controlling for pre-test measures). Bars denote standard errors. * $p < .01$.

Finally, we examined whether perceived variety in exercise mediated the relationship between exercise-related variety support and adherence to the exercise program, after statistically controlling for gender and baseline scores of exercise behaviour. Overall, the model had excellent fit, $\chi^2(23) = 21.56, p = .55, CFI = 1.00, TLI = 1.00, RMSEA = .00$. In the structural model, exercise-related variety support positively predicted variance in perceived variety in exercise at Time 2 ($\beta = .43, p < .001$), which subsequently predicted variance in adherence to the six-week exercise program ($\beta = .37, p = .001$; see Figure 4.2 and Table 4.3). Neither exercise

behaviour at Time 1 ($\beta = -.02, p > .05$), or gender ($\beta = .01, p > .05$), was found to be a statistically significant covariate of exercise adherence behaviour over the course of the six-week program. The indirect effect was found to be significant for the relationship between exercise-related variety support and adherence to the program, through perceived variety in exercise ($\beta = .16, p < .01$). After statistically controlling for the effects of perceived variety (i.e., the mediator), the direct effect of variety support in relation to exercise adherence was non-significant ($\beta = .07, p > .05$), which provided evidence of mediation.

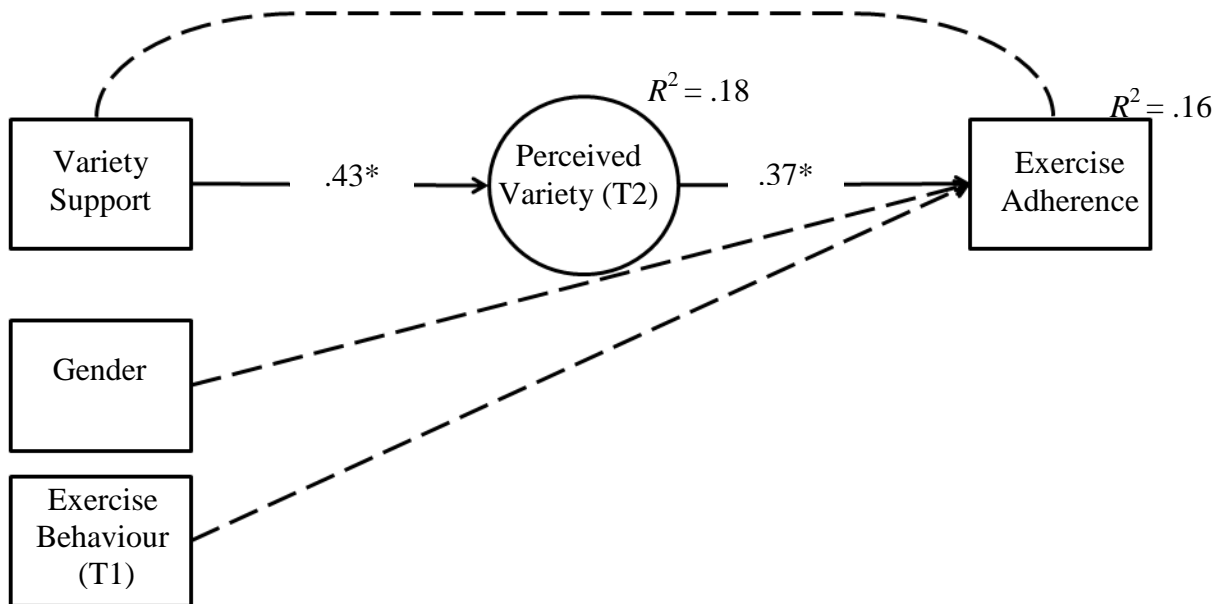


Figure 4.2 Path diagram of the relationships between exercise-related variety support (i.e., condition) and exercise adherence via perceived variety in exercise at Time 2 (T2) after controlling for gender and exercise behaviour at Time 1 (T1) as covariates. Solid lines represent standardized significant path coefficients and dashed lines represent non-significant path coefficients. * $p < .01$.

Table 4.3. Direct and indirect effects of variety support, covariates, and perceived variety on exercise adherence

Variables	Standardized Estimates	Unstandardized Estimates	SE	Bootstrapped 95% Confidence Interval
<i>Direct Effects on Exercise Adherence</i>				
Variety Support	.065	3.918	5.408	[-6.568, 14.332]
Perceived Variety (T2)	.365	11.460	3.250	[5.481, 18.251]
Exercise Behaviour (T1)	-.019	-.029	.204	[-.247, .465]
Gender	.010	.673	6.118	[-11.285, 12.775]
<i>Direct Effect on Perceived Variety</i>				
Variety Support	.425	.821	.181	[.461, 1.166]
<i>Indirect Effect of Variety Support on Exercise Adherence</i>				
Perceived Variety (T2)	.155	9.405	3.120	[4.421, 17.246]

Note: Boldface confidence intervals do not contain 0. T1 = Time 1; T2 = Time 2.

4.4 Discussion

The purpose of this study was to examine the extent to which experimentally manipulated variety support in the context of a resistance exercise program leads to the experience of variety (when examined alongside satisfaction of the three psychological needs embedded within SDT; Ryan & Deci, 2002), and exercise adherence behaviour in a sample of physically inactive adults. We also sought to examine whether the relationship between variety support and exercise adherence behaviour is mediated by perceived variety. The results showed that receiving high (compared to low) exercise-related variety support led to higher perceived variety in exercise, but not satisfaction of the needs for competence, relatedness, or autonomy, three-weeks later. Furthermore, higher variety support led to an increase in exercise adherence behaviour over the

course of six-weeks and the relationship between variety support and exercise adherence was mediated by perceptions of variety.

The positive effects of variety support on exercise adherence behaviour are consistent with findings reported by Glaros and Janelle (2001) who found evidence that providing variety support (i.e., switching the mode of exercise in an aerobic exercise program every two-weeks) leads to improved exercise adherence when compared to thwarting variety support (i.e., by prescribing only one mode of aerobic exercise for eight weeks). Adherence rates in the current study were similar to those reported by Glaros and Janelle (2001), as participants in the high and low variety support conditions in the current study attended 64% and 51% of exercise sessions respectively, compared to 63% and 54% in Glaros and Janelle's (2001) study. The results of our study substantively extend this work by explicating a mechanism through which variety support fosters improvements in exercise behaviour. Specifically, from an SDT perspective, Deci and Ryan (2002) posit that satisfaction of the needs for competence, relatedness, and autonomy represent the most salient psychological experiences (i.e., needs) through which well-being, motivation and achievement behaviour are supported. The results of the current study provide experimental evidence in support of the contention that perceived variety may act as an *additional psychological experience* (cf. Sheldon, 2011; Sylvester et al, 2014a, 2014b) that might bring about improved exercise behaviour. Indeed, these findings may have theoretical implications, as the experience of variety may be an additional type of positive experience (beyond satisfaction of the three basic psychological needs within SDT) that is involved in supporting adherence behaviour.

Although the mediation analysis provides valuable insight regarding how and why the intervention had an effect on exercise adherence, plausible additional explanations exist and

should be noted. For example, researchers have found empirical evidence that perceptions of variety explain the prospective relationship between perceived variety in exercise and exercise behaviour through the mediating role of autonomous motivation (i.e., Sylvester et al., 2014a). Although we did not test an extended multiple mediation model that also included autonomous motivation (e.g., interest/enjoyment inherent within an activity; Ryan & Deci, 2002), future research is warranted that examines the following sequence: exercise-related variety support → perceived variety in exercise → autonomous motivation toward exercise → exercise behaviour. It is also entirely possible that the *absence of variety* (in the LVS condition) may have resulted in reduced adherence via other (physical/physiological) mechanisms. Because our sample was comprised of non-exercisers, we recognized the importance of buffering against factors such as delayed onset muscle soreness (DOMS; Smith, 1992), and we did so by following a three-days-per-week resistance exercise program protocol that was previously conducted with inactive adults within a university setting (Sparkes & Behm, 2010). However, it is entirely possible that participants in this study may have experienced different levels of muscle soreness based on the condition to which they were assigned (due to the specificity of exercises), that in turn may have differentially contributed to their motivation and attendance of subsequent sessions. When taken together, although perceptions of variety were found to mediate the effects of variety support in relation to exercise adherence, other mechanisms warrant greater scrutiny in future research.

Nevertheless, from an applied perspective, the results of this study suggest that the provision of a varied exercise program may be an efficacious intervention strategy for those concerned with health promotion that can influence exercise adherence behaviour. In this study, we successfully manipulated the experience of variety through three modalities, namely, varying the exercise activities between sessions (i.e., from bout to bout), within sessions (i.e., prescribing

eight versus two exercise activities), as well as prescribing variation within the exercises (e.g., progressions). Within the current research it was not our aim to elucidate the relative importance of each discrete (i.e., micro) method of providing variety support, and instead took a more macro approach to maximizing variety in the HVS condition by operationalizing variety support between sessions, within sessions, and within exercises. Nevertheless, we certainly recognize that in future work it would be particularly informative for researchers to disentangle the unique effects of each method of variety support in their own right.

While the experimental design and the mediation analysis are notable strengths of the study, limitations should also be acknowledged. Specifically, the mediation results should be interpreted with some caution due to the fact that some participants dropped out of the study during the first three-weeks ($n = 33$). As a conservative approach, we used intent-to-treat analytic procedures (cf. Unnebrink, & Windeler, 2001), by carrying forward the Time 1 scores of the mediator for those participants. Although such an approach is preferable to listwise deletion (Unnebrink & Windeler, 2001), we recognize that dropout from any intervention study represents a challenge to internal validity of a study's findings (Shadish et al., 2002). A second limitation corresponds to the relative short-term nature of the exercise program. Although we used a prospective experimental design, and found significant effects with regard to the efficacy of providing variety support in facilitating exercise behaviour over time, it should be noted that the program was limited to six weeks. Given that sustained participation is required to achieve sufficient health outcomes (Physical Activity Guidelines Advisory Committee, 2008), future research is required to examine the efficacy of such (varied) exercise programs over a much longer period of time (i.e., six months or more).

Additionally, caution should be exercised in generalizing the findings beyond physically inactive adults. Although inactive adults represent an important population for intervention (Centers for Disease Control and Prevention, 2014), in future, researchers are encouraged to examine the external validity of variety support as a means of intervention in relation to physical activity adherence behaviours with other populations and in different contexts (e.g., physical education in schools, community exercise programs, adherence to rehabilitation protocols). Finally, while the present study sought to examine a psychological mediator (perceived variety) of the relations between variety support and exercise adherence, future work should also examine potential *moderators* (i.e., boundary conditions) that might interact with variety support in relation to supporting physical achievement outcomes. Such moderators might include variables such as age (children versus adults) and dose of variety. For example, an obvious question is *how much variety* is optimal to support exercise adherence?

4.4.1 Summary

In conclusion, the provision of exercise-related variety support was found to result in improved levels of exercise adherence among a sample of inactive university students, when compared to those who took part in a low variety support exercise program. Furthermore, participants' perceptions of 'felt' variety acted as the psychological mechanism that drove this effect. When taken together the results point to the potential utility of variety support as an efficacious strategy for supporting exercise behaviour, with further research now required to examine the long-term (≥ 6 months) effects of this intervention strategy in supporting health-enhancing physical activity, potential moderators, as well as the external validity of this approach with other populations and in different contexts.

Chapter 5: Effects of Variety Support on Exercise-Related Well-Being

5.1 Introduction

In recent years, there has been increased research interest in the concept of well-being, and its impact on health (i.e., Diener & Chan, 2011; Kobau et al., 2011; Lyubomirsky, King, & Diener, 2005). Scientific study has recognized the utility of considering both hedonic and eudaimonic components of well-being (e.g., Gallagher, Lopez, & Preacher, 2009). Hedonic well-being is characterized as the experience of positive feelings and a lack of negative feelings, while eudaimonic well-being corresponds to the notion of self-realization, feeling vital, and fully alive (c.f., Kahneman, Diener, & Schwarz, 1999; Ryan & Deci, 2001). Researchers have sought to understand the antecedents and psychological factors that are necessary to increase components of well-being (e.g., Sin & Lyubomirsky, 2009), with a promising line of research pertaining to the context of exercise (Biddle, Mutrie, & Gorely, 2015). To make robust inferences regarding possible antecedents and psychological mechanisms through which well-being may be enhanced in exercise contexts, experimental research is needed.

One psychological factor that may have a substantive effect on well-being in exercise is *variety*. Variety has been operationalized as both variety support, which refers to the provision of diverse endeavors, opportunities, and tasks within a given context (cf. Lyubomirsky & Layous, 2013), and also as an experience in which someone feels (or felt) as though they take part in diverse activities in a given context (cf. Sylvester et al., 2014). For example, within exercise contexts, variety *support* might involve the extent to which a personal trainer prescribes a diverse range of exercises, while the degree to which a person perceives that they actually engage in diverse exercises would constitute his/her *experience* of variety. In the present study,

we focus on both variety support and the experience of variety, along with indices of well-being, in the context of exercise.

Sheldon, Boehm, and Lyubomirsky (2012, Study 2) presented some of the only experimental data examining the influence of variety support on indices of well-being. Specifically, they conducted a kindness intervention in which participants were randomly assigned to either vary or repeat kind acts and behaviors each week. Results showed that people who vary their acts of kindness continue to experience well-being in that activity, while those who repeat the same acts of kindness adjust to the positive effect and derive less well-being from the activity over time. Although the results of Sheldon et al.'s (2012) study provide insight into the role of variety support in the context of a kindness intervention, the results also point to the importance of the provision of variety support in facilitating greater well-being in a given context.

Researchers have yet to examine variety support in relation to well-being in the context of exercise. However, research findings suggest that examining variety is a worthwhile line of enquiry (e.g., Sylvester et al., 2014). Specifically, in a prospective observational study, Sylvester et al. (2014) found that *perceptions* of variety in exercise positively predicted variance in exercise-related positive affect, and subjective vitality, but not exercise-related negative affect, over time. As such, the psychological experience of variety may be implicated in the promotion of well-being; although the non-experimental nature of Sylvester et al.'s (2014) study design limits inferences of causality. Another notable limitation of Sylvester et al.'s (2014) study pertains to the exclusion of exercise-related *variety support* as a potential antecedent of perceptions of variety and subsequent well-being in exercise contexts. In a recent experimental study, Sylvester et al. (2015) found that the provision of high variety support in the context of

six-week exercise program resulted in higher levels of perceived variety when compared to participants in a low variety-support program, and this was subsequently related to higher levels of exercise adherence. Thus, drawing from observational findings linking the perceptions of variety to exercise-related well-being (Sylvester et al., 2014), and the experimental findings linking variety support to perceptions of exercise variety (Sylvester et al., 2015), it would seem plausible to suggest that variety support would (causally) lead to improved perceptions of well-being in exercise and that perceptions of variety would mediate those effects.

One population that is an important target for exercise-related well-being intervention is adults who are physically inactive (Centers for Disease Control and Prevention, 2014). Physical inactivity has been described as a global health pandemic (Hallal et al., 2012) and is associated with numerous health consequences (World Health Organization, 2007). Researchers have found that affective responses to physical activity are proximal determinants of behavior (Kiviniemi, Voss-Humke, & Seifert, 2007) and suggest that understanding how to manipulate the causal antecedents of affective responses to exercise could support improved efforts to promote exercise participation among this population (Ekkekakis, Hargreaves, & Parfitt, 2013). While affect is not fully representative of well-being itself, affect is an index of hedonic well-being which, along with eudaimonic well-being, represent two broad components of well-being that researchers can assess to determine the extent to which people experience well-being in exercise contexts (cf. Ryan, Huta, & Deci, 2013).

The purpose of the present study was to examine the extent to which variety support in a resistance exercise program influences indices of exercise-related well-being, namely, positive affect, negative affect, and subjective vitality, in a sample of physically inactive adults. We also examined the extent to which the potential relationships between variety support and exercise-

related well-being are mediated by perceptions of variety in exercise. In this study, our hypotheses drew from previous research which has shown that (a) variety support increases both context-specific well-being (i.e., Sheldon, Boehm, & Lyubomirsky, 2012) and perceptions of variety in exercise (Sylvester et al., 2015), and (b) perceptions of variety in exercise have been found to explain variance in exercise-related positive affect and subjective vitality, but not exercise-related negative affect (i.e., Sylvester et al., 2014). Specifically, we hypothesized that the provision of exercise-related variety support would lead to higher scores of exercise-related positive affect and subjective vitality, when compared to a low-variety support exercise program, and that these relationships would be mediated by perceptions of variety in exercise. Finally, in a test of discriminant validity, we sought to experimentally examine the relationship between variety support, perceived variety in exercise, and exercise-related negative affect. Based on findings by Sylvester et al. (2014), we hypothesized that exercise-related variety support, and perceived variety in exercise, would have no effect on scores of exercise-related negative affect.

5.2 Methods

5.2.1 Participants

One hundred and forty four university students (i.e., $n = 104$ females, $n = 40$ males; $M_{age} = 21.39$ years, $SD_{age} = 3.67$ years) enrolled in the study and completed questionnaires at pre-test ($N = 144$), mid-test (i.e., after three-weeks; Time 2; $n = 88$) and at post-test of a six-week (i.e., Time 3; $n = 55$) resistance training exercise study². Eligibility criteria included: Being currently

²The present study was part of a larger program of research designed to examine the effects of variety support and the experience of variety in the context of exercise. Research on the effects of variety support in exercise in relation to perceived variety, physical activity behaviour, and the psychological needs for competence, relatedness, and autonomy were reported in Sylvester et al. (2015). In this study, our research question focused on the effects of variety support in relation

enrolled as a university student, being fluent in English, reporting no health risks that would impede engaging in moderate-intensity exercise (i.e., based on responses to the Physical Activity Readiness Questionnaire for Everyone; PARQ+, Warburton, Jamnik, Bredin, & Gledhill, 2011), and reporting two or fewer bouts, lasting at least 20 minutes, of moderate-vigorous exercise per week (i.e., categorized as physically inactive; cf. Wilcox, King, Brassington, & Ahn, 1999). Of the 144 people who completed baseline measures, 121 participants received the exercise-related variety support manipulation (i.e., $n_{high\ variety\ support} = 58$; $n_{low\ variety\ support} = 63$) by attending at least one exercise session, and were subsequently included in the main analyses.

5.2.2 Procedure

After obtaining ethical approval from the research ethics board of the lead author's institution (see Appendix C), participants attended a baseline orientation session, provided written informed consent, completed baseline measures, and were randomized (using a computer random number generator) to either the high variety support (HVS) or low variety support (LVS) exercise condition. Participants were blinded to the experimental condition/exercise program (which took place at a University fitness centre in British Columbia, Canada) and were asked to refrain from engaging in other resistance-exercise training programs over the course of the six-week study to avoid compromising internal validity. All participants were given the same exercise protocol instructions, which consisted of three 1-hour training sessions per week (i.e., 18 sessions total), and could drop-in to complete their exercise program at their convenience. The exercise program was structured (e.g., frequency, and duration of exercise bouts, number of sets and repetitions) to match a resistance-based exercise program conducted by Sparkes and

to various indices of exercise-related well-being. None of the well-being data were reported in the Sylvester et al. (2015) study.

