An Exploration into Physical Activity and Subjective Wellbeing Homeostasis

by

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CANDIDATE DECLARATION

I certify that the thesis entitled: **An Exploration into Physical Activity and Subjective Wellbeing Homeostasis**

submitted for the degree of Doctor of Psychology (Clinical) is the result of my own work and that where reference is made to the work of others, due acknowledgment is given.

I also certify that any material in the thesis which has been accepted for a degree or diploma by any university or institution is identified in the text.

'I certify that I am the student named below and that the information provided in the form is correct'

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EXECUTIVE SUMMARY

Physical Activity (PA) is a term used to describe all forms of large muscle movement including sports, dance, games, work, lifestyle activities, and exercise for fitness, as well as many others (Corbin, Welk, Corbin, & Welk, 2008). It is well known that engaging in PA can produce substantial physical benefits such as lowering cholesterol, reducing weight, lowering blood pressure, and increasing strength (Cox, 2002). In addition, there is a growing evidence of psychological advantages to engaging in PA. However, as noted by Biddle and Mutrie (2007) the majority of this research has utilised separate measures of mood, affect, and depression. Very limited research has used a reliable and valid measurement of subjective wellbeing (SWB).

There has also been no theoretical model that adequately accounts for the relationship between PA and SWB. However, SWB homeostasis is a theoretical model that explains the stability of SWB by proposing a number of mechanisms that attempt to absorb the impact of destabilising life events and therefore maintain SWB within a very narrow range of operation (Cummins, 1998). In search of possible psychological mechanisms to explain this phenomenon, attention has been given to the role of protective buffers (Cummins, 2009). It is proposed in this thesis that PA will operate as a protective buffer, acting as a resource to protect and maintain SWB.

This thesis involves four studies investigating the relationship between PA and SWB. Study 1 and Study 2 investigate the cross-sectional relationship between PA with SWB and depression. The results suggest that their relationship is complex. Some results were consistent with PA operating as a protective buffer by showing an increase in SWB with PA, a reduction in the proportion of people

experiencing homeostatic defeat as the frequency of PA increased, and an increase in the proportion of participants experiencing homeostatic defeat with the time since PA. However, subsequent analyses showed that when personality and household income were co-varied the relationship between PA and SWB became non-significant. This finding is not consistent with PA operating as a protective buffer.

A key element of homeostasis theory relates to the operation of SWB during challenging conditions. Consequently, Study 3 explores the PA/SWB relationship in terms of challenging life events. A sample of PA participants was used to determine whether PA moderated the effect of challenging life events upon SWB. However, the results did not show a significant moderating effect suggesting that PA did not protect SWB from adverse life events. While this result was unexpected, there were a number of measurement limitations, which may have reduced the likelihood of a significant moderating effect.

In contrast to the previous three studies, Study 4 investigates the longitudinal relationships between SWB and both time since last PA and frequency of PA. In this study PA participants report SWB and PA on four occasions over three months. Latent Growth Curve Modelling showed that changes in PA are not related to change in SWB. These results are not consistent with PA operating as a protection to SWB. However, issues related to participant attrition and the conceptualisation and measurement of PA may have reduced the likelihood of a longitudinal relationship between PA and SWB.

In conclusion, although there was some cross-sectional evidence to support the protective buffer hypothesis from Study 1 and Study 2, it is notable that PA did not moderate the relationship between challenging life events and SWB, nor

was there a longitudinal relationship between PA and SWB. Overall, these findings are not consistent with PA working as a buffer to protect SWB, which is in contrast with the majority of other research.

CHAPTER ONE: SUBJECTIVE WELLBEING

1.1 Introduction

During the 1960's, the concept of *quality of life* emerged as an important measurement of the wellbeing of individuals and communities. The origins of this concept arose from research related social indicators, when it was recognised that subjective indicators were important for measuring social change (Dolan & White, 2007; Land, 2000). Prior to the 1960s, social indicator research had been focussed on objective measures of life quality such as the economic indicators. It was thought that if such aspects of people's life were satisfied this would directly influence their quality of life, and to some degree this is true. For instance, compared to a developing nation, an industrial nation is generally better able to satisfy its population's basic needs (in areas such as healthcare, education and welfare); and therefore maintain a higher objective level of quality of life. However, when economic comparisons are made between industrialised nations, it becomes clear that such objective indicators (e.g., economic) are relatively poor predictors of subjective quality of life. It is now generally agreed, that in order to have a balanced view of overall life quality, objective data needs to be supplemented with information (provided by self-report descriptions of inner states) related to how people feel about their lives (Diener & Suh, 1997).

Despite consensus that both objective and subjective information is needed to assess quality of life, there have been a multitude of disparate interpretations of life satisfaction and SWB (Cummins, 1995; Jarden, 2010). Specifically, there has been confusion within the literature as to how life satisfaction should be defined (Diener, 2006), and measured (Diener, Suh, Lucas, & Smith, 1999). Thus, the forthcoming review will provide clear definitions of

relevant constructs: subjective wellbeing, positive and negative affect, and life satisfaction.

Subjective wellbeing (SWB) is therefore defined as a global term to describe how people feel about their lives, and is based on both an emotional reaction and cognitive judgment. SWB thus refers to the various types of evaluations, both positive and negative, that people make in their lives (Diener, 2006) and includes two distinct components: cognitive evaluations and affective reactions (Cummins & Nistico, 2002; Jarden, 2010). An important defining factor of SWB, as opposed to ill being, is that it is primarily a positive construct, meaning that it does not focus on undesirable states such as sadness (Cummins, 2009; Cummins, Lau & Davern, 2008). This suggests that a person is said to have high SWB if they evaluate their life positively and experience frequent joy, and only occasionally experiences unpleasant emotions (e.g., sadness or anger). Accordingly, a person is said to have low SWB if she or he is dissatisfied with life, and therefore experiences little joy and affection (Diener, Suh, & Oishi, 1997).

The affective or emotional component of SWB is conceptualised as a balance between positive and negative affect (Diener et al., 1997). Positive affect refers to pleasant moods or emotion, such as joy or happiness. Positive emotions are considered an important component of SWB because they reflect a person's response to events signifying that life is proceeding favourably. In comparison, negative affect includes moods or emotions that are unpleasant, such as sadness, anger, or loneliness. These emotions are important as they indicate when life is proceeding poorly (Diener, 2006).

The affective component of SWB, initially proposed by Watson and Tellegen (1985), hypothesized that individuals are inherently endowed with a tendency toward experiencing either positive or negative emotions that, in turn, influence feelings of satisfaction. The suggestion that levels of satisfaction are influenced by emotion was demonstrated in a study by Fogarty, Machin, Albion, Sutherland, Lalor, and Revitt, (1999) who found that positive or negative emotions could predict levels of job satisfaction (strain, job-related stress and coping) that were perceived and experienced by the participants. It was found that individuals who reported higher ratings of positive affect were less likely to report experiencing job related stressors, and were more likely to use cognitive coping strategies, resulting in greater levels of job satisfaction when compared to individuals experiencing negative emotions. A subsequent investigation by Davern, Cummins, and Stokes (2007) explored the relative contribution of affect and cognition to SWB, and confirmed the importance of affect in determining levels of SWB. Their results indicated that a remarkable 64% of the variance in SWB could be explained by only six core affects.

The second core component of SWB relates to a broad cognitive judgement an individual has about their lives (Heaven, 1989). The cognitive judgement is based upon an evaluation of current circumstances with internally imposed standards (Diener, Larson, Levine & Emmons, 1985) and relates to both life satisfaction and domain satisfaction. Life satisfaction represents the broad reflective appraisal of life taken as a whole, while domain satisfaction relates to judgements of specific areas (e.g., related to work, leisure, and health). Both life and domain satisfaction have shown to be important components in the assessment of SWB (Cummins, 1996).

1.2 Subjective Wellbeing Stability

An interesting attribute of SWB is its stability. Repeated analysis of both cross-sectional and longitudinal data consistently shows that SWB is maintained within a very narrow range. Research conducted by Cummins (1995), for example, first demonstrated the considerable stability, and therefore predictability of SWB population mean scores. In this initial study, Cummins (1995) conducted a meta-analysis combining data from population surveys derived from various Western countries, including England, the United States (US), Australia, Norway, and Canada. Each survey had its own particular scale of measurement, conducted at a different point in time (1970's - 1990's) and by diverse research groups. For compatibility, scores on each study were converted to a common statistic: Percentage of Scale Maximum (%SM), which converts the results of each study onto a 0-100 scale. The transformed data from the 16 population surveys found a mean of 75 percent of the scale maximum score (75%SM), and a standard deviation of just 2.5%SM. By using two standard deviations each side of the mean (representing a normative range), SWB across western populations can be predicted to lie within the narrow range of 70–80%SM (Cummins, 1995). Although the strength of these results must be considered in context of limitations of meta-analytic techniques (i.e., in combining studies that employ a variety of methodologies, there is always the influence of error variance) these results nevertheless indicate a strong approximation of the stability of SWB across populations.

Building upon this initial study Cummins later developed the Australian Unity Wellbeing Index survey to assess the wellbeing of the Australian population and has so far over a nine-year period (2001-2009) conducted 21 Australian Unity

Wellbeing surveys. To measure SWB, Cummins utilised both a global and domain measurement of life satisfaction. The global measure of life satisfaction is measured by a single question "How satisfied are you with your life as a whole?" In addition, the Personal Wellbeing Index (PWI: The International Wellbeing Group, 2006) was employed as a second measure of SWB. This index was designed to reflect the first level deconstruction of satisfaction with 'life as a whole' across 8 specific life domains (Cummins, 1996). The scale asked participants "How satisfied" they were with life domains related to standard of living, health, life achievements, personal relationships, safety, security, community connectedness, and spirituality/religion using an 11-point Likert scale. The PWI creates a composite variable, calculated by averaging life satisfaction across the 8 domains. The reliability coefficient of the PWI was reported as .82 and Cronbach's alpha of between .70 and .85 (The International Wellbeing Group, 2006).

Over the nine-year period of the Australian Unity Wellbeing surveys, the cumulative results of the PWI reveal a mean of 74.93 points and a standard deviation of just 0.75, giving a normative range of 73.43-76.43 points. This indicates that with 95% certainty a random sample of people in Australia can be predicted to lie within a 3.0 percentage point range. Cummins (2009) indicates there is no precedent within the literature for the extraordinary stability found in these results.

The two previously mentioned studies indicate that SWB reflected two distinct characteristics. First, these results indicate that SWB is highly stable. Second, that SWB is restricted to the positive half of the dissatisfied-satisfied continuum (Cummins, 2009). This suggests that SWB is not free to vary over its

theoretical range (0-100), but is rather maintained within a narrow range of positive values.

1.3 Subjective Wellbeing Homeostasis

Heady and Wearing (1989,1992) were the first researchers to develop a theory that would account for both the high average levels, and the moderate degree of individual stability of SWB found in previous research (see Abbey & Andrews, 1985; Headey, Glowacki, Holmstrom, & Wearing, 1985). To test SWB stability the authors implemented a longitudinal panel study in which 942 participants were followed up on five occasions. The longitudinal nature of this study enabled Headey and Wearing (1989, 1992) to observe that participants appeared to have a moderately stable, equilibrium level of SWB. Results also suggested that if a challenging life event was encountered SWB levels would reduce temporarily, but over time it appeared that SWB would adjust, and return to the previous level of SWB. The authors interpreted these results as supporting their hypothesis that SWB is stable around an individual set point that is mediated by personality characteristics. Termed the 'Dynamic Equilibrium model' this model considered the stability of SWB to be managed by a genetically influenced psychological system, which at its core was related to stable personality characteristics. The authors proposed that the main aim of this system was the protection and maintenance of self-esteem.

The search for a more comprehensive theory to explain SWB stability led to the development of the homeostatic theory of SWB by Cummins (1995). This theory, which built upon Headey and Wearing's (1992) Dynamic Equilibrium Model, extended the idea that SWB is maintained within a narrow range. In order

to explain this narrow, positive range of values, Cummins proposed a theory of Subjective Wellbeing Homeostasis (Cummins, 1998; Cummins & Nistico, 2002; Cummins et al., 2002). Homoeostasis theory proposes that SWB is managed by a system of psychological devices that have evolved for the purpose of maintaining levels of SWB within a controlled range of functioning (Cummins, Eckersley, Pallant, Van Vugt & Misajon, 2002). For each individual there is a 'set point' range within which SWB normally fluctuates (Cummins, 2008). An analogy for this process is that SWB homeostasis acts in a similar way to the maintenance of blood pressure or temperature. As SWB approaches the lower or upper thresholds of the individual's particular set-point range, the homeostatic system resists further change and then works to bring SWB levels back to within their normal range (Cummins, 2009).

Cummins (2008) indicates that this analogy makes clear predictions as to how this system should operate. These include:

i. The basic operation of the homeostatic system works by resisting change to SWB at the upper and lower thresholds. As the threshold level is approached the homeostatic system works harder to maintain a normal level of SWB. Once the lower threshold level is passed, homeostasis has failed and is therefore no longer in control of the regulation of SWB. Cummins refers to this failure as homeostatic defeat, which is equivalent to depression.

ii. Once homeostatic defeat has occurred, the homeostatic system will try to regain control to return SWB levels to a stable approximation of its set point.

iii. The function of this homeostatic mechanism is to manage SWB within a narrow range of values or 'set point range'. Each individual will differ in the range of homeostatic control, as some individuals will have more strictly controlled range than others. Figure 1 (Cummins, 2010) illustrates the characteristics of SWB homeostasis.

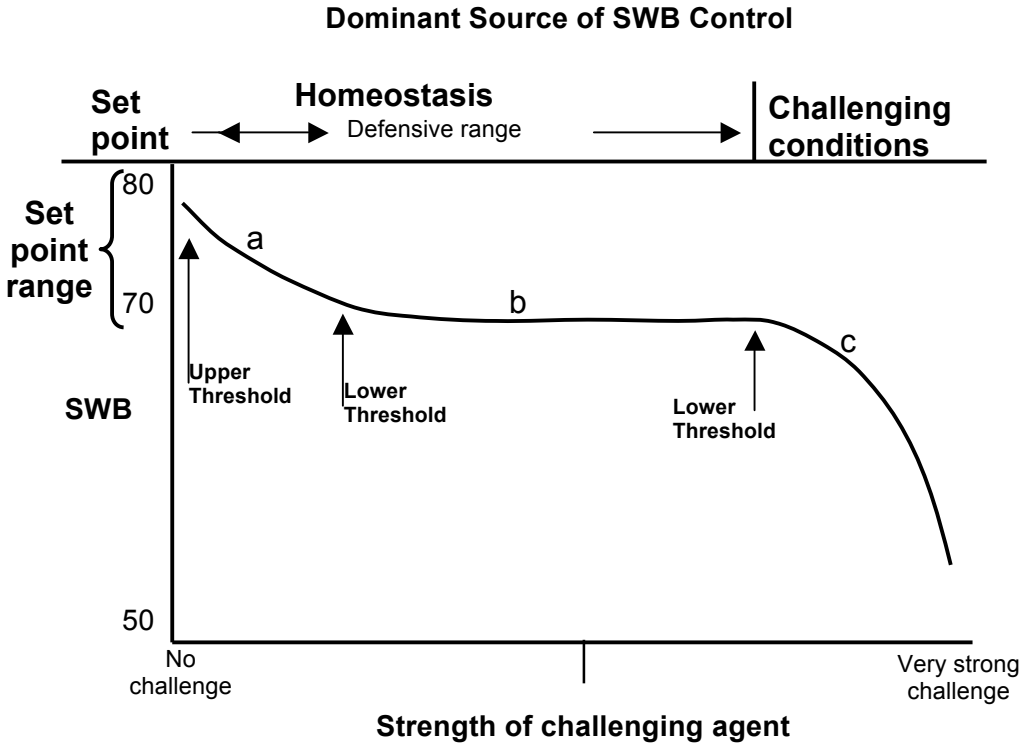

Figure 1. Changing levels of SWB as homeostasis is challenged (Cummins, 2010, p.5)

The diagram above comprises several parts:

i. The vertical axis indicates the range of SWB between 0-100 points. This vertical axis also includes an example of a set point range of 70-80 points.

ii. The lower horizontal axis depicts the strength of a negative challenge to SWB. For example this may involve social isolation or poverty.

iii. The upper horizontal axis depicts the dominant source of control. The source of control will depend upon the strength of the challenging agent.

iv. The line indicated by ‘a’ ‘b’ and ‘c’ represents the changes in SWB due to the increase in strength of the challenging agent. The upper (80 point), and lower (70 point) thresholds of the set point range are indicated by vertical arrows.

v. The important limitation of this figure in explaining SWB homeostasis is that it assumes each person will have the same set point range of between 70 and 80 points. In reality, individual differences will mean that set points will vary. Thus, for individuals with a higher set point range the response line will be higher. This is conversely true for an individual with a lower set point range.

From Figure 1 a number of predictions can be made. Firstly, under conditions lacking any substantial challenging agent SWB will average to its set point (in the example given in Figure 1 this will mean a score of 75 points). As the strength of the challenging agent increases, the level of SWB will fluctuate within its set point range. The level of SWB at this stage is what Cummins describes as a probability statement determined by the balance between good and bad momentary experience and the strength of the homeostatic system (Cummins et al., 2008). Thus, if individual experiences are predominantly pleasurable SWB will average within the higher portion of the set point range. However, if an individual experiences a challenging agent such as losing a wallet, or the break-up of a relationship, it is expected that SWB will average in the lower portion of the set point range.

So far the homeostatic model has explained what happens to SWB when there is mild challenging agent. As the challenging agent strengthens the homeostatic system will defend the level of SWB with greater strength. This is

indicated in Figure 1 ‘b’ in which the homeostatic system works to maintain the level of SWB at the threshold value of 70 points. In this way during ‘b’ the level of SWB is insensitive to the changing levels of the challenging agent. That is, although the challenging agent may strengthen, the homeostatic system will also strengthen maintaining SWB at its lower threshold. This model indicates that this phase will continue as long as the homeostatic defences are effective.

However, as the strength of the challenging agent further increases, the homeostatic system is predicted to fail (indicated in Figure 1, as ‘c’). This occurs as the challenging agent becomes too strong for the homeostatic system to manage. This will lead to the dominant source of control transferring from the homeostatic system to the challenging agent resulting in SWB becoming sensitive to the strength of the challenging agent. As the challenging agent increases further this will lead to a significant reduction in the level of SWB. If the challenging agent is chronic and strong the homeostatic system will not be able to adapt and recover SWB back to its set point range. The inability of the homeostatic system to recover is termed by Cummins as ‘homeostatic defeat’ and is synonymous with depression (Cummins et al. 2008).

1.4 SWB and Depression

Studies that have explored SWB and depression have consistently shown a clear inverse relationship between these two variables (Cook, 2003; Cummins, 2010; Davern, 2004; Lewinsohn, Redner & Seely, 1991). There is also substantial evidence that SWB levels are significantly reduced during a current state of depression (Lewinsohn, Hoberman & Rosenbaum, 1998; Lewinsohn et al., 1991), and that SWB will increase as the symptoms of depression diminish

(Hansson, 2002; Lewinsohn et al., 1991). Evidence has also shown that SWB is a significant predictor of depression symptomatology (Abbey & Andrews, 1985; Lewinsohn et al., 1991), and conversely depression has shown to predict low SWB (Barge-Schaapveld, Nicolson, Berkof & de Vries, 1999).

A number of studies have also explored the relationship between SWB and depression using SWB homeostasis theory (for a review of SWB homeostasis refer to section 1.3). For example, Cook (2003) hypothesised a curvilinear relationship between these two variables (see Figure 2 for an illustration).

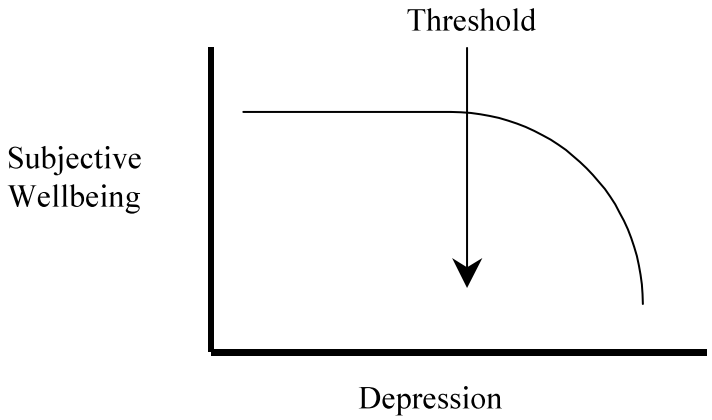

Figure 2. Curvilinear relationship between SWB and depression (Cook, 2003, p. 86)

As depression levels increase, Cook (2003) suggested that SWB levels would remain relatively stable until a threshold level of depression is reached. Once the threshold level of depression was reached SWB levels were predicted to drop sharply. To test this hypothesis Cook (2003) compared the depression subscale of the Depression, Anxiety, and Stress Scale (DASS; Lovibond & Lovibond, 1995) with the Personal Wellbeing Index (PWI: The International Wellbeing Group, 2006). She found that as depression scores increased from low

levels, PWI scores decreased linearly from approximately 81 to 70. As depression scores increased further SWB plateaued at a score of approximately 70. Finally, SWB scores dropped steeply as depression scores increased further.

In a later study, Davern (2004) replicated this analysis and found a similar curvilinear relationship between depression and SWB. Figure 3 represents the findings from Davern (2004) comparing scores from the Depression scale of the Depression, Anxiety, and Stress Scale (DASS; Lovibond & Lovibond, 1995) with the Personal Wellbeing Index (PWI: The International Wellbeing Group, 2006). Figure 3 was taken with permission from Cummins et al. (2008).

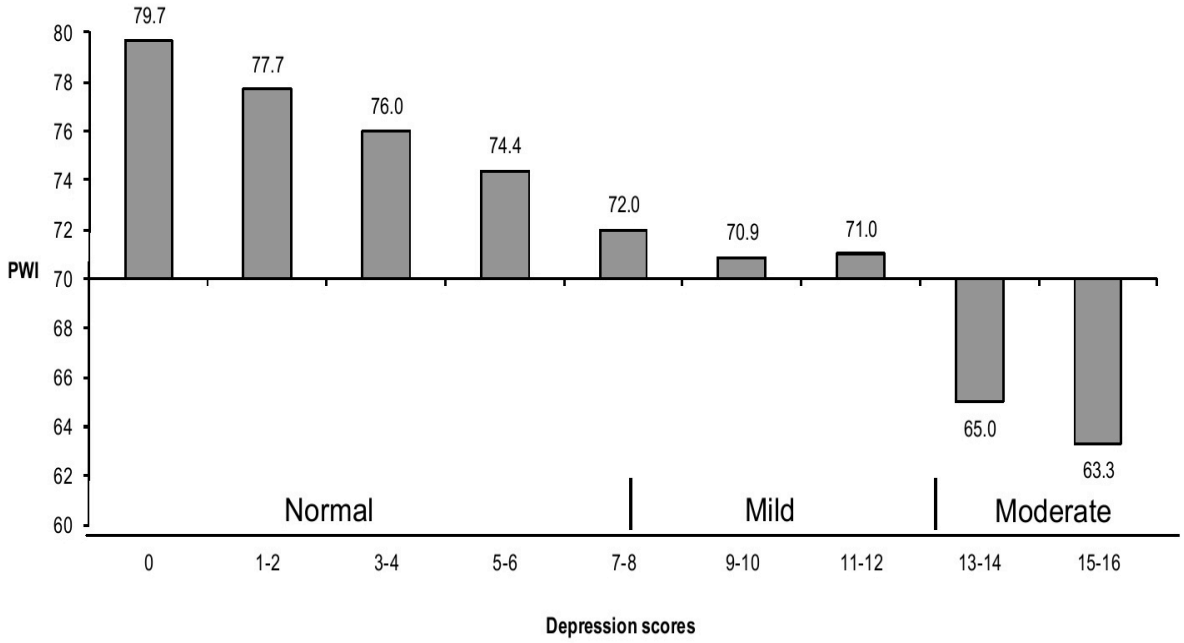

Figure 3. Comparison between SWB and depression scores (Cummins et al., 2008, p. 20)

Explaining the results in Figure 3 in terms of SWB homeostasis (see Figure 1) the following interpretation can be made. It can be seen that as depression increases from zero to eight, SWB decreases in a linear fashion to approximate the lower homeostatic threshold of 70 points (Cummins et al., 2008).

This represents stage (a) of Figure 1. As depression scores rise to between 9 and 12, homeostasis keeps SWB within the approximated homeostatic boundary of 70 points. However, as a depression scores exceed a score of 12 the homeostatic system is overwhelmed as seen in the considerably reduced SWB mean of 65 points (stage c of Figure 1).

Based upon this evidence Cummins, et al. (2008) has given the following guidelines to predict the likelihood of an individual being depressed. First, if an individual PWI score lies above 70 points the person is likely to be functioning normally and is unlikely to be depressed. Second, if the individual PWI score lies below 50 points the person is highly likely to be depressed. This is based upon theory suggesting that SWB is characterised as a stable positive mood state, and the loss of positive mood is indicative of depression (Cummins et al., 2008). A score of 50 or below falls in the negative (dissatisfied) sector and is therefore not positive. Evidence has shown that in general population samples, 4.4% of respondents score in the negative (dissatisfied) sector, which Cummins et al. (2008) suggest represents pathology. Evidence has also shown that a mean SWB score of 50 or below corresponds with Severe-Extremely Severe depression levels (Davern, 2004). Thus, this combined evidence suggests a high likelihood that a SWB score of 50 or below is indicative of depression and therefore the failure of homeostasis.

Third, it is not possible to be precise concerning the meaning of an individual SWB score that lies between 50 and 70 points as a score within this range can represent either a low set point or a depressed high set point. However, as scores move closer to a score of 50 the likelihood that the individual is experiencing depression increases (Cummins et al., 2008).

A later analysis by Cummins (2010) using cumulative data obtained from the Australian Unity Wellbeing surveys showed the same clear inverse relationship between SWB and Depression. As depression increased a 'homeostatic plateau' occurred as SWB held the line against homeostatic defeat. However, unlike the previous studies mentioned, the homeostatic plateau occurred between PWI values of 63.2 and 58.5, rather lower than the plateau of 70 found by both Cook (2003) and Davern (2004). This analysis also provided an explanation of where the boundary between homeostatic maintenance and homeostatic defeat should lie. Cummins (2010) indicates that values which lie one standard deviation from the normative mean are likely to approximate the boundary between homeostatic maintenance and homeostatic defeat. This study had an overall mean of 73.4 and a standard deviation of 14.5. One standard deviation below the mean gives a score of 58.9, which conveniently approximates the lower end of the plateau (58.5) found in this study.

The current study will adopt these approximations and use a PWI score of 59 as the boundary between homeostatic maintenance and defeat. However, as noted previously the boundary between homeostatic maintenance and defeat is imprecise. Scores between 50 and 70 could either represent a low set point or depression.

The boundary between normal and high levels of SWB will be set for this study using two sources of information. First, similar to the previous estimation, one standard deviation above the mean gives a score of 87.9. Second, results from Cummins (2010) show that individuals who endorse no depression symptomatology have a mean level SWB of 82.8. This may also be used as a reasonable approximation of the boundary between normal and high levels of

SWB. The average of these two scores (87.9 and 82.8) is 85.35, rounded down to 85. Thus, a score of 85 will be used to approximate the boundary between normal and high levels of SWB.

In summary low levels (homeostatic defeat) will be defined as a SWB score 59 or below. Normal levels of SWB will be defined as between 60 and 84. High levels of SWB will be defined as a score of 85 and above.