Behm (2010) that was designed for previously inactive adults within a university setting. In line with Sparkes and Behm (2010), we experimentally controlled for volume and intensity by instructing participants (after a brief warm-up consisting of aerobic exercise and dynamic stretching) to perform 10 repetitions for each set of each prescribed exercise (16 sets total; Sparkes and Behm prescribed two sets of eight different exercises). For each exercise, participants were instructed to select a weight at which they would be able to complete no more than 10 repetitions without conceding proper form. This way, participants would experience the same relative intensity even though the amount of weight for each given exercise was personalized. Each participant received an exercise booklet (copies of the HVS and LVS exercise booklets are available from the first author upon request) that remained at the exercise facility throughout the study, and included their exercise program as well as space for them to record their adherence to the protocol. Participants were invited to complete all study measures after three weeks into their respective programs (Time 2), as well as at the end of their six-week programs (Time 3).

5.2.3 Intervention

Consistent with our conceptual understanding of variety, to foster (or thwart) the experience of variety in exercise, we manipulated (a) the quantity of exercises to complete within each session (i.e., two sets of eight exercises for the HVS condition, compared to four sets of four exercises for the LVS condition; cf. Juvancic-Heltzel, Glickman, & Barkley, 2013; Sparkes & Behm, 2010), (b) whether exercises changed between consecutive bouts (cf. Glaros & Janelle, 2001), and (c) whether there was variation in the movement patterns of individual exercises (e.g., changing the hand grip on a pull-up to a chin-up; cf. Dimmock, Jackson, Podlog, & Magaraggia, 2013). To consistently support the experience of variety, participants in the HVS condition

performed different combinations of (novel and/or familiar) exercises each session, and those in the LVS condition repeated the same exercises each session.

5.2.4 Measures

Perceived variety in exercise. The PVE questionnaire (Sylvester et al., 2014b) was administered to measure the extent to which participants felt that they experienced variety in exercise. Each of the five items comprising the PVE questionnaire are rated on a 6-point Likert-type rating scale ranging from 1 “*false*” to 6 “*true*” with higher scores reflecting greater levels of perceived variety in exercise. An example item includes “I feel like I try a range of exercises.” In the current study, PVE scores were found to have an ordinal composite reliability (Zumbo, Gadermann, & Zeisser, 2007) estimate $\geq .93$ (see Tables 5.2 and 5.4).

Exercise-related well-being. Indices of exercise-related well-being were measured using the SPANE (Diener et al., 2010) as well as the SVS (Ryan & Frederick, 1997). The word ‘exercise’ was added to the instructions of both the SPANE and SVS to denote that we were interested in participant’s positive and negative affect and subjective vitality in the context of exercise. The SPANE was used to assess positive and negative experiences (e.g., pleasant, unpleasant) and is comprised of six adjectives that are rated on a 5-point ordinal scale ranging from 1 “*very rarely or never*” to 5 “*very often or always*” for each of the (positive and negative) subscales. Ordinal composite reliability in the current study was $\geq .87$ for scores of positive affect and \geq to $.85$ for scores of negative affect (see Tables 5.2 and 5.4).

To examine the extent to which participants experienced feelings of vitality in exercise, the SVS was administered (Ryan & Frederick, 1997). The SVS is comprised of six-items (cf. Bostic, Rubio, & Hood 2000), which participants rated on a 7-point Likert-type scale ranging from 1 “*not at all true*” to 7 “*very true*”. An example item includes “I nearly always feel alert

and awake”. Ordinal composite reliability indicators for SVS scores in the current study were \geq .87 (see Tables 5.2 and 5.4).

5.2.5 Data analysis

Potential patterns of missing data were examined using Little’s chi-square test (Little, 1988). Subsequently, *Mplus* 6.11 software was used to construct a series of structural equation models (described below). Since scores derived from the PVE, SPANE, and SVS questionnaires reflect ordinal data and have less than (or equal to) seven response options, a WLSMV method of estimation was used (Beauducel & Herzberg, 2006; Finney & DiStefano, 2006). The WLSMV algorithm within *Mplus* was used to estimate missing data. Goodness of fit for the model was assessed using the χ^2 goodness of fit index, the comparative fit index (CFI), Tucker-Lewis index (TLI), and the root mean square error of approximation (RMSEA; Brown, 2006; Hu & Bentler, 1999; Marsh, Hau, & Wen, 2004). Thresholds for categorizing model-data fit as good or excellent were designated as CFI and TLI values $> .90$, and RMSEA values $< .08$, or CFI and TLI values $> .95$, and RMSEA values $< .06$, respectively (cf. Hu & Bentler, 1998, 1999). To estimate score reliability we examined ordinal composite reliability based on the polychoric correlation matrix (Bollen, 1989; Fornell & Larcker, 1981; Zumbo, Gadermann, & Zeisser, 2007).

A preliminary analysis was conducted to determine whether participants who completed measures at Time 3 were systematically different than and those who did not. We examined a latent variable multivariate analysis of variance (LVMANOVA) to examine potential differences with regards to Time 1 age, gender, year of university, positive affect, negative affect, subjective vitality, and intervention condition, between participants who completed measures at Time 3, and those who did not. A LVMANOVA is a specific type of Structural Equation Model that is

used for difference testing with unobserved (latent) variables. Scores from each item have a unique weighting in the construction of latent variables (which reduces measurement error) while simultaneously modelling both the measurement and structural relations (which reduces the risk of Type 1 error).

Subsequently, we examined the extent to which receiving exercise-related variety support explains variance in exercise-related positive affect, negative affect and subjective vitality in those who completed measures at all three time points (i.e., completers analysis) through the mediating role of perceived variety in exercise measured at Time 2, after statistically controlling for gender and baseline scores of exercise-related perceived variety, positive affect, negative affect, and subjective vitality. Throughout the analyses we used the term ‘statistical control’ to refer to partialling out variance in the criterion variables (i.e., exercise-related positive affect, negative affect, and subjective vitality) that was attributable to covariates (e.g., gender).

Due to the fact that only 55 people completed post-test measures of well-being, and potential selection bias from estimating effects exclusively based on those who completed measures at Time 3, we subsequently conducted a more pragmatic secondary analysis to examine this sequential pathway for all participants who were randomized to a condition and received variety support (i.e., an intention-to-treat [ITT] analysis; Altman et al., 2001; Ruiz-Canela, Martinez-Gonzalez, De Irala-Esrevez, 2000). ITT analyses are considered the ‘gold standard’ for pragmatically evaluating the results of interventions in which researchers use randomization to condition (Altman et al., 2001). ITT analyses include all participants who are randomized to a condition (see Altman et al., 2001), however, based on recommendations by Fergusson, Aaron, Guyatt and Hebert (2002) if the participant never received any part of the intervention after randomization, it may be sensible for researchers to exclude those randomized participants from

the ITT analysis. Since our aim in conducting an ITT analysis was to pragmatically evaluate the effects of *receiving* variety support, consistent with Fergusson et al. (2002) it was not appropriate to include participants who did not receive any of the intervention (i.e., did not attend at least one exercise session; $n_{HVS} = 12$; $n_{LVS} = 11$). Therefore, we conducted a modified ITT analysis, based on recommendations by Fergusson et al. (2002) by including all participants who received variety support ($n = 121$) in the analysis. By considering all participants who received variety support as they were randomized, we were able to preserve some of the quality-control benefits of randomization (e.g., the likelihood that changes in indices of exercise-related well-being are attributable to differences in the variety support received, rather than extraneous factors). The ITT model was used to examine the extent to which receiving exercise-related variety support explains variance in exercise-related positive affect, negative affect and subjective vitality through the mediating role of perceived variety in exercise measured at Time 2, after statistically controlling for gender. Baseline measures of the study variables were not included as covariates in the ITT analyses, as we used the last value obtained from participants as a conservative estimate of the participant's true outcome (cf. Gadbury, Coffey, & Allison, 2003; Unnebrink, & Windeler, 2001).

In accordance with contemporary assessments of mediation (i.e., Rucker, Preacher, Tormala, & Petty, 2011), in both analyses the primary outcome of interest was the magnitude and significance of the indirect effect of exercise-related variety support on positive affect, negative affect and subjective vitality through perceptions of variety. Preacher and Hayes' (2008) bootstrapping procedure ($k = 5000$ samples) was used to estimate the indirect effects and confidence intervals. In addition to evaluating p -values, bias-corrected 95% confidence intervals

were assessed to determine statistical significance (i.e., whether the confidence intervals span zero).

5.3 Results

A total of fifty five participants completed measures of exercise-related positive affect, negative affect and subjective vitality at post-test (i.e., $n = 39$ females, $M_{age} = 20.95$ years; $SD_{age} = 3.49$ years; $n = 16$ males, $M_{age} = 21.81$ years; $SD_{age} = 4.37$ years). Most participants self-identified as Chinese ($n = 22$; 40%), White ($n = 16$; 29%), or multi-racial/other ($n = 10$; 18%), and most reported being in their second ($n = 17$; 31%), third ($n = 15$; 27%), or first ($n = 12$; 22%) year of university.

Evaluation of Little's chi-square test revealed that data were MCAR: $\chi^2(220) = 216.32, p = .557$. Subsequently, we examined any potential differences at baseline between participants who completed measures at post-test ($n = 55$) and participants who did not ($n = 89$). The fit indices of the LVMANOVA model were $\chi^2(355) = 637.30, p < .01$, CFI = .905, TLI = .891, RMSEA = .074. There were no statistically significant differences between participants who completed measures at post-test and those who did not (see Table 5.1).

Table 5.1. Differential effects between participants who completed post-test measures, and participants who did not

Variables	Standardized Estimates	Unstandardized Estimates	Bootstrapped 95% Confidence Interval
Age	-.041	-.306	[-1.624, .814]
Gender	-.023	-.021	[-.208, .100]
Year in University	-.051	-.136	[-.580, .257]
Positive Affect	.085	.151	[-.187, .465]
Negative Affect	.021	.036	[-.343, .284]
Subjective Vitality	.123	.212	[-.058, .561]
Intervention Condition	.042	.044	[-.137, .197]

Note: All variables were measured at Time 1.

Next, for those who completed Time 3 questionnaires (i.e., ‘completers’) we examined the extent to which exercise-related variety support explained variance in exercise-related positive affect, negative affect and subjective vitality, through the mediating role of perceived variety in exercise (at Time 2; after statistically controlling for gender and baseline scores of exercise-related perceived variety, positive affect, negative affect and subjective vitality). One of the positive affect items from the SPANE (Diener et al., 2010) measure at Time 1 created problems with respect to model convergence and so was removed from the analysis. The problem stemmed from the scores of the ‘Good’ item in relation to positive affect at Time 1 (but not Time 3). When we included the item ‘Good’ (at Time 1) in the analysis, a warning in the output indicated that the latent variable covariance matrix was not positive definite, and this was due to a negative residual variance from one of the items (i.e., ‘Good’ from the positive affect

scores at Time 1). However, the results do not provide an indication why the scores for ‘Good’ had negative residual variance in the analysis. Since variances cannot be negative by definition, and the item was one of six items representing positive affect at Time 1 (i.e., a covariate in the model), we deleted that item from the analysis. We proceeded with the analysis using the remaining five items to create the latent variable of ‘positive affect’ (that was operationalized as a covariate in the ‘completers’ model; i.e., those who completed measures at Time 3). All items in our outcome variable ‘positive affect’ (i.e., Time 3 scores) were included in the analysis. The model then converged normally, and overall had good fit ($\chi^2 (1012) = 1157.70, p < .01, CFI = .932, TLI = .928, RMSEA = .051$). Bivariate correlations and composite reliability values are reported in Table 5.2.

Table 5.2 Bivariate correlations and composite reliability for participants who completed post-test questionnaires

Variable	CR	1	2	3	4	5	6	7	8	9
1. Variety Support		--								
2. Perceived Variety-T1	.93	-.06	--							
3. Positive Affect-T1	.89	.11*	.07	--						
4. Negative Affect-T1	.85	.21*	.17	-.67*	--					
5. Subjective Vitality-T1	.87	-.12*	.44*	.52*	-.32*	--				
6. Perceived Variety-T2	.95	.40*	.37*	.03	.07	.17	--			
7. Positive Affect-T3	.90	.22*	.13	.58*	-.37*	.34*	.25*	--		
8. Negative Affect-T3	.95	.07*	.05	-.43*	.61*	-.25*	-.19	-.51*	--	
9. Subjective Vitality-T3	.90	-.03	.34*	.24*	-.12	.51*	.37*	.81*	-.33*	--

Note: CR = composite reliability; T1= time 1, T2 = Time 2, T3 = Time 3; $n = 55$. * $p < .05$.

With regard to the structural relations in the completers model (see values in Table 5.3), exercise-related variety support positively predicted perceived variety in exercise at Time 2 ($\beta = .49, p < .01$), which subsequently predicted variance in exercise-related positive affect ($\beta = .24, p < .01$), negative affect ($\beta = -.28, p < .01$) and subjective vitality ($\beta = .38, p < .01$) at the end of the six-week exercise program (see path diagram in Figure 5.1). Gender positively predicted positive affect ($\beta = .14, p < .01$), and negatively predicted negative affect ($\beta = -.16, p < .01$), with females experiencing higher levels of positive affect and less negative affect toward exercise than males. Indirect effects were found to be significant for the relationships between exercise-related variety support and positive affect ($\beta = .12, p < .01$), and subjective vitality ($\beta = .19, p < .01$), through perceived variety in exercise. The indirect effect for variety support in relation to negative affect, via perceptions of variety, approached statistical significance ($\beta = -.14, p = .06$). However, examination of the confidence intervals for this indirect effect revealed that the upper and lower points of the point estimate did not span zero (95% CI [-.479, -.147]), which suggests the existence of a significant indirect effect. After statistically accounting for the effects of perceived variety in exercise (Time 2; i.e., the mediator) and baseline values of positive affect, negative affect, and subjective vitality, the direct effects of variety support in relation to exercise-related positive affect (i.e., $\beta = .04, p = .85$), negative affect (i.e., $\beta = .06, p = .42$) and subjective vitality (i.e., $\beta = -.16, p = .16$) were non-significant. With regard to this latter direct effect of variety support on subjective vitality, examination of the confidence intervals revealed that caution should be exercised with interpreting the non-significant p -value (i.e., $p = .16$) given that the 95% CI [-.500, -.034]) did not span zero.

Table 5.3 Direct and indirect effects of exercise-related variety support for participants who completed measures at post-test

Variables	Standardized Estimates	Unstandardized Estimates	Bootstrapped 95% Confidence Interval
<i>Direct Effects of Exercise-Related Variety Support on:</i>			
Perceived Variety	.490	.993	 [.743, 1.094]
Positive Affect	-.041	.073	[-.036, .578]
Negative Affect	.055	.096	[-.164, .167]
Subjective Vitality	-.156	-.267	[-.500, -.034]
<i>Indirect Effects of Exercise-Related Variety Support on Positive Affect, Negative Affect, and Subjective Vitality via Perceived Variety</i>			
Positive Affect	.115	.203	 [.159, .350]
Negative Affect	-.137	-.238	[-.479, -.147]
Subjective Vitality	.186	.319	 [.273, .435]

Note: Bold confidence intervals do not contain 0. $n = 55$

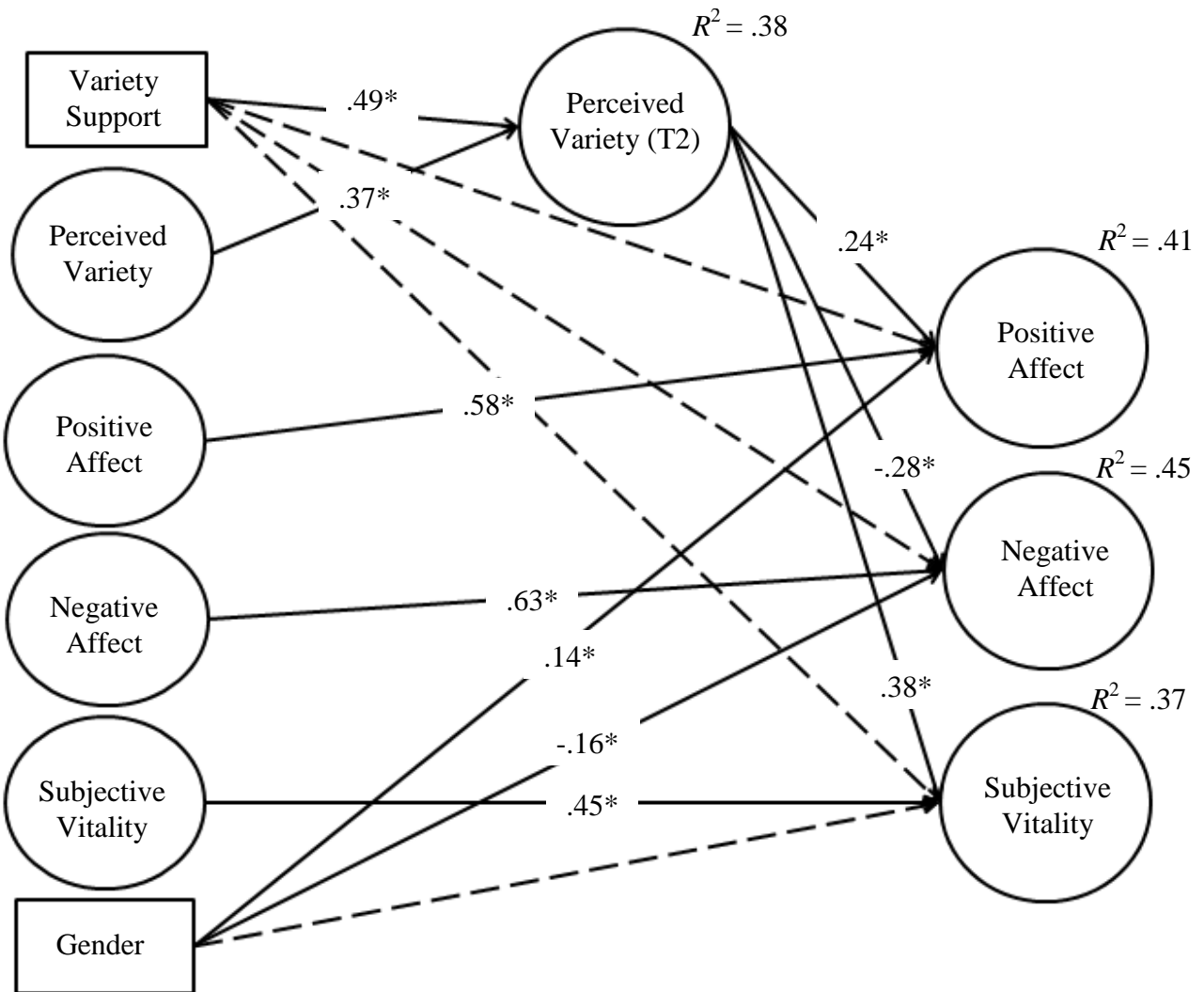


Figure 5.1 Path diagram of the relationships between variety support (i.e., condition) and exercise-related positive affect, negative affect, and subjective vitality (all measured at Time 3; T3) via perceived variety in exercise at Time 2 (T2) after controlling for gender and baseline scores of positive affect, negative affect, and subjective vitality at Time 1 (T1) as covariates. Solid lines represent standardized significant path coefficients and dashed lines represent non-significant path coefficients. * $p < .01$.

Subsequently, we examined the extent to which exercise-related variety support explains variance in exercise-related positive affect, negative affect and subjective vitality, through the mediating role of perceived variety in exercise in an ITT analysis. No problem with the positive

affect item ‘good’ emerged, and thus, all items were included to fully represent the construct ‘positive affect’ as our outcome variable. The overall model fit was $\chi^2(263) = 420.73, p < .01$, CFI = .961, TLI = .956, RMSEA = .070. Bivariate correlations and composite reliability values are presented in Table 5.4. Exercise-related variety support positively predicted perceived variety in exercise ($\beta = .43, p < .01$), which subsequently predicted exercise-related positive affect ($\beta = .42, p < .01$), negative affect ($\beta = -.35, p < .01$) and subjective vitality ($\beta = .53, p < .01$; see Table 5.5 and Figure 5.2). Gender was negatively related to negative affect ($\beta = -.18, p < .01$) with females reporting lower levels of negative affect than males. Indirect effects were found to be significant for the relationships between exercise-related variety support and positive affect ($\beta = .18, p < .01$), negative affect ($\beta = -.15, p < .01$) and subjective vitality ($\beta = .23, p < .01$) through perceived variety in exercise. After statistically accounting for the effects of perceived variety (i.e., the mediator), the direct effects of variety support in relation to positive affect ($p = .78$), negative affect ($p = .30$) and subjective vitality ($p = .18$) were not significant, thus supporting mediation.

Table 5.4 Bivariate correlations and composite reliability for variables in the intention-to-treat analysis

Variable	CR	1	2	3	4	5
1. Variety Support		--				
2. Perceived Variety	.93	.42*	--			
3. Positive Affect	.87	.14	.40*	--		
4. Negative Affect	.86	-.22*	-.38*	-.63*	--	
5. Subjective Vitality	.93	.10	.48*	.72*	-.49*	--

Note: CR = composite reliability. $N = 121$. * $p < .05$.

Table 5.5 Direct and indirect effects of exercise-related variety support in the intention-to-treat analysis

Variables	Standardized Estimates	Unstandardized Estimates	Bootstrapped 95% Confidence Interval
<i>Direct Effects of Exercise-Related Variety Support on:</i>			
Perceived Variety	.427	.821	[.469 – 1.156]
Positive Affect	-.029	-.051	[-.396, .357]
Negative Affect	-.105	-.175	[-.496, .138]
Subjective Vitality	-.124	-.225	[-.597, .072]
<i>Indirect Effects of Exercise-Related Variety Support on Positive Affect, Negative Affect, and Subjective Vitality via Perceived Variety</i>			
Positive Affect	.179	.313	[.136, .499]
Negative Affect	-.149	-.248	[-.439, -.082]
Subjective Vitality	.226	.412	[.192, .663]

Note: Bold confidence intervals do not contain 0. *N* = 121.

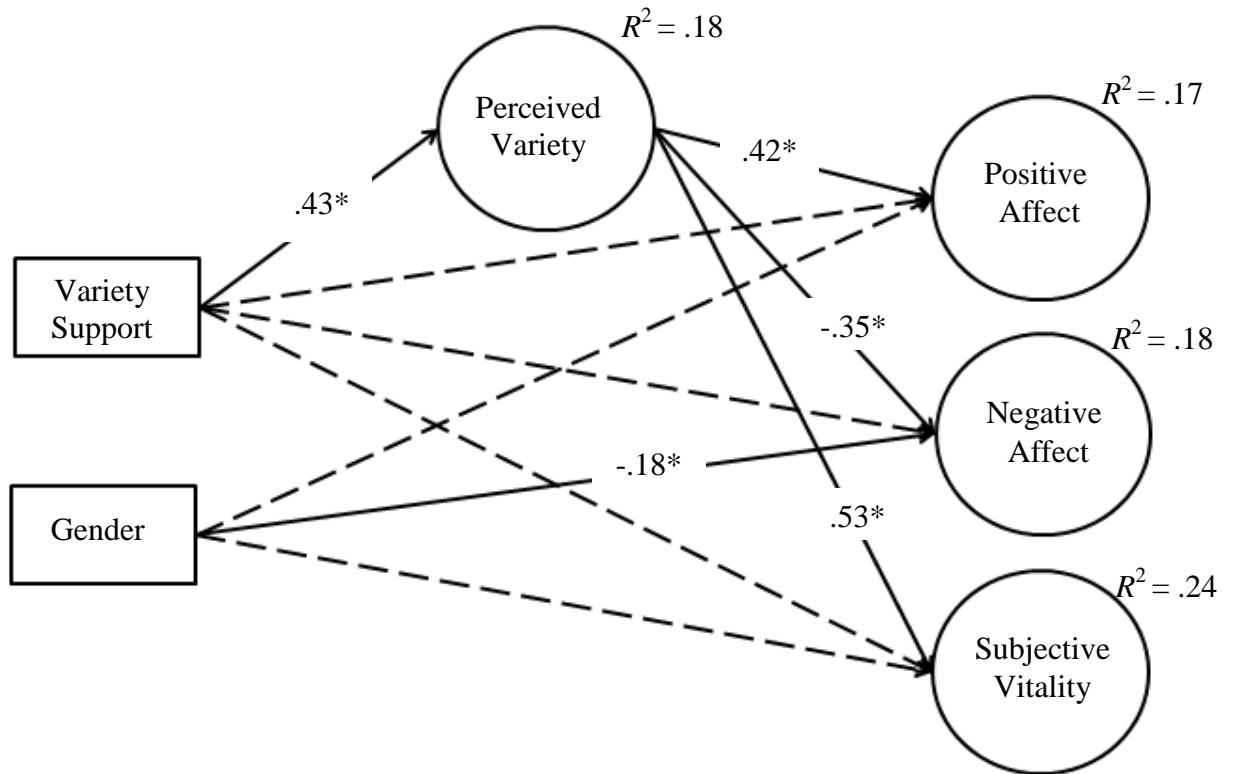


Figure 5.2 Path diagram of the relationships found in the intention-to-treat analysis between variety support (i.e., condition) and exercise-related positive affect, negative affect, and subjective vitality via perceived variety in exercise, after controlling for gender as a covariate. Solid lines represent standardized significant path coefficients and dashed lines represent non-significant path coefficients. * $p < .01$.

5.4 Discussion

It is widely recognized that the development of efficacious intervention strategies are warranted to enhance the experience of exercise for physically inactive adults. With this aim in mind, the purpose of this study was to examine the extent to which variety support in a resistance exercise program influences exercise-related well-being in a sample of inactive adults. We also examined the extent to which those relationships are mediated by perceived variety in exercise. Overall, the results provide evidence that inactive people tend to experience improved well-being in exercise contexts when they receive variety support. Furthermore, the experience of variety in

exercise was found to be a psychological mechanism that explained *how* variety support influences well-being in this setting.

Across both sets of analyses (i.e., based on the completers model and ITT analyses), an indirect causal effect was found between variety support and the three indices of exercise-related well-being operationalized in this study (positive affect, negative affect, subjective vitality) six-weeks later. In each case, these relationships were mediated through the psychological mechanism of perceived variety in exercise. Previous research has found that the provision of variety support influences well-being within the context of a kindness intervention (cf. Sheldon, et al., 2012; Study 2); our study suggests that the provision of variety might equally affect different indices of well-being within exercise setting as well. In an observational (non-experimental) study, Sylvester et al. (2014b) found that perceptions of variety in exercise settings were prospectively related to exercise-related positive affect and subjective vitality. The findings of the current study provide experimental evidence that the provision of variety results in improvements in positive affect (as a measure of hedonic well-being) and subjective vitality (as a measure of eudaimonic well-being).

Interestingly, the results of this study also suggest that in addition to influencing these different indices of positive well-being, the variety support intervention also resulted in reductions in negative feelings. Specifically, the provision of variety support resulted in lower levels of negative affect, and this effect was mediated by perceptions of variety. In previous non-experimental work (Sylvester et al., 2014b), perceptions of variety were unrelated to measures of negative affect, with the authors suggesting that the experience of variety might be more strongly implicated in supporting positive well-being than in alleviating negative affect. The results of the current experimental study challenge those earlier observations, and suggest

that the provision of variety in exercise might be able to offset negative affect as well as improve positive well-being in exercise (i.e., promote positive affect and subjective vitality, as well as reduce negative affect).

When considered in concert, the results of this study suggest that the provision of a varied exercise program may be an efficacious intervention strategy that can influence indices of both positive and negative exercise-related well-being. In line with existing research, in this study we provided variety support by varying the exercise activities from one session to the next (Glaros & Janelle, 2001), by increasing the quantity of diverse exercise activities (Juvancic-Heltzel et al., 2013), and by supporting variety within individual movements (Dimmock et al., 2013). While these three methods of providing variety support in exercise were effective at influencing perceptions of variety and subsequent indices of exercise-related well-being, additional variations in exercise may further increase perceptions of variety and improve exercise-related well-being. For example, participants in the current study engaged in one type of exercise (i.e., resistance training); however, engaging in multiple types of exercise (e.g., aerobic exercise, high intensity interval training, resistance training, different sports) may expand the effects of variety and have subsequent effects on indices of well-being. In future work, it would be an interesting line of enquiry for researchers to explore additional methods of fostering the experience of variety in relation to subsequent exercise-related well-being.

Similarly, in the current study, prescribing two sets of eight repetitions (for participants in the HVS condition) and four sets of four repetitions (for participants in the LVS condition) was effective at influencing indices of exercise-related well-being. However, the provision of variety support in exercise is certainly not limited to the structure of exercise sets and repetitions we implemented. In future work, researchers should test additional ways of structuring the sets and

repetitions of exercises to determine any systematic effects on indices of exercise-related well-being.

Balanced against the strengths of the study, limitations should also be acknowledged. First, within the context of a pretest-midtest-posttest control group design, the results provide preliminary evidence for the efficacy of a variety support intervention to engender improvements in well-being. However, by virtue of the very design employed, whereby participants were randomized to the two conditions, the results do not provide any indication of the extent to which people experience well-being when they choose to enroll in high (or low) variety support exercise programs in real world settings. Indeed, it is entirely conceivable that some people will have a high need for variety, and others will have a lower need for variety, and these preferences might shape the types of exercise programs with which they would naturally choose to participate. In light of the current findings, future research is encouraged that uses a hybrid preference/randomized control trial design (Bradley, 1993) that includes standard ‘randomization’ (high internal validity) and ‘choice’ (high external validity) arms. That way, researchers will be able to ascertain the effectiveness of a variety support intervention within real world settings (high external validity), whereby participants are able to choose to enroll in high variety or low variety programs, and compare the adherence rates to those of participants who are randomized to high and low variety support conditions. A second limitation of the study is that the sample included inactive university students, and therefore, one cannot generalize the findings to other populations such as active adults or those outside of university settings. Future work is needed to examine the effectiveness of variety support exercise interventions with other age groups and populations.

5.4.1 Conclusion

In summary, providing greater exercise-related variety support in a resistance exercise program led to higher ratings on indices of exercise-related well-being among a sample of university students who were physically inactive, when compared to those who received low variety support. The psychological mechanism that explained this effect was the extent to which participants' felt that they experienced variety. Variety support may be an efficacious strategy for fostering exercise-related well-being, and it appears prudent for researchers to examine the effectiveness of this intervention strategy in different applied settings and with other populations.

Chapter 6: General Discussion

The overall purpose of this dissertation was to examine variety in exercise, and explore the extent to which the experience of variety in exercise is an additional psychological experience (i.e., when examined alongside satisfaction of the needs for competence, relatedness, and autonomy, embedded within SDT) that has implications for exercise-related well-being and exercise behaviour. The results from the four investigations presented in this dissertation support the salience of the experience of variety in exercise, and the association it has with both exercise-related well-being and exercise behaviour. The purpose of this chapter is to (a) synthesize the research findings presented in the four studies and discuss the strengths of this dissertation, (b) discuss the novel contributions and implications of the current research, (c) outline study limitations, and (d) provide a series of potential directions for further research.

6.1 Synthesis of the Research Findings

The findings presented in this dissertation fall into two main categories, namely in relation to exercise-related well-being, and exercise behaviour. I address each in turn. Overall, with regard to exercise-related well-being, the experience of variety appears to be a relevant psychological factor that helps people feel better in exercise settings. Specifically, after creating a questionnaire to measure perceptions of variety in exercise (in chapter 2), using an observational research design, we found support for the notion that perceived variety in exercise is empirically distinct from satisfaction of the psychological needs for competence, relatedness, and autonomy in the context of exercise, and perceived variety in exercise appears to complement satisfaction of the three basic psychological needs incorporated within BPNT when predicting positive affect and subjective vitality in exercise contexts. Subsequently, in Study 4 (chapter 5) we used an experimental design and found evidence that in the context of exercise,

inactive people tend to experience improved positive affect, and subjective vitality and less negative affect when they receive variety support. Furthermore, the experience of variety in exercise was found to be a psychological mechanism that explained the process through which variety support has an effect on indices of exercise-related well-being.

In addition to helping people to feel better in exercise, within this dissertation, variety was also found to be associated with greater exercise behaviour. In Study 2 (chapter 3) we found that perceived variety (when examined alongside satisfaction of the needs for competence, relatedness, and autonomy in exercise) prospectively predicted exercise behaviour six-weeks later, and that relationship was explained by autonomous (but not controlled) motivation to engage in exercise. In Study 4 (chapter 5) we extended these findings by determining that providing physically inactive adults with more (compared to less) variety support in a resistance exercise program leads to the experience of variety (but not satisfaction of the needs for competence, relatedness, or autonomy), and improved exercise adherence behaviour. In addition, the relationship between variety support and exercise adherence behaviour was explained (mediated) by the extent to which people felt like they experienced variety in exercise.

Strengths of the Research. There are several positive aspects of the research that are noteworthy. One strength of this research includes the originality of the research topic. Calls for innovative exercise intervention strategies have been ongoing (e.g., Mâsse et al., 2011) and examining the experience of variety in exercise is an original research topic that holds potential for positively influencing exercise-related well-being and behaviour. Furthermore, utilizing a theoretical framework also enhanced this research (Rothman, 2004) by directing researchers to the relevant variables and processes that are theorized to promote well-being and behaviour in exercise contexts. Specifically, by examining the experience of variety alongside the basic

psychological needs conceptualized within the SDT framework, the findings from this dissertation built on existing knowledge of the types of positive psychological experiences that are implicated in promoting exercise-related well-being and exercise behaviour. Examining the experience of variety in exercise through a theoretical lens allowed us to determine whether novel insight (i.e., in addition to theoretical tenets) could be gained from examining the experience of variety in exercise. Another notable strength of this research corresponds to the use of contemporary validity theory. Specifically, by using Messick's (1995) unified theory of validity and current recommendations by validity theorists (Hubley & Zumbo, 2011), we sought to use appropriate methods for both developing a measure of perceptions of variety in exercise, and examining validity evidence of perceived variety in exercise scores. An additional asset of this research includes using diverse methods and samples. The use of prospective observational and experimental designs with multiple samples (which are recommended for developing validity evidence; Messick, 1995) provided various tests of whether the experience of variety in exercise has implications for exercise-related well-being and exercise behaviour. Finally, another strength of this research corresponds to the contemporary analytic methods we used. For example, throughout the studies in this dissertation we tested mediation using latent variables that were created using multiple categorical items for each psychological construct, and we used bootstrapping (as compared to other mediation approaches such as the causal steps approach endorsed by Baron and Kenny, 1986) to account for the ordinal/categorical nature of the scores (e.g., indices of exercise-related well-being; Studies 1 and 4), allow for the covariation of mediators (e.g., autonomous and controlled motivation; Study 2), and reduce Type I error rates (Preacher & Hayes, 2008).

6.2 Novel Contributions of the Research

This series of studies represent the first effort by researchers to measure and examine the experience of variety in exercise. Research on the experience of variety in exercise was made possible through the development of conceptually sound items, and empirically supported scores of perceived variety in exercise. The creation of the Perceived Variety in Exercise (PVE) questionnaire (Sylvester et al., 2014b) provides researchers with a tool to examine this potentially adaptive construct (i.e., perceptions of variety in exercise) and our initial findings indicate that perceived variety in exercise scores may explain why the provision of variety support influences how inactive people feel in exercise contexts, as well as their exercise behaviour.

Although the studies embedded in this thesis represent an initial attempt to examine the experience of variety in exercise contexts, we developed this line of work based on existing knowledge. Specifically, in Study 1 (chapter 2) we extended Sheldon and Lyubomirsky's (2012) conclusions that perceptions of variety directly predict positive emotions (an index of well-being) by demonstrating that in the context of exercise, perceived variety complements satisfaction of the three psychological needs incorporated within BPNT in the direct prediction of exercise-related positive affect and subjective vitality, over time. In Study 4, we built on Sheldon et al.'s (2012) findings (as well as our own findings in Study 1) through providing experimental evidence that the provision of variety in exercise results in improvements in exercise-related positive affect, negative affect, and subjective vitality. Furthermore, in the two studies conducted by Sheldon and colleagues, they examined positive emotions and happiness (akin to positive affect), and we extended their work by finding support for the relationship

between perceptions of variety and both hedonic (i.e., positive and negative affect) and eudaimonic (i.e., subjective vitality) components of exercise-related well-being.

With regards to our research on exercise behaviour, we predominantly built on the work of Glaros and Janelle (2001), Juvancic-Heltzel et al. (2013), and Dimmock et al. (2013) by examining variety within the SDT framework, as previous research had largely been conducted using atheoretical approaches. We extended their work by testing and finding support for a theoretical mediator (i.e., autonomous motivation) that explained the relationship between perceived variety and behaviour in exercise (Study 2). In Study 3, we further investigated perceived variety as a psychological mechanism through which variety support promotes exercise behaviour. As such, the contribution of this research to exercise psychology literature also holds theoretical implications for SDT.

Theoretical Implications. Ryan and Deci (2002) contend that satisfaction of the basic psychological needs for competence, relatedness, and autonomy are the most prominent psychological experiences through which well-being, motivation and behaviour are supported. However, the results of the studies presented in this dissertation provide evidence in support of the view that perceived variety may act as an *additional psychological experience* (cf. Sheldon, 2011) that might bring about improved exercise-related well-being and exercise behaviour. Each study provides insight into how the experience of variety in exercise fits alongside satisfaction of the basic psychological needs, within the SDT framework.