1.5 Homeostatic Mechanisms

In search of possible psychological mechanisms to explain the maintenance of a homeostatic system, considerable attention has been given to the role of cognitive schemata (Headey & Wearing 1989, 1992; Cummins 2009). According to Cummins model of SWB homeostasis, personality is the unconscious first order determinant of SWB. More specifically, the personality constructs of neuroticism and extraversion are thought to determine this 'set point range' (Cummins, Gullone & Lau, 2002), with evidence in the literature indicating that neuroticism and extraversion closely connected to SWB (Cummins et al., 2002; Cummins & Nistico, 2002; Diener, Sandvik, Pavot, & Fujita, 1992).

Evidence also suggests that a set of positive cognitive buffers form the conscious second order determinants of SWB, which are brought into action to sustain SWB within the positive 'set point range'. This was first suggested in a study comparing the happiness of lottery winners and paralysed accident victims (Brickman, Coates, & Janoff-Bulman, 1978). The study found that, after a period of time, lottery winners reported similar life satisfaction levels compared to paralysed accident victims despite the vast difference in external life events of these two groups. A process of adaptation and habituation was suggested to

explain the parity of happiness levels between lottery winners and paraplegics. This suggested that automatic processes of adaptation and habituation act to make us less aware of both adverse and fortunate external life events. Therefore, over time, an individual who encounters a challenging environment such as loss of the ability to walk would adapt their behaviour and their expectations of the environment. Conversely for the lottery winner's habituation should eventually reduce the value of new pleasures made possible by winning.

As well as habituation to ones environment, a number of other studies have proposed that positive cognitive biases are important to maintaining SWB. Evidence has shown that people perceive that they are 'better than others' (Diener, et al., 1999); and that they are 'luckier and happier' than others (Andrews & Withey, 1976), which equates to higher levels of SWB. In this way cognitive buffers provide a strong positive cognitive bias for perceiving the self and the world around the individual (Cummins, 2009; Weinstein, 1989).

1.6 External Protective Buffers

As well as internal psychological mechanisms, the SWB Homeostasis model proposes that external factors are also important to the protection of SWB. One particular factor related to wealth, has consistently shown to positively interact with levels of SWB. Evidence has shown that (at a population level) as level of income rises, levels of SWB also increase (Cummins et al., 2008). However, there are misconceptions relating to what money can do in improving personal wellbeing.

The previously reviewed model of SWB Homeostasis proposes that SWB is managed by a system of psychological devices, which have evolved for the

purpose of maintaining levels of SWB within a controlled range of functioning (Cummins, Eckersley, Pallant, Van Vugt & Misajon, 2002). It has been shown that for each individual there is a 'set point' range within which SWB normally fluctuates (Cummins, 1995). Therefore, money cannot improve SWB over an extended period: no matter how wealthy someone is, their average level of SWB cannot be sustained higher than their 'set point range'. This is illustrated by the study by Brickman, et al. (1978), which compared the happiness of lottery winners and paralysed accident victims. Although the lottery winners initially had significantly higher levels of life satisfaction, they adapted readily to the luxurious living standards, which resulted in a reduction in life satisfaction returning the level of wellbeing to within their 'set point range'.

SWB Homeostasis suggests that the real power of money lies not in making people happier, but in its ability to act as a flexible resource to assist and protect SWB (Cummins et al., 2008). In this way wealth allows individuals to protect themselves from undesirable circumstances. Wealthy people can leave the situation or distract themselves with the financial resources. For example a wealthy individual who has experienced a loss of employment can afford to take time off work or utilise financial resources to go on a holiday. In comparison an impoverished individual does not have the financial resources to counteract negative life events. As a consequence the SWB of poor people is more sensitive to negative life events.

Using cumulative data obtained through the Australian Unity Wellbeing Index (Cummins et al., 2008) Figure 4 depicts the relationship between SWB and gross household income. This evidence is based upon the responses of approximately 30,000 people and depicts the normative range for sample mean

scores. The asterisk above each of the columns indicates where the level of SWB is significantly greater than the previous lower income level. As revealed, SWB rises systematically to an income level of $90,000-$120,000. However, at higher income brackets there is no further systematic increase of SWB.

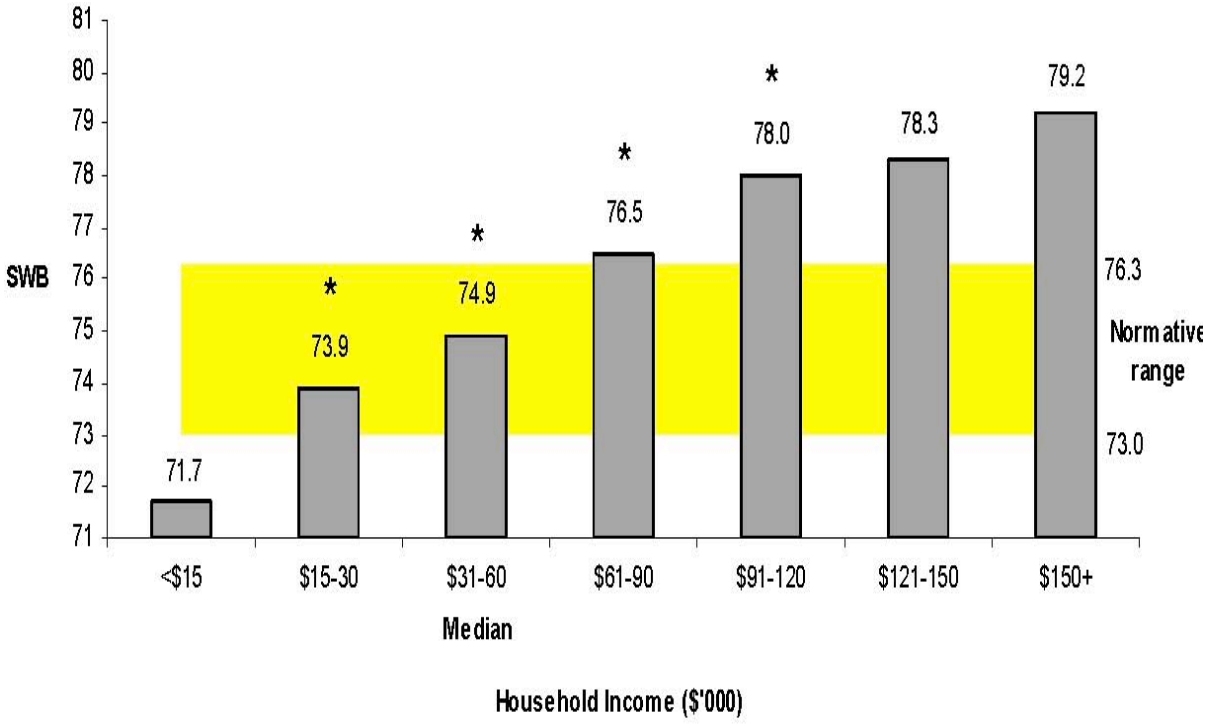

Figure 4. SWB vs. household income (Cummins et al., 2008, p. 11)

The results in Figure 4 further suggest that the power of money party lies in its ability to act as a flexible resource, diminishing the probability of encountering chronic negative life events. It is suggested that this occurs in two stages (Cummins et al., 2008). As income increases, fewer people within the sample experience homeostatic defeat resulting from a negative life event that can be suppressed by financial resources. This explains the significant rise in SWB up to $91,000- $120,000. As income increase further, SWB will increase

marginally, as more individuals within the sample experience an environment that improves their SWB to the upper portion of their 'set point range'. When these results are interpreted in terms of Figure 1, a person who increases financial wealth will experience a shift in the response line from being dominantly at 'c' and 'b' to being dominantly at 'a' and 'b'.

Other evidence also infers that the power of financial resources is in diminishing the probability of experiencing negative life events. An effective way to do this is to compare the way rich and poor people experience happy and sad events. It is expected that if money is a protective factor, rich people will experience more positive life events and fewer negative life events than poor people. To test this hypothesis Cummins and collegues (2008) asked respondents "Has something happened to you recently causing you to feel happier or sadder than normal?" The results in Figure 3 indicate that approximately 50% of respondents remember experiencing either a happy or sad event.

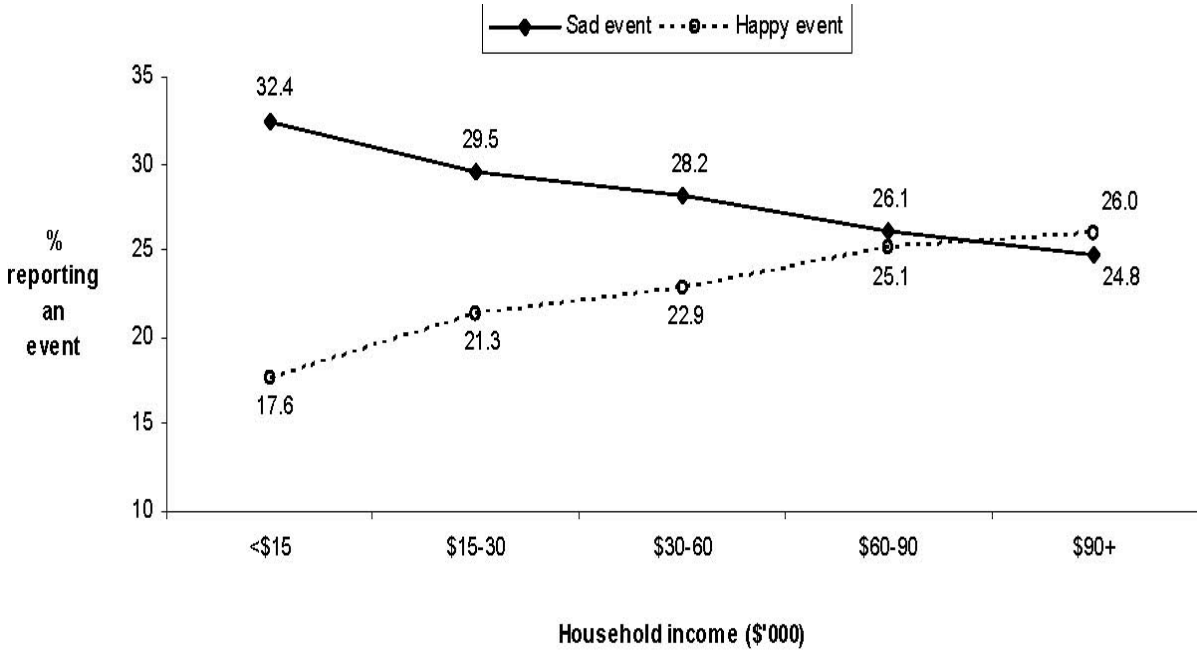

Figure 5. Income vs. happy and sad events (Cummins et al., 2008, p.12)

As predicted the results in Figure 3 indicate that poor people are more likely to experience a life event that made them sadder, and less likely to experience an event that made them feel happier when compared to rich people. This evidence is a further indication of power of money in reducing the influence of negative life events.

In summary, SWB homeostasis suggests that in response to environmental challenges, protective buffers work to protect a person's SWB from homeostatic defeat. In addition, evidence has shown that as level of income increases SWB levels also improve (Cummins et al., 2008). However, as indicated by Cummins (2009) money *cannot* make you happier over an extended period. Instead, the possession of larger amounts of money allow individuals to protect themselves from challenging circumstances, which will therefore make it less likely that SWB will decrease.

CHAPTER TWO: PHYSICAL ACTIVITY AND WELLBEING

2.1 Introduction

Many studies have investigated how people feel during and after Physical Activity (PA). From a variety of experimental designs (large scale population surveys, experimental trials, and meta-analytic reviews) both acute and chronic PA has consistently shown to be associated with an increase in positive affect, and mood and a reduction in depression (Biddle, Fox & Boutcher, 2000). However, the empirical basis for this is far from clear, as there are a number of limitations within the literature.

For example, one limitation relates to the definition and inconsistent use of terms such as *physical activity* and *exercise.* A majority of authors use the terms 'physical activity' or 'exercise' to describe physical body movements resulting in energy expenditure. However, the literature also reveals that PA and exercise have often been used interchangeably (e.g., Carron, Hausenblas, & Estabrooks, 2003; Cox, 2002), neglecting the distinction between these two constructs. Furthermore, other studies have made the distinction between Leisure Time PA (e.g., sport and exercise) and Non- Leisure Time PA (Chen, Stevinson, Ku, Chang & Chu, 2012). Therefore, this review will use the following definitions: PA will refer to all forms of large muscle movements including sports, dance, games, lifestyle activities, and exercise for fitness (Corbin, et al., 2008). Furthermore, this definition will exclude Non-Leisure Time PA such as work. Exercise will refer to a specific form of PA undertaken with a specific objective such as the improvement of fitness, health, or physical performance (Carron, Hausenblas, & Estabrooks, 2003).

Within this research area there is also the tendency to think of PA in a generic context with little attention paid to important considerations such as the type, intensity, frequency and duration. This has led to important issues such as PA 'dosage' not considered in a systematic and comprehensive manner (Morgan, 1999). In the light of these limitations the next section will review the relationship between PA and four particular wellbeing indices (mood/affect, SWB and depression). Furthermore, the role of PA in managing challenging life events along with the possible mechanisms whereby positive psychological states could be derived through engaging in PA will be discussed.

2.1 Physical Activity, Mood and Affect

2.1.1 Type of Physical Activity. An important issue in this literature is whether improvements in positive psychological states are related to particular types of PA. To address this question Berger and Owen (1988) assessed stress reduction and mood enhancement across four exercise modes including swimming, body conditioning, yoga, and fencing. Mood was assessed before and after each exercise class using the Profile of Mood States (POMS; McNair, Lorr, & Droppleman, 1971) and State Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, & Lushene, 1970). Results indicated that modes of exercise that are more aerobic, non-competitive, more predictable, and repetitive promote a greater degree of mood enhancement. However, in a similarly designed study Berger & Owen, (1992) compared yoga (non-aerobic) and swimming (aerobic) classes among college students, and found that both groups reported similar mood benefits. It was concluded from this study that aerobic exercise is not required to facilitate mood alteration.

More recently, Arent, Landers, and Etnier (2000) undertook a meta-analysis of 32 studies that had examined the influence of a single bout of PA (e.g., walking, running, swimming, cycling, weight training, yoga) on the mood states of older (>65 years) participants. Their results indicated that for older people positive changes in mood states are likely to occur in cardiovascular, resistive training or a combination of both.

In conclusion, the evidence suggests that both aerobic and non-aerobic PA is associated with temporary improvements in positive and decreases in negative mood states.

2.1.2 Intensity of Physical Activity. A number of studies and reviews have investigated the relationship between PA intensity and affect/mood. For example, Steptoe and colleagues (Steptoe & Bolton, 1988; Steptoe & Cox, 1988) conducted two separate studies. In both studies participants cycled on a bicycle ergometer maintaining 50 revolutions per minute against a load of .5 kg (moderate intensity) or 2 kg (high intensity). They found that high intensity exercise led to an increase in tension/anxiety and fatigue, whereas moderate intensity exercise had a positive mood-enhancing effect. Interestingly, in the Steptoe and Bolton study the highly fit participants reported greater mental vigour and exhilaration than the moderately fit subjects following high intensity PA. Similarly, Parfitt, Markland, and Holmes (1994) showed that mood states in exercise are significantly worse at an elevated intensity for less active individuals. This and other evidence (Ekkekakis, 2003), suggest that fitness level appears to interact with exercise intensity in relation to mood outcomes.

Similarly, Ekkekakis and colleagues conducted a series of studies

investigating the links between PA, affect and the intensity of exercise (Ekkekakis, Hall, & Petruzzello, 2004; Ekkekakis, Hall, Van Landuyt, & Petruzzello, 2000). In the first study Ekkekakis and collegues (2000) investigated the effects of short bouts of low to moderate intensity walking on affect. They found a consistent pattern of increased positive affect following a single bout of walking, suggesting that low and moderate intensity leads to improved positive affect. In a later study, Ekkekakis and collegues (2004) used two groups of healthy volunteers each participated in incremental treadmill tests until volitional exhaustion. The authors found that positive affect declined once the ventilatory threshold was surpassed. Ekkekakis and colleagues argued that once exercise intensity exceeds the point of transition between aerobic and anaerobic metabolism there is a significant decline in positive affective states. A meta-analytic review by Reed and Ones (2006) also supports an inverse relationship between PA intensity and positive affect with larger effect sizes found for low intensity PA compared to moderate and high intensity.

In conclusion, this evidence indicates that low and moderate intensity PA shows the most consistent evidence in improving mood and positive affective states. However, evidence also suggests that fitness level is important to determining the influence of PA intensity upon mood.

2.1.3 Magnitude of improvement to mood and affect. To assess the influence of PA upon mood, McDonald and Hodgdon (1991) undertook a meta-analysis of studies that had examined this relationship using the Profile of Mood States (POMS; McNair, Lorr, & Droppleman, 1971). The POMS assesses five negative moods (anger, tension, fatigue, depression, and confusion) and one

positive mood (vigour). Results for the five negative mood states indicated significant reductions varying from a small effect size of .18 for anger to a moderate effect size of .40 for confusion following PA. The results also indicated a moderate increase in magnitude for vigour following a bout of PA.

Similarly, Reed and Buck (2009) conducted a meta-analysis examining the effect of regular aerobic exercise on positive affect. The sample included 9840 participants, incorporated both published and unpublished studies, and employed multiple measures of affect. Overall, from an analysis of 105 separate studies it was concluded that regular PA results in moderate increases in self-reported positive affect (Reed & Buck, 2009). Results obtained from both of these meta-analyses (McDonald & Hodgdon 1991; Reed & Buck, 2009), and a number of other studies (Ekkekakis, et al., 2004; Ekkekakis et al., 2000) indicate that engaging in regular PA will at most, moderately improve mood and positive affective states.

2.1.4 Chronic Physical Activity. Two influential population studies show a clear positive relationship between chronic PA and emotional wellbeing. The first of these (Sports Council & Health Education Authority, 1992) interviewed a sample of 16-74 year olds (N=4136) with a proportion of the interview devoted to emotional wellbeing, including a measurement of mood. This survey found a small but consistent positive trend between chronic PA and emotional wellbeing across all age groups and both sexes. Furthermore, the same relationship was also found for those with poor health, thereby reducing the possibility that this effect was driven by healthy individuals being more likely to engage in PA. Further analyses from four North American surveys, identified a clear association

between chronic PA and positive affect for both men and women (Stephens, 1988). These results indicated above are common. In analysing 20 further reviews spanning several countries, populations (age, workplace, gender), and PA modes (sport, exercise class, walking) Biddle and collegues (2000) indicated support for the proposition that chronic PA is associated with a moderate enhancement of affect and mood.

The advantage of population surveys mentioned above is that they usually have large samples, are representative of the population, and hence allow good generalisability of findings (Biddle et al., 2000). However, the nature of population based research means that it can only be concluded that participation in PA is *associated* with positive psychological states. Such evidence cannot determine the influence of intensity level of PA on ratings of affect and mood. Similarly, the acute effects of PA cannot be studied in this way.

2.1.5 Acute Physical Activity. In relation to acute benefits to engaging in PA, Reed and Ones (2006) conducted a meta–analysis of 158 studies from 1979 to 2005, which examined effects of acute aerobic exercise on the time course of post-exercise positive affect. To examine the duration of post-exercise positive affect studies included in the analyses were coded for assessment time. The cumulative results indicated that the average effect size was highest within the first 2 minutes post-exercise (.61), by 5 to 10 minutes reduced to .43, and by 15 to 30 minutes reduced further to .27. It was concluded from this analysis that the effects of acute aerobic exercise on positive affect appear to peak within the first 2 to 5 minutes after exercise and remains elevated above pre-exercise levels for at least 30 minutes before returning to baseline.

The majority of the literature supports a pattern of initial improvement followed by an attenuation of effects across time. In some studies, positive affect peaked at 30 minutes and remained elevated up to 60 minutes post exercise (Cox, Thomas, & Davis, 2001) or positive affect peaked at 10 minutes then returned to baseline (Ekkekakis et al., 2000). Similar results have been found in relation to acute PA and positive mood. Consistent findings have shown that improvements to mood reduce to baseline within 1 to 2 hours of ceasing PA (Berger, Friedman, & Eaton, 1988; King Taylor, Haskell, & DeBusk, 1989). In summary, this evidence suggests that mood indices return to baseline soon after cessation of PA.

The results presented above suggest both acute and chronic benefits to engaging in PA. There are a number of theories, which will be discussed later, which suggest the mechanisms by which both chronic and acute PA lead to improvements in wellbeing.

2.1.6 Frequency of PA. In relation to specific measures of PA, attention has been given to the role of frequency of PA per week (Arent, Landers, & Etnier, 2000; Reed & Buck, 2009). For example, a meta-analysis by Arent and collegues (2000) examined the exercise-mood relationship in older adults. The study found that regardless of whether participants engage in PA at low (less than three days per week) or high levels (greater or equal to three days per week) there was an improvement to mood. Furthermore, greater affective improvements were found in studies where participants engage in PA less than three days per week. However, as this analysis was confined to older people it is difficult to generalize these findings. By comparison, a meta-analysis by Reed and Buck (2009) utilized studies from a variety of ages. This study found that those engaging in

PA more than three times per week had a greater level of positive affect than those who did not. Thus, this evidence suggests mood improves regardless of the frequency of PA. Additionally, age may have a key role in understanding the relationship between frequency of PA per week and mood.

In conclusion, research indicates that both acute and chronic PA is associated with improved mood (Biddle, et al., 2000; Reed & Ones, 2006; Stephens, 1988). Both aerobic and non-aerobic PA modes have also shown to be associated with improvements in mood and affect (Berger & Owen, 1992). Moderate intensity and frequency PA appears to have most value in improving mood and positive affective states (Arent, et al., 2000; Ekkekakis, et al., 2004; Reed & Buck, 2009; Steptoe & Bolton, 1988). Engaging in PA is associated with moderate improvements in mood and affect (McDonald & Hodgdon 1991; Reed & Buck, 2009). However, research also suggests that improvements to mood and affect return to baseline within a few hours of ceasing PA (Berger, et al., 1988; King et al., 1989; Reed & Ones, 2006)

2.2 Subjective Wellbeing and Physical Activity

A number of studies have investigated the relationship between PA and SWB with varying results. For example, Hansson, Hillerås and Forsell (2005) examined the various strategies people choose to improve or maintain SWB using a sample of 871 Swedish adults. Participants were asked: "what kind of self care strategies do you use to improve or maintain your psychological wellbeing?" PA was the most commonly reported self-care strategy and was also associated with higher SWB. Later, Kavetsos (2011) investigated the relationship between SWB and PA using an international sample of almost 50 000 participants. Participants

were asked: 'If you consider your life in general these days, how happy or unhappy would you say you are, on the whole? [Very happy; fairly happy; not very happy; not at all happy; can't choose]'. It was found that SWB increased with frequency of PA and inactive individuals reported significantly lower levels of SWB.

Intervention research also supports a positive relationship between PA and SWB. For example, Lox, McAuley and Tucker (1995) investigated the effects of a 12-week exercise intervention upon measures of life satisfaction and mood using a sample of HIV-positive adult males. They found that both aerobic and weight training were associated with increased life satisfaction and positive mood and a decrease in negative mood.

While there is fairly consistent evidence for a positive relationship between PA and SWB there may be other variables such as age, genetics and personality, which have an important role in explaining this relationship. With regards to age, a number of studies have focussed on older adults with conflicting results. For example, McAuley and colleagues (2006) investigated the longitudinal relationship between PA and SWB with participants randomized into an aerobic activity or a stretching and toning control group. SWB was measured by the Satisfaction with Life Scale (SWLS: Diener, Emmons, Larsen, & Griffin, 1985) and two affective measures of happiness and loneliness. Results indicated a curvilinear improvement in SWB over the course of the intervention followed by significant decline 6-months after ceasing the program. In contrast, Morgan & Bath (1998) investigated the longitudinal relationship between habitual levels of PA and life satisfaction using a sample of older adults. The results indicated that previous and concurrent outdoor/leisure activity did not significantly contribute to

life satisfaction. Similar findings were found in a meta-analysis of intervention studies, which explored the relationship between PA and life satisfaction in older adults (Netz, Wu, Becker, & Tenenbaum, 2005). The cumulative results indicated that the PA groups did not have a greater level of life satisfaction compared to control groups.

One explanation for the incongruent results using older adults is that compared to younger people, older adults may be more accepting of compromised physical functioning or may place lower importance on their physical functioning or ability to engage in PA (Netz et al., 2005; Rejeski & Mihalko, 2001). Thus, engaging in PA may be a less effective approach for improving life satisfaction in people who are elderly than with younger people.

Many of the authors presented above have suggested a causal relationship in which PA *influences* SWB (Lox et al., 1995; McAuley et al., 2006; Netz et al., 2005). However, others have suggested that this relationship is the consequence of predisposing factors such as genetics (Bartels, de Moor, van der Aa, Boomsma and de Geus, 2012; Stubbe, De Moor, Boomsma, & de Geus, 2007). For example, Bartels, and collegues (2012) used a sample of monozygotic twins, dizygotic twins and sibling pairs to investigate the cross-sectional and longitudinal relationship between PA and a variety of wellbeing measures. Within dizygotic twins and sibling pairs, the sibling who exercised more had an increase in SWB. In contrast, the genetically identical twin who exercised more did not have higher levels of SWB than the more sedentary genetically identical twin. Stubbe and collegues (2007) have found similar results. These authors suggest that the genetic variability in the dizygotic and sibling pairs was responsible for the difference in SWB compared to the non-significance in SWB

for genetically identical twins.

However, one limitation of the research by Bartels et al., (2012) and Stubbe et al., (2007) relates to the level of PA for the monozygotic twin pairs. In Bartels and colleagues study they reported a high degree of similarity in the level of PA for monozygotic pairs (correlations between .69 and .72) compared to dizygotic and sibling pairs (correlations between .28 and .42). Consequently, a high degree of similarity in the level of PA may have reduced the likelihood of finding a significant difference in SWB for monozygotic twins.

A further factor implicated in explaining the relationship between PA and SWB is personality. It has commonly been found that high neuroticism is associated with lower levels of SWB (Cook, 2003) and PA (Rhodes & Smith, 2006) and that high extraversion is associated with higher levels of SWB (Cook, 2003) and PA (Rhodes & Smith, 2006). Thus, it is conceivable that there is no direct effect of PA upon SWB, but rather predisposing personality characteristics influence both the frequency of PA and the level of SWB separately. In terms of evidence, only one study was identified which explored the relationship between PA, SWB and personality (Selkirk, 2008). This investigation found a difference in SWB between regular and non-regular exercisers, even after controlling for extraversion and neuroticism. This suggests a relationship between PA and SWB beyond the influence of predisposing personality characteristics.

In conclusion, the majority of evidence suggests both a cross-sectional and longitudinal positive relationship between PA and SWB. This research also suggests that factors such as age, genetics and personality may also be important to explain the relationship between PA and SWB.

The next section will focus upon research investigating the relationship

between PA and depression.

2.3 Physical Activity and Depression

2.3.1 Population surveys. Large-scale population surveys such as Stephens (1988) provide consistent evidence in support of the association between exercise and depression. The results obtained from a sample of over 3000 American participants revealed that depression scores (measured by the Center for Epidemiological Studies Depression Scale) was highest amongst those who reported 'little/no exercise' when compared to those who reported 'moderate' or 'much' exercise.

More recent evidence from a national study (N=9,333) of young women in Australia showed that the time engaged in exercise per day was one aspect of lifestyle that was negatively associated with depressive symptoms (France, Lee & Powers, 2004). Other data from Australia (Cassidy, Kotynia-English, Acres, Flicker, Lautenschlager, & Almeida, 2004) showed that activity levels were also important for older women. For women aged 70 years and over (N=278; mean age 74.6 years), those who were physically active were half as likely to be depressed (measured by the Beck Depression Inventory: Beck, & Steer, 1984) when compared with the physically inactive.