Specifically, in Study 1 through an initial test of discriminant validity, perceived variety in exercise was found to be positively related but empirically distinct from perceived competence, relatedness and autonomy in the context of exercise. This finding was consistent with our hypothesis, as the experience of variety (i.e., feeling as though one engages in diverse

behaviours, activities, and opportunities), is conceptually distinct from feeling competent (e.g., capable and effective), related (i.e., caring for and being cared for by others) or autonomous (i.e., feeling free and volitional in one's decisions and actions). Furthermore, in Study 1 we also examined whether perceived variety in exercise complements satisfaction of the three basic psychological needs in the prediction of exercise-related well-being to infer whether novel insight into explaining indices of well-being could be gained, while also providing a test of BPNT. Results from Study 1 were consistent with BPNT (Deci & Ryan, 2002) as satisfaction of each of the three basic psychological needs predicted variance in well-being. Perceived variety in exercise was found to be a complementary psychological experience that also simultaneously explained variance in exercise-related well-being. Based on the calculated Pratt indices (Thomas, Hughes, & Zumbo, 1998) in Study 1, perceived variety in exercise accounted for an important amount of variance in exercise-related positive affect and subjective vitality that was relatively similar to satisfaction of the basic psychological needs. Results from Study 4 extended these findings by indicating that perceived variety in exercise is a psychological mechanism that explains why exercise-related variety support has a causal influence on indices of exercise-related well-being.

Furthermore, in relation to CET (which involves the factors that contribute to intrinsic motivation) and OIT (which concerns internalization of behaviour and extrinsic regulations), in Study 2 (chapter 3) the experience of variety in exercise was related to exercise behaviour, through autonomous motivation, but not controlled motivation. Consistent with Dimmock et al. (2013), these findings are in line with the notion that experiencing variety in exercise is associated with intrinsic motivation in exercise (which is applicable to CET), and the internalization of exercise behaviour (applicable to OIT). Our findings in Study 2 also fit within

Ryan and Deci's (2002) conceptualization that autonomous motivation explains why certain psychological factors can lead to behaviour (e.g., in the context of exercise: experience of variety → autonomous motivation → exercise adherence behaviour). Since the experience of variety explained variance in high quality autonomous motivation, the results of Study 2 support Sheldon's (2011) claim that satisfaction of the needs for competence, relatedness, and autonomy, embedded within SDT may not be an exhaustive set of the types of positive experiences that support behaviour through autonomous motivation. In Study 4 we extended these results by finding that the provision of variety support, influenced perceptions of variety, but not satisfaction of competence, relatedness, or autonomy (which provides further support for discriminant validity between the perception of variety in exercise, and satisfaction of each of the basic psychological needs). Subsequently, we found that the experience of variety in exercise explained why the provision of variety support causes an increase in exercise behaviour.

Overall, the findings from the current studies underscore that the experience of variety in exercise may be a unique psychological experience when compared to the satisfaction of the basic psychological needs. While it would certainly be premature at this point to posit whether (or not) perceived variety represents a "psychological need", in the context of exercise, the felt experience of exercise may complement satisfaction of the needs for competence, relatedness, and autonomy in (a) shaping feelings of positive affect, negative affect, and subjective vitality in exercise, (b) predicting autonomous motivation for engaging in exercise, and (c) influencing exercise behaviour. Researchers should continue to examine the experience of variety within the SDT framework.

Practical Implications. Finally, from an applied perspective, the results of these studies may be useful for helping health promotion specialists predict and influence exercise-related

well-being and exercise behaviour. Specifically, results from Studies 1 and 2 indicated that knowing how much variety people feel like they experience in exercise provides an indication of how much exercise-related well-being they experience, and how much exercise behaviour they engage in, six-weeks later. Furthermore, results from Studies 3 and 4 suggest that fostering the experience of variety in exercise may be an efficacious intervention strategy that can influence how physically inactivity people feel in exercise, as well as the extent to which they adhere to an exercise program.

Based on the findings from the intervention reported in Studies 3 and 4, health promotion specialists can support the experience of variety by structuring exercise activities, behaviours, and opportunities, to vary from one session to the next, by varying the quantity of exercise activities within each session, as well as including variation within the exercise movements. From an applied perspective, additional methods of providing variety support in exercise may also influence perceptions of variety, as well as improvements in exercise-related well-being and exercise adherence behaviour. In Studies 3 and 4 (chapters 4 and 5), we provided exercise-related variety support within resistance training (which included body weight, free weights, and machine-based exercises). However, conceptually, the provision of variety is not limited to resistance exercise and engaging in multiple types of exercise such as aerobic exercise, flexibility training, high intensity interval training, *and* resistance training may also enhance the experience of variety and influence indices of exercise-related well-being and exercise adherence. Future directions for exploring variety support in exercise are discussed below.

6.3 Limitations of the Studies and Future Directions

In spite of the contributions of the research presented within this dissertation, limitations also exist and should be recognized. While the unique limitations to each study are outlined in

the individual chapters, one broad limitation corresponds to the relative short-term duration of the designs. Specifically, we used prospective designs throughout this research to examine the effects of variety over time. However, we used a six-week period to examine prospective effects through both the observational and experimental designs. Given the evidence that variety support can influence well-being (Sheldon, Boehm, & Lyubomirsky, 2012), motivation (Dimmock et al., 2012) and exercise behaviour (Glaros & Janelle, 2001; Juvancic-Heltzel et al., 2013) over time-periods ranging from one bout to 10 weeks (in the studies mentioned above), the effects of experiencing variety in exercise on exercise-related well-being and exercise behaviour may also vary over diverse periods of time. It is certainly conceivable that variety plays a role in supporting exercise-related well-being and promoting the adoption and maintenance of exercise behaviour over shorter and longer periods of time, and researchers should further examine the influence of variety in exercise over a range of timeframes.

One interesting line of enquiry for researchers to examine involves the notion that over longer time intervals, variety may be more beneficial for well-being (by fostering feelings of productivity), however during shorter time intervals people may feel overwhelmed with highly varied activities, which could decrease their well-being. For example, preliminary research by Etkin and Mogilner (2015) indicates that perceptions of greater variety may make people feel more productive, which translates to happiness (akin to positive affect). Indeed, when they looked at various timeframes, Etkin and Mogilner (2015) found that over an hour, a day, a week, and a month, recalling more (compared to less) varied activities was associated with greater happiness. However, for timeframes that were less than one hour (i.e., 10 or 30 minutes), recalling greater variety in activities was inversely related to happiness because people felt less

productive (Etkin & Mogilner, 2015). In future, researchers should examine the possible interaction between perceptions of variety and time in exercise contexts.

A second limitation across the four studies corresponds to the contextual level through which we operationalized perceived variety. Specifically, while the aim of this dissertation was to examine variety *in exercise settings*, we recognize that satisfaction of the basic psychological needs, the experience of well-being, as well as behaviour, operate/exist at both situational and global levels, as well as at the contextual level (e.g., Diener & Emmons, 1985; Vallerand, 1997). In addition to the contextual level, the provision of variety support and the experience of variety may also have implications at situational and global levels, and along with the basic psychological needs, may have associations with well-being and behaviour at these different levels. For example, fostering the experience of variety in a single bout of exercise could complement satisfaction of the basic psychological needs and have an immediate impact on exercise-related well-being and behaviour (cf. Juvancic-Heltzel et al., 2012). Similarly, fostering the experience of variety in life in general (perhaps through the provision of variety in various contexts such as work, school, leisure, and social activities), could influence global markers of well-being and general behaviour, beyond satisfaction of the psychological needs. Since we did not test for any situational/global effects (or potential effects beyond the context of exercise), our inferences are limited to the context of exercise. In future, studies are required that examine the effects of supporting variety/experiencing variety at situational/global levels, and in different contexts.

Along with research on the generalizability/applicability of the current findings to situations and global evaluations, research is also warranted regarding the *external validity* of the relationships between providing variety support, perceptions of variety, well-being, and

behaviour. Examining the external validity of the effects of variety in exercise would be valuable for researchers to identify the various populations and contexts for which the experience of variety may be particularly salient. For example, examining the provision of variety support in physical education classes could be valuable as physical education administrators attempt to foster long-term physical activity behaviour in students. The provision of variety support in physical education classes could foster the experience of variety, and in turn influence how students feel in physical education, as well as their physical activity participation both within, and outside of class. Exploring the salience of variety within physical education classes and other health-promotion contexts (e.g., variety with regard to rehabilitation protocols, dietary behaviours) holds considerable potential, especially with regard to the utility of variety support as a viable means of intervention in those diverse settings.

Furthermore, in addition to the generalizability of the findings, research on the *boundary conditions* of variety is also warranted. That is, researchers should examine potential moderating variables that might interact with variety support, or the experience of variety in exercise, in relation to cultivating exercise-related well-being and exercise behaviour. For example, the level of complexity and novelty in exercise tasks could influence the strength and/or direction of the relationship between variety support and exercise-related well-being and/or exercise behaviour. Researchers have found that a balance between complex and simple stimuli, and familiar and novel stimuli result in an optimal level of hedonic value (Berlyne, 1970). Specifically, Berlyne (1970) found that stimuli that were the highest hedonically valued (i.e., pleasant and interesting) were either complex *and* familiar or simple *and* novel, while stimuli that were complex and novel had low (or negative) hedonic value and stimuli that were simple and familiar also had low hedonic value (see Wundt curve in Berlyne, (1970)). As such, optimal variety support may

represent a balance of complex and familiar, and simple and novel stimuli to promote positive hedonic value. However, with repeated exposure, complex stimuli may *become simple*, and novel stimuli may *become familiar* (Berlyne, 1970) and subsequently, the hedonic value of a stimulus could decrease. In other words, complex stimuli that are familiar may lose hedonic value as they become simple, and simple stimuli that are novel, may lose hedonic value as they become familiar. While an in-depth analysis of these phenomena in exercise settings was beyond the scope of this dissertation, the level of complexity and novelty in the provision of variety may interact to support pleasant (e.g., positive affect) and interesting (e.g., autonomously motivating) experiences.

Another boundary condition that warrants research attention involves the different *modes* through which the experience of variety in exercise might be fostered. For example, although we provided variety support in an exercise facility in the intervention studies presented in this dissertation, it is conceivable that the experience of variety could be supported through various other means. For example, walking, running, exercising in a public park, and using sports fields, playgrounds and other recreational space could potentially be used (cost efficiently) in many ways to foster the experience of variety in exercise. Additionally, engaging in multiple types of group/individual sports (e.g., recreational athletics) or exercise classes such as yoga, bootcamp, or spin classes, could also result in the meaningful experience of variety. As such, fostering the experience of variety in exercise may be supported through a wide range of strategies. These should be explored to improve our understanding of how to best support the experience of variety and subsequently influence exercise-related well-being and exercise behaviour.

Another practical line of enquiry that would be particularly relevant for researchers to explore is variety within exercise periodization. Periodization refers to the structure of variety in

training methods (and volume loads) to optimize exercise programs for peak performance (Turner, 2011). A wealth of research has been conducted to learn about optimizing performance through exercise periodization (including how and when to vary one's exercise; Turner, 2011). However, researchers have not yet examined how various methods of periodization (e.g., linear, undulating) foster, or thwart, the experience of variety, and subsequent effects. Various methods of periodization may influence the experience of variety differentially, which could have implications for exercise-related well-being and exercise behaviour (and possibly performance, indirectly).

Finally, to further our ability to use variety in practical applications, researchers should also conduct additional work to examine theoretical implications of variety. Specifically, within SDT, need-supportive social contexts are theorized to satisfy a person's basic psychological needs and subsequently promote autonomous motivation and behaviour (Standage & Vallerand, 2014). As such, a relevant line of enquiry would be to examine the extent to which the provision of variety within exercise contexts is causally related to autonomous motivation towards exercise and subsequent behaviour. In Study 2, we found that autonomous motivation mediated the relationship between perceptions of variety and exercise behaviour. However, the observational design limits our ability to make causal inferences. As such, researchers should experimentally examine whether autonomous motivation is a causal outcome of the experience of variety in exercise. By examining this relationship experimentally and in a mediation model (i.e., exercise-related variety support → perceived variety in exercise → autonomous motivation toward exercise → exercise behaviour), researchers can gain insight into the causal mechanisms that explain why experiencing variety in exercise influences exercise behaviour.

We used SDT to identify possible mechanisms (e.g., satisfaction of the needs for competence, relatedness, and/or autonomy in exercise) that explain the relationship between contextual support (e.g., exercise-related variety support) and adaptive psychological outcomes (e.g., exercise-related well-being and behaviour). Conversely, within SDT, social contexts that *thwart* satisfaction of the basic psychological needs are also theorized to lead to controlling forms of motivation and a decrease in behaviour (Standage & Vallerand, 2014). In the current studies, we utilized a control group that included relatively less variety support than the treatment group (i.e., high variety support), however, we did not specifically seek to thwart the experience of variety and the potential maladaptive consequences it may have (e.g., controlled motivation, disengagement). As such, empirical tests of thwarting the experience of variety are needed to help clarify the theoretical implications regarding the experience of variety in exercise.

6.4 Summary

In conclusion, the studies presented in this dissertation represent initial empirical enquiry into the experience of variety in exercise. We developed a questionnaire to measure the experience of variety in exercise, and used that questionnaire in the present series of studies to gain insight regarding the antecedents and effects of experiencing variety in exercise. The findings provide evidence that knowing the degree to which people feel like they experience variety in exercise can explain additional variance (when examined alongside satisfaction of the needs for competence, relatedness, and autonomy embedded within SDT) in indices of exercise-related well-being (chapter 2) and exercise behaviour (via autonomous motivation; chapter 3). Furthermore, supporting the experience of variety in exercise among physically inactive adults appears to be a salient technique for influencing exercise adherence behaviour (chapter 4) and exercise-related well-being (chapter 5). The degree to which participants felt like they

experienced variety in exercise, acted as the psychological mechanism that explained these causal effects. As such, fostering the experience of variety in exercise may be one strategy to improve how people feel in exercise and increase their exercise behaviour. Supporting the experience of variety in exercise holds potential to be an innovative strategy that could be used to improve public health through exercise. When taken together, the research presented in this dissertation provides an empirical basis for researchers to further explore the experience of variety in exercise as well as the theoretical and applied implications of this psychological construct in relation to increasing exercise-related well-being and exercise behaviour.

References

- Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50(2), 179-211.
- Altman, D. G., Schulz, K. F., Moher, D., Egger, M., Davidoff, F., Elbourne, D., ... CONSORT GROUP. (2001). The revised CONSORT statement for reporting randomized trials: Explanation and elaboration. *Annals of Internal Medicine*, 134, 663-694.
doi:10.7326/0003-4819-134-8-200104170-00012
- Archer, E., Blair, S. N. (2012). Physical activity, exercise and non-Communicable diseases. *Research in Exercise Epidemiology*, 14, 1-18.
- Bandura, A. (1986). The explanatory and predictive scope of self-efficacy theory. *Journal of Social and Clinical Psychology*, 4(3), 359-373.
- Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: W. H. Freeman.
- Baranowski, T., Anderson, C., & Carmack, C. (1998). Mediating variable framework in physical activity interventions. How are we doing? How might we do better? *American Journal of Preventive Medicine*, 15(4), 266-297.
- Barbeau, A., Sweet, S. N., & Fortier, M. (2009). A path-analytic model of self-determination theory in a physical activity context. *Journal of Applied Biobehavioral Research*, 14, 103–118.
- Baron, R. M., & Kenny D., A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality & Social Psychology*, 51, 1173–1182. doi: 10.1037/0022-3514.51.6.1173
- Barrett, P. (2007). Structural equation modelling: Adjudging model fit. *Personality & Individual Differences*, 42, 815-824. doi:10.1016/j.paid.2006.09.018

- Bauman, A. E., Reis, R. S., Sallis, J. F., Wells, J. C., Loos, R. J., Martin, B. W., & Lancet Physical Activity Series Working Group. (2012). Correlates of physical activity: why are some people physically active and others not? *The Lancet*, *380*(9838), 258-271.
- Baumeister, R. F., & Leary, M. R. (1995). The need to belong: Desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin*, *117*, 497-529. doi:10.1037/0033-2909.117.3.497
- Berlyne, D. E. (1970). Novelty, complexity, and hedonic value. *Perception & Psychophysics*, *8*, 279-286.
- Beauducel, A., & Herzberg, P.Y. (2006). On the performance of maximum likelihood versus means and variance adjusted weighted least squares estimation in CFA. *Structural Equation Modeling*, *13*, 186–203. doi: 10.1207/s15328007sem1302_2
- Bentler, P. M., & Chou, C. H. (1987). Practical issues in structural modeling. *Sociological Methods & Research*, *16*, 78-117.
- Biddle, S. J. H., & Ekkekakis, P. (2005). Physically active lifestyles and well-being. In F. A. Huppert, B. Keverne, & N. Baylis (Eds.), *The science of well-being* (pp. 140-168). Oxford, United Kingdom: Oxford University Press.
- Biddle, S. J. H., Mutrie, N., & Gorely, T. (2015). *Psychology of physical activity: Determinants, well-being and interventions* (3rd ed.). Oxford, United Kingdom: Routledge.
- Bize, R., Johnson, J., & Plotnikoff, R. (2007). Physical activity level and health-related quality of life in the general adult population: A systematic review. *Preventive Medicine*, *45*, 401–415. doi:10.1016/j.ypmed.2007.07.017
- Bollen, K. A. (1989). *Structural equations with latent variables*. New York: Wiley.