Population surveys utilising clinically defined criteria for depression also indicate a similar relationship. One such study conducted by Weyerer (1992) interviewed 1,536 Bavarian participants. A research psychiatrist interviewed all participants in this study with 8.3 percent identified as depressed. It was shown that participants rated as 'physically inactive' were over three times more likely to have clinically diagnosed depression than those who were regularly active.

However, one limitation of population surveys is they tend to be cross-sectional, and thus they lack an ability to establish causality. Since lethargy and inactivity are quite common symptoms of depression it is just as likely that the depression causes low activity, as it is that high levels of PA reduce depression scores (Biddle & Mutrie, 2007). Nevertheless, among community populations, there is consistent support for a negative correlation between PA and depression.

To clarify the direction of these associations, Biddle and Mutrie (2007) conducted a review of eight longitudinal studies that assessed the relationship between activity level and likelihood of depression. Factors likely to lead to depression (e.g., poor health status) were accounted for since people suffering a medical condition or disability have found to predict both inactivity and depression. The results of the Biddle and Mutrie review indicated that low levels of activity (without depressive symptomatology) preceded clinically defined depression at a later date (between two and thirty years later). This review concluded that it was unlikely that those who are depressed being inactive caused the relationship between depression and PA found in cross-sectional data.

Thus, evidence from both cross-sectional and longitudinal population surveys supports a negative relationship between PA and depression.

2.3.2 Physical activity as a treatment for depression. A study by Singh, Clements, and Fiatarone (1997) investigated the influence of a 10-week progressive resistance exercise training study among elderly subjects who met criteria for major or minor depression or dysthymia. Subjects were randomised into either a supervised resistance-training group or a control group. The resistance exercisers had larger reductions (about 4-5SD) in depressive symptoms

compared to the control group.

Studies have also compared the effectiveness of exercise to drug therapy in the treatment of clinical depression. A study by Blumenthal, and colleagues (1999) was one of the first to compare standard treatment for depression against an exercise intervention. This study utilized three treatment groups; antidepressant medication, aerobic exercise, and a combination of both treatments over a sixteen-week period for a cohort of individuals diagnosed with Major Depressive Disorder (MDD). It was found all three groups reported significant reductions in depression scores (measured by the Beck Depression Inventory) after treatment. Furthermore, participants from the exercise condition on average reduced depression severity from the 'moderate to severe' category pre intervention, to 'mild' post intervention. In a follow-up study of the same participants 6 months post intervention, it was found that the exercise group had maintained low levels of depression, equivalent to both comparison groups (Babyak et al., 2000). This is evidence that an exercise program may be as effective as antidepressant medication in significantly reducing depression symptomology.

Later, Mead and collegues (2009) conducted a meta-analysis to determine the effectiveness of exercise as a treatment for depression. The study included randomised controlled trials whereby exercise was compared to standard treatment, no treatment or a placebo treatment in adults. Twenty-eight trials were included in this analysis. The review found that exercise had a large clinical effect on symptoms in people with a diagnosis of depression compared with no treatment or control group. However, the authors argued this result may be biased in favour of exercise as a consequence of methodological reasons. For

example, a number of studies did not conceal allocation to group, intention to treat or involve a blinded outcome assessment. When these studies were omitted there was a moderate and non-significant reduction in symptoms post exercise intervention.

Thus, it appears that the evidence to support PA as a treatment for depression is equivocal. Although some research suggests an antidepressant effect of PA; a lack of methodological rigour in this area restricts sound conclusions from being made.

2.3.3 Exercise Deprivation. While the majority of the existing research has focused on how PA can improve negative psychological states, there is also evidence to suggest the deprivation of chronic PA is associated with reduced emotional wellbeing. Research has consistently found that when habitual exercisers give up their usual pattern of exercise this leads to a variety of negative psychological states (Biddle & Mutrie, 2007). For instance, researchers have asked regular exercisers to stop exercise for a period of days (Mondin et al., 1996), weeks (Morris, Steinberg, Sykes, & Salmon, 1990) or months (Baekeland, 1970) and have found that the inability to exercise is associated with a number of negative psychological states (irritability, negative affect, depression). However, once participants return to exercise routinely, these negative states recede. A review by Szabo (1995) found that survey, cross-sectional and experimental studies consistently show that interruption to the normal exercise pattern of a habitual exerciser will have a negative impact on emotional wellbeing. This negative impact is most commonly expressed as a series of 'withdrawal' symptoms such as guilt, irritability, tension and depression. Research has also

shown a similar relationship for those who were forced to give up PA (Chan & Grossman, 1988). Thus, for those who participate in regular PA, evidence suggests that the absence of PA can lead to negative mood states.

In conclusion, there is some evidence that PA can be effective as a treatment for depression (Babyak et al., 2000; Blumenthal et al., 1999; Singh et al., 1997). Evidence also suggests that deprivation of chronic PA is associated with an increase in depression symptoms (Baekeland, 1970; Mondin et al., 1996; Morris et al., 1990; Szabo, 1995).

2.4 Physical Activity and challenging life events

A number of studies have explored the influence of PA in moderating the relationship between challenging life events and wellbeing indices (Carmack, Boudreaux, Amaral-Melendez, Brantley & de Moor, 1999; Harris, Cronkite & Moos, 2006; LaPerriere et al., 1990; Sigfusdottir, Asgeirsdottir, Sigurdsson, & Gudjonsson, 2011). For example, Carmack and colleagues (1999) explored PA and aerobic fitness as potential "buffers" between minor stress and wellbeing indices. They found that PA, as opposed to aerobic fitness moderated the relationship between minor life events and anxiety amongst undergraduate students. In contrast, no effect was found for depression. However, as Carmack and colleagues sample was younger and well educated, they were also more physically active and fit than would be seen in the general population. Thus, the generalisability of the study results is limited. Additionally the cross-sectional design, and correlational results of the study prevent directionality from being established.

In comparison, Harris and colleagues (2006) longitudinally investigated whether PA would reduce the strength of association between negative life events and depression. Using a sample of initially depressed patients assessed at baseline, 1 year, 4 years and 10 years they found that each negative life event was associated with a 3.90-point increase in depression, but each increase in PA was associated with a decline of .89 depression points. This suggests that while challenging life events are likely to negatively influence mood, PA may be able to reduce the magnitude of that impact.

Other authors have investigated whether PA buffers the effects of family conflict upon depressed mood amongst students from 9th and 10th grade (Sigfusdottir et al., 2011). Family conflict was defined by whether severe arguments and/or physical violence were experienced by the teenagers, whilst PA was measured by questions related to both frequency and intensity of PA. The results showed that family conflict increased the likelihood of depressed mood among adolescents, while participation in PA decreased the likelihood of depressed mood. Also the effects of family conflict on depressed mood were stronger when PA was low than when it was high. Although the authors concluded that PA counteracts the influence of family conflict on depressed mood, since the study is cross-sectional the direction of causality between PA, family conflict, and depression could not be determined.

Unlike the studies previously discussed, LaPerriere and collegues (1990) operationalised “challenging life events” using an objective measure, the notification of HIV-1 antibody status. A sample of homosexual men with average and below average fitness levels were randomly allocated to either an aerobic exercise training program or a no-contact control condition. Emotional distress,

fitness and immunologic data were gathered pre and post HIV-1 status notification. HIV-positive controls showed significant increases in anxiety and depression, following notification whereas HIV-positive exercisers showed no similar changes and resembled both HIV-negative groups. These findings suggest that the emotional response to an acute stressor may be attenuated by exercise participation.

In summary, a number of studies have shown that PA counteracts the effects of family conflict on depressed mood among adolescents (Sigfusdottir et al., 2011), moderates the influence of minor stress on anxiety symptoms among college students (Carmack et al., 1999), reduces the strength of association between negative life events and global depression among a sample of depressed adults (Harris et al., 2006), and may attenuate affective changes in response to an acute stressor (LaPerriere et al., 1990). Although this indicates that PA is likely to buffer mood, there is an absence of research, concerning the ability of PA to buffer satisfaction with life.

2.5 Physical Activity and wellbeing over time

A number of studies have investigated the longitudinal relationship between PA and wellbeing indices (Birkeland, Torsheim, & Wold, 2009; Harris et al., 2006; Motl, Birnbaum, Kubic, & Dishman, 2004; Morgan & Bath, 1998). For example, using a sample of older participants Morgan & Bath (1998) investigated the longitudinal relationship between habitual levels of PA and depression and life satisfaction. Habitual PA was assessed by three mutually exclusive categories: purposeful walking, indoor activities (e.g., housework, indoor maintenance), and outdoor/leisure activities (e.g., gardening, cycling and

swimming). The results indicated that outdoor /leisure activity was associated with a reduction in the risk of depression four years later, whilst previous and concurrent outdoor/leisure activity did not significantly contribute to life satisfaction. The authors concluded that although the PA contributed to levels of psychological wellbeing in later life, the contribution was extremely modest. Similarly, using a sample of initially depressed patients, Harris and colleagues (2006) explored the long-term relationship between PA and depression over ten years. The results indicated that that greater PA was associated with less concurrent depression, however there was a non-significant relationship between PA and depression over time.

Using a sample of adolescents Motl and colleagues (2004) also investigated the relationship between naturally occurring changes in PA and depressive symptoms. They reported that change in the frequency of PA was inversely related to a change in depressive symptoms. This relationship remained significant when sex, socioeconomic status, smoking, alcohol consumption and the perceived value of appearance, health and achievement were accounted for. Another study utilising an adolescent sample investigated the possible directions of the relationships between PA and depressed mood (Birkeland et al., 2009). They investigated whether PA would protect against depressed mood (protection hypothesis), or depressed mood disables an individual's capacity for PA (inhibition hypothesis). Using a sample of 924 adolescents data were collected on eight occasions from age 13 to 23 years. Whilst change in PA was related to a modest change in depression, the direction of the relationship was inconclusive. Thus, the study did not provide support for either PA protecting against later depressed mood, or that depressed mood prevents engagement in PA.

In conclusion, a number of studies have shown that changes in PA are inversely related to change in depressive symptoms (Motl et al., 2004; Birkeland et al., 2009), however Harris and collegues (2006) found a non-significant relationship between PA and depression over time. Only one study could be identified which used a measure of life satisfaction and this found that earlier levels of PA did not contribute to changes in life satisfaction in a sample of older participants (Morgan & Bath, 1998). In terms of a direction of causality the research is equivocal. One study found that lower levels of outdoor/leisure activity were associated with an increased risk of depression 4 years later (Morgan & Bath, 1998), whilst another found inconclusive results (Birkeland et al., 2009). The ambiguous nature of these results suggests future research is needed to clarify the longitudinal relationship between PA and wellbeing indices.

CHAPTER THREE: PHYSICAL ACTIVITY AND POSITIVE PSYCHOLOGICAL STATES: CAUSAL MECHANISMS

3.1 Introduction

This section presents a discussion of the possible mechanisms whereby positive psychological states could be derived through engaging in PA. These include Self-Esteem, Distraction, Flow, Endorphin and Monoamine hypotheses.

3.2 Self-Esteem hypothesis

Self-esteem is defined as an evaluation of personal worth or worthiness (Rosenberg, 1989) and has been shown to be one of the strongest predictors of SWB (Blore, 2008). In explaining the relationship between PA and positive psychological states, a number of studies have indicated that participation in PA is associated with small and positive change in measures of self-concept/self esteem (Fox, 2000; McDonald & Hodgdon, 1991; Spence, McGannon & Poon, 2005).

In terms of mechanisms to explain the self-esteem benefits derived from PA, the researchers Sonstroem and Morgan (1989) proposed their Exercise and Self-Esteem Model. Later revised to an expanded version (Sonstroem, Harlow & Josephs, 1994), this model suggests that participation in PA generates a sense of achievement, competence and mastery with the activity. The model also suggests that by engaging in regular participation in PA there are also improvements in physical condition, which improve perceptions of body image and strength/endurance. Finally, the combination of improved sense of achievement, competence, mastery and physical condition enhance perceptions of overall physical self-worth, which then leads to improvement in global self-esteem.

Using a sample of older adults at a single time point Sonstroem, Harlow, Gemma, and Osborne (1991) demonstrated the validity of this model using structural equation modelling. The proposed model provided the most parsimonious fit and explained 29% of the variance in self-esteem. Baldwin and Courneya (1997) also demonstrated this models validity in a study using a sample of 64 female breast cancer survivors. A multiple regression showed that physical acceptance, physical competence and exercise participation explained 46 percent of the variance in global self-esteem, whilst a path analysis showed that exercise participation and global self-esteem was mediated entirely by physical competence.

Longitudinal research also provides support for the Exercise and Self-Esteem Model (McAuley et al., 2005; McAuley, Blissmer, Katula, Duncan, & Mihalko, 2000). For example, Mcauley and collegues (2000) followed a sample of 174 initially sedentary adults over a 12-month period (6 month exercise intervention and 6-month follow-up) to assess the validity of the Exercise and Self-Esteem Model. Latent growth curve modelling showed a curvilinear pattern of growth with significant increases in self-esteem during the intervention followed by significant declines post intervention. The analysis also found support for most of the model's relationships over time.

In explaining the relationship between PA and improvements to wellbeing indices, this implicates self-esteem as an important factor. Research has shown that participation in PA improves the sense of achievement, mastery, competence, physical conditioning and body image, which can have concomitant benefits to global self-esteem.

3.3 Distraction hypothesis

The distraction hypothesis proposed by Bahrke and Morgan (1978) suggests that it is not acute PA per se that is responsible for improvements to mood, but rather PA affords an opportunity for respite and distraction from the stress, worries, and frustrations of day-to-day routines. As a consequence of spending less time preoccupied with such thoughts or activities there is an improvement in mood. This suggestion was based upon the author's study comparing three activities (treadmill, meditation, or rest in a comfortable chair). They observed that quiet rest was no more effective than an acute dose of treadmill running or meditation in reducing state anxiety measured by the State-Trait Anxiety Inventory (Spielberger et al., 1970). Consequently, it was concluded that by simply taking a "time out" from stressful stimuli and feelings may be just as effective as PA or meditation in reducing anxiety. A number of other studies have documented similar anxiolytic responses following PA and sedentary activities (Breus & O'Connor, 1998; Raglin, & Morgan, 1987).

Other research has found that distracting activities result in a greater reduction in the severity and duration of a depressed mood than the use of more self-focused or introspective activities (e.g., journal keeping; Morrow & Nolen-Hoeksema, 1990; Nolen-Hoeksema & Morrow 1991). This is based upon the response styles theory of depression (Nolen-Hoeksema, 1987), which suggests that individuals who employ ruminative responses to depressed mood will experience intensification and prolongation of the mood, whereas those who utilise distracting responses to their depressed mood will experience respite. In their 1990 study Morrow and Nolen-Hoeksema induced depressed mood in 69 participants by asking them to read a depressing story whilst sad music played.

Participants were then randomly assigned to engage in one of four types of responses: an active task that distracted them from their mood; a passive, distracting task; an active task designed to lead to ruminations about their mood; or a passive, ruminative task. In both passive conditions participants read sentences that were printed individually on cards with the distracting-passive group content focused upon external events whilst the ruminating passive focussed upon self and emotions. Subjects in the active groups sorted 34 index cards into seven ranked groups with participants only being able to complete the task by standing and walking back and forth numerous times. Similar to the passive conditions, the distracting-active content focussed upon external events whilst the ruminative-active focussed upon self and emotion focussed content. As predicted, the greatest reduction in depression occurred in the distractive-active condition followed by the distractive-passive condition.

Although this evidence suggests that the distracting qualities of PA may be important in explaining mood improvement post PA there have also been a number of criticisms disputing the role of distraction. In studies such as Morrow and Nolen-Hoeksema (1990), the 'activity' involved tasks requiring a low level of PA intensity (walking and card sorting). Higher levels of PA intensity may have produced different results. Indeed, a number of studies have found reduced negative mood states following PA (moderate and high levels of intensity) but not quiet rest (Roth, 1989; Roth, Bachtler & Fullingim, 1990). Also, it has also been shown that mood enhancement after engaging in an acute bout of PA persists for a longer period than for distraction activity (Cox, 2002). This evidence suggests that a distraction mechanism may only partially explain improvements to wellbeing indices post PA.

3.4 Flow hypothesis

The term *flow* was first coined in Csikszentmihalyi's (1975) qualitative study comparing the subjective experiences of amateur athletes, chess masters, rock climbers, dancers, high school basketball players, and composers of music. He found remarkable similarity in the descriptions of how it felt when participant's favourite activity was progressing well. Many of these individuals reported a loss of self-consciousness, a sense of timelessness, feelings of energized focus, a lack of awareness of bodily needs (e.g., unaware of fatigue or hunger), an inability to think of anything else but the task at hand, and feelings of pleasure and enjoyment. Consequently, Csikszentmihalyi (1975) used these elements to define the *flow* experience. It is suggested that *flow* is so pleasurable and rewarding that it is a major reason for further participation in a given activity (Elbe, Strahler, Krustrup, Wikman & Stelter, 2010).

As flow experience is associated with feelings of enjoyment and pleasure, a number of studies have focused upon the relationship between flow and positive psychological states (Jackson & Eklund, 2002; Karageorghis, Vlachopoulos & Terry, 2000; Rogatko, 2007; Stein, Kimiecik, Daniels & Jackson, 1995). For example Rogatko (2007) examined the extent to which high *flow* activities were associated with positive affect using a sample of university students randomly assigned to either a *high* or *low flow* group. Participants were asked to list 8-10 major activities engaged in during a given week and then rated the emotions experienced whilst engaged in these activities. Participants in the *high flow* condition were asked to engage in one of their top three "in the zone" activities for an hour in the following week, whilst the *low flow* participants were asked to engage in one of the three lowest "in the zone" activities. Before and after the

activity participants filled out of the Flow State Scale-2 (FSS-2; Jackson & Eklund, 2002) and the Positive Affect Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988). Results showed that those in the *high flow* group reported greater increases in positive affect and *flow* than those in the *low flow* condition, and change in *flow* mediated the group membership and positive affect. This evidence suggests that engaging in high flow activities can lead to improvements to positive psychological states.

Research has also focused specifically upon the *flow* qualities of PA, for example Stein et al., (1995) examined the *flow* experience in recreational sport using a sample of tennis players, college students enrolled in a basketball class and golfers playing at a country club. Results indicated that participants who experienced *flow* whilst engaged in their activity experienced greater satisfaction and enjoyment compared to those not in *flow*. Later, Karageorghis and colleagues (2000) investigated the relationship between self-reported levels of *flow* and post exercise feelings of positive engagement, revitalization, tranquility and physical exhaustion. This study used a sample of 1,231 aerobic dance exercise participants who were asked to fill out the Flow State Scale (FSS; Jackson & Marsh, 1996) and the Exercise-Induced Feeling Inventory (EFI; Gauvin & Rajeski, 1993) immediately after a dance class. Results showed that *flow* was positively associated with post exercise positive engagement, revitalization, and tranquility, but not with physical exhaustion. Flow level also explained 35 percent of the variance in positive engagement, 31 percent of the variance in revitalization and 22 percent of the variance in tranquility. It was concluded that *flow* in aerobic dance exercise is moderately associated with the experience of positive post-exercise feelings (Karageorghis et al., 2000).

In conclusion, there has been limited research, which has investigated *flow* as a possible reason for improvements to wellbeing indices both during and after PA. Whilst there is evidence to support an *association* between flow and improvements to wellbeing indices the paucity of research in this area suggests that future research is needed to explore causal relationships between PA, *flow* and wellbeing indices.

3.5 Monoamine Hypothesis

The monoamine hypothesis suggests that engaging in PA leads to an increase in the availability of specific neurotransmitters (serotonin and norepinephrine) implicated in the regulation of mood. Research has shown through the efficacy of a variety of antidepressant medications (e.g., monaoamine oxidase inhibitors, selective-serotonin reuptake inhibitors) that an imbalance of neurotransmitters within the brain is implicated in the aetiology of depression (Nemeroff, 2002). The moanoamine hypothesis suggests that engaging in PA facilitates a greater degree of synthesis and release of monoamines and their metabolites, leading to an alleviation of depressive symptoms. Animal studies have shown increased serotonin synthesis and increased levels of tryptophan, the amino acid precursor for serotonin in both blood plasma and cerebrospinal fluid and concentrations of 5-hydoxyindoleactic acid (serotonin metabolite) in cerebrospinal fluid post PA (Dishman, 1997; Ransford, 1982). Research conducted on rats has also implicated norepinephrine. Barchas and Freedman (1973) showed that acute exercise (swimming) produced significant change in brain levels of norepinephrine, whilst Brown and van Huss (1979) demonstrated norepinephrine increases in rats following chronic exercise. In human studies a

serotonin metabolite 5-hydroxyindoleactic acid was found in the urine of participants post PA (Post, Kotin, Goodwin & Gordon, 1973).

However, methodological difficulties have prevented this line of research from advancing. Due to the invasive nature of obtaining monoamine samples from the human brain, research has focused primarily on either animal samples (Barchas & Freedman, 1973) or samples from the monoamine metabolites (Post et al., 1973). Thus, the pharmacodynamics of these substances in the previously mentioned studies may not directly relate to the activity of these compounds in the human brain.

3.6 Endorphin Hypothesis

The endorphin hypothesis suggests that PA has a positive effect on mood due to increased levels of endogenous opioids known as endorphins (aan het Rot, Collins, & Fitterling, 2009). It is suggested that a consequence of strenuous exercise the body releases endorphins, which leads to the subjective experience of euphoria and analgesia commonly referred to as 'the runners high'. Proponents of this theory, cite as evidence, raised levels of endorphins in both blood plasma and cerebrospinal fluid following an exercise session (Farrell, Gates, Maksud & Morgan, 1982; Hoffman, Tereniuous & Thoren, 1990) and more recently brain imaging (using positron emission topography) has demonstrated an increase in opioid activity in a number of fronto-limbic brain regions following 2 hours of running (Boecker et al., 2008). This study also found the amount of opioid activity correlated significantly with the amount of self-reported euphoria.

However, this research has not been without criticism. Although a number of studies have shown increases in plasma endorphins following acute

and chronic exercise, it remains unclear if these elevations in plasma endorphins are directly linked to a subjective increase in positive mood (aan het Rot et al., 2009). There is also evidence that some participants do not experience a sense of euphoria in spite of an endorphin increase post exercise (aan het Rot et al., 2009). Finally, research has also shown that feelings of euphoria whilst engaged in strenuous PA are not reduced by the administration of a naloxone injection, which is an opiate antagonist (Larson, Himmelberger & Flynn, 1990). Thus, the evidence supporting the endorphin hypothesis is unclear as there is evidence both supporting and disputing this hypothesis. Similar to the monoamine hypothesis, methodological difficulties have prevented this line of research from advancing due to the invasive nature of obtaining samples from the human brain. Further research is needed in this area to provide clarity.

3.7 Conclusion

In conclusion, a number of psychological and biological mechanisms have been proposed which attempt to explain improvements to a variety of wellbeing indices post PA. Although it is likely that a combination of these mechanisms work simultaneously to explain both the acute and chronic benefits to wellbeing indices post PA, more research is needed to clarify the contribution of these mechanisms and the causal directions.

CHAPTER FOUR: PHYSICAL ACTIVITY AND SWB HOMEOSTASIS

There are a number of limitations articulated in Chapter 2 in considering the relationship between PA and wellbeing indices. First, in assessing the relationship between PA and wellbeing, there has been limited research using a reliable and valid measurement of SWB. Second, There has also been no theoretical model that adequately accounts for the relationship between PA and SWB. In light of these limitations, this next section will consider this relationship in terms of the SWB homeostasis model.

As previously proposed, SWB homeostasis suggests that SWB is managed by a system of psychological devices, which have evolved for the purpose of maintaining levels of SWB within a controlled range of functioning (Cummins et al., 2002; see Chapter 1 for an explanation of this model). As an individual experiences a challenge in their environment, a number of homeostatic mechanisms attempt to absorb the impact of destabilising life events, and therefore maintain SWB within the 'set point range' (Cummins, 1998; Cummins & Nistico, 2002; Cummins et al., 2002). In search of possible psychological mechanisms to explain the maintenance of the SWB homeostatic system, attention has been given to the role of protective buffers (Cummins, 2009).

Evidence has shown that, at a population level, as income increases the level of SWB also improves (Cummins et al., 2008). However, as indicated by Cummins (2009) money cannot make a person happier over an extended period. No matter how wealthy a person is, their average level of SWB cannot be sustained higher than their 'set point range'. This is illustrated by the previously mentioned study by Brickman et al. (1978), who compared the happiness of

lottery winners and paralysed accident victims: although the lottery winners initially had significantly higher levels of life satisfaction, they adapted readily to the luxurious living standards, resulting in a reduction in life satisfaction, ultimately returning the level of wellbeing to within their 'set point range'. Thus, the real power of money may not lie in making people happier, but in allowing individuals to protect themselves from challenging circumstances. Evidence (see Chapter 1 for a review) comparing household income to SWB (Cummins, 2009), and household income to the reporting of happy and sad events (Cummins et al., 2008) suggests the possession of larger amounts of money allow individuals to protect themselves from negative life events, which will make it less likely that SWB will decrease.

When the relationship between PA and wellbeing indices (SWB, mood, affect, and depression) is interpreted in terms of SWB homeostasis the results appear to be consistent with the operation of this model. For example, the majority of evidence suggests both a cross-sectional and longitudinal positive relationship between PA and SWB (Lox, et al., 1995; McAuley et al., 2006; Selkirk, 2008). A substantial body of literature has shown that individuals who engage in regular PA report higher levels of positive mood and affect when compared to those who do not (e.g., Sports Council & Health Education Authority, 1992; Stephens, 1988), and the adoption of an exercise program is associated with at least a temporary improvement to both positive mood and affect (McAuley, 1991; McDonald & Hodgdon, 1991; Steptoe & Bolton, 1988; Steptoe & Cox, 1988). Importantly however, this research has also indicated that there is an upper limit to improvements to mood and affect achieved through participation in PA. A number of meta-analytic reviews have shown that

engaging in PA will at best, lead to a moderate improvement to positive mood and affect (McDonald & Hodgdon 1991; Reed & Buck, 2009).

Moderate gains to wellbeing (i.e., improved mood, affect,) suggest that an individual who exercises regularly will benefit psychologically from physical activity but that there is a ceiling level to these benefits. By engaging in PA the moderate increase to mood and affect suggests that improvements to SWB would be limited to the upper threshold of the 'set point range'.

Evidence related to PA and depression also appears to conform to the SWB homeostasis model. From a variety of experimental designs (large scale population surveys and experimental trials, meta-analytic reviews) a significant amount of literature indicates that people who exercise consistently are less likely to suffer depression (France, et al., 2004; Stephens, 1988; Weyerer, 1992), and that those who cease engaging in PA increase their likelihood of suffering depression symptomatology (Morris et al., 1990; Szabo, 1995). Furthermore, there is some evidence that PA can be effective as a treatment for depression (Babyak et al., 2000; Blumenthal et al., 1999; Singh et al., 1997). Viewed in terms of SWB Homeostasis, this research suggests that an individual who experiences depression (homeostatic defeat) can utilize PA as a resource to return SWB to within their 'set point range' (Cummins et al., 2008). Conversely, this research also indicates that if an individual who regularly participates in PA discontinues participation (removal of a protective buffer), this will increase their potential for suffering depression (Baekeland, 1970; Morris et al., 1990; Szabo, 1995).

A number of studies have also shown that PA counteracts the effects of family conflict on depressed mood among adolescents (Sigfusdottir et al., 2011),

moderates the influence of minor stress on anxiety symptoms among college students (Carmack et al., 1999), reduces the strength of association between negative life events and global depression among a sample of depressed adults (Harris et al., 2006), and may attenuate affective changes in response to an acute stressor (LaPerriere et al., 1990). Within the context of homeostasis theory this suggests that engaging in greater amounts of PA would protect SWB from the influence of adverse life events.

From the cumulative evidence mentioned above it is therefore proposed that PA acts as a protective buffer to SWB in a similar way as financial resources. Improving SWB within the 'set point range', and protecting SWB from homeostatic defeat. The diagram below (Figure 6) is an adapted version of Figure 1 by Cummins (2009) and explains the hypothesised relationship between PA and SWB. For a review of the original diagram see Chapter 1.

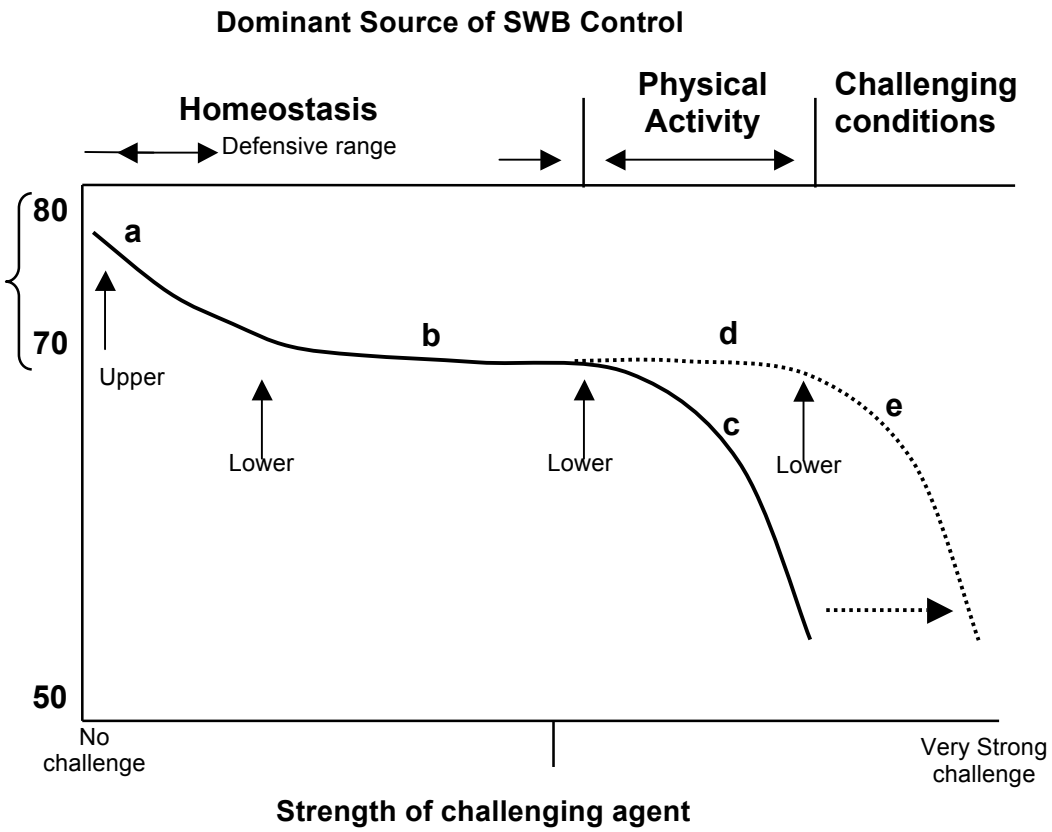

Figure 6. Physical Activity as a homeostatic buffer

The line indicated in Figure 6 by 'a', 'b', and 'c' represents the changes in an individual's SWB due to the increase in strength of the challenging agent. As the strength of the challenging agent increases the level of SWB will fluctuate within its set point range indicated at 'a' and 'b'. However as the challenging agent increases further this will lead to the strength of the challenging agent exceeding the homeostatic defensive range (indicated by the upper horizontal axis). This will result in a significant reduction to SWB indicated at 'c' as the challenging agent becomes too strong for the homeostatic defences to protect SWB.

However this model also proposes that if the individual regularly engages in PA this will act as a buffer to protect SWB, extending the homeostatic defensive

range of the individual (indicated by 'Physical Activity' in the upper axis). In this way as the strength of the challenging agent increases, PA adds to the homeostatic defensive range and therefore decreases the likelihood of this individual experiencing homeostatic defeat (depression). The dotted line indicated by 'd' and 'e' indicates the level of SWB for the individual who engages in PA. At point 'd' this shows how the effect of PA prevents homeostatic defeat, by holding SWB to the minimum value of the 'set point range'. However as the challenging agent increases further, the homeostatic defensive range is exceeded and homeostatic defeat occurs (indicated at by 'e').

It must be noted that one limitation of Figure 6 is that 'Physical Activity' indicated in the upper axis could be interpreted to suggest that it is *only* PA that is defending homeostasis at point 'd'. This is not how Figure 6 should be interpreted. 'Physical Activity' will only add to the power of existing homeostatic buffers. All homeostatic buffers will continue to operate throughout the period indicated by 'd'.

In summary, Figure 6 proposes that the utility of PA is in its power to improve SWB within the 'set point range' of function, and to act as a protective mechanism against depression (homeostatic defeat).

CHAPTER FIVE: AIMS AND HYPOTHESES

In light of the evidence in Chapter 4, a series of four studies are proposed to test the proposition that PA improves SWB within the 'set point range', and that PA acts as a buffer to protect SWB from homeostatic defeat.

Study 1

Aim:

The first study examines the cross-sectional relationship between PA, SWB and depression.

Sample:

The PA sample for Study 1 comprises surfers, swimmers, and yoga practitioners. They will respond to measures of PA, SWB and depression on one occasion. The PA sample will also be compared to a comparison sample from the general population.

The following hypotheses are tested:

Hypothesis 1:

There will be a significant positive relationship between the frequency of PA and SWB.

Hypothesis 2:

There will be a reduction in the proportion of participants facing homeostatic defeat (measured by DASS-21 depression) as the frequency of PA increases.

Hypothesis 3:

There will be a significant negative relationship between the time since the last

PA experience and SWB, and a positive relationship between time since last PA and depression.

Hypothesis 4:

Groups who engage in PA will show a level of SWB below the upper limit of the 'set point range', which is approximated by a SWB score of 85.

Hypothesis 5:

The PA sample will have higher levels of SWB when compared to the Australian population comparison sample.

Hypothesis 6:

The PA sample will have a significantly lower proportion of participants facing homeostatic defeat (SWB score <60) when compared to the Australian population comparison sample.

Sample 2

A second sample of participants will be utilised for Study 2, Study 3, and Study 4. The sample will include surfers, swimmers, and yoga practitioners who will complete questionnaires on four occasions, over a three-month period.

Study 2

Aim:

The aim of Study 2 is to confirm the findings of Study 1 in relation to Hypotheses 1, 2, 3, and 4 using cross-sectional data from the first time-point. It will also test the following new hypothesis:

Hypothesis 7:

There will be a positive relationship between PA and SWB after co-varying for

personality and household income.

Study 3

Aim:

The aim of Study 3 is to explore the cross-sectional relationship between challenging life events, SWB and PA.

Sample:

Study 3 will utilize data from the fourth time point of Sample 2 (only the fourth time point will be used to assess challenging life events).

Hypothesis 8:

That PA will moderate the relationship between challenging life events and SWB.

Study 4

Aim:

The purpose of Study 4 is to investigate the longitudinal relationship between PA and SWB.

Sample:

Study 4 will utilize data from all four-time points of Sample 2 to investigate the longitudinal relationship between PA and SWB.

Hypothesis 9:

That change in PA will predict change in SWB over time.

CHAPTER SIX: STUDY ONE

6.1 Method

Approval to conduct the following research project was granted by the Deakin University Ethics Committee. The letter of ethics approval is attached (see Appendix A).

6.1.1 Participants. A sample of 600 participants who engaged in physical activity was utilized for study 1. The sample consisted of 351 males (58.3%) and 249 females (41.6%) with participant's ages ranging from 18 - 78 with a mean age of 36.22. The sample included 312 surfers, 141 swimmers, and 147 yoga enthusiasts. This was compared to an Australian sample of 600 individuals derived from the Australian Unity Wellbeing Index Survey.

6.1.2 Recruitment. Recruitment occurred through placing advertisements on special interest websites related to surfing, swimming, or yoga. Individuals interested in participating in the study clicked on a link provided within the online advertisement directing them to the questionnaire located on the Deakin University website. Participants first read the plain language statement (Appendix B) outlining the purpose and procedure of the research. Individuals who wished to participate were asked for their consent by clicking 'I Agree' on the bottom of the plain language statement, which directed them to the start of the questionnaire. Once participants completed the questionnaire the information was electronically sent to a secure password protected computer located at Deakin University.

6.1.3 Questionnaire. Each participant completed an 89-item questionnaire (see Appendix C). The questionnaire contained four sections including Subjective Wellbeing, Depression/Stress/Anxiety, Physical Activity, and Descriptive information. The four sections are described below.

6.1.3.1 Subjective Wellbeing. SWB was measured using both a single global question and the Personal Wellbeing Index. The global measure used a single question "How satisfied are you with your life as a whole?" The Personal Wellbeing Index (PWI: The International Wellbeing Group, 2006) was designed to reflect the first level deconstruction of satisfaction with 'life as a whole' across 8 specific life domains (Cummins, 1996). The scale asks participants "How satisfied" they are with life domains related to standard of living, health, achieving in life, personal relationships, safety, security, community connectedness and spirituality/religion. The scale utilises an 11-point end-defined scale (scores range from 0 = Completely dissatisfied, 5 = Neutral, 10 = Completely Satisfied). Previous analysis of the PWI indicates a reliability coefficient of .82 in an Australian sample and Cronbach's alpha of between .70 and .85 in samples from Australia, Hong Kong, and Algeria (Lau, Cummins & McPherson, 2005; The International Wellbeing Group, 2006; Tiliouine, Cummins, & Davern, 2006).

6.1.3.2 Depression, Anxiety and Stress. The DASS-21 (Lovibond & Lovibond, 1995) was a screening tool designed to measure three separate constructs of depression, anxiety and stress. Evidence suggests that the DASS-21 possesses adequate construct, and discriminant validity in samples

drawn from both clinical and non-clinical samples (Antony, Bieling, Cox, Enns, & Swinston, 1998; Henry & Crawford, 2005). Comparisons with the longer 42 item version of the DASS and a number of other mood scales obtained high correlations ranging from .79 to .85 (Antony et al., 1998). Cronbach's alphas for the DASS-21 Depression, Anxiety and Stress subscales were .97, .92, and .95 respectively (Antony et al., 1998). All subsequent analyses in this thesis only used the DASS-21 depression scale.

Calculation of the DASS depression categories

The DASS-21 depression scale contains seven items and utilizes a 4-point response scale (0-3) to give a range of raw scores between zero and 21. As the DASS depression severity ratings are based upon the original 14 item version scores from the seven items are multiplied by two to give a score range of between zero and 42 (Lovibond & Lovibond, 1995). The DASS-21 dissects depression severity into five categories including normal, mild, moderate, severe or extremely severe. Table 1 outlines the depression severity ranges with Z-scores and percentiles taken from the DASS manual.

Table 1

DASS Depression Severity Ratings, Z-Scores and Percentiles

Severity Ratings	Score Range	Z-score	Percentile
Normal	0-9	<0.5	0-78
Mild	10-13	0.5-1.0	78-87
Moderate	14-20	1.0-2.0	97-95
Severe	21-27	2.0-3.0	95-98
Extremely Severe	28+	>3.0	98-100

Although the DASS manual states that the threshold scores were based upon the normative data set of Australian participants the precise process for obtaining the threshold scores in Table 1 is not provided. However, inspection of the Z-score and percentiles (see Table 1) suggests a high probability that both were utilized to determine DASS depression severity ratings (Bittar, 2008).

In contrast to the original 4-point response scale the current study utilized an 11-point response scale (0-10). To ensure that results were in a standard form and easily comparable data were converted using 'percentage scale maximum' (%SM) technique, which converts scores to between zero and 100 (International Wellbeing Group, 2006). The %SM formula is given below.

$$\frac{X - k^{min}}{k^{max} - k^{min}} \times 100$$

X = the score or mean to be converted

k^{min} = the minimum score possible on the scale

i.e., If a scale is score from 1 to 5, then $k^{min} = 1$

If a scale is score from -5 to +5, then $k^{min} = -5$

k^{max} = the maximum score possible on the scale ie

If a scale is score from 1 to 5, then $k^{max} = 5$

If a scale is score from -5 to +5, then $k^{max} = +5$

Table 2 shows the Depression severity score ranges converted to %SM values.

Table 2

DASS Depression Severity Ratings for the %SM Scores

Depression Severity Ratings	%SM	Adj. %SM range
Normal	0-21.42	0-21.42
Mild	23.81-30.95	21.43-30.95
Moderate	33.33-47.62	30.96-47.62
Severe	50 .00-64.29	47.63-64.29
Extreme	66.67 +	64.30 +

Table 2 gives the depression severity ratings for %SM and the adjusted scores. DASS-21 %SM scores are adjusted because after converting severity ranges to %SM there exists a gap between each level of depression severity. For example the upper boundary for *normal* depression is 21.42 whilst the lower boundary for *mild* depression severity begins at 23.81 (see Table 2). This leaves a gap of 2.39 points between *normal* and *mild* depression levels. Similar gaps exist between each level of depression severity. As a consequence, the lower cut off value for each depression severity is lowered to encompass this gap (*mild*: 21.43, *moderate*: 30.96, *severe*: 47.63 and *extremely severe*: 64.30).

All subsequent analyses utilize data converted using the %SM technique.

6.1.3.3 Physical Activity. This is measured by two questions, the first of which is the frequency of PA per week. A number of studies have measured this to approximate PA behaviour (Birkeland, Torsheim and Wold, 2009; Booth, Oakely, Chevy, & Bauman, 2001; Godin & Sheperd,

1985; Jacobs, Ainsworth, Hartman & Leon, 1993; Motl, Birnbaum, Kubic, & Dishman, 2004; Samdal, Tynjala, Roberts, Sallis, Villberg, & Wold, 2007). For example, the Leisure Score Index of the Godin Leisure-Time Exercise Questionnaire includes three questions on how many times, during a typical week, the respondent participates in mild, moderate, and strenuous exercise (Godin & Shephard 1985). The authors reported test-retest reliability coefficients of 0.48 for mild, 0.46 for moderate, and 0.94 for strenuous exercise. The Leisure Score Index has also been compared with nine other self-report measures of PA and was found to have adequate reliability and validity (Jacobs, et al., 1993). Using a sample of 78 men and women aged 20-59 the Leisure Score Index was found to have convergent validity with two other measures of PA (Correlation coefficients: Accelerometer = .32, Maximal Oxygen Consumption = .56), and a one-month test-retest correlation coefficient of 0.62.

Other research has included the number of times per week participants engaged in activities that caused them to sweat or lose their breath (Birkeland, et al., 2009; Booth, et al., 2001). Evidence has suggested a question encompassing the frequency of PA per week "to sweat or loss of breath", is a simple and rapid way of assessing fitness (Siconolfi, Lasater, Snow & Carelton, 1985). In a 10 year longitudinal study of adolescents PA frequency was measured by a single item: Outside school hours, how often do you do sports or exercise until you are out of breath or sweat? The seven response categories were: Every day, 4–6 times per week, 2–3 times per week, Once per week, 1–3 times per month, Less than once per month, and Never (Birkeland, et al., 2009). This question revealed adequate test-retest reliability with correlation coefficients between .48-.62 for time points measured a one-year apart, and .18 when measured 10 years apart. A

number of other studies have also found this item to have acceptable test–retest reliability (Booth, et al., 2001; Samdal, et al., 2007).

The evidence presented here suggests that the frequency of PA per week has been used in a number of studies and has shown to have adequate reliability (Booth, et al., 2001; Samdal, et al., 2007; Birkeland, et al., 2009) and convergent validity (Godin & Shephard 1985). For the current study the frequency of PA was approximated by the following question: How many times each week do you engage in PA? With response options: Less than once per week, 1-2 times per week, 3-4 times per week, 5-6 times per week, 7 or more times per week. The statement "until you are out of breath or sweat" was not included as the three PA modalities (surfing, swimming, and yoga) used in this study do not necessarily involve breathlessness or sweating. In a longitudinal study of high school students a single-item measure of the frequency of regular PA without "to sweat or loss their breath", was found to have a test-retest reliability of 0.69 across the three time periods over two years (Motl, et al., 2004).

The second question approximating PA behaviour relates to the time since the last PA experience: When was the last time you engaged in PA? With response options: Today, Yesterday, 2-6 days ago, 1-3 weeks ago, 1-2 months ago, 2+ months ago. To my knowledge, no studies or scales to date have used this measure. This question was devised to investigate the relationship between SWB and PA in terms of SWB homeostasis theory. Specifically, what happens to SWB when there is extended periods of time without engaging in PA.

6.1.3.4 Descriptive Information. Descriptive information included items related to age, gender, country of origin, type of PA.

6.2 Data Preparation

6.2.1 Data cleaning. Consistent with data cleaning guidelines (International Wellbeing Group, 2006) responses with maximum or minimum scores across all PWI domains were eliminated prior to data analysis (7 cases). To minimize the potential of cultural/language differences within the sample influencing the results participants who did not indicate residence in Australia, United States, Britain, South Africa, Canada or New Zealand were removed from the sample (32 cases).

6.2.2 Missing Data. Estimation maximization was used to replace missing values in all independent variables with less than 5% data missing. Due to the high proportion of missing values in the SWB item "how satisfied are you with your spirituality or religion" (24.70%) this item was excluded from the analyses. Subsequently, SWB was calculated using the remaining 7 domains.

6.2.3 Outliers. Univariate outliers were removed by calculating standardized scores on all dependent variables. On inspection of the z-scores, all values greater than 3.3 were removed (5 cases). Multivariate outliers within all dependent variables were calculated using a Regression analyses to compute the Malhalanobis distance. Malhalanobis distance is distributed as a chi-square (χ^2) variable, with degrees of freedom equal to the number of dependent variables. To determine which cases were multivariate outliers, the critical χ^2 was calculated

with an alpha level for seven degrees of freedom (χ^2 at α=.001 for 7df = 24.32). 128 cases were identified as multivariate outliers and removed.

6.2.4 Normality. Normality was assessed across all dependent variables. Using the SPSS descriptive statistics function, SWB (*z* = -.80) was negatively skewed, whilst Depression (z = 1.44) was positively skewed. Analysis of the dependent variables revealed kurtosis values between z=1.42 (Depression) and z= -.75 (SWB). According to Cohen and Cohen (1983), skewness and kurtosis are acceptable within the range of -7.0 to 7.0. Further, Tabachnick and Fidell (2001), advises normality issues are seldom critical for analyses using large samples (n>300). As this study had an acceptable range of values for skewness and kurtosis, and utilized a large sample (n = 600) the assumptions of normality were satisfied.

6.2.5 Multicollinearity. Dependent variables were tested for multicollinearity. The correlation between Depression and SWB was -.55. According to Tabachnick and Fidell (2001) multicollinearity occurs when correlations exceed .90. Therefore the assumption of multicollinearity was met for this sample.

After data cleaning the remaining 600 participants were utilized in following analyses.

6.3 Results

Prior to testing the hypotheses, data from both samples are examined for appropriate factorial composition of the scales and the descriptive statistics are also examined. The hypotheses are then tested.

The structure of this chapter is as follows:

1. Factor Analyses
2. Analysis of descriptive statistics
3. Analysis of the hypotheses
4. Analysis of PWI domains
5. Results summary

6.3.1 Factor Analyses. The purpose of this section is to explore the factor structure of each dependent variable and to test whether the results are consistent with the structure hypothesized by the authors of each scale. The PA and comparison samples were combined into a single data set for the analyses of the DASS-21 and PWI scales (N= 1200).

Factor Analysis- Depression Anxiety Stress Scale- 21 (DASS-21)

The DASS-21 consists of three underlying dimensions: depression, anxiety, and stress (Lovibond & Lovibond, 1995a). This study uses the depression measure only. Principal Component Analysis (SPSS Version 12) was used to explore the structure of the seven DASS-21 depression items.

Prior to performing this analysis, the suitability of data was assessed. Inspection of the correlation matrix revealed two coefficients below .3 (depression item 2 and 7= .28). The Kaiser-Meyer-Oklin value was .89,

exceeding the recommended value of .6 (Kaiser, 1970, 1974) and Bartlett's Test of Sphericity (Bartlett, 1954) reached statistical significance, supporting the factorability of the correlation matrix.

Principal Component Analysis revealed the presence of one component with an eigenvalue exceeding one (3.88), explaining 55.44% of the variance. Inspection of the scree plot revealed a clear break after the first component. Item loadings on this component are presented in Table 3 below.

Table 3

DASS-21 Item Loading on PCA Component

DASS-21 Item	Component 1
Lack of interest/involvement	.82
Self-deprecation	.79
Hopelessness	.78
Devaluation of Life	.73
Dysphoria	.72
Anhedonia	.72
Inertia	.65

It is concluded that the seven items factor as intended by the authors for the current sample.

Factor Analysis- Personal Wellbeing Index (PWI)

The PWI seven domains have consistently shown to form a single stable factor, which accounts for about 50% of the variance in Australia and other countries (The International Wellbeing Group, 2006).

Inspection of the correlation matrix revealed that only one coefficient was below .3 (Health and relationships= .28). The Kaiser-Meyer-Oklin value was .85, exceeding the recommended value of .6 (Kaiser, 1970, 1974) and Bartlett's Test of Sphericity (Bartlett, 1954) reached statistical significance, supporting the factorability of the correlation matrix.

Principal Components Analysis revealed the presence of one component with an eigenvalue exceeding one (3.47), explaining 49.55% of the variance. Inspection of the scree plot revealed a clear break after the first component. Item loadings on this component are presented in Table 4 below.

Table 4

Personal Wellbeing Index Item Loading on PCA Component

Personal Wellbeing Index Item	Component 1
Security	.76
Standard of Living	.76
Achievements	.75
Community	.69
Safety	.68
Relationships	.64
Health	.63

It is concluded that the item loadings from Table 4 support the current conceptualisation of the PWI representing a single factor.

In conclusion, the results from the Principal Component Analyses above suggest that the PWI and DASS-21 (depression) correctly factor and may be used to conduct further analyses.

6.3.2 Descriptive Statistics for the Physical Activity Sample. Table 5 presents the means, standard deviations and correlations for the dependent variables for both the PA (N= 600) and comparison sample (N= 600). Overall, the PA sample has a SWB mean of 76.45 (SD: 11.95), which is within the Australian Unity Wellbeing Index normative range of 76.7-73.7 (The International Wellbeing Group, 2010). Depression had a mean of 11.23 (SD: 11.84), which is within the 'normal' range on the DASS-21 depression scale.

Table 5 also shows a clear inverse relationship between SWB and depression (r= -.47**), which is consistent with previous research (Cummins, 2010).

Table 5

Means, Standard Deviations and Correlation Matrix for all Dependent Variables

	Mean	SD	Correlation
1. SWB (PA)	76.45	11.95	
2. Depression (PA)	11.23	11.84	-.47**
SWB (Comparison)	75.67	12.35	
Depression (Comparison)	14.36	15.10	

**Correlation is significant at the 0.01 level.

*Correlation is significant at the 0.05 level.

Analysis of the comparison sample also revealed SWB to be within the Australian Unity Wellbeing Index normative range and DASS-21 to be within the 'normal' range on the DASS-21 depression scale.

Table 6 presents mean SWB for the groups to be studied. Over all groups the mean SWB varies between 79.85 (age 18-25) and 72.24 points (participants from the UK) (a range of 8.58 points). Of these groups seven were found to fall above the Australian Unity Wellbeing Index normative range of 76.7-73.7 (The International Wellbeing Group, 2010), which included Surfers, Australians, Americans, Canadians, Males, and participants aged 18-24 and 50-59. One group was found to fall below the normative range (British).

Table 6

SWB Descriptive Statistics for the Physical Activity Groups and Relevant Demographics

		N	Mean	SD
Overall		600	76.45	11.95
Physical Activity	Surfing	312	77.24	10.65
	Swimming	141	75.73	14.10
	Yoga	147	75.48	12.29
Country	Australia	300	77.48	10.49
	USA	155	77.32	12.26
	Britain	95	72.24	14.31
	Canada	50	76.86	12.79
Gender	Male	348	76.95	11.45
	Female	252	75.68	12.72
Age	18-24	107	79.85	10.18
	25-34	172	75.69	12.12
	35-49	211	75.23	12.30
	50-59	70	77.18	13.01
	60+	40	75.17	11.17

Analysis of variance found that participants from Australia and the USA had a higher SWB than participants from Britain. Despite these differences no country was removed from the PA sample.

In conclusion, the analysis of the descriptive statistics suggests that: 1. All dependent variables are within an acceptable range of values, 2. The SWB means for the demographic variables fell within an acceptable range of values.

6.4 Testing the Hypotheses

The next part of these analyses is separated into two sections. First, the PA sample will be analysed in terms of how SWB and Depression change as the frequency of PA, and time since PA, increase. Second, the PA sample will be compared to a sample of Australian participants.

6.4.1 Hypothesis 1. The first hypothesis proposes a significant positive relationship between the frequency of PA and SWB. This is weakly supported (r= .12 p= .03). Table 7 shows the changes in SWB with PA frequency.

Table 7

SWB Descriptive Statistics for the Frequency of Physical Activity Per Week

		N	Mean	SD
Frequency of	<1	45	75.37	10.88
Physical	1-2	159	75.04	12.13
Activity Per	3-4	213	75.87	12.21
Week	5-6	132	77.67	10.98
	7+	50	80.82	12.62

At low and moderate levels of PA (<1, 1-2 and 3-4) SWB levels are normal at approximately 75. At higher levels of PA there is an increase in SWB up to 80.82. An analysis of variance is significant F(4, 594)= 2.82, p= .02 (Levene's statistic *p*= .70). Post hoc tests (Tuckey HSD) revealed the 7+ group to have a SWB level significantly greater than the 1-2 group. No other differences are significant.

Figure 7 shows these results against the SWB normative range (cumulative data from the Australian Unity Wellbeing Index surveys: Cummins, 2010).

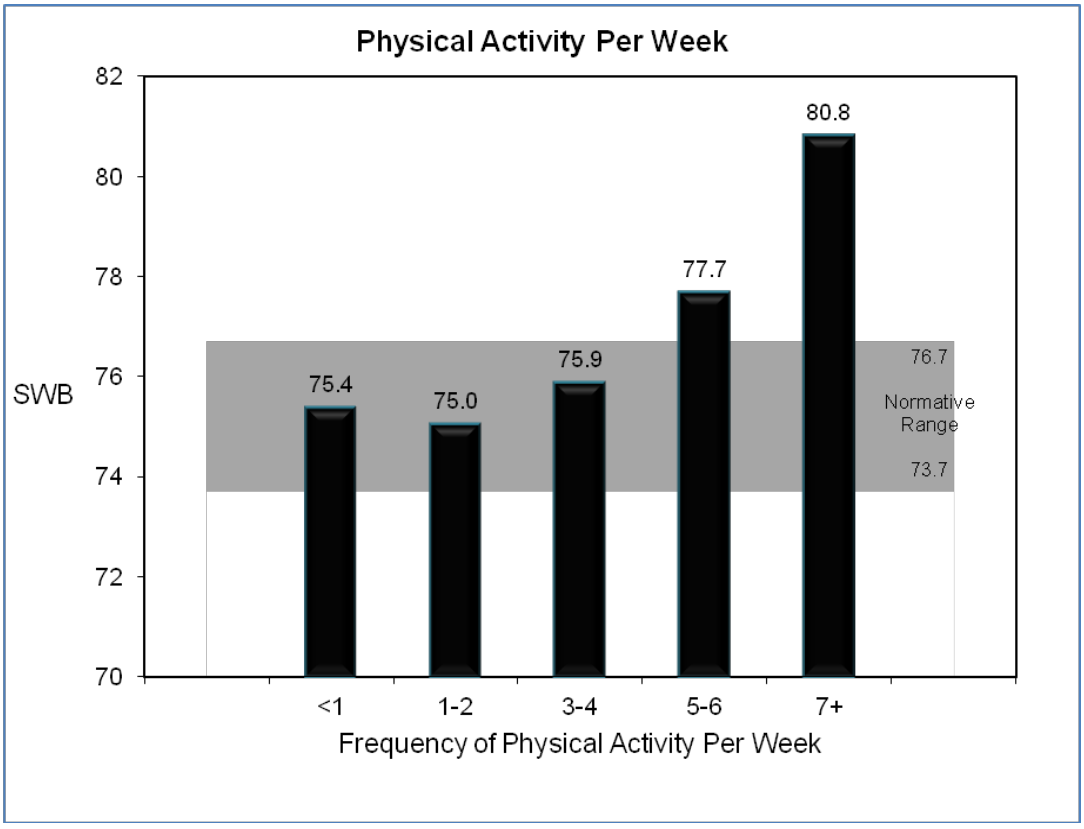

Figure 7. Mean SWB level versus the frequency of Physical Activity per week

Figure 7 illustrates that at low to medium levels of PA up to 3-4 per week the mean level of SWB lies within the normative range. At higher levels of PA (five or more), SWB exceeds this range.