- Bostic, T. J., Rubio, D. M., & Hood, M. (2000). A validation of the subjective vitality scale using structural equation modeling. *Social Indicators Research*, *52*, 313-324.
- Bouchard, C., Blair, S. N., & Haskell, W. L. (2007). *Physical activity and health*. Champaign, IL: Human Kinetics.
- Bradley, C. (1993). Designing medical and educational intervention studies. A review of some alternatives to conventional randomized controlled trials. *Diabetes Care*, *16*, 509–158.
doi: 10.2337/diacare.16.2.509
- Brown, A. (2006). *Confirmatory Factor Analysis for Applied Research*. New York, NY: Guilford Press.
- Centers for Disease Control and Prevention (2014). Health, United States, 2014. Retrieved on November 27th, 2015 from: <http://www.cdc.gov/nchs/data/hus/hus14.pdf>
- Clark, L. A., & Watson, D. (1995). Constructing validity: Basic issues in objective scale development. *Psychological Assessment*, *7*, 309–319.
- Colley, R. C., Garriguet, D., Janssen, I., Craig, C. L., Clarke, J., & Tremblay, M. S. (2011). *Physical activity of Canadian adults: Accelerometer results from the 2007 to 2009 Canadian health measures survey*. Statistics Canada Ottawa.
- Cooney, G. M., Dwan, K., Greig, C. A., Lawlor, D. A., Rimer, J., Waugh, F. R., McMurdo, M., & Mead, G. E. (2013). Exercise for depression. *Cochrane Database Systematic Reviews*, *9*, CD004366.
- Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika*, *16*, 297-334.
- D'Alessandro, D. M., Kingsley, P., & Johnson-West, J. (2001). The readability of pediatric patient education materials on the World Wide Web. *Archives of Pediatrics & Adolescent*

- Medicine*, 155, 807–812. doi:10.1001/archpedi.155.7.807
- deCharms, R. (1968). *Personal causation: The internal affective determinants of behavior*. New York, NY: Academic Press.
- Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior*. New York: Plenum.
- Deci, E. L., & Ryan, R. M. (2000). The “what” and the “why” of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry*, 11, 227-268.
- Deci, E. L., & Ryan, R. M. (2002). *Handbook of Self-Determination Research*. Rochester, NY: The University of Rochester Press.
- Deci, E. L., & Ryan, R. M. (2008). Facilitating optimal motivation and psychological well-being across life’s domains. *Canadian Psychology*, 49, 14-23. doi: 10.1037/0708-5591.49.1.14
- Deci, E. L., & Ryan, R. M. (2012). Motivation, personality, and development within embedded social contexts: An overview of self-determination theory. In R. M. Ryan (Ed.), *Oxford handbook of human motivation* (pp. 85–107). New York: Oxford University Press.
- Deci, E. L., & Ryan, R. M. (2014). Autonomy and need satisfaction in close relationships: Relationship Motivation Theory. In Weinstein (Ed.), *Human motivation and interpersonal relationships* (pp. 178- 248). New York: Oxford University Press. doi: 10.1007/978-94-017-8542-6_3
- Diener, E., & Chan, M. Y. (2011). Happy people live longer: Subjective well-being contributes to health and longevity. *Applied Psychology: Health & Well-Being*, 3, 1-43.
doi:10.1111/j.1758-0854.2010.01045.x
- Diener, E., & Emmons, R. A. (1985). The independence of positive and negative affect. *Journal of Personality & Social Psychology*, 47, 1105-1117.

- Diener, E., Wirtz, D., Tov, W., Kim-Prieto, C., Choi, D., Oishi, S., & Biswas-Diener, R. (2010). New Well-being Measures: Short scales to assess flourishing and positive and negative feelings. *Social Indicators Research, 97*, 143-156. doi: 10.1007/s11205-009-9493-y
- Diener, E., Suh, E. M., Lucas, R. E., & Smith, H. (1999). Subjective well-being: Three decades of progress. *Psychological Bulletin, 125*, 276-302. doi: 10.1037/0033-2909.125.2.276
- Dimmock, J., Jackson, B., Podlong, L., & Magaraggia, C. (2013). The effect of variety expectations on interest, enjoyment, and locus of causality in exercise. *Motivation & Emotion, 1-8*. doi: 10.1007/s11031-012-9294-5
- Dishman, R. K., & Buckworth, J. A. N. E. T. (1996). Increasing physical activity: a quantitative synthesis. *Medicine and science in sports and exercise, 28*(6), 706-719.
- Dolan, P., Peasgood, T., & White, M. P. (2006). *Review of research on the influences on personal well-being and application to policy making*. London, United Kingdom: DEFRA Publications.
- Edmunds, J., Ntoumanis, N., & Duda, J. L. (2007). Adherence and well-being in overweight and obese patients referred to an exercise on prescription scheme: A self-determination theory perspective. *Psychology of Sport & Exercise, 8*, 722-740.
doi:10.1016/j.psychsport.2006.07.006
- Etkin, J. & Mogilner, C. (2015). Does variety make people happy? *Advances in Consumer Research, 42*, 54-56.
- Ekkekakis, P., Hargreaves, E.A., & Parfitt, G. (2013). Envisioning the next fifty years of research on the exercise-affect relationship. *Psychology of Sport & Exercise, 14*, 751-758. doi: 10.1016/j.psychsport.2013.04.007

- Faul, F., Erdfelder, E., Lang, A. G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*, *39*, 175-191.
- Fergusson, D. Aaron, S. D., Guyatt, G., & Hebert, P. (2002). Post-randomisation exclusions: The intention to treat principle and excluding patients from analysis. *British Medical Journal*, *325*, 652-654. doi: 10.1136/bmj.325.7365.652
- Finney, S. J., & DiStefano, C. (2006). Non-normal and categorical data in structural equation modeling. *Structural equation modeling: A second course*, 269-314.
- Flesch, R. F. (1948). A new readability yardstick. *The Journal of Applied Psychology*, *32*, 221-233.
- Fornell, C., & Larcker, D. F. (1981). Structural equation models with unobservable variables and measurement error: Algebra and statistics. *Journal of Marketing Research*, *18*, 39-50.
- Fox, K. R., & Wilson, P. M. (2008). Self-perceptual systems and physical activity. In T. Hom's (Ed.), *Advances in sport psychology-3rd edition* (pp.49-64). Champaign, IL: Human Kinetics.
- Fritz, M. S., & MacKinnon, D. P. (2007). Required sample size to detect the mediated effect. *Psychological Science*, *18*, 233-239.
- Gadbury, G. L., Coffey, C. S., & Allison, D. B. (2003). Modern statistical methods for handling missing repeated measures in obesity trial data: Beyond LOCF. *Obesity Review*, *4*, 175-184. doi: 10.1046/j.1467-789x.2003.00109.x
- Gallagher, M. W., Lopez, S. J., & Preacher, K. J. (2009). The hierarchical structure of well-being. *Journal of Personality*, *77*(4), 1025-1050. doi: 10.1111/j.1467-6494.2009.00573.x

- Glanz, K., Lewis, F.M. & Rimer, B.K. (1997). Linking theory, research and practice. In Glanz, K., Lewis, F.M. and Rimer, B.K. (eds), *Health Behavior and Health Education: Theory, Research and Practice, 2nd ed.* Jossey-Bass, San Francisco, CA, pp. 19–35.
- Glaros, N., & Janelle, M. (2001). Varying the mode of cardiovascular exercise to increase adherence. *Journal of Sport Behavior, 24*, 42–62.
- Godin, G. (2011). The Godin-Shephard leisure-time physical activity questionnaire. *The Health & Fitness Journal of Canada, 4*, 18-22.
- Godin, G., & Shephard, R. J. (1985). A simple method to assess exercise behavior in the community. *Canadian Journal of Applied Sport Sciences, 10*, 141-146.
- Gorsuch, R. (1983). *Factor analysis* (2nd ed.). Hillsdale, NJ: Erlbaum.
- Gunnell, K. E., Crocker, P. R. E., Mack, D. E., Wilson, P. M., & Zumbo, B. D. (2014). Goal contents, motivation, psychological need satisfaction, well-being and physical activity: A test of Self-Determination Theory over 6 months. *Psychology of Sport & Exercise, 15*, 19-29. doi: 10.1016/j.psychsport.2013.08.005
- Hackman, J. R., & Oldham, G. R. (1976). Development of the job diagnostic survey. *Journal of Applied Psychology, 60*, 159-170.
- Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2009). *Multivariate data analysis* (7th ed.). Upper Saddle River, N.J: Prentice Hall.
- Hallal, P. C., Bo Andersen, L., Bull, F. C., Guthold, R., Haskell, W., Ekelund, U., & Lancet Physical Activity Series Working Group. (2012). Global physical activity levels: surveillance progress, pitfalls, and prospects. *Lancet, 380*, 247-257.

- Head, K. J., & Noar, S. M. (2014). Facilitating progress in health behaviour theory development and modification: The reasoned action approach as a case study. *Health Psychology Review*, 8(1), 34-52.
- Hebb, D. O., (1949). *The organisation of behavior*. New York: Wiley.
- Hillsdon, M., Foster, C., & Thorogood, M. (2005). Interventions for promoting physical activity. Cochrane Database of Systematic Reviews.
- Hu, L., & Bentler, P. M. (1998). Fit indices in covariance structure analysis: Sensitivity to underparameterized model misspecification. *Psychological Methods*, 3, 424-453.
- Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*, 6, 1–55.
- Jacobs, D. R., Ainsworth, B. E., Hartman, T. J., & Leon, A. S. (1993). A simultaneous evaluation of 10 commonly used physical activity questionnaires. *Medicine & Science in Sports & Exercise*, 25, 81-91.
- Johnson, M. M., & Finney, S. J. (2010). Measuring basic needs satisfaction: Evaluating previous research and conducting new psychometric evaluations of the basic needs satisfaction in general scale. *Contemporary Educational Psychology*, 35, 280-296.
doi:10.1016/j.cedpsych.2010.04.003
- Juvancic-Heltzel, J. A., Glickman, E. L., & Barkley, J. E. (2013). The effect of variety on physical activity: A cross-sectional study. *The Journal of Strength & Conditioning Research*, 27, 244-251. doi: 10.1519/JSC.0b013e3182518010
- Kahn, B. E., & Ratner, R. (2005). Variety for the sake of variety? Diversification motives in consumer choice. In S. Ratneshwar & D. G. Mick (Eds.) *Inside Consumption: Frontiers of Research on Consumer Motives, Goals, and Desires*, London: Routledge.

- Kahneman, D. (1999). Objective Happiness. In D. Kahneman, E. Diener, & N. Schwarz (Eds.), *Well-being: The foundations of hedonic psychology* (pp.3-25). New York: Russell Sage Foundation.
- Kahneman, D., Diener, E., & Schwarz, N. (1999). *Well-being: The foundations of hedonic psychology*. New York, NY: Russell Sage Foundation.
- Katzmarzyk PT, Janssen I. (2004). The economic costs associated with physical inactivity and obesity in Canada: an update. *Canadian Journal of Applied Physiology*, 291, 90–115.
- Kiviniemi, M .T., Voss-Humke, A., M. & Seifert, A., L. (2007). How do I feel about the behavior? The interplay of affective associations with behaviors and cognitive beliefs as influences on physical activity behavior. *Health Psychology*, 26, 152–158.
doi:10.1037/0278-6133.26.2.152
- Kline, R. B. (2005). *Principles and practice of structural equation modelling* (2nd Ed). New York, Guilford Press.
- Kobau, R., Seligman, M. E. P., Peterson, C., Diener, E., Zack, M. M., Chapman, D., & Thompson, W. (2011). Mental health promotion in public health: Perspectives and strategies from positive psychology. *American Journal of Public Health*, 101, e1-e9.
doi:10.2105/AJPH.2010.300083.
- Lee, I.-M., Shiroma, E. J., Lobelo, F., Puska, P., Blair, S. N., & Katzmarzyk, P. T. (2012). Impact of Physical Inactivity on the World’s Major Non-Communicable Diseases. *Lancet*, 380(9838), 219–229. [http://doi.org/10.1016/S0140-6736\(12\)61031-9](http://doi.org/10.1016/S0140-6736(12)61031-9)
- Lewis, B. A., Marcus, B. H., Pate, R. R., & Dunn, A. L. (2002). Psychosocial mediators of physical activity behavior among adults and children. *American journal of preventive medicine*, 23(2), 26-35.

- Little, R. J. A. (1988). A test of missing completely at random for multivariate data with missing values. *Journal of American Statistical Association*, *83*, 1198-1202.
- Longbottom, J-L., Grove, J. R., & Dimmock, J. A. (2012). Trait perfectionism, self-determination, and self-presentation processes in relation to exercise behavior. *Psychology of Sport & Exercise*, *13*, 224-235. doi: 10.1016/j.psychsport.2011.11.003
- Lyubomirsky, S., King, L., & Diener, E. (2005). The benefits of frequent positive affect: Does happiness lead to success? *Psychological Bulletin*, *131*, 803. doi: 10.1037/0033-2909.131.6.803
- Lyubomirsky, S., & Layous, K. (2013). How do simple positive activities increase well-being? *Current Directions in Psychological Science*, *22*, 57-62. doi: 10.1177/0963721412469809
- MacCallum, R. C., Browne, M. W., & Sugawara, H. M. (1996). Power analysis and determination of sample size for covariance structure modeling. *Psychological Methods*, *1*, 130-149.
- Magill, R. A., & Hall, K. G. (1990). A review of the contextual interference effect in motor skill acquisition. *Human Movement Science*, *9*, 241-289.
- Marsh, H. W., Hau, K., & Wen, Z. (2004). In search of golden rules: Comments on hypothesis-testing approaches to seeing cut-off values for fit indexes and dangers in overgeneralizing Hu and Bentler's (1999) findings. *Structural Equation Modeling*, *11*, 320-341. doi:10.1207/s15328007sem1103_2
- Mâsse, L. C., Nigg, C. R., Basen-Engquist, K., & Atienza, A. A. (2011). Understanding the mechanism of physical activity behavior change: Challenges and a call for action. *Psychology of Sport & Exercise*. *12*, 1-6. doi: 10.1016/j.psychsport.2010.07.011

- McAlister, L., & Pessemier, E. (1982). Variety seeking behavior: An interdisciplinary review. *Journal of Consumer Research*, 9, 311-322.
- McIntosh, C. N. (2007). Rethinking fit assessment in structural equation modelling: A commentary and elaboration on Barrett. *Personality & Individual Differences*, 42, 859–867. doi:10.1016/j.paid.2006.09.020
- Messick, S. (1995). Standards of validity and the validity of standards in performance assessment. *Educational Measurement: Issues & Practice*, 14, 5-8.
- Muthén, B. O. (1993). Goodness of fit with categorical and other non-normal variables. In K.A. Bollen & J.S. Long (Eds.), *Testing structural equation models* (pp. 205–234). Newbury Park, CA: Sage.
- Muthén, B. O. (2002). Beyond SEM: General latent variable modeling. *Behaviormetrika*, 29, 81–117.
- Netz, Y., Wu, M. J., Becker, B. J., & Tenenbaum G. (2005). Physical activity and psychological well-being in advanced age: A meta-analysis of intervention studies. *Psychology of Aging*, 20, 272-284. doi: 10.1037/0882-7974.20.2.272
- Nieman, D. (2011). *Exercise testing and prescription: a health-related approach*. 7th ed. New York: McGraw Hill.
- Noar, S. M., & Head, K. J. (2014). Mind the gap: bringing our theories in line with the empirical data—a response to commentaries. *Health Psychology Review*, 8(1), 65-69.
- Oremus, M., Cosby, J. L., & Wolfson, C. (2005). A hybrid qualitative method for pretesting questionnaires: The example of a questionnaire to caregivers of Alzheimer disease patients. *Research in Nursing & Health*, 28, 419–430. doi: 10.1002/nur.20095

- Penedo, F. J., & Dahn, J. R. (2005). Exercise and well-being: A review of mental and physical health benefits associated with physical activity. *Current Opinion in Psychiatry*, *18*, 189-193.
- Physical Activity Guidelines Advisory Committee (2008). *Physical activity guidelines advisory committee report*. Washington DC: U.S. Department of Health and Human Services.
- Pratt, M., Perez, L. G., Goenka, S., Brownson, R. C., Bauman, A., Sarmiento, O. L., & Hallal, P. C. (2015). Can population levels of physical activity be increased? Global evidence and experience. *Progress in cardiovascular diseases*, *57*(4), 356-367.
- Preacher, K. J., & Hayes, A. F. (2007). Contemporary approaches to assessing mediation in communication research. In A. F. Hayes, M. S. Slater, & L. B. Snyder (Eds.), *The SAGE Sourcebook of Advanced Data Analysis Methods for Communication Research* (pp. 13-54). Thousand Oaks, CA: Sage Publications, Inc.
- Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior Research Methods*, *40*, 879-891. doi: 10.3758/BRM.40.3.879
- Pronin, E., & Jacobs, E. (2008). Thought speed, mood, and the experience of mental motion. *Perspectives on Psychological Science*, *3*, 461-485. doi: 10.1111/j.1745-6924.2008.00091.x
- Rhodes, R. E., & Dickau, L. (2012). Experimental evidence for the intention-behavior relationship in the physical activity domain: A meta-analysis. *Health Psychology*, *31*(6), 724.
- Rothman, A. J. (2004). "Is there nothing more practical than a good theory?: Why innovations and advances in health behavior change will arise is interventions are used to test and

- refine theory. *International Journal of Behavioral Nutrition & Physical Activity*, *1*, 1-7.
doi:10.1186/1479-5868-1-11
- Rucker, D. D., Preacher, K. J., Z. L., Tormala, & Petty, R. E. (2011). Mediation analysis in social psychology: Current practices and new recommendations. *Social & Personality Psychology Compass*, *5*, 359-371. doi: 10.1111/j.1751-9004.2011.00355.x
- Ruiz-Canela, M., Martinez-Gonzalez, M. A., De Irala-Estevez, J. (2000). Intention to treat analysis is related to methodological quality. *British Medical Journal*, *320*, 1007–1008.
doi:10.1136/bmj.320.7240.1007
- Ryan, R. M., & Deci, E., L. (2000). Intrinsic and extrinsic motivations: Classic definition and new directions. *Contemporary Educational Psychology* *25*, 54–67.
doi:10.1006/ceps.1999.1020
- Ryan, R. M., & Deci, E. L. (2001). On happiness and human potentials: A review of research on hedonic and eudaimonic well-being. *Annual Review of Psychology*, *52*, 141-166.
- Ryan, R. M., & Deci, E. L. (2002). An overview of self-determination theory. In E. L. Deci & R. M. Ryan (Eds.), *Handbook of self-determination research* (pp. 3-33). Rochester, NY: University of Rochester Press.
- Ryan, R. M., & Frederick, C. M. (1997). On energy, personality, and health: subjective vitality as a dynamic reflection of well-being. *Journal of Personality*, *65*, 529-565.
- Ryan, R. M., Frederick, C. M., Lepes, D., Rubio, N., & Sheldon, K. M. (1997). Intrinsic motivation and exercise adherence. *International Journal of Sport Psychology*, *28*, 335-354.

- Ryan, R. M., Williams, G. C., Patrick, H., & Deci, E. L. (2009). Self-determination theory and physical activity: The dynamics of motivation in development and wellness. *Hellenic Journal of Psychology*, 6, 107–124.
- Sallis, J. F., Owen, N., & Fisher, E. B. (2008). Ecological Models of Health Behavior. In *Health Behavior and Health Education: Theory, Research, and Practice*, 4th ed., edited by K. Glanz, B. K. Rimer, and K. Viswanath, pp. 465-486. San Francisco: Jossey-Bass.
- Shadish, W. R., Cook, T. D., & Campbell, D. T. (2002). *Experimental and quasi-experimental designs for generalized causal inference*. Boston, MA: Houghton Mifflin.
- Sheldon, K. M. (2011). Integrating behavioral-motive and experiential-requirement perspectives on psychological needs: a two process model. *Psychological Review*, 118, 552-569. doi: 10.1037/a0024758
- Sheldon, K. M., Boehm, J., & Lyubomirsky, S. L. (2012). Variety is the spice of happiness: The hedonic adaptation prevention (HAP) model. In I. Boniwell & S. David (Eds.), *Oxford handbook of happiness*. Oxford, UK: Oxford University Press.
- Sheldon, K. M., & Lyubomirsky, S. (2012). The challenge of staying happier: Testing the hedonic adaptation prevention model. *Personality & Social Psychological Bulletin*, 38, 670-680. doi: 10.1177/0146167212436400
- Shrout, P. E., & Bolger, N. (2002). Mediation in experimental and nonexperimental studies: New procedures and recommendations. *Psychological Methods*, 7, 422–445.
- Silva, M. N., Markland, D., Vieira, P. N., Coutinho, S. R., Carraça, E. V., Palmeira, A. L., Minderico, C. S., Matos, M. G., Sardinha, L. B., & Teixeira, P. J. (2010). Helping overweight women become more active: Need support and motivational regulations for

- different forms of physical activity. *Psychology of Sport & Exercise*, *11*, 591-601.
doi:10.1016/j.psychsport.2010.06.011
- Silva, M. N., Vieira, P. N., Coutinho, S. R., Minderico, C. S., Matos, M. G., Sardinha, L. B., et al. (2010). Using self-determination theory to promote physical activity and weight control: A randomized controlled trial in women. *Journal of Behavioral Medicine*, *33*, 110-122. doi:10.1007/s10865-009-9239-y
- Silvia, P. J. (2008). Interest-the curious emotion. *Current Directions in Psychological Science*, *17*, 57-60.
- Sin, N. L., & Lyubomirsky, S. (2009). Enhancing well-being and alleviating depressive symptoms with positive psychology interventions: A practice friendly meta-analysis. *Journal of Clinical Psychology*, *65*, 467-487. doi: 10.1002/jclp.20593
- Smith, L. L. (1992). Causes of delayed onset muscle soreness and the impact on athletic performance: A review. *Journal of Applied Sport Science Research*, *6*, 135-41
- Sparkes, R., & Behm, D. G. (2010). Training adaptations associated with an 8-week instability resistance training program with recreationally active individuals. *Journal of Strength & Conditioning Research*, *24*, 1931-1941.
- Standage, M., & Ryan, R. M. (2012). Self-determination theory and exercise motivation: Facilitating self-regulatory processes to support and maintain health and well-being. In G. C. Roberts & D. C. Treasure (Eds.), *Advances in motivation in sport and exercise* 3rd ed., (pp. 233-270). Champaign, IL: Human Kinetics.
- Standage, M., & Vallerand, R. J. (2014). Motivation in sport and exercise groups: A self-determination theory perspective. In M. R. Beauchamp, & M. A. Eys (Eds.), *Group dynamics in exercise and sport psychology* (2nd edition) (pp. 259-278). New York:

Routledge.

- Strauss, A. L., & Corbin, J. M. (1998). *Basics of qualitative research: Techniques and procedures for developing grounded theory*. Thousand Oaks, CA: Sage.
- Sweet, S. N., Fortier, M. S., Strachan, S. M., & Blanchard, C. M. (2012). Testing and integrating self-determination theory and self-efficacy theory in a physical activity context. *Canadian Psychology, 53*, 319-327. doi:10.1037/a0030280
- Sylvester, B. D., Standage, M., Ark, T., Sweet, S. N., Crocker, P. R. E., Zumbo, B. D., & Beauchamp, M. R. (2014a). Is variety a spice of (an active) life?: Perceived variety, exercise behavior, and the mediating role of autonomous motivation. *Journal of Sport & Exercise Psychology, 36*(5), 516-527. doi:10.1123/jsep.2014-0102
- Sylvester, B. D., Standage, M., Dowd, A. J., Martin, L. J., Sweet, S. N., & Beauchamp, M. R. (2014b). Perceived variety, psychological needs satisfaction, and exercise-related well-being. *Psychology & Health, 29*, 1044-1061. doi: 10.1080/08870446.2014.907900
- Sylvester, B. D., Standage, M., McEwan, D., Wolf, S. A., Lubans, D. R., Eather, N., Kaulius, M., Ruissen, G. R., Crocker, P. R. E., Zumbo, B. D., & Beauchamp, M. R. (2015). Variety support and exercise adherence behavior: Experimental and mediating effects. *Journal of Behavioral Medicine*. doi: 10.1007/s10865-015-9688-4
- Tabachnick, B. G., & Fidell, L. S. (2012). *Using multivariate statistics* (6th edn.). Needham Heights, MA: Allyn & Bacon.
- Teixeira, P. J., Carraça, E. V., Markland, D., Silva, M. N., & Ryan, R. M. (2012). Exercise, physical activity, and self-determination theory: A systematic review. *International Journal of Behavioral Nutrition & Physical Activity, 9*, 78. doi:10.1186/1479-5868-9-78

- Thomas, D. R., (1992). Interpreting discriminant functions: A data analytic approach. *Multivariate Behavioral Research, 27*, 335–362.
- Thomas, D. R., Hughes, E., & Zumbo, B. D. (1998). On variable importance in linear regression. *Social Indicators Research, 45*, 253–275.
- Thurstone, L. L. (1947). *Multiple-factor analysis*. Chicago: University of Chicago Press.
- Turner, A. (2011). The science and practice of periodization: A brief review. *Strength & Conditioning Journal, 33*, 34-46.
- Unnebrink, K., & Windeler, J. (2001). Intention-to-treat: Methods for dealing with missing values in clinical trials of progressively deteriorating diseases. *Statistics in Medicine, 20*, 3931–3946. doi: 10.1002/sim.1149
- Vallerand, R. J. (1997). Towards a Hierarchical Model of Intrinsic and Extrinsic Motivation. In M. P. Zanna, (Ed). *Advances in Experimental Social Psychology*, (pp. 271-360). Academic Press, New York, NY.
- Vansteenkiste, M., & Ryan, R. M. (2013). On psychological growth and vulnerability: Basic psychological need satisfaction and need frustration as a unifying principle. *Journal of Psychotherapy Integration, 23*, 263-280. doi: 10.1037/a0032359
- Vogt, D. S., King, D. W., & King, L. A. (2004). Focus groups in psychological assessment: Enhancing content validity by consulting members of the target population. *Psychological Assessment, 16*, 231–243. doi: 10.1037/1040-3590.16.3.231
- Warburton, D. E. R., Charlesworth, S., Ivey, A., Nettlefold, L., & Bredin, S. S. D. (2010). A systematic review of the evidence for Canada’s Physical Activity Guidelines for Adults. *International Journal of Behavioral Nutrition & Physical Activity, 7*: 39. doi:10.1186/1479-5868-7-39.

- Warburton, D. E. R., Jamnik, V. K., Bredin, S. S. D., & Gledhill, N. (2011). The Physical Activity Readiness Questionnaire (PAR-Q+) and electronic Physical Activity Readiness Medical Examination (ePARmed- X+). *Health & Fitness Journal of Canada, 4*, 3–17.
- White, R. W. (1959). Motivation reconsidered: The concept of competence. *Psychological Review, 66*, 297-333. doi: 10.1037/h0040934
- Wilcox, S., King A. C., Brassington, G. S., & Ahn, D. K. (1999). Physical activity preferences of middle-aged and older adults: a community analysis. *Journal of Aging & Physical Activity, 7*, 386–399.
- Williams, S. L., & French, D. P. (2011). What are the most effective intervention techniques for changing physical activity self-efficacy and physical activity behaviour—and are they the same?. *Health education research, 26*(2), 308-322.
- Willis, G. (2005). *Cognitive interviewing: A tool for improving questionnaire design*. Thousand Oaks, CA: Sage.
- Wilson, P. M., Mack, D. E., Gunnell, K. E., Oster, K., & Gregson, J. P. (2008). Analyzing the measurement of psychological need satisfaction in exercise contexts: Evidence, issues, and future directions. In M. P. Simmons & L. A. Foster (Eds.), *Sport and exercise psychology research advances* (pp. 361-391). Hauppauge, NY: Nova Science.
- Wilson, P. M., Rogers, W. T., Rodgers, W. M., & Wild, T. C. (2006). The psychological need satisfaction in exercise scale. *Journal of Sport & Exercise Psychology, 28*, 231–251.
- Wilson, P. M., Rodgers, W. M., Loitz, C. C., & Scime, G. (2006). "It's who I am... really!": The importance of integrated regulation in exercise contexts. *Journal of Applied Biobehavioral Research, 11*, 79–104. doi: 10.1111/j.1751-9861.2006.tb00021.x

- Wilson, P. M., & Rogers, W. M. (2008). Examining relationships between perceived psychological need satisfaction and behavioral regulations in exercise. *Journal of Applied Biobehavioral Research, 13*, 119–142. doi:10.1111/j.1751-9861.2008.00031.x
- Wolf, E. J., Harrington, K. M., Clark, S. L., & Miller, M. W. (2013). Sample size requirements for structural equation models an evaluation of power, bias, and solution propriety. *Educational & Psychological Measurement, 73*, 913-934.
doi:10.1177/0013164413495237
- World Health Organization (2007). *A guide for population-based approaches to increasing levels of physical activity: Implementation of the WHO global strategy on diet, physical activity and health*. Geneva, Switzerland: World Health Organization.
- World Health Organization. (2009). Global health risks: Mortality and burden of disease attributable to selected major risks. Retrieved on November 24th, 2015 from:
http://www.who.int/healthinfo/global_burden_disease/GlobalHealthRisks_report_Front.pdf
- World Health Organization. (2010). Global recommendations on physical activity for health. World Health Organization. Geneva, Switzerland.
- Zuckerman, M. (1994). *Behavioral expressions and biosocial bases of sensation seeking*. Cambridge: Cambridge University Press.
- Zuckerman, M. (2007). The sensation seeking scale V (SSS-V): Still reliable and valid. *Personality & Individual Differences, 43*, 1303-1305. doi:10.1016/j.paid.2007.03.021
- Zumbo, B. D. (2007). Validity: Foundational issues and statistical methodology. In C.R. Rao and S. Sinharay (Eds.) *Handbook of statistics, Vol. 26: Psychometrics*, (pp. 45–79). The Netherlands: Elsevier Science B.V.

Zumbo, B. D., Gadermann, A. M., & Zeisser, C. (2007). Ordinal versions of coefficients alpha and theta for likert rating scales. *Journal of Modern Applied Statistical Methods*, 6, 21-29.

Appendices

Appendix A Focus Group Study

A.1 Participant Letter of Information



*Psychology of Exercise, Health, and Physical
Activity Lab-Room 122
School of Kinesiology
The University of British Columbia
6081 University Blvd, Vancouver, BC, V6T 1Z1*

Letter of Information- Study A Experiencing Variety in Exercise

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

Co-Investigator:
Ben Sylvester, MA
School of Kinesiology
University of British Columbia

Purpose: The purpose of this study is to refine and pretest a preliminary measure of *need for variety* in exercise settings.

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

1. 18 years of age or older
2. Able to read and converse in English

Involvement: Should you choose to participate, we will ask you to complete a short questionnaire and answer a few follow-up questions about this questionnaire in a small focus group setting. The discussions that take place within these focus groups will be tape recorded and transcribed for analysis. Your participation will take approximately 30 minutes.

Benefits: To compensate you for your time, participants will be given \$5.

Confidentiality: Completed measures (i.e., questionnaires) will be shredded upon study completion. Qualitative data (audio tapes) will be stored in a locked and secure storage room in the War Memorial Gym (Room 310). All computer 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). We will make sure that any recordings (e.g., tape recordings, written

records) of our discussions are not heard or read by anyone other than researchers involved with this study. You should note that we cannot control what other participants do with the information discussed in these focus groups (i.e., speak with others outside of the group), and as such if there is anything you'd like to share with us in confidence that you do so after the focus group session (i.e., on a one-on-one basis).

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 doctoral scholarship awarded to Ben Sylvester by the Social Sciences and Humanities Research Council of Canada.

We want to hear your opinion on these issues. There are no right or wrong answers. There are no good or bad answers and this is NOT a test. Your answers are very important to us so please make sure you answer honestly.

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 Benjamin Sylvester, or Dr. Mark Beauchamp. Alternatively, if you have any concerns about your rights or treatment as a research participant please contact the 'Research Subject Information Line' in the UBC Office of Research Services at (604) 822-8598 or if long distance email to RSIL@ors.ubc.ca.

Thank you for your help,

Mark Beauchamp, PhD

Ben Sylvester, MA

A.2 Consent Form



*Psychology of Exercise, Health, and Physical
Activity Lab-Room 122
School of Kinesiology
The University of British Columbia
6081 University Blvd, Vancouver, BC, V6T 1Z1*

Consent Form

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

Co-Investigator:
Ben Sylvester, MA
School of Kinesiology
University of British Columbia

Project Title: Understanding Exercise Experiences: An Experimental Study

Purpose: The purpose of this study is to examine university students' exercise experiences in various exercise programs.

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

1. 18 years of age or older
2. Able to read and converse in English
3. Enrolled as a student at UBC
4. Engage in moderate-vigorous intensity exercise on two or less days per week
5. Have no health risks that would interfere with exercise (as identified by responses to the physical activity readiness questionnaire).

Involvement: Should you choose to participate, you will be asked to engage in a one-hour exercise session, three times per week, for a 6 week period in the BodyWorks Fitness Centre. Questionnaires asking people a range of questions about their exercise experiences will be administered at three time points and take approximately 15 minutes to complete.

Benefits: Participants will receive FREE access to the BodyWorks Fitness Centre, a FREE exercise program, and FREE access to a personal trainer.

Confidentiality: Any information that you provide will be made anonymous. This means that no information that can identify you will be made available within any reports that may result from this research. Completed measures (i.e., questionnaires) will be shredded upon study completion.

All computer 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). You should note that participants will be assigned an ID number which will need to be presented to gain entry to the facility for each exercise session. Furthermore, other participants (and members of the BodyWorks Fitness Centre) may see you in the facility and thus, your participation cannot be 100% confidential.

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.

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 Benjamin Sylvester, or Dr. Mark Beauchamp. Alternatively, if you have any concerns about your rights or treatment as a research participant please contact the 'Research Subject Information Line' in the UBC Office of Research Services at (604) 822-8598 or if long distance email to RSIL@ors.ubc.ca.

Consent: By signing below means that the study has been explained to me, I understand what is involved, and that I agree to take part in this study. It also means that:

I understand that my participation in this study is entirely my choice and that I may pull out from the study at any time without having to give any reason for doing so, and without experiencing any negative consequences. I understand that that if I do not wish to answer any question or discuss any topic that is raised, I may refuse to answer and the interviewer will go on to the next question. If I withdraw from the study, the information I have supplied (tapes, notes) will be destroyed.

I am willing to take part in a group discussion as well as a one-on-one interview over the next few months at a time that is good for me. I understand that both the group discussion and the personal interview will last approximately one to two hours, and I am happy for these discussions to be tape-recorded. I have received a copy of this consent form for my own records.

By signing this form you have consented to participate in this study.

SIGNED.....

NAME IN BLOCK LETTERS.....

DATE.....

A.3 Recruitment Poster Study A



Tell Us About Your Exercise Experiences!

PARTICIPANTS NEEDED!



What's Involved?

This study involves completing a questionnaire about your exercise experiences and answering four questions (in a focus group format) about a particular measure that we are developing. This will take approximately 30 minutes of your time. This study is being conducted through the UBC School of Kinesiology.

Am I Eligible to Participate?

We are currently looking for adults who are 18+ to participate in this study. If you would like to participate, please contact Ben Sylvester at the email address listed below. Data collection will begin in April, 2012. Please contact Ben to sign up.

What are the Benefits of Participating in this Study?

Participants will be given \$5 for their time.

What are the Risks Associated with this Study?

There are no known risks associated with participating in this study.

Will the information I Provide Remain Confidential?

Only limited confidentiality can be offered as the investigators cannot control what other participants, that take part in focus groups, do with the information discussed. Regardless, the information we will be discussing will not be of a sensitive nature; we are simply looking to get some feedback questionnaire items (about exercise) that we have developed.

I'm Interested, Who Should I Contact?

If you would like to participate in this study please contact Ben (ubcexercise@gmail.com).

Study on Exercise Experiences ubcexercise@gmail.com	Study on Exercise Experiences ubcexercise@gmail.com	Study on Exercise Experiences ubcexercise@gmail.com	Study on Exercise Experiences ubcexercise@gmail.com	Study on Exercise Experiences ubcexercise@gmail.com	Study on Exercise Experiences ubcexercise@gmail.com	Study on Exercise Experiences ubcexercise@gmail.com	Study on Exercise Experiences ubcexercise@gmail.com	Study on Exercise Experiences ubcexercise@gmail.com	Study on Exercise Experiences ubcexercise@gmail.com	Study on Exercise Experiences ubcexercise@gmail.com
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A.4 Interview Guide Study A

Summary of Procedures

Study A: This study will utilize a retrospective think aloud protocol (Oremus, Cosby, & Wolfson, 2005; Willis, 2005) with adults in focus groups to refine and pretest the initial measure of need for variety. Interviews will be conducted in small groups in the Psychology of Exercise, Health and Physical Activity Lab in War Memorial Gym (UBC campus), to better understand how members of the target population **interpret and respond to items**. Participants ($n = 12-16$) will be recruited by means of a study poster (see attached Recruitment Poster- Study A) and consistent with a retrospective think aloud protocol, asked to complete the items regarding need for variety in exercise and discuss them with the researcher (see attached Interview Guide- Study A). Once potential participants respond to recruitment (via e-mail) the researcher will respond with a letter of information (see attached Recruitment Response E-mail-Study A and Letter of Information Study A). If participants elect to take part, they will be invited to the lab, at which point their informed consent will be obtained and the think aloud focus group session will proceed. The number of focus groups (approx 3-4) will be determined by an iterative process until no further changes are warranted. On conclusion of the think aloud protocol, problematic items will be reworked or deleted. To ensure that the items are representative of the target construct, the revised item pool will subsequently be reviewed by five scholars with expertise in BPNT.

- Initial greeting/ consent form, procedure of the focus group, give questionnaire.

Variety involves the experience of a diverse range of activities, behaviours, and opportunities in a given context.

Exercise is the physical exertion of the body - making the body do a physical activity which aims to maintain or enhance physical fitness and general health. The following questions correspond to your experience with, and involvement in, exercise.

- Give Questionnaire

Following this, a series of questions will be used to guide participants to discuss all elements of the preliminary measure (i.e., instructions, response format, and each item) in turn. Probes include:

- (a) What in your own words does the question mean to you?
- (b) Did the answer choices include your answer?
- (c) Did you understand how to answer the questions?
- (d) Did the questionnaire leave anything out you felt was important?

A.5 Focus Group Questionnaire

Exercise Experiences Focus Group

PART A

1. What is your age (years): _____
2. Gender (check one): Male Female
3. What is the highest level of education you have completed?
 Some high school Some college/ university Some graduate school
 High school diploma College diploma/ university degree Graduate degree
4. What is your current marital status?
 Single Married/ common law Divorced/separated Widowed
5. How do you describe yourself in terms of your ethnic origin? PLEASE CHECK **ALL** THAT APPLY.

<input type="checkbox"/> White	<input type="checkbox"/> South East Asian
<input type="checkbox"/> Russian	(e.g. Vietnamese, Cambodian, etc.)
<input type="checkbox"/> Chinese	<input type="checkbox"/> West Asian
<input type="checkbox"/> Black	(e.g. Iranian, Afghan, etc.)
<input type="checkbox"/> African	<input type="checkbox"/> Korean
<input type="checkbox"/> Filipino	<input type="checkbox"/> Native/Aboriginal
<input type="checkbox"/> Latin American	<input type="checkbox"/> Other (please specify)
<input type="checkbox"/> Arab	_____
<input type="checkbox"/> Japanese	

Exercise is the physical exertion of the body - making the body do a physical activity which aims to maintain or enhance physical fitness and general health. The following questions correspond to your experience with, and involvement in, exercise.