As indicated in Chapter 5, as PA per week increases it is expected that there will be a reduction in the proportion of participants with a SWB <60 and an increase in the proportion of participants with a SWB 85+. To test this proposition the frequency of PA is compared between three SWB groupings: <60, 60-84, 85+ (see Table 8). These groups represent homeostatic defeat (<60), normal (60-84) and high (85+) levels of SWB (see Chapter 1 for a explanation of these groupings).

Table 8

SWB Grouping (<60, 60-84, and 85+) Compared to the Frequency of Physical Activity Per Week

		Frequency of Physical Activity Per Week									
		<1		1-2		3-4		5-6		7+	
		N	%	N	%	N	%	N	%	N	%
SWB Category	<60	2	4.4	17	10.7	22	10.3	9	6.8	4	8.0
	60-84	36	80.0	117	73.6	139	65.3	83	62.9	24	48
	85+	7	15.5	25	15.7	52	24.4	40	30.3	22	44
	Total	45	100	159	100	213	100	132	100	50	100

Table 8 shows that as the frequency of PA increases the proportion of participants with a low level of SWB (<60) remains relatively stable, with values between 4.4% and 10.7%. This does not show the hypothesised reduction in the

proportion of participants with low levels of SWB (<60) as the frequency of PA rises. In comparison participants with high levels of SWB (85+) increased from 15.5% (PA <1 per week) to 44.0% (PA 7+ per week). For a visual representation of this relationship see Figure 8.

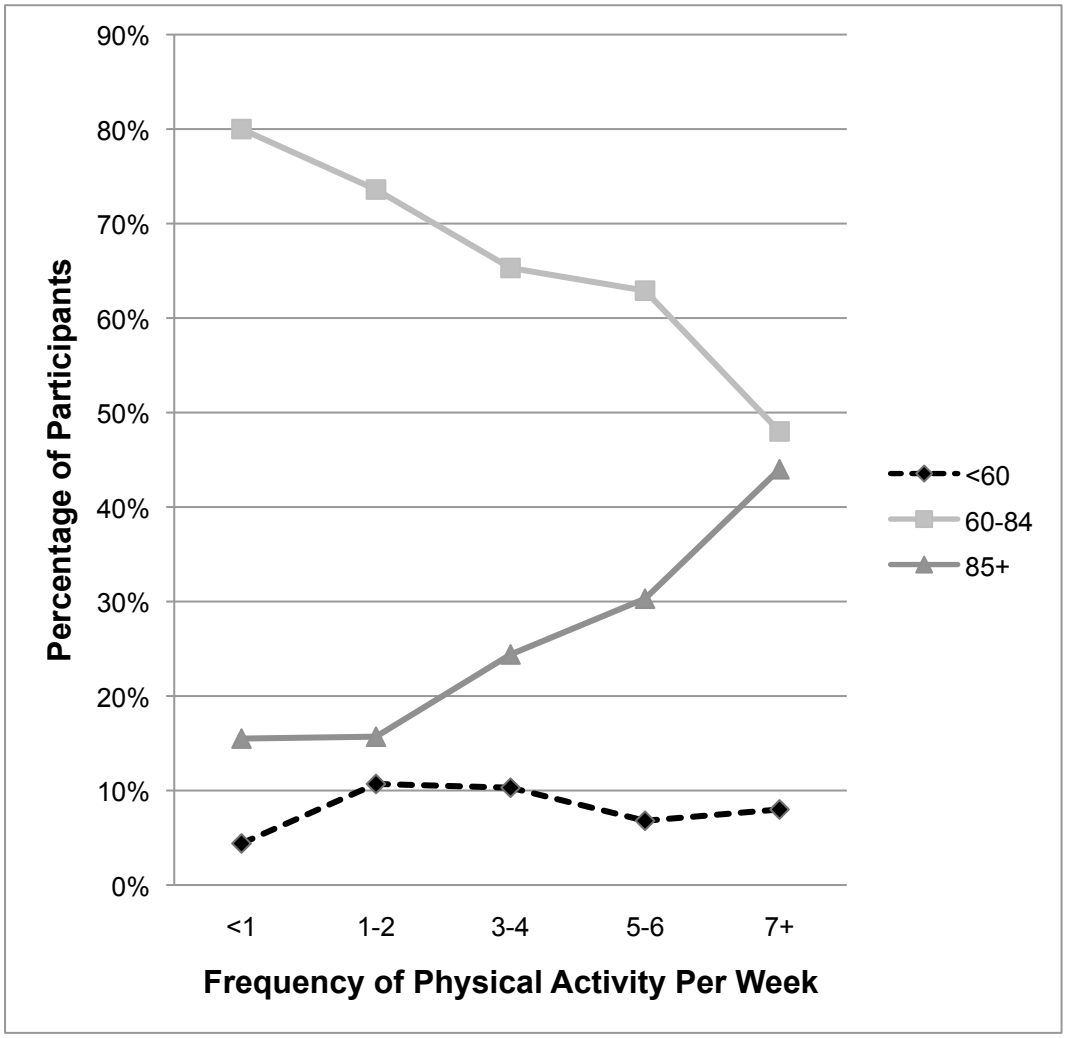

Figure 8. Percentage of participants in each SWB grouping (≤60, 70-84, and 85+) versus frequency of Physical Activity per week

Figure 8 shows that the rise in the proportion of high-group SWB (85+) is reciprocated from the normal range grouping (60-84), with no change in the proportion of people in the lowest group (<60). Interpreted in terms of homeostasis theory, a shift of participants from normal to high levels of SWB

suggests there are a greater number of participants operating towards the top of their set point range.

A difficulty in interpreting these results is that, as suggested in Chapter 1, it is not possible to be precise concerning the meaning of an individual SWB score that lies between 50 and 70 points. A score within this range can represent either a low set point or depression. Because of this uncertainty, the analyses above were repeated using the DASS-21 depression (Lovibond & Lovibond, 1995) to represent homeostatic defeat according to the DASS criterion.

6.4.2 Hypothesis 2. The second hypothesis proposes that there will be a reduction in the proportion of participants facing homeostatic defeat (measured by DASS-21 depression) as the frequency of PA increases.

In Chapter 1 it was shown that in comparing SWB and depression scores, the end of the homeostatic plateau coincides with mild depression (for a review of the relationship between SWB and depression levels in terms of SWB Homeostasis see Figure 3, Chapter 1). Using the end of the homeostatic plateau as the boundary between homeostatic maintenance and defeat it is likely that *normal* and *mild* depression scores are within the control of the homeostatic system, whilst levels in excess of *mild* depression (*moderate, severe* and *extremely severe*) indicate the likelihood of homeostatic defeat. Consequently, a DASS-21 depression level exceeding *mild* depression was initially proposed to represent homeostatic defeat. However, as a consequence of an insufficient number of participants *mild* depression was included to represent homeostatic defeat. Table 9 shows the proportion of participants with *normal* and the combined proportion of participants with *mild, moderate, severe* and *extremely*

severe depression for each level of PA.

Table 9

Comparison of Physical Activity Engaged in Per Week by DASS-21 Depression Category

			Physical Activity (per week)					
			<1	1-2	3-4	5-6	7+	Total
DASS-21	Mean		13.43	11.58	12.17	10.30	6.74	11.25
	SD		11.36	11.71	12.76	11.65	7.39	11.85
Depression Category	Normal	N	34	127	169	116	46	492
		%	75.6	79.8	79.3	87.9	92.0	83.8
	Depressed	N	11	32	44	16	4	97
		%	24.4	20.1	21.6	12.1	8.0	19.7

Overall, Table 9 demonstrates as the frequency of PA increases there is a decrease in the proportion of participants experiencing homeostatic defeat from 24.4% (PA <1 per week) to 8.0% (PA 7+ per week). For a visual representation of this relationship Figure 9 shows the proportion of participants experiencing homeostatic defeat for each level of PA.

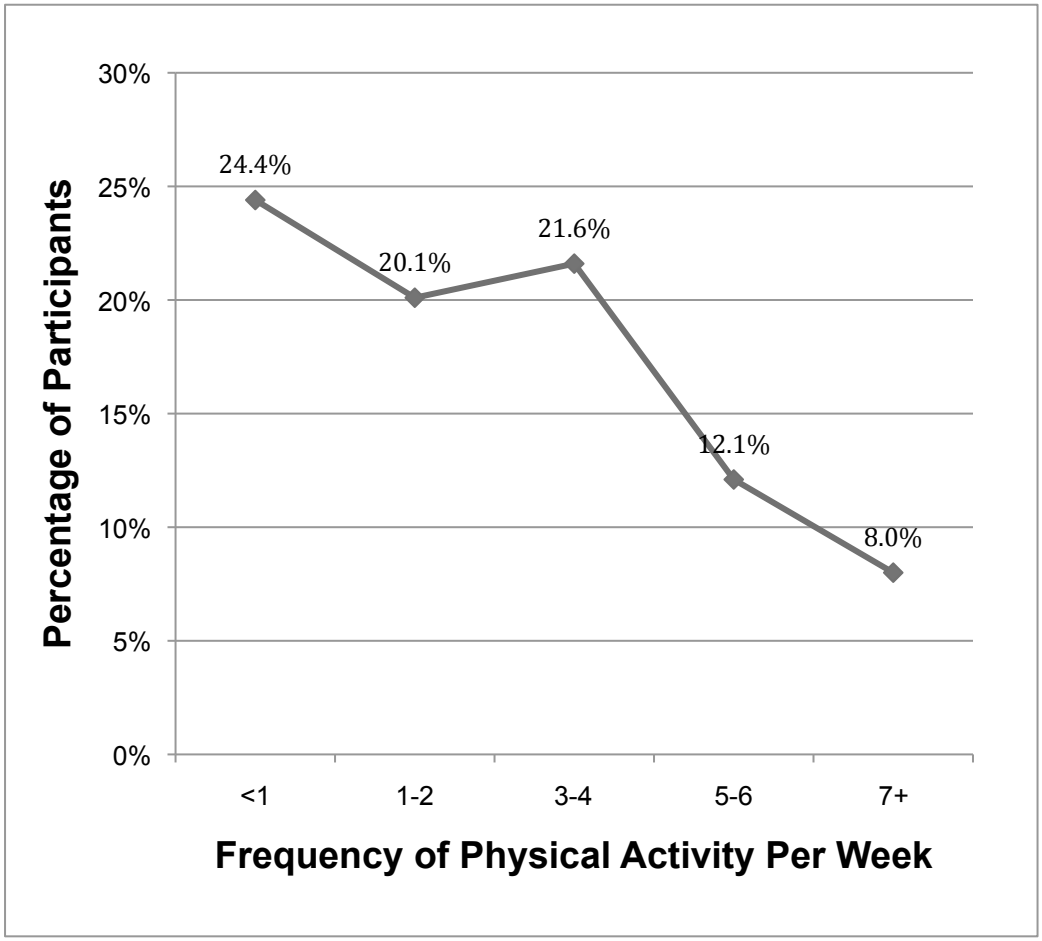

Figure 9. Percentage of participants experiencing homeostatic defeat (using DASS-21 depression) versus frequency of Physical Activity

It can be seen in Figure 9 that as the frequency of PA increases there is a reduction in the proportion of participants experiencing homeostatic defeat.

In summary, the results support Hypothesis 1 in showing a significant positive relationship between SWB and frequency of PA. As the frequency of PA increased there was an increase in the proportion of participants with high (85+) levels of SWB. However, from the SWB groupings an increase in the frequency of PA is not associated with a reduction in proportion of participants experiencing homeostatic defeat. The proportion of these participants remained relatively stable. In contrast, the results testing Hypothesis 2, using the depression measure,

as the frequency of PA increased the proportion of participants experiencing homeostatic defeat reduced.

6.4.3 Hypothesis 3. The third hypothesis proposes a significant negative relationship between the time since the last PA experience and SWB and a positive relationship with depression. This is weakly supported for depression (r= .12, p= .00) but not for SWB (r= -.08, p= .06). Table 10 shows these results.

Table 10

Comparison of the Time Since Physical Activity with SWB and DASS-21 Depression

		Time Since Physical Activity					
		Today	Yesterday	2-6 days	1-3 Weeks	1-2 Months	2+ Months
SWB	Mean	76.61	77.68	76.23	75.16	76.88	69.33
	SD	12.71	11.19	12.06	9.63	6.29	16.06
Depression	Mean	9.88	9.87	13.03	10.82	14.11	17.71
	SD	11.18	11.81	13.10	8.81	10.63	13.50
	N	160	161	177	71	16	15

Table 10 shows that depression scores remain relatively stable over the first three weeks then increase steadily as the time since PA increases further. In comparison, SWB remains relatively stable, between approximately 75-78 points. While beyond two months SWB reduces to 69.33, which is below the normal range of 76.7-73.7 points (Cummins, 2010), the variance also greatly expanded. An analysis of variance between time since PA and SWB, and time since PA and

depression, found a significant difference for depression F(5, 594)= 2.81, p= .02 (Levene's statistic *p*= .70), but not for SWB. Post hoc testing for both analyses revealed no differences between each level of PA. Interestingly, participants engaging in PA 2 or more months ago recorded the highest standard deviations for both SWB (16.06) and depression (13.50). This is consistent with previous research, which has shown a decrease in SWB (or increase in depression) is associated with an increase in the standard deviation (Bittar, 2009).

The next part of the analyses will compare the time since PA to the proportion of participants with either normal or DASS-determined levels of depression (see Table 11 for these results). As with hypothesis 1 due to the low number of participants with *moderate, severe* and *extremely severe* depression, the category of homeostatic defeat will include participants with *mild* depression.

Table 11

Comparing Time Since PA to the Proportion of Participants experiencing depression

	DASS-21 Depression			
Time since Physical Activity	Normal		Depression (Homeostatic Defeat)	
	N	%	N	%
Today	135	84.4	25	15.6
Yesterday	140	87.0	21	13.0
2-6 days ago	139	78.5	38	21.5
1-3 weeks ago	60	84.5	9	15.5
1-2 months ago	11	68.8	4	31.2
2+ months ago	8	53.3	5	46.7

It can be seen in Table 11 shows that as the time since PA increases there is a decrease in the proportion of participants with *normal* levels of depression and an increase in the proportion of participants with a significant level of depression ($\chi^2(5)= 11.53$, $p= .04$). Interestingly for groups who did not engage in PA for at least 2 months almost half of participants (46.7%) had a significant level of depression.

In conclusion, hypothesis 3 shows a significant positive relationship between time since PA and depression and a non-significant relationship for SWB. Further analysis revealed the proportion of participants with at least *mild* levels of depression increased as the time since PA increased.

The next part of the analysis concerns the operation of SWB at high levels. In Chapter 1, it was argued that SWB could not be sustained higher than the 'set point range' for prolonged periods (Cummins, 2009). Thus, it is expected that at all levels of PA SWB will be below the upper limit of the 'set point range', but not beyond it. As with previous analyses the boundary between normal and high levels of SWB is a score of 85.

6.4.4 Hypothesis 4. The fourth hypothesis proposes that all groups engaging in PA will have an average SWB score that is less than 85. Table 12 shows the SWB descriptives for the frequency and time since PA.

Table 12

SWB Descriptive Statistics for the Frequency and Time Since Physical Activity

Frequency of Physical Activity Per Week			Time Since Physical Activity		
	Mean	SD		Mean	SD
<1	75.37	10.88	Today	76.61	12.71
1-2	75.04	12.13	Yesterday	77.68	11.19
3-4	75.87	12.21	2-6 days	76.23	12.06
5-6	77.67	10.98	1-3 Weeks	75.16	9.63
7+	80.82	12.62	1-2 Months	76.88	6.29
			2+ Months	69.33	16.06

Table 12 shows that for all groups SWB was below 85 with means between 80.82-75.04 for frequency of PA per week and 77.68-69.33 for time since PA, therefore supporting the hypothesis.

The next analysis explores the extent to which PA predicts SWB.

Standard Multiple Regression Analysis Predicting Subjective Wellbeing by Physical Activity

A standard multiple regression was performed using SWB as the dependent variable and both PA per week and time since PA as independent variables. Table 13 displays the correlations between the variables, the unstandardised regression coefficients (*B*), the standardised regression coefficients (β), R^2, adjusted R^2 and the semi-partial correlations (sr^2: unique contribution of each independent variable).

Table 13

Multiple Regression for PA Variables Predicting SWB

Variables	SWB	1	2	*B*	β	*sr2*
1. PA Per week	.12**	1	-.55**	.13	.11*	1.0%
2. Time since PA	-.08	-.55**	1	-.14	.05	.01%

R^2= .015 Total explained unique variance= .010

Adjusted R^2= .012 Total explained shared variance = .002

**p< .01

* p< .05

The R for the regression was significantly different from zero F (1, 597) = 4.52, p = .01. The adjusted R^2 value of .012 indicates that only 1.2% of the variability in SWB scores is predicted by both the frequency of PA per week and the time since PA. Only frequency of PA per week contributed significantly to the prediction of PWI scores.

In summary, while PA weakly predicts SWB, only 1.2% of the variability could be accounted for, and time since PA made no independent contribution.

The next section compares the PA sample to an Australian sample derived from the Australian Unity Wellbeing Index Survey.

6.4.5 Hypothesis 5. The fifth hypothesis is that groups who engage in PA will have higher levels of SWB when compared to a sample of Australian participants. This was not supported t (1198)= .95, p= .34 (Levene's statistic p= .46, Bonferroni correction: p< .008). Subsequent analyses compared each level of

PA to the comparison sample. As an independent sample t-test can become unreliable if the two samples are unequal in size (Gardner, 1975) for each PA grouping the following analyses used a random sample of Australian participants with the same sample size. Table 14 shows these comparisons.

Table 14

Comparisons of SWB for the Physical Activity and Comparison Sample

Comparison sample				Physical Activity sample			
N	Mean	SD		N	Mean	SD	t-tests
45	75.96	9.00	Frequency of Physical Activity Per Week	<1	45	75.37	10.88	t (88)= -.91 p= .94
159	75.52	10.79		1-2	159	75.04	12.13	t (316)= -.15 p= .55
213	75.99	12.22		3-4	213	75.87	12.21	t (424)= -1.00 p= .92
132	75.23	12.85		5-6	132	77.67	10.98	t (264)= 2.39, p= .01
50	75.96	12.61		7+	50	80.82	12.62	t (94)= 2.16, p= .03
600	75.65	11.01		Total	600	76.45	11.95	t (1200)= .95, p = .34

Overall, the PA sample (mean: 76.45) had a SWB mean .80 points higher than the Australian comparison sample (mean: 75.65), however this was not significantly different. Subsequent analysis found that participants who engage in PA 5-6 and 7+ times per week had a significantly higher level of SWB compared to the Australian comparison group. No other differences were significant. The analysis above was repeated using DASS-21 Depression. Table 15 shows these results.

Table 15

Comparisons of DASS-21 Depression for the Physical Activity and Comparison Sample

Comparison sample					Physical Activity sample			
N	Mean	SD			N	Mean	SD	t-tests
45	15.65	11.75		<1	45	13.42	11.35	t (88)= -.91, p= .36
159	15.05	13.33	Frequency of Physical Activity Per Week	1-2	159	11.59	11.71	t (316)= -2.47, p= .01
213	15.04	10.30		3-4	213	12.17	12.76	t (424)= -1.88, p= .06
132	15.99	12.02		5-6	132	10.30	11.65	t (264)= -3.20, p= .00
50	15.65	11.62		7+	50	6.74	7.39	t (264)= -3.54, p= .00
600	15.34	15.03		Total	600	11.22	11.84	t (1200)= -4.09, p = .00

In contrast, the PA sample (mean: 11.22) had an overall DASS-21 depression score 3.12 points lower than the Australian comparison sample (mean: 14.34), which was significantly different t(1198)= -4.09, p= .00 (Levene's statistic p= .00, Bonferroni correction: p< .008). Subsequent analysis found that groups engaging in PA 1-2, 5-6 and 7+ per week had significantly lower depression levels than the comparative sample.

In summary, the analysis showed that individuals engaging in PA 5-6 and 7+ times per week had a higher level of SWB and lower level of depression compared to the comparison sample. Analysis of the overall samples showed a significant difference between the PA and comparison sample for depression but not for SWB.

6.5.6 Hypothesis 6. The sixth hypothesis is that groups who engage in

PA will have a significantly lower proportion of participants facing homeostatic defeat (SWB score <60) when compared to the Australian comparison sample. The PA sample overall did not differ from the comparison sample in this regard (PA: 9.0%, comparison: 11.7%: $\chi^2(1)= 2.30$, p= .07).

Because it is not possible to be precise concerning the meaning of an individual SWB score that lies between 50 and 70 points the analysis above was repeated using the DASS-21 depression subscale (Lovibond & Lovibond, 1995). A DASS-21 depression level of *mild* depression or higher was used to represent homeostatic defeat. Table 16 compares the proportion of participants experiencing homeostatic defeat for both the PA and comparison samples.

Table 16

Depression N (%) and Chi-square Tests for the Physical Activity and Australian Comparison Sample

	DASS-21 Depression		Chi-Square tests
	Homeostatic Control	Homeostatic Defeat	
Physical Activity	547 (91.2%)	53 (8.8%)	$\chi^2(1)= 14.75$, p= .00
Comparison Sample	503 (83.8%)	97 (16.2%)	

It can be seen in Table 16 that the PA sample had significantly lower proportion of participants facing homeostatic defeat than the comparison sample.

The analyses above have shown inconclusive results with regard to the proportion of participants facing homeostatic defeat. Results indicate a

significant difference for depression but not SWB.

6.5 Personal Wellbeing Index (SWB) Item Analysis

The purpose of this next section is to investigate differences between the PA and comparison samples for each PWI domain. Each domain will also be examined for its ability to predict PA.

A multivariate analysis of variance examining differences between the PA and comparison samples, using the PWI domains as the dependant variables, was significant $F(7, 1192)= 10.37$, $p= .00$, Wilk's $\lambda= .945$. The means, standard deviations, univariate results and normative ranges are presented in Table 17.

Table 17

Means, Standard Deviations, Univariate Comparisons and Normative Ranges for the SWB Domains

	Physical Activity sample N=600		Comparison sample N=600			Normative Ranges
Domain	M	SD	M	SD	t-tests	
Standard of Living	77.89	15.23	79.47	15.09	F(1, 1198)= 3.40, p= .07	**75.09-79.47**
Health	78.45	16.41	73.62	16.91	F(1, 1198)= 26.31, p= .00	**73.90-76.29**
Achieving	73.61	16.72	72.75	17.42	F(1, 1198)= .79, p= .38	**72.64-75.73**
Relationships	75.35	19.41	76.64	20.00	F(1, 1198)= 3.63, p= .06	**77.80-81.82**
Safety	84.37	16.36	80.91	15.23	F(1, 1198)= 10.68, p= .00	**74.47-80.80**
Community	73.30	18.69	71.90	17.92	F(1, 1198)= .46, p= .50	**68.58-72.46**
Future Security	72.21	19.61	72.64	18.68	F(1, 1198)= .91, p= .34	**67.95-73.04**

Table 17 shows the domains Safety and Health had the two highest means for the PA sample, whilst univariate comparisons revealed both of these domains to be significantly higher for the PA compared to the comparison sample (Bonferroni correction: $p < .007$). Comparisons also revealed the PA sample means for Health (2.16 points), Safety (3.57 points), and Community (.84 points) were above, and Relationships (2.45 points) below the Australian Unity Wellbeing Index normative domain ranges (The International Wellbeing Group,

2010).

The next analysis explores the extent to which the PWI domains are cross-sectional predictors of frequency of PA per week and time since PA.

Standard Multiple Regression Analysis Predicting frequency of Physical Activity by PWI Domains

A standard multiple regression was performed using frequency of PA per week as the dependent variable and the PWI domains as independent variables. Table 18 displays the correlations between the variables, the unstandardised regression coefficients (*B*), the standardised regression coefficients (β), R^2, adjusted R^2 and the semi-partial correlations (sr^2: unique contribution of each independent variable).

Table 18

Multiple Regression for the PWI Domains Predicting Frequency of Physical Activity Per Week

	Frequency of PA Per Week (Correlation)	B	*B*	sr^2
Standard of living	.09*	.033	.047	.12%
Health	.12**	.039	.061	.28%
Achieving	.13**	.066*	.105	.71%
Relationships	.03	-.034	-.062	.28%
Safety	.04	-.039	-.060	.23%
Community	.15**	.093**	.163	1.85%
Future Security	.06	-.033	-.061	.21%
R^2	.043			
Adjusted R^2	.032			

**p< .01

*p< .05

The R for the regression was significantly different from zero F (7, 591) = 4.14, p = .00. The adjusted R^2 value of .032 indicates that only 3.2% of the variability in frequency of PA per week is predicted by the PWI domains. Standard of living, Health, Achieving and Community correlated with frequency of PA, however, only Achieving and Community were cross-sectional predictors of PA.

The next regression uses time since PA as the dependent variable and the

PWI domains as independent variables. Table 19 displays the correlations between the variables, the unstandardised regression coefficients (*B*), the standardised regression coefficients (β), R^2, adjusted R^2 and the semi-partial correlations (sr^2: unique contribution of each independent variable).

Table 19

Multiple Regression for the PWI domains Predicting Time Since Physical Activity

	Time since PA (Correlation)	B	*B*	sr^2
1 Standard of living	-.01	.047	.059	.20%
2 Health	-.07	-.032	-.043	.14%
3 Achieving	-.11*	-.094**	-.129	1.08%
4 Relationships	.01	.046	.074	.41%
5 Safety	-.05	-.011	-.015	.01%
6 Community	-.13**	-.092**	-.141	1.39%
7 Security	-.02	.043	.070	.27%
R^2	.035			
Adjusted R^2	.024			

**p< .01

*p< .05

The R for the regression was significantly different from zero F (7, 591) = 3.08, p = .00. The adjusted R^2 value of .024 indicates that only 2.4% of the variability in time since PA is predicted by the PWI domains. Only Achieving and Community were cross-sectional negative predictors of PA.

In conclusion, analyses of the PWI domains showed Health and Safety to be higher for the PA sample compared to the comparative sample, whilst Health, Safety, and Community were above, and Relationships below the Australian Unity Wellbeing Index normative domain ranges. These findings may reflect the idiosyncrasies of the sample. Analyses also showed that only the domains Achieving and Community contributed weakly to the prediction of both frequency of PA and time since PA.