The following statements represent different feelings people have when they exercise. Please answer the following questions by considering how you typically feel while you are exercising.

	Strongly Disagree						Strongly Agree
I feel like I engage in a variety of exercises.	1	2	3	4	5	6	7
I feel like I try out a wide range of exercises.	1	2	3	4	5	6	7
I feel like doing different routines when I exercise.	1	2	3	4	5	6	7
I feel like I mix up the types of tasks and exercises that I do.	1	2	3	4	5	6	7
I feel like my exercise program is varied.	1	2	3	4	5	6	7
I feel like doing different exercises when I'm physically active.	1	2	3	4	5	6	7
When I exercise, I like to vary what I do.	1	2	3	4	5	6	7
I feel like I have different experiences each time I exercise.	1	2	3	4	5	6	7

A.6 Expert Reviewer Guide



*Psychology of Exercise, Health, and Physical
Activity Lab-Room 122
School of Kinesiology
The University of British Columbia
6081 University Blvd, Vancouver, BC, V6T 1Z1*

Dear _____

We are writing to request your assistance in developing a questionnaire that measures a **psychological need for variety in exercise**. Specifically, this measure is for use with **adults** and will focus on their perceptions of the extent to which they experience *a need for variety* in exercise. In spite of the potential application of a **psychological need for variety in exercise** to inform health promotion specialists and health-behaviour researchers, at present there is no measure of this construct. Based on an extensive literature review of psychological needs and exercise, as well as previously established measures, and an extensive series of focus groups (utilizing a think aloud validity protocol), we have identified ___ items to assess this construct.

In order to assess the content validity of the questionnaire, we would like to ask for your help. In the next pages we have provided a *definition* of a 'need for variety', followed by the specific items we have (provisionally) identified/developed. Below each item are: four 7-point scales and a comments section. Please use the 7-point scales to rate each item with regard to (a) *relevance* to the context of exercise, (b) *representative* of the construct, (c) wording clarity and (d) potential item redundancy. In addition, please provide any relevant comments in the space(s) provided.

We would like to thank you in advance for your help. We understand that your time is valuable, but as your input at this stage is essential, we really hope that you will be able to assist us in this process. If you agree to contribute to this project, please complete and return this document to Ben or Mark by _____. If this is a tight deadline, but you are still able to assist us, please let us know by when you could return the completed document. Once again, thank you very much for your help. It is **greatly appreciated!**

Many thanks,

Ben Sylvester & Mark Beauchamp

The Psychological Need for Variety in Exercise Scale

In the next pages we have provided a definition of a *psychological need for variety*, followed by the items that we would like you to assess. Using the scales presented below, please rate each item with regard to (a) *relevance* to the context of exercise, (b) *representative* of the construct, (c) wording clarity and (d) potential item redundancy. In the comments section following each item, please provide relevant comments in the space(s) provided.

The Psychological Need for Variety in Exercise Scale is anchored by 1 (strongly disagree) and 7 (strongly agree).

The Psychological Need for Variety in Exercise Scale

Definition. (The need for) variety involves the pursuit and experience of a diverse range of activities, behaviours, and opportunities in a given context.

Please use the 7-point scales to rate each item with regard to (a) *relevance* to the context of exercise, (b) *representative* of the construct, (c) wording clarity and (d) potential item redundancy.

-3	-2	-1	0	1	2	3
Not at all			Uncertain			Very

The following statements represent different feelings people have when they exercise. Please answer the following questions by considering how you typically feel while you are exercising.

1. I feel like I engage in a variety of exercises.

Relevance of Item	-3	-2	-1	0	1	2	3
Representative of definition	-3	-2	-1	0	1	2	3
Clarity of wording	-3	-2	-1	0	1	2	3
Redundancy of Item	-3	-2	-1	0	1	2	3

Comments

.....

.....

.....

2. I feel like I try out a wide range of exercises.

Relevance of Item	-3	-2	-1	0	1	2	3
Representative of definition	-3	-2	-1	0	1	2	3
Clarity of wording	-3	-2	-1	0	1	2	3
Redundancy of Item	-3	-2	-1	0	1	2	3

Comments

.....

.....

.....

3. I feel like doing different routines when I exercise.

Relevance of Item	-3	-2	-1	0	1	2	3
Representative of definition	-3	-2	-1	0	1	2	3
Clarity of wording	-3	-2	-1	0	1	2	3
Redundancy of Item	-3	-2	-1	0	1	2	3

Comments

.....
.....
.....

4. I feel like I mix up the types of tasks and exercises that I do.

Relevance of Item	-3	-2	-1	0	1	2	3
Representative of definition	-3	-2	-1	0	1	2	3
Clarity of wording	-3	-2	-1	0	1	2	3
Redundancy of Item	-3	-2	-1	0	1	2	3

Comments

.....
.....
.....

5. I feel like my exercise program is varied.

Relevance of Item	-3	-2	-1	0	1	2	3
Representative of definition	-3	-2	-1	0	1	2	3
Clarity of wording	-3	-2	-1	0	1	2	3
Redundancy of Item	-3	-2	-1	0	1	2	3

Comments

.....
.....
.....

6. I feel like doing different exercises when I'm physically active.

Relevance of Item	-3	-2	-1	0	1	2	3
Representative of definition	-3	-2	-1	0	1	2	3
Clarity of wording	-3	-2	-1	0	1	2	3
Redundancy of Item	-3	-2	-1	0	1	2	3

Comments

.....
.....
.....

7. I feel like I have different experiences each time I exercise.

Relevance of Item	-3	-2	-1	0	1	2	3
Representative of definition	-3	-2	-1	0	1	2	3
Clarity of wording	-3	-2	-1	0	1	2	3
Redundancy of Item	-3	-2	-1	0	1	2	3

Comments

.....
.....
.....

8. When I exercise, I like to vary what I do.

Relevance of Item	-3	-2	-1	0	1	2	3
Representative of definition	-3	-2	-1	0	1	2	3
Clarity of wording	-3	-2	-1	0	1	2	3
Redundancy of Item	-3	-2	-1	0	1	2	3

Comments

.....
.....
.....

Appendix B

B.1 Recruitment Poster Study B



Tell Us About Your Exercise Experiences! PARTICIPANTS NEEDED!



What's Involved?

This study involves completing a web-based questionnaire three times over the course of 6 months. Questionnaire completion will take approximately 15 minutes, whereby we will ask people a range of questions about their experiences of exercising. This study is being conducted through the UBC School of Kinesiology.

Am I Eligible to Participate?

We are currently looking for adults who are 18+ to participate in this study. If you would like to participate, please contact Ben Sylvester at the email address listed below. Data collection will begin in May, 2012. Please contact Ben to sign up.

What are the Benefits of Participating in this Study?

Participants will be entered in a prize draw to win one of six \$50 gift certificates.

What are the Risks Associated with this Study?

There are no known risks associated with participating in this study.

Will the information I Provide Remain Confidential?

Yes! The data collected for this study is solely for research purposes. The data that you provide in this study will remain completely confidential.

I'm Interested, Who Should I Contact?

If you would like to participate in this study please contact Ben (ubcexercise@gmail.com).

Study on Exercise Experiences ubcexercise@gmail.com	Study on Exercise Experiences ubcexercise@gmail.com	Study on Exercise Experiences ubcexercise@gmail.com	Study on Exercise Experiences ubcexercise@gmail.com	Study on Exercise Experiences ubcexercise@gmail.com	Study on Exercise Experiences ubcexercise@gmail.com	Study on Exercise Experiences ubcexercise@gmail.com	Study on Exercise Experiences ubcexercise@gmail.com	Study on Exercise Experiences ubcexercise@gmail.com	Study on Exercise Experiences ubcexercise@gmail.com	Study on Exercise Experiences ubcexercise@gmail.com
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B.2 Letter of Information Study B



Psychology of Exercise, Health, and Physical Activity Lab-
Room 122
School of Kinesiology
The University of British Columbia
6081 University Blvd, Vancouver, BC, V6T 1Z1

Letter of Information- Study B Exercise Experiences

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

Co-Investigator:
Ben Sylvester, MA
School of Kinesiology
University of British Columbia

Purpose: The purpose of this study is to develop a greater understanding of people's experiences of exercise.

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

1. 18 years of age or older
2. Able to read and converse in English

Involvement: Should you choose to participate, we will ask that you complete an online questionnaire that takes approximately 15 minutes on three occasions over the next 6 months.

Benefits: Participants will be entered into a prize draw to win one of six \$50 gift certificates.

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 survey instrument. 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 doctoral scholarship awarded to Ben Sylvester by the Social Sciences and Humanities Research Council of Canada.

We want to hear your opinion on these issues. There are no right or wrong answers. There are no good or bad answers and this is NOT a test. You are asked to do this on your own. Your answers are very important to us so please make sure you complete all answers honestly.

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 Benjamin Sylvester, or Dr. Mark Beauchamp. Alternatively, if you have any concerns about your rights or treatment as a research participant please contact the 'Research Subject Information Line' in the UBC Office of Research Services at (604) 822-8598 or if long distance email to RSIL@ors.ubc.ca.

Please note that by clicking on this link to the online questionnaire you have denoted your consent to participate in this study.

Web-link: <https://survey.edudata.ca/es/exercise-experiences-baseline/>

Thank you for your help,

Mark Beauchamp, PhD

Ben Sylvester, MA

B.3 Recruitment Response E-mail and Consent

Recruitment Response E-mail-Study B

Hi,

Thank you for your interest in the Exercise Experiences study! I have attached the letter of information for you to read. After reading the letter of information, if you are happy to take part please click on the following link (<https://survey.edudata.ca/es/exercise-experiences-baseline/>). By clicking on the link to access the questionnaire you are denoting your consent to take part in this study. As we mention in the attached information letter, you are free with withdraw from the study at any time or decline to answer any question. The link can also be accessed through the letter of information attached.

If you elect to participate in this study, your e-mail address will be entered into a prize draw to win one of six \$50 gift certificates. If you have any questions or concerns about participating, please contact me either by telephone or e-mail (see below).

Login (to access the questionnaire): Your e-mail address

Thank you for your time.

Sincerely,

Ben Sylvester

B.4 Follow-up E-mail Time 2- Study B

Hi,

Thank you for your participation in the Exercise Experiences Study! Please follow the link below as we are now in phase two of data collection and your involvement would greatly help us understand how you experience exercise.

Web-link: <https://survey.edudata.ca/es/exercise-experiences-time-2-exercise-experiences-time-2/>

Login: your email address

After you complete this questionnaire, I will contact you in 18 weeks to send you the link to the final questionnaire in our study. You will be entered to win one of six \$50 gift certificates for your participation. If you have any questions or concerns please don't hesitate to contact me (see below).

Thank you for your time.

Sincerely,

Ben Sylvester

B.5 Follow-up E-mail Time 3- Study B

Hi,

Thank you for your participation in the Exercise Experiences Study! Please follow the link below as we are now in the last phase of data collection and your involvement would greatly help us understand how you experience exercise.

Web-link: <https://survey.edudata.ca/es/czQzNQ/YzQyOA/>

Login: your email address

Your e-mail address will be entered into a draw to win one of six \$50 gift certificates for participating in our study. You will be contacted by e-mail if you win. If you are interested in the results of this study please contact me indicating your wish to receive a summary report of the findings. If you have any questions or concerns please don't hesitate to contact me (see below).

Thank you very much for your participation!

Sincerely,

Ben Sylvester

B.6 Questionnaire

Exercise Experiences Questionnaire

PART A: Background Information

1. What is your age (years):

2. Gender (check one):

Male

Female

3. Where do you live?

City/Town

State/Province

e

Country

4. What is the highest level of education you have completed?

Some high school

High school diploma

Some college/university

College diploma/university degree

Some graduate school

Graduate degree

5. What is your current marital status?

Single

Married/common law

Divorced/separated

Widowed

6. How many times have you been to the doctor in the past 3 months?

7. What is your job situation? Please check one that fits you best.

- Homemaker
- Retired
- Student
- Paid full-time employment/self-employed
- Paid part-time employment/self-employed
- Temporarily unemployed

8. What is your annual household income (check one):

- \$0-25,000
- \$25,000-50,000
- \$50,000-75,000
- \$75,000- 100,000
- \$100,000+

9. How do you describe yourself in terms of your ethnic origin? PLEASE CHECK ALL THAT APPLY.

- White
- Chinese
- Black
- Filipino
- Latin American
- Arab
- Japanese
- Russian
- African
- South East Asian (e.g., Vietnamese, Cambodian, etc.)
- West Asian (e.g., Iranian, Afghan, etc)
- Korean

Native/Aboriginal

Other (please specify)

Physical Healthiness

	Poor				Excellent
1. How would you rate your general health?	0	1	2	3	4
2. How would you rate your physical fitness?	0	1	2	3	4
3. How would you rate your attitude to health?	0	1	2	3	4
4. How good is your knowledge of health matters?	0	1	2	3	4
5. How healthy are your eating habits?	0	1	2	3	4
6. How healthy is your general lifestyle?	0	1	2	3	4

Exercise Behaviour

During a typical 7- day period (a week), how many times on the average do you do the following kinds of exercise for more than 15 minutes during your free time? (write on each line the appropriate number)

Mild (minimal effort) (e.g., yoga, archery, fishing from a river bank, bowling, horseshoeing, golf without using a cart, snow-mobiling, easy walking)

Times per week

Moderate (not exhausting) (e.g., fast walking, baseball, tennis, easy bicycling, volleyball, badminton, alpine skiing, easy swimming, popular and folk dancing)

Times per week

Strenuous (heart beats rapidly) (e.g., running or jogging, hockey, football, soccer, squash, basketball, cross country skiing, judo, roller skating, vigorous swimming, vigorous long distance bicycling)

Times per week

Exercise Experiences

Please think about what exercise you have been doing and experiencing during the past 4 weeks. Then report how much you experienced each of the following feelings, using the scale below. For each item, select a number from 1 to 5.

	Very rarely or never	Rarely	Sometime	Often	Very often or always
Positive	1	2	3	4	5
Negative	1	2	3	4	5
Good	1	2	3	4	5
Bad	1	2	3	4	5
Pleasant	1	2	3	4	5
Unpleasant	1	2	3	4	5
Happy	1	2	3	4	5
Sad	1	2	3	4	5
Afraid	1	2	3	4	5
Joyful	1	2	3	4	5
Angry	1	2	3	4	5
Contented	1	2	3	4	5

Please respond to each of the following statements by indicating the degree to which the statement is true for you when you engage in *exercise*. Use the following scale:

	Not At All True			Somewhat True			Very True
1. I feel alive and vital.	1	2	3	4	5	6	7
2. Sometimes I feel so alive I just want to burst.	1	2	3	4	5	6	7
3. I have energy and spirit.	1	2	3	4	5	6	7
4. I look forward to each new day.	1	2	3	4	5	6	7
5. I nearly always feel alert and awake.	1	2	3	4	5	6	7
6. I feel energized.	1	2	3	4	5	6	7

The following statements represent different feelings people have when they exercise. Please answer the following questions by considering how you typically feel while you are exercising.

	False	Mostly False	More False Than True	More True Than False	Mostly True	True
I feel that I am able to complete exercises that are personally challenging	1	2	3	4	5	6
I feel attached to my exercise companions because they accept me for who I am	1	2	3	4	5	6
I feel like I am the one who decides what exercises I do	1	2	3	4	5	6
I feel close to my exercise companions who appreciate how difficult exercise can be	1	2	3	4	5	6
I feel good about the way I am able to complete challenging exercises	1	2	3	4	5	6
I feel free to exercise in my own way	1	2	3	4	5	6
I feel free to make my own exercise program decisions	1	2	3	4	5	6
I feel a sense of camaraderie with my exercise companions because we exercise for the same reasons	1	2	3	4	5	6
I feel like I get along well with other people who I interact with while we exercise together	1	2	3	4	5	6
I feel confident I can do even the most challenging exercises	1	2	3	4	5	6
I feel free to choose which exercises I participate in	1	2	3	4	5	6
I feel capable of completing exercises that are challenging to me	1	2	3	4	5	6
I feel like I am in charge of my exercise program decisions	1	2	3	4	5	6
I feel confident in my ability to perform exercises that personally challenge me	1	2	3	4	5	6
I feel like I share a common bond with people who are important to me when we exercise together	1	2	3	4	5	6
I feel like I have a say in choosing the exercises that I do	1	2	3	4	5	6
I feel like I am capable of doing even the most challenging exercises	1	2	3	4	5	6
I feel connected to the people who I interact with while we exercise together	1	2	3	4	5	6

The following statements represent different feelings people have when they exercise. Please answer the following questions by considering how you typically feel while you are exercising.

	False	Mostly False	More False Than True	More True Than False	Mostly True	True
I feel like I engage in a variety of exercises.	1	2	3	4	5	6
I feel like I try a range of exercises.	1	2	3	4	5	6
I feel like I change the types of exercise that I do.	1	2	3	4	5	6
I feel like my exercise program is varied.	1	2	3	4	5	6
I feel like I experience variety in my exercise.	1	2	3	4	5	6

WHY DO YOU ENGAGE IN EXERCISE?

We are interested in the reasons underlying peoples' decisions to engage, or not engage in physical exercise. Using the scale below, please indicate to what extent each of the following items is true for you. Please note that there are no right or wrong answers and no trick questions. We simply want to know how you personally feel about exercise. Your responses will be held in confidence and only used for our research purposes.

		Not true for me		Sometimes true for me		Very true for me
1	I exercise because other people say I should	0	1	2	3	4
2	I consider exercise to be part of my identity	0	1	2	3	4
3	I feel guilty when I don't exercise	0	1	2	3	4
4	I value the benefits of exercise	0	1	2	3	4
5	I exercise because it's fun	0	1	2	3	4
6	I don't see why I should have to exercise	0	1	2	3	4
7	I take part in exercise because my friends/family/partner say I should	0	1	2	3	4
8	I feel ashamed when I miss an exercise session	0	1	2	3	4
9	It's important to me to exercise regularly	0	1	2	3	4
10	I can't see why I should bother exercising	0	1	2	3	4
11	I consider exercise consistent with my values	0	1	2	3	4
12	I enjoy my exercise sessions	0	1	2	3	4
13	I exercise because others will not be pleased with me if I don't	0	1	2	3	4
14	I don't see the point in exercising	0	1	2	3	4

		Not true for me		Sometimes true for me		Very true for me
		0	1	2	3	4
15	I feel like a failure when I haven't exercised in a while	0	1	2	3	4
16	I consider exercise a fundamental part of who I am	0	1	2	3	4
17	I think it is important to make the effort to exercise regularly	0	1	2	3	4
18	I find exercise a pleasurable activity	0	1	2	3	4
19	I feel under pressure from my friends/family to exercise	0	1	2	3	4
20	I get restless if I don't exercise regularly	0	1	2	3	4
21	I get pleasure and satisfaction from participating in exercise	0	1	2	3	4
22	I think exercising is a waste of time	0	1	2	3	4
23	I exercise because it is consistent with life goals	0	1	2	3	4

Thank you for taking part in our research

Appendix C Experimental Study

C.1 Recruitment Poster


**Free 6-Week Exercise
Membership/Program
Now Recruiting Study Participants**



What's Involved?