6.6 Results Summary

To briefly summarize these results:

- The PWI and DASS-21 factored correctly.
- Analysis of the demographic variables found seven (Surfers, Australians, Americans, Canadians, Males, and participants aged 18-24 and 50-59) to fall above the Australian Unity Wellbeing Index normative range, and one group below (British).
- The results support Hypothesis 1 in showing a significant but weak positive relationship between SWB and frequency of PA ($r = .12$ $p = .03$). A comparison of SWB between 5 levels of PA showed SWB to be higher for participants engaging in 7+ times per week than those engaging 1-2 times per week. No other differences were significant.
- As the frequency of PA increased there was an increase in the proportion of participants with high (85+) levels of SWB. While there was no change in the proportion of participants with low levels of SWB, the proportion of participants with depression decreased.
- As the time since PA increased there was an increase in depression, which

was not reciprocated with a decrease in SWB. Further analysis revealed the proportion of participants with depression increased with the time since PA.

- All groups engaging in PA had an average SWB score less than 85.
- A regression analyses showed that PA weakly predicted SWB, however time since PA made no independent contribution to this analysis.
- Comparisons between the PA and comparison samples showed a significant difference for depression but not for SWB. Analyses also showed that groups engaging in PA 5-6 and 7+ times per week had a higher level of SWB and lower level of depression when compared to the comparison sample.
- The PA sample had a significantly lower proportion of participants facing homeostatic defeat when compared to the Australian comparison sample using the depression measure, but not for the SWB measure.
- The items Health and Safety were the only domains higher for the PA sample compared to the comparative sample, whilst Health, Safety, and Community were above, and Relationships below the Australian Unity Wellbeing Index normative domain ranges. Analyses also revealed that Achieving and Community contributed weakly to the prediction of both frequency of PA and time since PA.

CHAPTER SEVEN: SAMPLE 2

7.1 Method

Approval to conduct this research project was granted by the Deakin University Ethics Committee (see Appendix D).

7.1.1 Participants. An initial sample of 707 participants who engaged in PA were utilized for Study 2, Study 3, and Study 4. The sample comprised 377 males (53.3%) and 330 females (46.7%) with ages ranging from 18 - 73 with a mean age of 34.4. The sample included 366 surfers, 43 swimmers, and 298 yoga enthusiasts. Participants completed four questionnaires in total, over a three-month period (a gap of one month in between each questionnaire). Four periods of data collection were used, as this satisfied the minimum amount of time points (at least three) needed for longitudinal statistical analysis (latent growth curve modelling).

Study 2 utilized data from the first time point to repeat the cross-sectional analyses in Study 1 (specifically in relation to the PA sample). Study 3 utilized data from the fourth time point to determine the potential moderating influence of PA between challenging life events and SWB. Study 4 utilized data from all four-time points to investigate the longitudinal relationship between PA and SWB. As a consequence participant attrition, only one-quarter of the initial sample completed all four-time points. Subsequently, Study 2 (time point one) utilised the entire sample (n= 707). Study 3 utilised all participants who

completed time point four (n= 247). Study 4 utilised participants who completed all four time-points (n= 186)

7.1.2 Recruitment. Recruitment was achieved by placing advertisements on special interest websites related to surfing, swimming, or yoga. Individuals interested in participating in the study clicked on a link provided within the online advertisement directing them to the questionnaire located on the Deakin University website. Participants first read the plain language statement (Appendix E) outlining the purpose and procedure of the research. Individuals who wished to participate were asked for their consent by clicking 'I Agree' on the bottom of the plain language statement, which directed them to the start of the questionnaire. At the end of the questionnaire participants were asked to submit an email address to which the subsequent three questionnaires were sent.

Once participants completed the first questionnaire the information was electronically sent to a secure password protected computer located at Deakin University. A month after completing the first questionnaire, participants were sent the link to the second questionnaire. The returned information was stored as before. This process was repeated for the third and fourth questionnaires.

7.1.3 Questionnaire. Each participant completed a 65-item questionnaire (see Appendix F). This contained five sections measuring Subjective Wellbeing, Depression/Stress/Anxiety, and Descriptive information (see Chapter 6 for a description of these measures). A measure of Personality was also utilised, and is described below.

7.1.3.1 Personality. The Big Five 16-Adjective Measure (BF-16AM) is a measure of adult personality across the personality domains neuroticism, extraversion, openness, agreeableness, and conscientiousness (Herzberg & Brähler, 2006). Participants are asked to rate on a 7-point Likert scale the extent to which they agree or disagree with a statement about themselves (e.g., "I see my self as easily upset"). For each of the personality domains the BF-16AM yielded coefficient alpha's ranging from .57 for Optimism to .74 for Conscientious, indicating reasonable internal consistency (Herzberg & Brähler, 2006). The convergent validity between the BF-16AM and the NEO- Five Factor Inventory NEO-FFI was also shown to be statistically significant (Herzberg & Brähler, 2006).

7.1.3.2 Descriptive Information. Descriptive information was collected on age, gender, Physical Activity (PA) ability, the amount of PA achieved per week, and the length of time since participation in PA. As previously defined, PA is a term used to describe all forms of large muscle movements including sports, dance, games, work, lifestyle activities, and exercise for fitness, as well as many others (Corbin, et al., 2008). For the current study participation in surfing, swimming and yoga will be used to represent PA.

7.1.3.3 Challenging Life Events. In time point 4 (used for Study 3) the construct of 'challenging life events' is measured by the following question: "In the last month has something happened to you causing you to feel happier or sadder than normal?" The response options were: Yes, happier /Yes, sadder/ No. Refer to Chapter 10 for a discussion of this measure.

7.2 Data Preparation

7.2.1 Data cleaning. Consistent with data cleaning guidelines (International Wellbeing Group, 2006) data with maximum or minimum scores across all PWI domains were eliminated prior to data analysis (19 cases). To minimize the potential of cultural/language differences influencing the results participants who did not indicate residence in Australia, United States, Britain, South Africa, Canada or New Zealand were removed from the sample (14 cases).

7.2.2 Missing Data. Estimation maximization was used to replace missing values in all independent variables with less than 5% missing data. Due to the high proportion of missing values in the SWB item "how satisfied are you with your spirituality or religion" (22.7%) this item was excluded from the analyses. Subsequently SWB was calculated using the remaining 7 domains.

7.2.3 Outliers. Univariate outliers were removed by calculating standardized scores on all dependent variables. On inspection of the z-scores, all values greater than 3.3 were removed (20 cases). Multivariate outliers within all dependent variables were calculated using a Regression analyses to compute the Malhalanobis distance. Malhalanobis distance is distributed as a chi-square (χ^2) variable, with degrees of freedom equal to the number of dependent variables. To determine which cases were multivariate outliers, the critical χ^2 was calculated with an alpha level for seven degrees of freedom (χ^2 at α=.001 for 7df = 24.32). 11 cases were identified as multivariate outliers and removed.

7.2.4 Normality. Normality was assessed across all dependent variables. Using the SPSS descriptive statistics function, negative skews were found in the following variables: SWB (*z* = -.77), Extraversion (*z* = -.013). Positive skews were found for the following variables: Depression (z = 1.21), and Neuroticism (z = .36). Analysis of the dependent variables revealed kurtosis values between z= .78 (Depression) and z= -.79 (Extroversion). According to Cohen and Cohen (1983), skewness and kurtosis are acceptable within the range of -7.0 to 7.0. Further, Tabachnick and Fidell (2001), advises normality issues are seldom critical for analyses using large samples (n>300). As this study had an acceptable range of values for skewness and kurtosis, and utilized a large sample (n = 707) the assumptions of normality were satisfied.

7.2.5 Multicollinearity. All dependent variables including SWB, depression, extraversion and neuroticism were tested for multicollinearity. The highest correlations were found between SWB and neuroticism (r= -.48), and SWB and depression(r= -.57). According to Tabachnick and Fidell (2001) multicollinearity occurs when correlations exceed .90. Therefore the assumption of multicollinearity was met for this sample.

CHAPTER EIGHT: STUDY TWO

After data cleaning the remaining 707 participants were utilized in the following analyses.

8.1 Results

The structure of this chapter is as follows:

1. Factor Analyses
2. Analysis of descriptive statistics
3. Analysis of the hypotheses
4. Analysis of PWI items
5. Results summary

8.1.1 Factor Analyses. The purpose of this section is to determine the factor structure of each scale using this new data set.

Factor Analysis- Personal Wellbeing Index (PWI)

The PWI seven domains have consistently shown to form a single stable factor, which accounts for about 50% of the variance in Australia and other countries (The International Wellbeing Group, 2006).

Inspection of the correlation matrix revealed one coefficient below .3 (Health and standard of living= .29). The Kaiser-Meyer-Oklin value was .86, exceeding the recommended value of .6 (Kaiser, 1970, 1974) and Bartlett's Test of Sphericity (Bartlett, 1954) reached statistical significance, supporting the factorability of the correlation matrix. Principal Components Analysis revealed

the presence of one component with an eigenvalue exceeding one (3.36), explaining 48.0% of the variance. Inspection of the scree plot revealed a clear break after the first component. Item loadings on this component are presented in Table 20 below.

Table 20

Personal Wellbeing Index Item Loading on PCA Component

Personal Wellbeing Index Item	Component 1
Achievements	.80
Security	.77
Community	.72
Safety	.70
Relationships	.69
Health	.66
Standard of Living	.44

Table 20 shows the item loadings for the Principal Components analysis. Whilst the item loading for Standard of Living is relatively low, it is still regarded as interpretable (Tabachnick & Fidell, 2007). It is concluded that the item loadings from Table 20 support the current conceptualisation of the PWI representing a single factor.

Factor Analysis- Depression Anxiety Stress Scale- 21 (DASS-21)

The DASS-21 consists of three underlying dimensions: depression, anxiety, and stress (Lovibond & Lovibond, 1995). This study uses the 7-item depression measure only.

Prior to performing this analysis, the suitability of data was assessed. Inspection of the correlation matrix revealed coefficients between .33 (self-deprecation and inertia) and .67 (dysphoria and hopelessness). The Kaiser-Meyer-Oklin value was .91, exceeding the recommended value of .6 (Kaiser, 1970, 1974) and Bartlett's Test of Sphericity (Bartlett, 1954) reached statistical significance, supporting the factorability of the correlation matrix. Principal Component Analysis revealed the presence of one component with an eigenvalue exceeding one (4.32), explaining 61.75% of the variance. Inspection of the scree plot revealed a clear break after the first component. Item loadings on this component are presented in Table 21 below.

Table 21

DASS-21 Item Loading on PCA Component

DASS-21 Item	Component 1
Lack of interest/involvement	.84
Self-deprecation	.84
Hopelessness	.80
Devaluation of Life	.78
Dysphoria	.76
Anhedonia	.72
Inertia	.64

Table 21 shows the item loadings for the Principal Components analysis. It is concluded that the seven items factor as intended by the authors of the scale.

Factor Analysis- Big Five 16-Adjective Measure (BF-16AM)

The BF-16AM is a measure of adult personality across the factors of neuroticism, extraversion, openness, agreeableness, and conscientiousness (Herzberg & Brähler, 2006). This study will use the three-item extraversion and four-item neuroticism scales only.

Inspection of the correlation matrix for each variable revealed no coefficients below .3. The Kaiser-Meyer-Oklin value was .72, exceeding the recommended value of .6 (Kaiser, 1970, 1974) and Bartlett's Test of Sphericity (Bartlett, 1954) reached statistical significance, supporting the factorability of the correlation matrix.

Principal Components Analysis revealed the presence of two components. The first component (eigenvalue: 2.33), explained 33.28% of the variance. The second component (eigenvalue: 1.91) explained 27.34% of the variance. Inspection of the scree plot revealed a clear break after the second component. Item loadings on both components are presented in Table 22 below.

Table 22

Neuroticism and Extraversion Item Loading on PCA Components

	Component	
Item	1	2
Quiet (E)*	**.87**	.07
Reserved (E)*	**.83**	-.02
Introverted (E)*	**.76**	-.11
Calm (N)*	.34	**.75**
Easily upset (N)	-.11	**.78**
Anxious (N)	-.26	**.72**
Emotionally stable (N)*	-.02	**.71**

N= Neuroticism, E= Extraversion

* Reverse scored

Item loadings from Table 22 support the current conceptualisation of two factors representing extraversion and neuroticism.

8.1.2 Descriptive Statistics for the Physical Activity Sample. Table 23 presents the means, standard deviations and correlations for the dependent variables for the PA sample (N= 707).

Table 23

Means, Standard Deviations and Correlation Matrix for all Dependent Variables

			Correlation Matrix		
	Mean	SD	1.	2.	3.
1. SWB (PA)	71.60	14.99	1		
2. Depression (PA)	13.19	13.18	-.57**	1	
3. Extraversion (PA)	13.47	7.33	.18*	-.18**	1
Neuroticism (PA)	26.57	7.82	-.48**	.57**	-.09*

**Correlation is significant at the 0.01 level.

*Correlation is significant at the 0.05 level.

The correlation matrix in Table 23 shows all of the correlations to be significant. The highest correlation was between SWB and depression (-.57). The smallest correlation was between extraversion with neuroticism (-.09). Table 23 also shows the mean depression level was 13.19 (SD: 13.18), which is within the 'normal' range on the DASS-21 depression scale. Overall, the PA sample has a SWB mean of 71.60 (SD: 14.99), which is below the Australian Unity Wellbeing Index normative range of 76.7-73.7 (The International Wellbeing Group, 2010), and is significantly less than the SWB of Study 1 (mean: 76.45) t (1305)= -6.39, p= .00.

There are a number of explanations for the low SWB in Study 2, the first of which relates to the country of origin. Table 24 depicts the SWB descriptives and the percentage of participants from each country for Study 1 and 2.

Table 24

Means, N and Percentages for each Country for Study 1 and 2

	Country	Mean	N	%
Study 1	Australia	77.48	300	50.0
	USA	77.32	155	25.8
	Britain	72.24	95	15.8
	Canada	76.86	50	8.3
	Total	76.45	600	
Study 2	Australia	75.49	141	19.9
	USA	70.23	206	29.1
	Britain	68.85	231	32.7
	Canada	74.00	118	16.6
	Total	71.60	707	

Table 24 shows lower values from Study 1 to 2 for all countries. These differences range between 1.99 for Australians to 7.09 for Americans. Table 24 also shows that in both studies Australians had the numerically highest SWB. For Study 1 an analysis of variance of country of origin was significant $F(3, 597)= 3.37$, $p=.01$, with post hoc comparisons showing Australians have a higher SWB than British participants. For Study 2 an analysis of variance of country of origin was significant $F(3, 703)= 5.20$, $p=.00$, with post hoc comparisons showing Australians have a higher SWB than American and British participants. From Study 1 to 2 the proportion of participants from Australia decreased from 50.0% to 19.9%, whilst the proportion from all other countries increased. Thus, a

reduction in the SWB for each country, coupled with a reduction in the proportion of Australian participants contributed to the lower overall SWB in Study 2.

A second explanation for the low SWB in Study 2 relates to the proportion of participants engaging at low levels of PA. Table 25 depicts the N, mean and percentages against the frequency of PA per week for Study 1 and 2.

Table 25

Means, N and Percentages Against the Frequency of Physical Activity Per Week for Study 1 and 2

	PA per week	N	%	Mean
Study 1	<1	45	7.5	75.37
	1-2	159	26.5	75.04
	3-4	213	35.5	75.87
	5-6	132	22.0	77.67
	7+	50	8.3	80.82
Study 2	<1	129	18.3	68.22
	1-2	211	29.8	70.45
	3-4	200	28.3	72.49
	5-6	101	14.3	72.84
	7+	66	9.3	77.21

Table 25 shows proportion of participants engaging in PA <1 and 1-2 times per week in Study 2 was 48.1%, compared to 34.0% in Study 1, a difference of 14.1%. Findings in Study 1 showed a positive relationship between the frequency of PA and SWB, and that those who engage at low levels of PA

have significantly lower SWB to those participating at higher levels. Thus, an increase proportion of participants engaging at low levels contributed to the low overall SWB in Study 2.

The last explanation for the low SWB in Study 2 relates to the proportion of participants engaging in PA 2 or more months ago. Table 26 depicts the N, mean and percentages against the PA per week for Study 1 and 2.

Table 26

Means, N and Percentages for each Country for Study 1 and 2

	Time since PA	N	%	Mean
Study 1	Today	160	26.7	76.61
	Yesterday	161	26.8	77.98
	1-6 days	177	29.5	76.23
	1-3 Weeks	71	11.8	75.16
	1-2 Months	16	2.7	76.88
	2+ months	15	2.5	69.33
Study 2	Today	133	18.8	75.65
	Yesterday	122	17.3	69.65
	1-6 days	207	29.3	72.03
	1-3 Weeks	86	12.2	72.04
	1-2 Months	36	5.1	73.87
	2+ months	123	17.4	67.44

Table 26 shows that for those engaging in PA 2 or more months ago the mean SWB for both Study 1 and 2 was below the Australian Unity Wellbeing

Index normative range (4.37 and 6.36 points respectively). Table 26 also shows the proportion of participants engaged in PA 2 or more months ago increased from 2.5% in Study 1 to 17.4% in Study 2. Thus, the greater proportion of participants engaging in PA 2 or more months ago also contributed to the lower overall SWB level in Study 2.

In conclusion, the lower SWB in Study 2 is explained by the combined influence of a decrease in the proportion of participants from Australia, an increase the proportion of participants engaging at low levels of PA, and an increase in the proportion of participants engaging in PA 2 or more months ago.

8.2 Testing the Hypotheses

8.2.1 Hypothesis 1

The first hypothesis proposes a significant positive relationship between the frequency of PA and SWB. This is weakly supported (r= .15 p= .00). Table 27 shows the changes in SWB with PA frequency.

Table 27

SWB Descriptive Statistics for the Frequency of Physical Activity Per Week

		N	Mean	SD
Frequency of	<1	129	68.22	15.42
Physical	1-2	211	70.45	15.79
Activity Per	3-4	200	72.49	14.15
Week	5-6	101	72.84	14.67
	7+	66	77.21	12.61

As PA per week increases, SWB improves steadily at low to moderate

levels of PA (<1, 1-2 and 3-4). Between 3-4 and 5-6 times per week SWB plateaus at approximately 72. At higher levels SWB increases from 72.84 points (PA 5-6 per week) to 77.21 (PA 7+ per week). An analysis of variance is significant F (4, 701)= 4.70, p= .00 (Levene's statistic *p*= .21). Post hoc tests (Tuckey HSD) revealed the 7+ group had a SWB level significantly greater than the <1 and 1-2 groups. No other differences are significant.

Figure 10 shows these results against the SWB normative range (cumulative data from the Australian Unity Wellbeing surveys: Cummins, 2010).

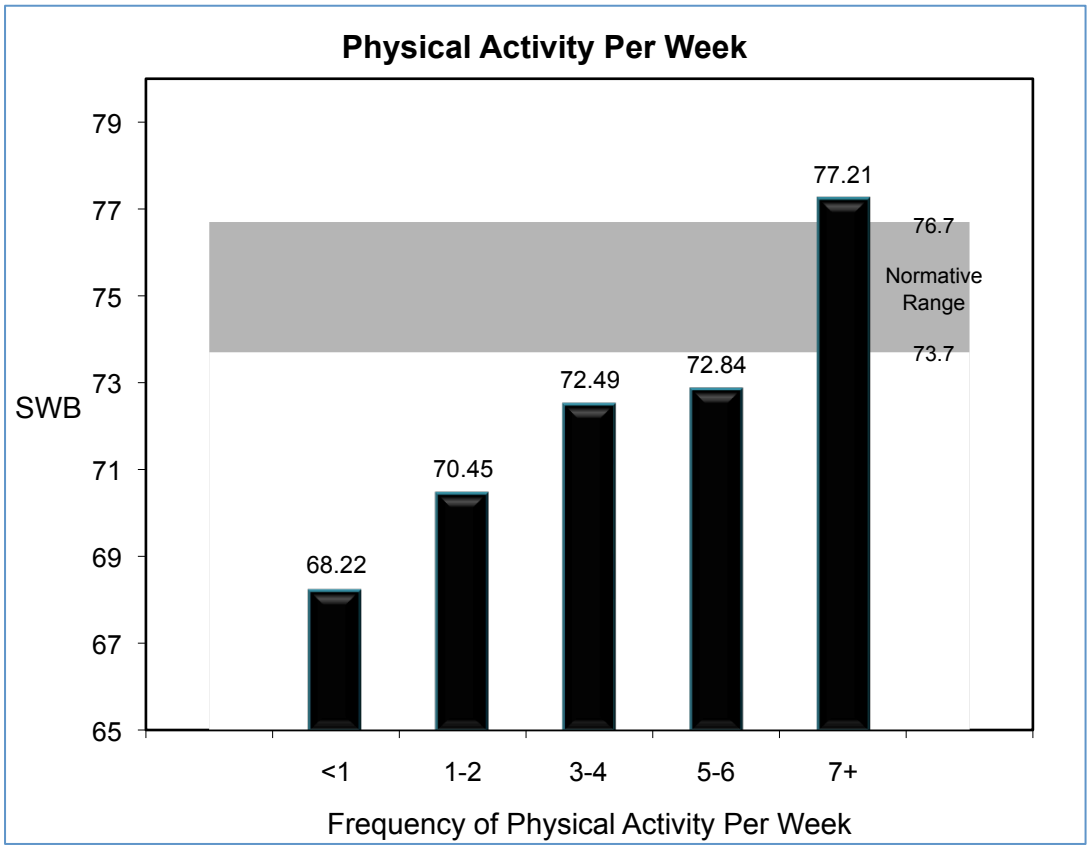

Figure 10. Mean SWB level versus the frequency of Physical Activity per week

Figure 10 illustrates that up to 5-6 times per week the mean level of SWB lies below the normative range. At higher levels of PA (7+), SWB exceeds this range.

Personality and household income

Research has shown that personality factors influence SWB levels (Kozma, Stone & Stones, 2000). The strongest evidence relates to the dimensions of extraversion and neuroticism. Extraversion has been found to positively correlate, whilst neuroticism correlates negatively with SWB (Hayes & Joseph, 2002; 1984, Lucas, Diener, Grob, Suh & Shao, 1998). It has also been found that extraversion correlates positively (r= 0.23) and neuroticism negatively (r= -0.11) with PA (Rhodes & Smith, 2006). As a consequence of the neuroticism and extraversion relationship with SWB and PA there is the potential that these personality factors may influence the relationship between PA and SWB in Hypothesis 1. Research has also shown that there is strong evidence that SWB increases with household income (Cummins, 2010). There is also strong evidence, which has shown a moderate positive relationship between income and the level of PA (Gordon-Larsen, McMurray, Popkin, 2000; Stephens, Jacobs & White, 1985). Thus, the relationship between PA and SWB in Hypothesis 1 may also be influenced by income level.

An analysis of covariance was conducted between the frequency of PA and SWB with neuroticism, extraversion and household income as covariates. The analysis revealed no main effect for PA per week; but a significant relationship between SWB and neuroticism $F(1, 695)= 182.96$, $p= .00$, extraversion $F(1, 695)= 14.90$, $p= .00$, and household income $F(1, 695)= 21.80$, $p= .00$.

In summary, these results indicate a significant positive relationship between SWB and the frequency of PA. Results also showed that when controlling for neuroticism, extraversion and household income there was a non-significant relationship between SWB and the frequency of PA.

Analysis of Low, Normal and High SWB

As indicated in Chapter 5 as PA per week increases it is expected that there will be a reduction in the proportion of participants with a SWB <60 and an increase in the proportion of participants with a SWB 85+. Thus, the next section compares the frequency of PA to three SWB groupings: <60, 60-84 and 85+ (see Table 28). These groups represent homeostatic defeat (<60), normal (60-84) and high (85+) levels of SWB (see Chapter 1 for a explanation of these groupings).

Table 28

SWB grouping (<60, 60-84, and 85+) Compared to the Frequency of Physical Activity Per Week

		Frequency of Physical Activity Per Week									
		<1		1-2		3-4		5-6		7+	
		N	%	N	%	N	%	N	%	N	%
SWB Category	<60	25	19.4	38	18.0	25	12.5	11	10.9	6	9.1
	60-84	86	66.7	140	66.4	135	67.5	69	68.3	39	59.1
	85+	18	14.0	33	15.6	40	20.4	21	20.8	21	31.8
	Total	129	100	211	100	200	100	101	100	66	100

Table 28 shows that as the frequency of PA increases the proportion of participants with a low level of SWB (<60) decreases from 19.4% (<1 per week)

to 9.1% (7+ per week). In comparison the proportion of participants with high levels of SWB (85+) displayed the greatest amount of change increasing from 14.0% (PA <1 per week) to 31.8% of the sample (PA 7+ per week). The proportion of participants with a normal level of SWB (60-84) remained relatively stable as PA per week increased to 5-6 times per week, and then dropped by 8.8% to 59.1%. For a visual representation of this relationship see Figure 11.

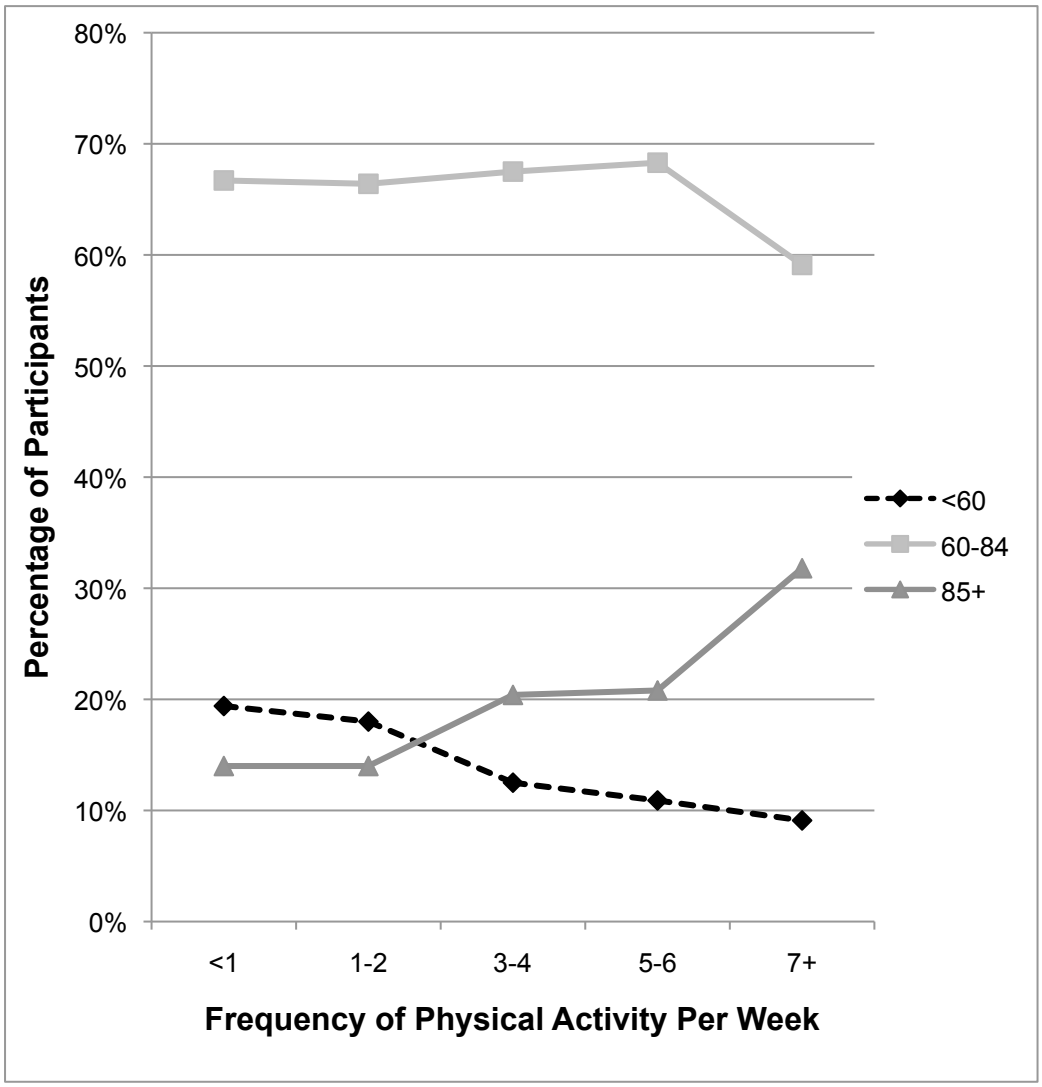

Figure 11. Percentage of participants in each SWB grouping (<60, 60-84, and 85+) versus frequency of Physical Activity

Figure 11 shows that, as the frequency of PA increases, the proportion of people in the normal range group (60-84) remains relatively stable up to 5-6 times per week before reducing. The proportion of participants in the high group (85+) increases, which is reciprocated by a reduction in the proportion of participants in the lowest group (<60). Interpreted in terms of homeostasis theory a shift in the proportion of participants from low to high levels of SWB suggests there are a greater proportion of participants operating towards the top of their set point range and also indicates a reduction in the proportion of participants who are experiencing homeostatic defeat.