This study involves participating in an exercise program at the BodyWorks Fitness Centre (UBC campus). Participants will be asked to engage in a 1-hour exercise session, 3 times per week, for a 6-week period. Questionnaires asking people a range of questions about their exercise experiences will be administered at 3 time points and take approximately 10 minutes to complete. This study is being conducted through the UBC School of Kinesiology.

Am I Eligible to Participate?

We are currently looking for male and female university students between the age of 18 and 40 who are physically inactive (i.e., engage in moderate-vigorous intensity exercise no more than **two** days per week) but are physically able to exercise.

What are the Benefits of Participating in this Study?

Participants will receive FREE access to the BodyWorks Fitness Centre, a FREE 6-week exercise program, and FREE access to a personal trainer. Participating in regular exercise has numerous health benefits including reduced stress, improved mood, and better sleep.

What are the Risks Associated with this Study?

Engaging in a supervised exercise program has minimal physical health risks. Participants will be briefed with the exercise protocol and facility prior to initiating the exercise program and provided the opportunity to ask personal trainers questions throughout the study. Participants will be provided with information regarding the proper form and technique of all exercises to minimize the risk of injury.

I'm Interested, Who Should I Contact?

If you would like to participate in this study please contact Ben (ubcexercisestudy@gmail.com).

Exercise Study E-mail Ben ubcexercisestudy@gmail.com	Exercise Study E-mail Ben ubcexercisestudy@gmail.com	Exercise Study E-mail Ben ubcexercisestudy@gmail.com	Exercise Study E-mail Ben ubcexercisestudy@gmail.com	Exercise Study E-mail Ben ubcexercisestudy@gmail.com	Exercise Study E-mail Ben ubcexercisestudy@gmail.com	Exercise Study E-mail Ben ubcexercisestudy@gmail.com	Exercise Study E-mail Ben ubcexercisestudy@gmail.com	Exercise Study E-mail Ben ubcexercisestudy@gmail.com	Exercise Study E-mail Ben ubcexercisestudy@gmail.com	Exercise Study E-mail Ben ubcexercisestudy@gmail.com
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C.2 Letter of Information



Psychology of Exercise, Health, and Physical Activity Lab-
Room 122
School of Kinesiology
The University of British Columbia
6081 University Blvd, Vancouver, BC, V6T 1Z1

Letter of Information Understanding Exercise Experiences

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

Co-Investigator:
Ben Sylvester, MA
School of Kinesiology
University of British Columbia

Purpose: The purpose of this study is to examine university students' exercise experiences in exercise programs.

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

1. 18-40 years of age
2. Able to read and converse in English
3. Enrolled as a student at UBC
4. Are physically inactive (i.e., engage in moderate-vigorous intensity exercise no more than two days per week)
5. Have no health risks that would interfere with exercise (as identified by responses to the physical activity readiness questionnaire)

Involvement: Should you choose to participate, you will be asked to attend a 30 minute baseline appointment to become familiarized with the BodyWorks Fitness Centre (UBC campus), study procedures, and complete informed consent and baseline measures. The study consists of engaging in a 1-hour exercise session, 3 times per week, for a 6-week period in the BodyWorks Fitness Centre. Questionnaires asking people a range of questions about their exercise experiences will be administered at 3 time points and take approximately 10 minutes to complete.

Benefits: Participants will receive FREE access to the BodyWorks Fitness Centre, a FREE six-week exercise program, and FREE access to a personal trainer.

Confidentiality: Any information that you provide will be made anonymous. This means that no information that can identify you will be made available within any reports that may result from this research. Completed measures (i.e., questionnaires) will be imputed into electronic files. All computer 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). Paper copies of the questionnaires will be kept in a secure storage facility in War Memorial Gym (Room 310) for five years and then shredded. You should note that participants will be assigned an identification number which will need to be presented to gain entry to the facility for each exercise session. Furthermore, other participants (and members of the BodyWorks Fitness Centre) may see you in the facility and thus, your participation in this study cannot be 100% confidential.

Participation: Participation in this study is voluntary and individuals may decline to answer any question(s) that they choose. Engaging in a supervised exercise program has minimal physical health risks. Participants will be briefed with the exercise protocol and facility prior to initiating the exercise program and provided the opportunity to ask personal trainers questions throughout the study. Furthermore, participants will be provided with information regarding the proper form and technique to minimize the risk of injury. You may choose to decline or withdraw your participation at any time throughout the course of the study.

We want to hear about your experiences. There are no right or wrong answers. There are no good or bad answers and this is NOT a test. Your answers are very important to us so please make sure you answer honestly.

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 Ben Sylvester, or Dr. Mark Beauchamp. Alternatively, if you have any concerns about your rights or treatment as a research participant please contact the 'Research Subject Information Line' in the UBC Office of Research Services at (604) 822-8598 or if long distance email to RSIL@ors.ubc.ca.

Thank you for your help,

Mark Beauchamp, PhD

Ben Sylvester, MA

C.3 UBC BodyWorks Fitness Centre Rules and Regulations

UBC BodyWorks Fitness Centre Rules and Regulations

Welcome...

BODYWORKS Health and Fitness Center have developed the following Rules and Regulations to insure a safer and more enjoyable environment in which to exercise. So, please be thoughtful and observe the Rules and Regulations as you, and all members, agreed to follow.

BODYWORKS may modify the Rules and Regulations without notice at any time. BODYWORKS will post the changes. It is your responsibility to know and follow the most current Rules and Regulations, Any individual who utilize BODYWORKS in any manner shall be bound by these Rules and Regulations as the same may be revised, supplemented, or amended from time to time, regardless of whether he/she has signed a copy of these Rules and Regulations.

- A. Each member shall **register** his or her complete name, address, home and business telephone numbers with the Center. BODYWORKS must be notified of any **change in address** and/or telephone number, account number, within 14 days of that change. Parents are responsible for minors.
- B. Only members 16 years of age and older are allowed in BODYWORKS Facilities unattended. An **Adult Guardian** must accompany 14 and 15 year olds, at all times. Any Minor who does not adhere to BODYWORKS Rules and Regulations will have their membership terminated.
- C. All members, and their guests, shall give written notice to BODYWORKS of any **medical disorder**, disease, or other malady, which may require special precautions in case of emergency. Medical personnel, medical treatment, or paramedic personnel shall not be provided by BODYWORKS.
- D. Appropriate social **conduct** is expected of all members and guests while in, on or about BODYWORKS Facilities. Inappropriate conduct, which will not be tolerated, includes without limitation, using loud, abusive, offensive, insulting, demeaning language, profanity, any conduct or strong offensive odor that harasses or is bothersome to members or employees of BODYWORKS. All equipment/facilities shall be used properly. If not familiar with use of a piece of equipment, please ask an employee of BODYWORKS.
- E. BODYWORKS requires all individuals to wear clothing and footwear appropriate to **dress code** while using facilities. BODYWORKS requires the wearing of shirts, shorts, and closed toed tennis shoes. No street shoes or black-soled shoes are allowed at any time. No Jeans. General guidelines include gym shorts, T-shirts, jogging, aerobic and sweat outfits for exercising or aerobics. Swimming suits only are allowed in the pool area, but leotards, danskins, or cutoffs are not. Protective eye gear is required in racquetball courts and tanning beds. You must have a towel with you, and use towel during your workouts to wipe your sweat.

- F. If any member or guest violates any of the Rules and Regulations, BODYWORKS reserves the right to ask that person to stop or leave. A **violation** may also cause BODYWORKS to terminate the violator's membership according to the terms of its Membership Agreement.
- G. Each Member must show his/her **membership card** when entering BODYWORKS. Temporary or short-term membership cards must be shown with a picture I.D. card. A day pass must be purchased if the membership card is not available. There is a \$10 charge to replace a lost membership card. Memberships and membership cards are non-transferable, and may be used only by the person to whom they are issued. Any abuse of membership card may result in termination of membership.
- H. Each Member must **check in** at the front desk and present your membership card. BODYWORKS may charge you a day pass fee if your membership due payment is not current.
- I. All **guests** must complete and sign a Guest Card and BODYWORKS Waiver and Release of Liability Form. Each guest will be charged the day pass fee. BODYWORKS may restrict the number of guest and time you may bring guests, and all guests are subject to BODYWORKS Rules and Regulations. Members may not invite a terminated or delinquent Member to use the facilities. All Guests must be instructed and given an orientation by a Member Representative before using the facilities. Any Guest who is under 18 years of age must be accompanied by an Adult Guardian at all times.
- J. **Lockers** are for day use only, on a first-come, first-serve basis. You must provide your own lock. Locks left overnight will be removed and the contents of the locker will be discarded.
- K. Members should not bring **valuables**, including large sums of money, on to Center premises. Each Individual understands that BODYWORKS will not be liable for the loss or theft of, or damage to, the personal property of Members or guests.
- L. Members shall take proper **care of equipment and facilities**. Each Member or guest shall be liable for any property damage and/or personal injury caused. Payment is obligated upon presentation of statement. Please adhere to specific Rules posted requiring the use of specific equipment or facility.

Weights, Cardio, and Fitness Areas

- a. Replace weights on the proper rack after you use them.
- b. Do not drop weights. Weights are to remain in the matted area.
- c. Do not slam weight stacks. Put handles and benches in their proper places.
- d. Wipe off benches or machines after use. No chalk allowed.
- e. Be considerate of all exercisers, do not monopolize equipment/facility area.
- f. Time limit of 30 minutes on cardiovascular equipment if someone is waiting.
- g. Use sign-up list or schedule as requested.


- h. If there is a conflict over use, let BODYWORKS management resolve issue.
- i. No gym bags allowed in workout areas, please leave in locker room.


M. **Food and beverages** must be consumed in the Juice Bar area. Only water in spill proof containers will be allowed in work out areas.

N. **BODYWORKS does not permit smoking, alcohol, illegal drugs, weapons, or steroid use** in, on, or about the premises. No individual may use BODYWORKS Facilities while under the influence of drugs or alcohol. Cameras and picture taking are not allowed without BODYWORKS' and individual's authorization.

O. No Member or guest may **coach or train** other Members or Guests (Parent may assist his minor child) and may not engage in any type of business or enterprise while at BODYWORKS Facilities. BODYWORKS may permit independent contractors to offer products or services to Members with written authorization. BODYWORKS does not make any representations or warranties concerning, or guarantee the training, quality, or reliability of their products or services, including whether or not these independent contractors will remain in business for any period of time. See front desk to sign up and pay for independent contracting services, personal training, massage, special classes.

C.4 BodyWorks Waiver

a place of mind
THE UNIVERSITY OF BRITISH COLUMBIA



School of Kinesiology

UBC BODYWORKS

RELEASE OF LIABILITY, WAIVER OF CLAIMS, ASSUMPTION OF RISKS

**BY SIGNING THIS DOCUMENT YOU WILL WAIVE CERTAIN LEGAL RIGHTS,
INCLUDING THE RIGHT TO SUE IN THE EVENT OF INJURY**

PLEASE READ CAREFULLY

INITIAL

TO: THE UNIVERSITY OF BRITISH COLUMBIA, including its School of Kinesiology

ASSUMPTION OF RISKS

I am aware that using the UBC BODYWORKS FITNESS CENTRE and/or participating in any UBC BODYWORKS programs and/or services involves many risks, dangers and hazards including, but not limited to: overexertion or lack of conditioning or fitness; defective, dangerous or unsafe equipment; use, misuse or non-use of any equipment; dangerous or unsafe conditions in any facilities; impact or entanglement with obstructions, apparatus, equipment, floor surface or walls; contact or collision with other participants; negligence of other participants; and **NEGLIGENCE ON THE PART OF THE UNIVERSITY OF BRITISH COLUMBIA OR ITS EMPLOYEES INCLUDING THE FAILURE ON THE PART OF THE UNIVERSITY OF BRITISH COLUMBIA OR ITS EMPLOYEES TO SAFEGUARD OR PROTECT ME FROM THE RISKS, DANGERS AND HAZARDS REFERRED TO ABOVE.** I am also aware that the risks, dangers and hazards referred to above exist within a variety of facilities on or off campus, including but not limited to: roadways, parking areas, shower rooms, hallways, stairs, elevators, change rooms, fields, campus buildings and other facilities.

I AM AWARE OF THE RISKS, DANGERS AND HAZARDS ASSOCIATED WITH MY USE OF THE UBC BODYWORKS FITNESS CENTRE AND MY PARTICIPATION IN ANY PROGRAMS AND/OR SERVICES OFFERED BY UBC BODYWORKS AND I FREELY ACCEPT AND FULLY ASSUME ALL SUCH RISKS, DANGERS AND HAZARDS AND THE POSSIBILITY OF PERSONAL INJURY, DEATH, PROPERTY DAMAGE AND LOSS RESULTING THEREFROM. I am also aware that the University of British Columbia does not carry accident or medical or dental insurance on my behalf.

RELEASE OF LIABILITY, WAIVER OF CLAIMS

In consideration of the University of British Columbia allowing me to use the UBC BodyWorks Fitness Centre and/or to participate in any UBC BodyWorks Fitness Centre programs and/or services and permitting my use of its equipment, structures and other facilities, and for good and valuable consideration, the receipt and sufficiency of which is acknowledged, I hereby agree as follows:

1. **TO WAIVE ANY AND ALL CLAIMS** that I have or may in the future have against **THE UNIVERSITY OF BRITISH COLUMBIA**, its Board of Governors, directors, officers, employees, agents and representatives, (all of whom are hereinafter collectively referred to as "THE RELEASEES") and **TO RELEASE THE RELEASEES** from any and all liability for any loss, damage, expense or injury including death that I may suffer, or that my next of kin may suffer, resulting from my use of the UBC BodyWorks Fitness Centre and/or my participation in any UBC BodyWorks programs and/or services **DUE TO ANY CAUSE WHATSOEVER, INCLUDING NEGLIGENCE, BREACH OF CONTRACT, OR BREACH OF ANY STATUTORY OR OTHER DUTY OF CARE, INCLUDING ANY DUTY OF CARE OWED UNDER THE OCCUPIERS LIABILITY ACT, R.S.B.C. 1996, c. 337, ON THE PART OF THE RELEASEES, AND ALSO INCLUDING THE FAILURE ON THE PART OF THE RELEASEES TO SAFEGUARD OR PROTECT ME FROM THE RISKS, DANGERS AND HAZARDS REFERRED TO ABOVE;**

- This Agreement and any rights, duties and obligations as between the parties to this Agreement shall be governed by and interpreted solely in accordance with the laws of the Province of British Columbia and no other jurisdiction; and
- Any litigation involving the parties to this Agreement shall be brought solely within the Province of British Columbia and shall be within the exclusive jurisdiction of the Courts of the Province of British Columbia.

In entering into this Agreement I am not relying upon any oral or written representations or statements made by the Releasees with respect to the safety of the UBC BodyWorks Fitness Centre and/or any UBC BodyWorks Fitness Centre programs and/or services other than what is set forth in this Agreement.

I HAVE READ AND UNDERSTAND THIS AGREEMENT AND I AM AWARE THAT BY SIGNING THIS AGREEMENT I AM WAIVING CERTAIN LEGAL RIGHTS WHICH I OR MY HEIRS, NEXT OF KIN, EXECUTORS, ADMINISTRATORS AND REPRESENTATIVES MAY HAVE AGAINST THE RELEASEES.

Signed this _____ day of _____, 20____

Signature of Participant

Please print name clearly

C.5 Consent form and Questionnaire



Psychology of Exercise, Health, and Physical Activity Lab
School of Kinesiology
The University of British Columbia
6081 University Blvd, Vancouver, BC, V6T 1Z1

Consent Form

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

Co-Investigator:
Ben Sylvester, MA
School of Kinesiology
University of British Columbia

Project Title: Understanding Exercise Experiences: An Experimental Study

Purpose: The purpose of this study is to examine university students' exercise experiences in exercise programs.

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

1. 18-40 years of age or older
2. Able to read and converse in English
3. Enrolled as a student at UBC
4. Are physically inactive (i.e., engage in moderate-vigorous intensity exercise no more than two days per week)
5. Have no health risks that would interfere with exercise (as identified by responses to the physical activity readiness questionnaire).

Involvement: The study consists of engaging in a 1-hour exercise session, 3-times per week, for a 6-week period in the BodyWorks Fitness Centre (UBC campus). Questionnaires asking a range of questions about your exercise experiences will be administered at 3 time points (i.e., at baseline, halfway through, and again at the end of the study). They take approximately 10 minutes to complete.

Benefits: Participants will receive FREE access to the BodyWorks Fitness Centre, a FREE exercise program, and FREE access to a personal trainer.

Confidentiality: Any information that you provide will be made anonymous. This means that no information that can identify you will be made available within any reports that may result from this research. Completed measures (i.e., questionnaires) will be imputed into electronic files. All computer 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). Paper copies of the questionnaires will be kept in a secure storage facility in War Memorial Gym (Room 310) for five years and then shredded. You should note that participants will be assigned an identification number which will need to be presented to gain entry to the facility for each exercise session. Furthermore, other participants (and members of the BodyWorks Fitness Centre) may see you in the facility and thus, your participation in this study cannot be 100% confidential.

Participation: Participation in this study is voluntary and individuals may decline to answer any question(s) that they choose. Engaging in any supervised exercise program has some physical health risks. Participants will be briefed with the exercise protocol and facility prior to initiating the exercise program and provided the opportunity to ask personal trainers questions throughout the study. Furthermore, participants will be provided with information regarding the proper form and technique to minimize the risk of injury. You may choose to decline or withdraw your participation at any time throughout the course of the study.

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 Benjamin Sylvester, or Dr. Mark Beauchamp. Alternatively, if you have any concerns about your rights or treatment as a research participant please contact the 'Research Subject Information Line' in the UBC Office of Research Services at (604) 822-8598 or if long distance email to RSIL@ors.ubc.ca.

Consent: By signing below means that the study has been explained to me, I understand what is involved, and that I agree to take part in this study. It also means that:

I understand that my participation in this study is entirely my choice and that I may pull out from the study at any time without having to give any reason for doing so, and without experiencing any negative consequences. I understand that if I do not wish to answer any question, I may refuse to answer and move on to the next question. If I withdraw from the study, the information I have supplied will be destroyed.

I am willing to take part in an exercise program over the next 6-weeks. I understand that there are 3 exercise sessions scheduled each week and each exercise session will last approximately 1-hour in length. I have received a copy of this consent form for my own records.

By signing this form you have consented to participate in this study.

SIGNED.....

NAME IN BLOCK LETTERS.....

DATE.....