A difficulty in interpreting these results is that, as suggested in Chapter 1, it is not possible to be precise concerning the meaning of an individual SWB score that lies between 50 and 70 points. A score within this range can represent either a low set point or depression. Because of this uncertainty, the analyses above were repeated using the DASS-21 depression (Lovibond & Lovibond, 1995) to represent homeostatic defeat according to the DASS criterion.

8.2.2 Hypothesis 2. The second hypothesis proposes that there will be a reduction in the proportion of participants facing homeostatic defeat (measured by DASS-21 depression) as the frequency of PA increases.

In Chapter 1 it was shown that in comparing SWB and depression scores, the end of the homeostatic plateau coincides with mild depression (for a review of the relationship between SWB and depression levels in terms of SWB Homeostasis see Figure 3, Chapter 1). Using the end of the homeostatic plateau as the boundary between homeostatic maintenance and defeat it is likely that *normal* and *mild* depression scores are within the control of the homeostatic

system, whilst levels in excess of *mild* depression (*moderate, severe* and *extremely severe*) indicate the likelihood of homeostatic defeat. Consequently, a DASS-21 depression level exceeding *mild* depression was used to represent homeostatic defeat. Table 29 shows for each level of PA the proportion of participants with *moderate, severe* and *extremely severe depression* compared to those with *normal* and *mild* depression.

Table 29

Comparison of Physical Activity Engaged in Per Week by DASS-21 Depression Category

			Physical Activity (per week)					
			<1	1-2	3-4	5-6	7+	Total
DASS-21	Mean		25.00	19.75	17.61	15.08	13.17	18.82
	SD		22.02	18.22	18.61	16.09	15.19	18.84
Depression Category	Normal (*normal and mild depression*)	N	89	157	160	89	56	551
		%	69.0	74.4	80.0	88.1	84.8	77.9
	Homeostatic Defeat (*moderate, severe and extremely severe depression)*	N	40	54	40	12	10	156
		%	31.0	25.6	20.0	11.1	15.2	22.1

Table 29 demonstrates as PA increases to 5-6 times per week the percentage of participants experiencing homeostatic defeat decreases from 31.1% to 11.9%. As the frequency of PA increases to 7+ per week the percentage increases to 15.2%. A Chi-Square analysis found that as the frequency PA increases there is a significant decrease in the proportion of participants with a significant level of depression ($\chi^2(4)= 15.95$, $p= .00$). Figure 12 shows the proportion of participants experiencing homeostatic defeat for each level of PA.

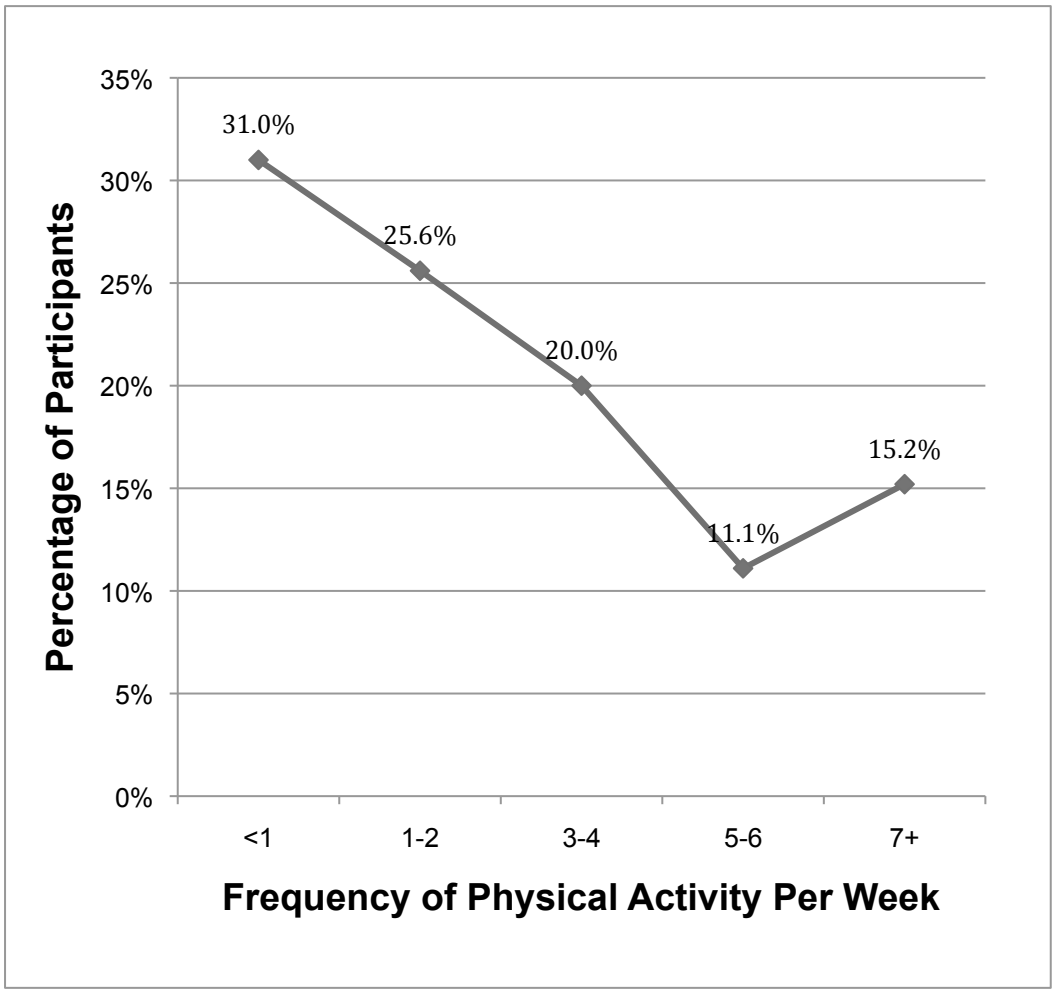

Figure 12. Percentage of participants experiencing homeostatic defeat (using DASS-21 depression) versus frequency of Physical Activity

It can be seen in Figure 12 that as the frequency of PA increases there is a

reduction in the proportion of participants experiencing homeostatic defeat, followed by a moderate increase.

In summary, as the frequency of PA increased there was an increase in the proportion of participants with high (85+) levels of SWB, which was reciprocated by a reduction in the proportion of participants in the lowest group (<60). The results also showed that as the frequency of PA increased the proportion of participants experiencing depression reduced.

8.2.3 Hypothesis 3. The third hypothesis proposes a significant negative relationship between the time since the last PA experience and SWB, and a positive relationship with depression. This is weakly supported for depression (r= .16, p= .00) and for SWB (r= -.12, p= .00). Table 30 shows the means and standard deviations against time since PA.

Table 30

Comparison of the Time Since Physical Activity with SWB and DASS-21 Depression

		Time Since Physical Activity					
		Today	Yesterday	2-6 days	1-3 Weeks	1-2 Months	2+ Months
SWB	Mean	75.65	69.65	72.03	72.04	73.87	67.44
	SD	13.45	14.90	14.69	15.68	11.85	16.38
Depression	Mean	13.71	17.53	19.14	19.52	21.11	23.93
	SD	16.61	17.79	17.89	19.29	20.50	21.49
	N	133	122	207	86	36	123

An analysis of variance between time since PA and SWB, and time since PA and depression found a significant difference for both depression F (5, 701)= 4.11, p= .00 (Levene's statistic *p*= .06), and SWB F (5, 701)= 4.58, p= .00 (Games-Howell equal variances not assumed). Post hoc testing for both SWB and depression revealed a significant difference between those who participated today and 2+ months ago.

The next part of the analyses will compare the time since PA to the proportion of participants with either normal or DASS-determined levels of depression (see Table 31 for these results). As with Hypothesis 1, homeostatic defeat will include participants with *moderate, severe* and *extremely severe* depression.

Table 31

Comparing Time Since PA to the Proportion of Participants Experiencing Depression

	DASS-21 Depression			
Time since Physical Activity	Normal		Depression (Homeostatic Defeat)	
	N	%	N	%
Today	116	87.2	17	12.8
Yesterday	98	80.3	24	19.7
2-6 days ago	157	75.8	50	24.2
1-3 weeks ago	64	74.4	22	25.6
1-2 months ago	29	80.6	7	19.4
2+ months ago	87	70.7	36	29.3

It can be seen in Table 31 that as the time since PA increases there an

increase in the proportion of participants with at least *moderate* levels of depression ($\chi^2(5)= 12.07$, $p= .03$). Interestingly for groups who did not engage in PA for at least 2 months almost one third of participants (29.3%) had at least a *moderate* level of depression.

In conclusion, Hypothesis 3 shows a significant negative relationship between the time since the last PA experience and SWB, and a positive relationship with depression. An analysis of variance between time since PA and SWB, and time since PA and depression found a significant difference for both depression and SWB. Further analysis revealed the proportion of participants with at least *moderate* levels of depression increased as the time since PA increased.

The next part of the analysis concerns the operation of SWB at high levels. In Chapter 1, it was argued that SWB could not be sustained higher than the 'set point range' for prolonged periods (Cummins, 2009). Thus, it is expected that at all levels of PA, SWB will be below the upper limit of the 'set point range', but not beyond it. As with previous analyses the boundary between normal and high levels of SWB is a score of 85.

8.2.4 Hypothesis 4. The fourth hypothesis proposes that all groups engaging in PA will have an average SWB score that is less than 85. Table 32 shows the SWB descriptives for the frequency and time since PA.

Table 32

SWB Descriptive Statistics for the Frequency and Time Since Physical Activity

Frequency of Physical Activity Per Week			Time Since Physical Activity		
	Mean	SD		Mean	SD
<1	68.22	15.42	Today	75.65	13.45
1-2	70.45	15.79	Yesterday	69.65	14.90
3-4	72.49	14.15	2-6 days ago	72.03	14.69
5-6	72.84	14.67	1-3 weeks ago	72.04	15.68
7+	77.21	12.61	1-2 months ago	73.87	11.85
			2+ months ago	67.44	16.38

Table 32 shows that for all groups SWB was below 85 with means between 68.22-77.21 for frequency of PA per week and 67.44-75.65 for time since PA, therefore supporting the hypothesis.

The next part of the analysis will explore the extent to which PA predicts SWB.

Standard Multiple Regression Analysis Predicting Subjective Wellbeing by Physical Activity

A standard multiple regression was performed using SWB as the dependent variable and both PA per week and time since PA as independent variables. Table 33 displays the correlations between the variables, the unstandardised regression coefficients (*B*), the standardised regression coefficients (β), R^2, adjusted R^2 and the semi-partial correlations (sr^2: unique

contribution of each independent variable).

Table 33

Multiple Regression for Physical Activity Variables Predicting SWB

Variables	SWB	1	2	*B*	β	sr^2
1. PA per week	.17**	1	-.57**	.16	.13*	1.2%
2. Time since PA	-.12	-.57**	1	.05	-.06	.3%
R^2= .027				Total explained unique variance= .015		
Adjusted R^2= .024				Total explained shared variance = .009		

**p< .01

* p< .05

The R for the regression was significantly different from zero F (2, 704) = 9.72, p = .00. The adjusted R^2 value of .27 indicates that only 2.7% of the variability in SWB scores is predicted by both the frequency of PA per week and the time since PA. Only frequency of PA per week contributed significantly to the prediction of PWI scores.

In summary, while PA weakly predicts SWB, only 2.4% of the variability could be accounted for, and time since PA made no independent contribution.

8.3 Personal Wellbeing Index (SWB) Item Analysis

The next section will analyse the individual SWB items. Means and standard deviations and normative ranges for SWB are presented in Table 34.

Table 34

Means, Standard Deviations, Univariate Comparisons and Normative Ranges for the SWB Domains

	Physical Activity sample (N=701)		Normative Ranges
Domain	M	SD	
Standard of Living	72.16	19.66	**75.09-79.47**
Health	75.10	19.78	**73.90-76.29**
Achieving	69.91	21.38	**72.64-75.73**
Relationships	69.51	24.61	**77.80-81.82**
Safety	79.94	19.86	**74.47-80.80**
Community	67.92	22.99	**68.58-72.46**
Future Security	66.62	23.79	**67.95-73.04**

Table 34 shows the domains Safety and Health had the two highest means, which were also the only domains with means within the Australian Unity Wellbeing Index normative domain ranges (The International Wellbeing Group, 2010). All other domains fell below the normal range.

The next analysis explores the extent to which the PWI domains are cross-sectional predictors of frequency of PA per week and time since PA.

Standard Multiple Regression Analysis Predicting Frequency of Physical Activity by PWI Domains

A standard multiple regression was performed using frequency of PA per

week as the dependent variable and the PWI domains as independent variables. Table 35 displays the correlations between the variables, the unstandardised regression coefficients (*B*), the standardised regression coefficients (β), R^2, adjusted R^2 and the semi-partial correlations (sr^2: unique contribution of each independent variable).

Table 35

Multiple Regression for the PWI Domains Predicting Frequency of Physical Activity Per Week

	Frequency of PA Per Week (Correlation)	B	*B*	sr^2
Standard of living	.10*	.035	.057	.29%
Health	.16**	.073**	.121	.98%
Achieving	.11**	.001	.003	.00%
Relationships	.03	-.008	-.016	.01%
Safety	.10*	-.003	.005	.00%
Community	.14**	.047*	.090	.50%
Future Security	.09*	-.007	-.013	.01%
R^2	.036			
Adjusted R^2	.026			

**p< .01

*p< .05

The R for the regression was significantly different from zero F (7, 699) = 3.72, p = .00. The adjusted R^2 value of .026 indicates that only 2.6% of the variability in frequency of PA per week is predicted by the PWI domains.

Standard of living, Health, Achieving, Safety, Community and Future Security correlated with frequency of PA, however, only Health and Community were cross-sectional predictors of PA.

The next regression uses time since PA as the dependent variable and the PWI domains as independent variables. Table 36 displays the correlations between the variables, the unstandardised regression coefficients (*B*), the standardised regression coefficients (β), R^2, adjusted R^2 and the semi-partial correlations (sr^2: unique contribution of each independent variable).

Table 36

Multiple Regression for the PWI Domains Predicting Time Since Physical Activity

	Time since PA (Correlation)	B	*B*	sr^2
Standard of living	-.049	-.011	-.013	.01%
Health	-.15**	-.100**	-.119	.96%
Achieving	-.09*	.005	.007	.00%
Relationships	-.02	.049	.073	.36%
Safety	-.06	.020	.023	.04%
Community	-.13**	-.074*	-.102	.66%
Security	-.10**	-.035	.049	.14%
R^2	.033			
Adjusted R^2	.024			

**p< .01

*p< .05

The R for the regression was significantly different from zero F (7, 699) = 3.72, p = .00. The adjusted R^2 value of .024 indicates that only 2.4% of the variability in time since PA is predicted by the PWI domains. Only Health and Community were cross-sectional predictors of PA.

In conclusion, analyses showed that only the domains Health and Community contributed weakly to the prediction of both frequency of PA and time since PA.

8.4 Results Summary

To briefly summarize these results:

- The PWI, DASS-21 and BF-16AM factored correctly.
- The lower SWB in Study 2 was explained by the combined influence of a decrease in the proportion of participants from Australia, an increase the proportion of participants engaging at low levels of PA, and an increase in the proportion of participants engaging in PA 2 or more months ago.
- The results support Hypothesis 1 in showing a significant but weak positive relationship between SWB and frequency of PA. Results also showed that when controlling for neuroticism, extraversion and household income there was a non-significant relationship between the frequency of PA and SWB.
- As the frequency of PA increased there was an increase in the proportion of participants with high (85+) SWB. There was also a decrease in the proportion of participants with depression and low (<60) levels of SWB.
- As the time since PA increased there was a decrease in SWB, which was reciprocated with an increase in depression. Further analysis revealed the

proportion of participants with depression increased with the time since PA.

- A regression analyses showed that PA weakly predicted SWB, however time since PA made no independent contribution to this analysis.
- The PWI domains of Health and Safety were the only domains within the Australian Unity Wellbeing Index normative domain ranges (The International Wellbeing Group, 2010). All other domains fell below the normal range. Analyses also revealed that Health and Community contributed weakly to the prediction of both frequency of PA and time since PA.

CHAPTER NINE: STUDY ONE AND TWO DISCUSSION

The aim of Study 1 and 2 was to investigate the relationship between PA and SWB within the context of homeostasis theory.

9.1 Frequency of Physical Activity and Subjective Wellbeing

The first analysis investigates the cross-sectional relationship between PA and SWB. In both studies 1 and 2 there was a positive relationship between PA and SWB, which is consistent with previous research (Bartels, et al., 2012; Lox et al., 1995; Selkirk, 2008). However, after controlling for neuroticism, extraversion and household income in Study 2 the relationship between PA and SWB became non-significant. To the authors knowledge only one other study has compared the relationship between PA and SWB whilst co-varying for other variables (Selkirk, 2008). In contrast, Selkirk found a difference in SWB between regular and non-regular exercisers even after controlling for extraversion and neuroticism. This difference may be explained by the covariance from income. Whereas Study 2 co varied both personality *and* household income, with both accounting for a significant amount of variance, Selkirk only co varied for personality. Thus, the addition of household income to the list of covariates may explain the difference in results between these studies.

In terms of explaining the relationship between PA, SWB and personality, there seems to be two possibilities. First, the relationship may be a consequence of predisposing personality characteristics. It is known that high neuroticism is a risk factor for depression (Rovner & Casten, 2001), and is associated with lower levels of SWB (Cook, 2003). Additionally, Rhodes & Smith, (2006) conducted a

meta-analysis and found that high neuroticism was associated with low levels of PA participation. The authors suggested that these findings might be explained by high levels of neuroticism being associated with the avoidance of PA or cancellation of PA plans. In regards to extraversion, research has shown that extraverts have a higher level of positive affect (Lucas & Baird, 2004) and SWB (Cook, 2003). Research has also shown that high extraversion is associated with high levels of PA participation (De Moor, Beem, Stubbe, Boomsma, de Geus, 2006; Rhodes & Smith, 2006). As extraverts have a preference for social interaction and excitement seeking (Lucas, et al., 2000) this may explain the high levels of PA participation. Consequently, there may be no direct effect of PA upon SWB, but rather predisposing personality characteristics may influence both the frequency of PA and the level of SWB separately.

A second possible explanation for the linkage comes from Selkirk (2008) and Yeung and Hemsley (1997) who found a positive relationship between PA and wellbeing indices independent of personality. This may suggest that engagement in PA directly influences SWB. In conclusion, there is insufficient research to inform which of these two possible explanations is the strongest.

There are also two possible explanations for the relationship between PA, SWB and household income. First, predisposing financial resources may influence the frequency of PA and the level of SWB separately. In support of this explanation both evidence and theory have suggested that opportunities and resources predict PA participation (Chung, Domino, Stearns, & Popkin, 2009; Harrison et al., 2011; Stephens; 1988). Thus, people with limited financial means may be less likely to have access to recreational facilities, or be part of a family/community that prioritises regular PA participation. Limited financial

resources may also reduce the ability to protect against challenging circumstances, and thus increase the probability that SWB will be lower (Cummins, 2009). Therefore, there may be no direct effect of PA upon SWB, but rather the level of financial resources determines the frequency of PA and SWB separately.

There is also evidence to suggest a relationship between PA and SWB independent of household income. A meta-analysis of 25 studies, that involved participants from a range of socioeconomic backgrounds, found that exercise groups had a significant reduction in depression compared to a wait list or placebo groups (Mead, Morley, Campbell, Greig, McMurdo, & Lawlor, 2009). As these studies randomly assigned to either treatment or control group, this suggests that a reduction in depression was independent of household income. The results in the Mead and colleagues (2009) study indicate that PA may directly influence wellbeing levels, which again is inconsistent with the findings of Study 2. However, as a consequence of a limited amount of research investigating the relationship between PA, SWB and household income, it seems that further research is needed to investigate this relationship.

In conclusion, while it seems clear that personality and household income are important in explaining the relationship between PA and SWB, further research is needed to clarify the nature of this relationship.

9.2 Homeostatic defeat and Physical Activity

Although the analysis above gives an *association* between PA and SWB it gives us limited information relating to homeostatic defeat. Thus, the next analysis compares the proportion of participants experiencing homeostatic defeat

as the frequency of PA increases. As the frequency of PA increased, the proportion of participants experiencing homeostatic defeat (SWB<60) remained relatively stable in Study 1, whilst in Study 2 the proportion decreased. As indicated in Chapter 1, it is not possible to accurately interpret the meaning of an individual SWB score that lies between 50 and 70 points. A score within this range can represent either a low set point range or homeostatic defeat. Due to this uncertainty, the analyses were repeated using a depression measure.

Using depression, the results in Study 1 and 2 are in agreement, showing that as the frequency of PA increased there was a significant decrease in the proportion of participants experiencing homeostatic defeat. These results are consistent with research, which has shown that depression scores were highest amongst those who were physically inactive (France, et al., 2004; Stephens, 1988; Weyerer, 1992). However, as these studies are cross-sectional the direction of causality cannot be determined. As depression is associated with a lack of interest and involvement in activity (Antony et al., 1998; Henry, & Crawford, 2005) it is possible that rather than PA working as a protection against homeostatic defeat, these results may be explained by depressed individuals experiencing an aversion to activity.

9.3 Time since Physical Activity, Subjective Wellbeing and Depression

To this point a measure of frequency has been used to approximate PA behaviour. In the next analysis a measure of time since PA will be used. As suggested previously, a measure of the time since PA gives important information related to the relationship between wellbeing indices and the cessation of PA. The results showed a weak, but significant positive relationship between time since in

PA and depression in both Study 1 and 2. In comparison, there was a weak negative relationship between time since PA and SWB in Study 2, but not for Study 1. It was also found that as the time since PA increased, the proportion of participants experiencing homeostatic defeat (using DASS-21 depression) increased. Although no research could be found using a similar measurement of time since PA, a number of studies have shown that when participants voluntarily ceased PA for a period of days (Mondin et al., 1996), weeks (Morris, et al., 1990), or months (Baekeland, 1970) there was an increase in tension, anxiety and depression symptoms. Other authors have shown a similar relationship for those who were forced to give up PA (Chan & Grossman, 1988). This suggests that, for those who normally regularly engage in PA, cessation of this behaviour negatively influences mood.

9.4 Physical Activity and the Comparison sample

The previous analyses have been confined to the PA sample. The next part of this discussion focuses upon the differences between the PA and the comparison sample of Australian adults. Using the depression measure, a greater proportion of participants experienced homeostatic defeat in the comparison sample, which is consistent with previous research (Weyerer, 1992). However, in terms of SWB there were no significant differences in the proportion of participants experiencing homeostatic defeat. As previously discussed the non-significance using the SWB measure may be due to the imprecision of this measure at determining homeostatic defeat.

Although the relationship above gives important information related to the proportion of participants experiencing homeostatic defeat, it is also important to

determine potential mean group differences between the PA and comparison samples. A second analysis found the PA sample had a depression score below that of the comparison sample, which is consistent with previous research (Stephens, 1988). Other research has also shown that, compared to control groups, those engaged in a PA program have significantly less depression (Singh et al., 1997).

In contrast, using the SWB measure there was a non-significant difference between the PA and comparison sample, which is contrary to other research (Selkirk, 2008). The difference in findings between Study 1 and Selkirk may be explained by sample characteristics. Selkirk dissected a single sample into regular and non-regular exercisers. In comparison, Study 1 used two separate samples; PA sample and a comparison sample of Australian participants derived from the Australian Unity Wellbeing Index Survey. Although the frequency of PA was not assessed for the comparison sample, data from the Australian Bureau of Statistics (2011) shows that Australian adults engage in PA in the following proportions: 18% of people exercised once in the last week, just over one third (36%) exercised two to three times, 22% engaged four to five times, and almost a quarter of the sample (24%) engaged six to seven times per week. Thus, if the Australian Bureau of Statistics results were used to approximate the PA participation for the comparison sample, almost half of the participants would be engaging in PA four or more times per week. This is comparable to the PA sample for both Study 1 and 2. Consequently, as there is a positive relationship between the frequency of PA per week and SWB, a similar level of frequency of PA for the PA and comparison sample may have contributed to the non-significant difference in SWB.

The differences in findings between the SWB and depression measures will be discussed in the next section.

9.5 Subjective Wellbeing and Depression

A relatively consistent finding was the DASS-21 depression measure was more likely to find differences in both Study 1 and Study 2 compared to the PWI. One explanation for this comes from Bittar (2008) who suggests that an important difference between these measures relates to the reporting periods of these measures. Bittar explains that depression scales such as the DASS-21 are cast in terms of "how much the statement applied to you *over the past week*" which aims to illicit how participants feel over a specific time period (state affect). By comparison, each PWI item begins with "How satisfied are you…" which is deliberately non specific (Cummins, 2009) and aims to illicit how the respondent generally feel or experience different aspects of their lives (trait affect). Thus, as these measures of SWB and depression focus upon different levels of affect (trait versus state respectively), it is possible that this accounts for the difference in results between them (Bittar, 2008). Consequently, compared to the depression measure, the non-specificity of the PWI reporting period may have reduced its sensitivity.

9.6 Set Point Range

Another interesting finding relates to the upper limit of an individuals 'set point range'. Homoeostasis theory proposes that SWB is managed by a system of psychological devices that have evolved for the purpose of maintaining levels of SWB within a controlled range of functioning (Cummins, et al., 2002). The basic

operation of the homeostatic system works by resisting change to SWB at the upper and lower thresholds (Cummins, 2008). Thus, it was expected that at all levels of PA and SWB will be near the upper limit of the 'set point range', but not beyond it (approximated by a SWB score of 85). In both Study 1 and 2 all groups engaging in PA had a mean SWB below 85. Although no studies could be found which focused upon SWB and PA in terms of homeostasis theory, a number of experimental and meta-analytic studies have shown that engaging in PA will at best, lead to a moderate improvement to positive mood and affect (Arent, et al., 2000; Biddle, et al., 2000; McDonald & Hodgdon, 1991; Reed & Buck, 2009). Moderate gains to wellbeing (i.e., improved mood, affect) suggest that there may be a ceiling level to SWB benefits from engaging in PA, as predicted.

9.7 SWB in Study 1 and Study 2

The next part of the analyses focuses upon the differences between Study 1 and 2. An unexpected finding is that the sample SWB was higher in Study 1 than 2. Participant country of origin was identified as a potential factor to account for the difference. In both studies Australians had the highest SWB and from Study 1 to 2 the proportion of participants from Australia decreased from 50.0% to 19.9%.

A second possible reason for the lower SWB in Study 2 may be fewer participants engaging at low levels of PA. The proportion at PA <1 and 1-2 times per week in Study 2 was 48.1%, compared to 34.0% in Study 1. Moreover the current study and previous research (Selkirk, 2008) has found a positive relationship between the frequency of PA and SWB. In a similar vein the

proportion of participants who engaged in PA at least 2 months ago increased from 2.5% in Study 1 to 17.4% in Study 2.

In summary, the lower SWB in Study 2 is likely to be explained by the combined influence of a decrease in the proportion of Australians, a higher proportion at low levels of PA, and an increase in the proportion of participants engaging in PA 2 or more months ago. In spite of these differences, the results in Study 1 and Study 2 show a high degree of similarity. This may suggests that the relationship between PA, SWB and Depression are relatively consistent, regardless of the characteristics of the sample.

9.8 PWI Item Analysis

A further matter of interest from these results concerns the PWI items that were greater for the PA sample and/or significantly contributed to PA. In particular, PA sample had a Health domain greater than the comparative sample. There are a number of potential explanations for this. For example, it may be that engaging in regular PA leads to improvements to physical health, contributing to an improvement in health satisfaction. Evidence suggests that regular PA can reduce weight and improve muscle tone, which is associated with enhanced body image, body satisfaction and self-esteem (Fox & Corbin, 1989; Fox, Page, Armstrong & Kirby, 1994). Evidence also suggests that regular PA is associated with the prevention of a number of chronic diseases (e.g., cardiovascular disease, diabetes, cancer, hypertension, obesity, osteoporosis; Warburton, Nicol & Bredin, 2006). As regular PA protects against disease it is reasonable to assume that those engaged in PA have a greater chance of being satisfied with their health. Research has also shown a reduction in PA is common for those diagnosed with

chronic conditions such as Chronic Obstructive Pulmonary Disease (Pitta, Troosters, Spruit, Probst, Decramer, & Gosselink, 2005). Thus, those who have an illness and consequently a lower satisfaction with their health would be less likely to engage in PA and be represented in a PA sample.

The Safety item was also found to be higher for the PA sample. There are three potential explanations for this result. For example, it may be that engaging in PA encourages and generates thoughts and feelings that serve to counteract negative mood states by distracting individuals from their worries and frustrations (Distraction Hypothesis: Bahrke & Morgan, 1978). In this way, those engaging in regular PA benefit from the distracting qualities of PA and therefore may be less likely to worry or ruminate about their personal safety. Research has also suggested that regular PA is associated with improved physical condition, enhance perceptions of overall physical self worth and competence, which then leads to improvement in global self-esteem (Sonstroem, et al., 1994). Thus, increases in physical self-efficacy and self esteem may also relate to feeling more secure in relation to personal safety. Alternatively, these findings may be the consequence of personality. Those who have high levels of neuroticism are more prone to rumination and worry (Roelofs, Huibers, Peeters, Arntz, & van Os, 2008). A logical extension of which may be greater concern for personal safety. As those high in neuroticism are also less likely to engage in regular PA (Rhodes & Smith, 2006), they may also be less likely to be part of the PA sample.

A second analysis revealed the domain of Achieving was sensitive to both frequency and time since PA. One explanation is that regular PA satisfies these individuals' sense of achieving. Sonstroem and Morgan (1989) proposed their Exercise and Self-Esteem Model, which suggests that regular PA produces a

sense of achievement, which if regularly repeated generates greater feelings of competence and mastery. A number of studies have demonstrated the validity of this model (Baldwin & Courneya, 1997; Sonstroem, et al., 1991). Interestingly, there was a non-significant difference in Achieving between the PA and comparison sample. It may be that those who do not regularly engage in PA find achievement through participation in other activities. Community connectedness was also shown to contribute to both frequency and time since PA. The social interaction hypothesis (Ransford, 1982) may explain this result. According to this theory, as regular PA is often done with other people, greater amounts of social interaction leads to a greater sense of social connection and improvement in mood. In support of this theory, a qualitative analysis of the relationship between PA and SWB using a sample of Chinese older adults suggested that engaging in PA facilitated greater social engagement and SWB (Ku, McKenna & Fox, 2007).

In conclusion, while a number of PWI domains were either greater for the PA sample or significantly contributed to PA, further research is needed to clarify the nature of these relationships.

9.9 Conclusion

The above results suggest that the relationship between PA and SWB is complex. While there appears to be a positive relationship between the frequency of PA and SWB it is likely that a number of variables have a role in understanding this relationship. Furthermore the cross-sectional nature of these findings means that causality cannot be determined. Additionally, how PA and homeostasis theory are conceptualised and subsequently measured is likely to influence the findings in Study 1 and 2.

CHAPTER TEN: STUDY THREE

10.1 Introduction

As discussed in Chapter 1 a key element of homeostasis theory relates to the operation of SWB during challenging conditions. When a challenging life event is experienced it is hypothesised that the homeostatic system works to defend SWB (Cummins, 2010). Integral to this defence is the idea that regular participation of PA acts as a protective buffer to SWB. Thus, for example, PA partially counteracts the effects of family conflict on depressed mood among adolescents (Sigfusdottir et al., 2011), moderates the influence of minor stress on anxiety symptoms among college students (Carmack et al., 1999), and reduces the strength of association between negative life events and global depression among a sample of depressed adults (Harris et al., 2006). Interpreted in terms of homeostasis theory, these findings suggest that when a negative or stressful life event is experienced PA works as a protective buffer, decreasing the likelihood of homeostatic defeat. The purpose of Study 3 is to explore the relationship between challenging life events, SWB and PA.

10.1.1 Method

This study utilised the same method as Study 2.

10.1.2 Questionnaire. The optimal way of measuring challenging life is controversial. The earliest such measure, the Social Readjustment Ratings Scale (Holmes & Rahe, 1967), remains as one of the most widely used measures of stress (Scully, Tosi, & Banning, 2000). However, it has also received criticisms

in terms of its limited reliability and validity (Monroe, 1982), the questionable validity of using different weights for different life events (Dohrenwend, Krasnoff, Askenasy & Dohrenwend, 1978), and individual or cultural differences in the significance of life events (Woon, Masuda, Wagner & Holmes, 1971). Consequently, in the current study the construct of 'challenging life events' is measured by the following question: "In the last month has something happened to you causing you to feel happier or sadder than normal?" The response options were: Yes, happier /Yes, sadder/ No. This question has been used by other studies (e.g., Cummins et al., 2008) as it is deliberately non-specific, allowing the respondent to evaluate the relative importance of life events and whether these events had an influence upon mood. The remainder of the questionnaire was the same as used in Study 2.

10.1.4 Participants. Of the 247 participants, 77 (31.2%) reported a happier life event, 92 (37.2%) reported no life event, and 78 (31.5%) reported a sad life event. The sample comprised 107 males (43.3%) and 140 females (56.7%) with ages ranging from 18-73 years with a mean age of 36.23. The sample included 120 surfers (48.6%), 16 swimmers (6.5%), and 112 yoga participants (45.3%).

10.3 Results

The first part of the analyses explores SWB for those reporting happy, sad and no life events. Overall those reporting a happy (Mean: 80.09, SD: 12.17) and no event (Mean: 80.15, SD: 14.15) had a SWB above the Australian Unity Wellbeing Index normative range of 76.7-73.7 (The International Wellbeing

Group, 2010). In comparison, those reporting a sad life event had a SWB level below this range (Mean: 67.28, SD: 16.69). An analysis of variance found a significant difference in SWB between those reporting a happy, sad and no life event F (2, 244)= 21.11, p= .00 (Levene's statistic p= .02). As a consequence of a significant Levene's statistic, the Games-Howell unequal variances not assumed option was used in post hoc testing, as suggested by Asthna and Bhushan (2007). Post hoc testing revealed participants reporting a sadder life event had SWB below that of those reporting both happier (p= .00) and no life events (p= .00).

The next analysis compares the proportion of participants with SWB below 60 for happy, sad and no life events (see Table 37). As previously outlined in Study 1 and 2 a SWB score of 60 approximates the boundary between homeostatic maintenance and defeat.

Table 37

Comparing Happy, Sad and No Life Events to the Proportion of Participants with SWB<60

	SWB<60		SWB≥60	
	N	%	N	%
Yes, Happier	6	7.8	71	92.2
No	8	8.7	84	91.3
Yes, Sadder	23	29.5	55	70.5

Table 37 indicates that almost one third of those reporting a sadder life event had a SWB below 60 compared to 7.8% for those reporting a happy event and 8.7% for those reporting no life event.

In conclusion, the analyses revealed that those reporting a happy and no

life event had a mean SWB of approximately 80, and a similar proportion of participants with SWB below 60. In comparison, those reporting a sad life event had a lower SWB than the other two groups and more than triple the proportion of participants with a SWB below 60 for both happy and no life event. Interpreted in terms of homeostasis theory, this supports theory in that experiencing a sad life event is related to a greater chance of homeostatic defeat, compared to those experiencing a happier or no life event. Thus, for the following analyses the data are dichotomised where "Yes, sadder" will represent a challenging life event, whilst "Yes, happier" and "No" responses are combined to represent the absence of a challenging life event.

10.3.1 Moderation analyses. The next part of the analyses investigates whether the frequency and time since PA moderate the relationship between challenging life events and SWB. The regression assumptions of linearity, homoscedascity, and normality (see Cohen, Cohen, West, & Aiken, 2003) were first examined. The results indicated that there was no violation of the assumption of linearity or residual homoscedacity. There was also no statistically significant departure from normality, which met the residual normality assumption in the regression analysis.

Bivariate correlations were conducted to examine relations among the major study variables. Table 38 presents the means, standard deviations and correlations for SWB, challenging life events, and time since and frequency of PA.

Table 38

Means, Standard Deviations and Correlation Matrix for the Dependent and Independent Variables

	Mean	SD	Correlation		
			1.	2.	3.
1. SWB	75.93	15.69			
2. Challenging Life Events	2.06	.83	-.33**		
3. Time since PA	4.39	2.25	-.25**	-.02	
4. Frequency of PA	2.91	2.18	.13*	-.01	-.44**

**Correlation is significant at the 0.01 level.

*Correlation is significant at the 0.05 level.

Table 38 shows the sample has a SWB mean of 75.93 (SD: 15.69), which is within the Australian normative range of 76.7-73.7 (The International Wellbeing Group, 2010). The correlation matrix in Table 38 shows that challenging life events, time since PA and frequency of PA all correlate significantly with SWB.

A multivariate hierarchical regression was performed using SWB as the dependant variable and challenging life events, and frequency of PA as the predictor variables. Frequency of PA had five levels (<1, 1-2, 3-4, 5-6 and 7+ days per week) and challenging life events had two levels (happier/no event, sadder). In Step 1 challenging life events and time since PA were entered as covariate variables, whilst in Step 2 the interaction term was added, as suggested by Frazier, Tix and Barron (2004). The findings are summarised in Table 39.

Table 39

Summary of Hierarchical Regression Analysis for Variables Predicting SWB

Variables	*B*	β	R^2	Adjusted R^2	Δ R^2
Step 1			.12	.11	
Challenging life Events	-.65	-.33**			
Frequency of PA per week	.16	.12			
Step 2			.13	.11	.005
Challenging life events X Frequency of PA per week	-.12	-.07			

**Correlation is significant at the 0.01 level.

*Correlation is significant at the 0.05 level.

For Step 1 the R for regression was significantly different from zero, F (2, 244)= 16.75, p= .00. The adjusted R^2 indicates that 11.4% of the variability in SWB is predicted by challenging life events and frequency of PA, however frequency of PA did not contribute significantly to this relationship. In Step 2 the addition of the interaction variable adds 0.5% of variance accounted for, which is not significant.

A second multivariate hierarchical regression was performed using SWB as the dependant variable and challenging life events and time since PA as the predictor variables. Time since PA had six levels (today, yesterday, 2-6 days ago, 1-3 weeks ago, 1-2 months ago and 2+ months ago). In Step 1 challenging life

events and time since PA were entered as covariate variables. The interaction was added in step 2. The findings are summarised in Table 40.

Table 40

Summary of Hierarchical Regression Analysis for Variables Predicting SWB

Variables	*B*	β	R^2	Adjusted R^2	Δ R^2
Step 1			.16	.15	
Challenging life Events	-.64	-.32**			
Time since PA	-.16	-.23**			
Step 2			.16	.15	.002
Challenging life events X Time since PA	.04	.04			

**Correlation is significant at the 0.01 level.

*Correlation is significant at the 0.05 level.

For Step 1 the R for regression was significantly different from zero, F (2, 244)= 23.29, p= .00. The adjusted R^2 value indicates that 15.3% of the variability in SWB is predicted by challenging life events and time since PA. In Step 2 the addition of the interaction variable adds 0.2% of variance accounted for, which is not significant.

In conclusion, the moderation analysis showed that both the frequency and time since PA did not moderate the relationship between challenging life events and SWB.

CHAPTER ELEVEN: STUDY THREE DISCUSSION

The purpose of Study 3 was to explore the relationship between challenging life events, SWB and PA. It was found that those reporting a sad life event had a level of SWB below those reporting a happier event and no life event in the last month. Previous research has shown that those reporting a happy event were above the Australian Unity Wellbeing Index normative range (Cummins, et al., 2003), whilst those reporting a sad event were below. This suggests that the experience of a challenging life event influences SWB. This also conforms to the expectation and findings of other studies (Headey & Wearing, 1989; Lucas, Clark, Georgellis, & Diener, 2003).

However, in contrast with expectation, the results in Study 3 indicated that neither frequency nor time since PA moderated the relationship between challenging life events and SWB. This is in contrast to the majority of relevant research. For example, PA was found to partially counteract the effect of family conflict on depressed mood among adolescents (Sigfusdottir et al., 2011), reduce the strength of association between negative life events and global depression among a sample of depressed adults (Harris et al., 2006), and reduce anxiety and depression symptoms in response an objectively stressful event (notification of HIV-1 status: LaPerriere et al., 1990). Only one study could be found which showed that PA did not moderate the influence of minor stress on depression (Carmack et al., 1999).

A number of potential reasons may account for the current lack of effect. The first is that PA may not buffer SWB. In investigating the buffering effect of PA, the majority of research has utilised depression (Harris et al., 2006;

LaPerriere et al., 1990; Sigfusdottir et al., 2011) as an outcome measure, while the current study used a measure of SWB. Moreover, as suggested in Study 1 and 2 Discussion, the different reporting periods of the SWB and depression measures may account for the disparity in results (Bittar, 2008). For example the PWI item begins with "How satisfied are you…" which is deliberately non-specific (Cummins, 2009) and aims to elicit how the respondent generally feel or experience different aspects of their lives (trait affect). In comparison, depression measures such as DASS-21 depression cast items in terms of "how much the statement applied to you *over the past week*" which aims to elicit how participants feel over a specific time period (state affect). Consequently, the non-specificity of the PWI reporting period may have reduced its sensitivity and account for the non-significance in Study 3.

A second explanation for the absence of moderation in Study 3 relates to the severity of challenging life events. The best evidence for a moderating effect for PA appears to come from studies that have used challenging life events of moderate to severe intensity. For example, LaPerriere et al. (1990) utilized a sample of men who were awaiting HIV-1 status notification; Sigfusdottir and collegues (2011) operationalised challenging life events as the witness/experience of severe arguments and/or physical violence; and Harris et al., (2006) used a multiple item questionnaire describing events such as divorce, death of a close friend and loss of work. In comparison, Carmack and collegues (1999) focused upon minor life stress and found no buffering effect. In the current study, challenging life events was measured by a single question: *"In the last month has something happened to you causing you to feel happier or sadder than normal?"* The response options were: *Yes, happier* or *Yes, sadder* or *No*.

This question was deliberately non-specific, allowing the respondent to evaluate the relative importance of life events. Furthermore, this question does not measure the severity of the stressor. Thus, it may be that the inability of this question to delineate between minor and severe stress may account for the non-significance in the current study. Future research may wish to explore the intensity of the stressors as a determining factor in the success of PA as a potential buffer.

A final potential explanation for the absence of moderation in Study 3 relates to the measurement of PA. The studies that showed a buffering effect of PA used a multiple item questionnaire (Carmack et al., 1999; Harris et al., 2006), a measure of PA frequency and intensity (Sigfusdottir et al., 2011), or involvement in an exercise-training program (LaPerriere et al., 1990) to approximate PA. For each of these studies the intensity of PA was either assessed through questionnaire or regulated in an exercise-training program. In comparison, Study 3 used both frequency of and time since PA. No measurement of intensity was recorded. Thus, the absence of a measure of PA intensity may have also contributed to the non-significant results in Study 3.

In conclusion, the findings in Study 3 are in contrast to a diverse range of studies, which found PA moderated the relationship between challenging life events and mood indices (Harris, et al., 2006; LaPerriere et al., 1990; Sigfusdottir et al., 2011). This is likely to be due to the use of a SWB instead of a depression measure. However, other reasons such as the measurement of challenging life events and PA may also contribute to the inconsistency in findings between Study 3 and the existing literature. The implications of these findings will be discussed in terms of homeostasis theory in the General Discussion section.

CHAPTER TWELVE: STUDY FOUR

12.1 Introduction

The purpose of Study 4 is to investigate the extent to which change in PA predicts change in SWB. We used a sample of PA participants with information collected over four-time points, with a month separating each time point. Latent Growth Curve Modelling (LGCM) was used to examine the patterns of change in PA and SWB separately, and then change in PA predicting change in SWB. This analysis was performed using AMOS 17.0.

LGCM is a special type of Structural Equation Modelling, which has a number of advantages over other techniques to measure change among continuous variables (e.g., ANOVA, MANOVA). For example LGCM has the ability to describe individual as well as group change, and model a number of different forms of change (e.g., linear and optimal growth; Motl, et al., 2004) and utilizes more of the information available than traditional methods (Birkeland, et al., 2009).

12.2 Method

This study utilised same method as Study the 2.

12.2.1 Missing Values. All cases with missing values were deleted listwise from the sample. Although this approach is the most commonly employed method of dealing with missing data this technique can lead to a smaller sample size and less power to detect statistical effects (Allison, 2002; Davey, Shanahan & Schafer, 2001). Consequently, a dropout analysis was

performed by comparing baseline scores of those who completed all four-time points to those who did not. There were 186 participants who completed all four-time points with a SWB of 74.35 (SD: 19.88). In comparison, 482 participants completed three or less time points with a SWB of 69.41 (SD: 17.14). An analysis of variance revealed a significantly greater SWB for those who completed all four time points $F(1, 705)= 10.16$, $p= .00$.

Those who completed all four time points had an average frequency of PA per week of 4.2 times per week compared to 3.8 times per week for those who did not. The difference between these means was also significant $F(1, 705)= 4.36$, $p= .04$. This indicates that the findings presented below are not representative of the original sample of PA participants. This is discussed in more detail in the Study 3 Discussion (Chapter 13).

12.3 Model Specification

This section describes the first stage of the LGCM analysis, investigating the pattern of change in PA over four time points, using data from the 186 people who completed all four-time points. Figure 13 depicts this relationship with PA1, PA2, PA3 and PA4 representing the measurement of PA over the four time points. The latent variables are represented by η_1 (Intercept) and η_2 (Slope).

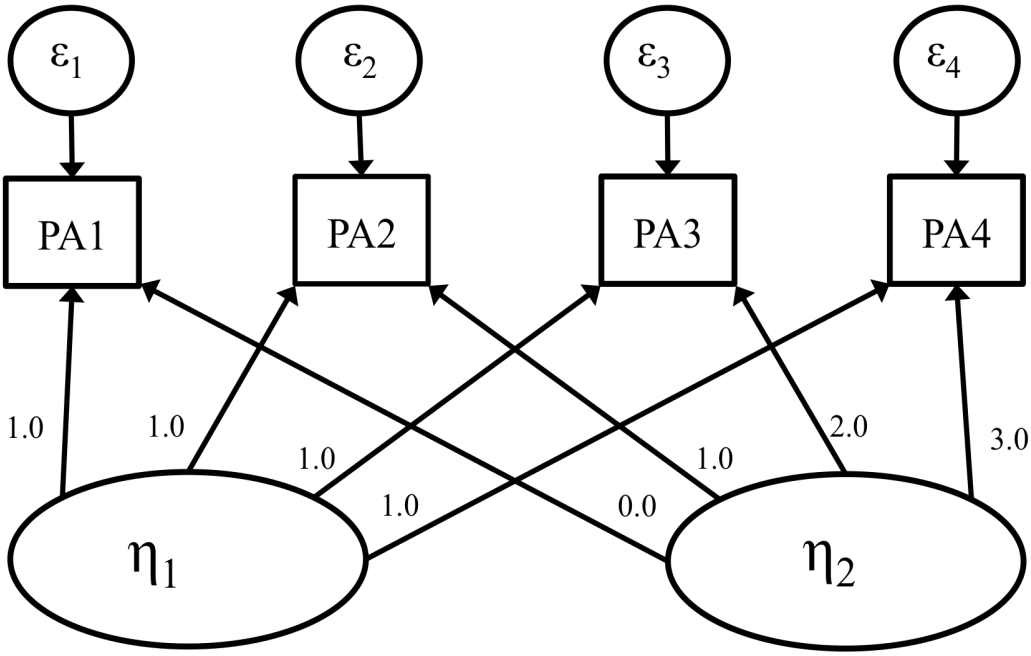

Figure 13. Depiction of the first-stage of Latent Growth Curve Model

In Figure 13 the factor loadings of the PAs on η_1 (Intercept) are fixed equal to 1.0 and represent the initial level from which change is measured. The factor loadings of the PAs on η_2 are fixed equal to 0.0, 1.0, 2.0 and 3.0 and represent linear change in PA over time. The model in Figure 13 predicts linear growth in PA over the four time points. This model is identical for the measure of SWB over time.

The second stage of the LGCM depicted in Figure 14 investigates the relationship between PA and SWB. This model includes the first stage of LGCM for both PA and SWB. It also includes the paths (ßs) between the Intercepts and Slopes.

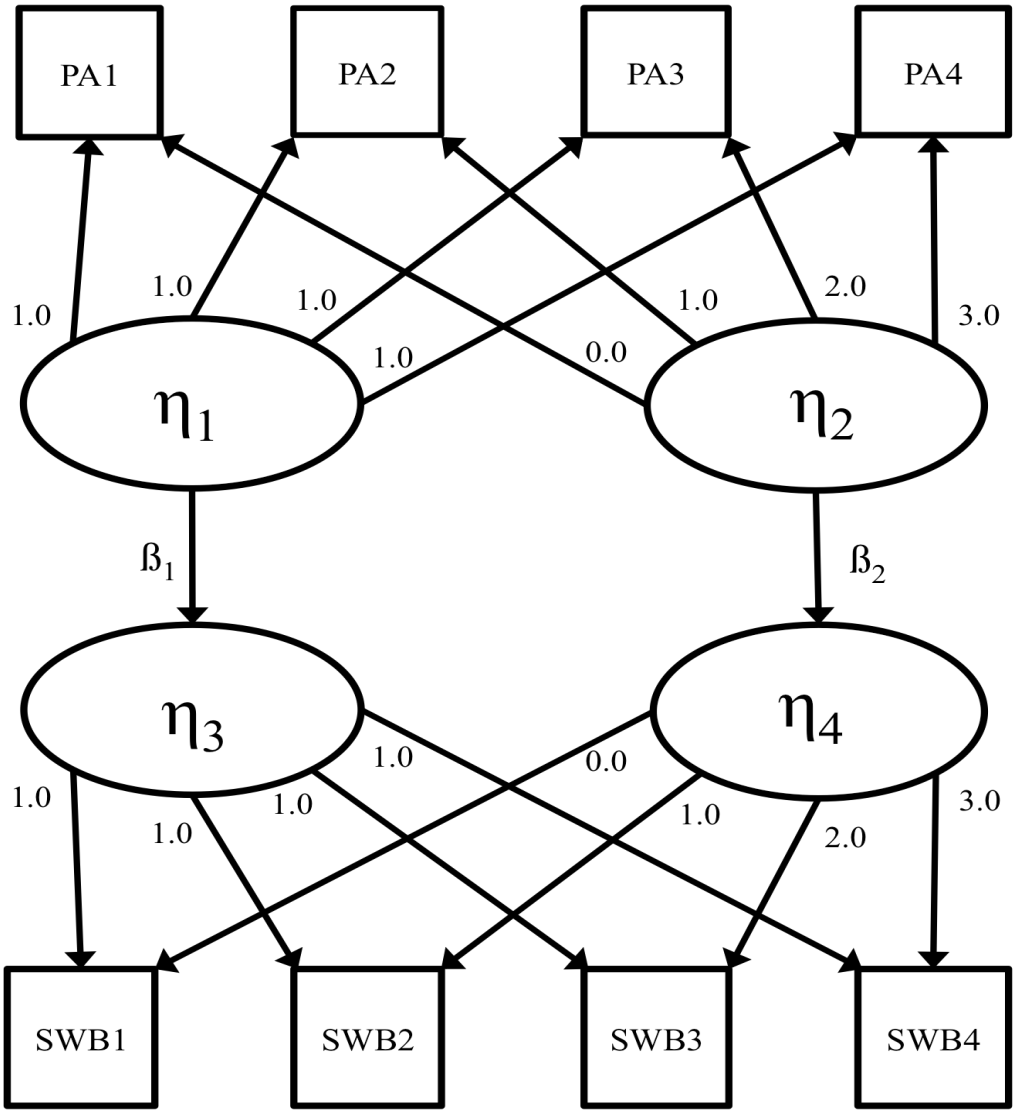

Figure 14. Depiction of the second-stage of LGCM for Physical Activity and SWB

In Figure 14 PA1, PA2, PA3, and PA4 represent four measures of PA, whilst SWB1, SWB2, SWB3, and SWB4 represent four corresponding measures of SWB. The latent variables η_1 and η_3 represent the initial status (Intercept) for PA and SWB respectively. The latent variables η_2 and η_4 represent the linear change (Slope) for PA and SWB. In Figure 14 $ß_1$ represents the relationship between initial status (Intercept) for PA and initial status (Intercept) for SWB. $ß_1$ represents the relationship between initial status (Intercept) for PA and initial

status (Intercept) for SWB. $ß_1$ is interpreted as cross-sectional relationship between PA and SWB. $ß_2$ represents the relationship between change (Slope) in PA and change (Slope) in SWB.

12.4 Results

The next section presents the descriptive statistics and correlations for frequency and time since PA and SWB. The descriptive statistics for SWB, frequency of PA and time since PA for the four time points are presented in Table 41.

Table 41

Descriptive Statistics for the Four Time Points

		SWB		Frequency of PA per week		Time since PA	
	N	Mean	SD	Mean	SD	Mean	SD
Time Point 1	186	74.57	13.25	2.77	1.19	2.90	1.50
Time Point 2	186	75.07	13.84	2.70	1.16	3.03	1.55
Time Point 3	186	76.34	13.80	2.71	1.17	3.05	1.66
Time Point 4	186	78.20	13.20	2.72	1.14	2.83	1.49

In Table 41 it can be seen that both frequency and time since PA remain relatively stable. The SWB increased across the four time points $F(2.75, 418.6)= 5.36$, $p= .00$, from within to above the Australian Unity Wellbeing Index normative range of 76.7-73.7 (The International Wellbeing Group, 2010).

The correlation coefficients for the four time points for frequency of PA and SWB are presented in Table 42.

Table 42

Correlation Coefficients Between Frequency of Physical Activity and SWB for the Four Time Points

	1.	2.	3.	4	5.	6.	7.
1. Frequency of PA 1	1						
2. Frequency of PA 2	.85**	1					
3. Frequency of PA 3	.81**	.86**	1				
4. Frequency of PA 4	.80**	.87**	.88**	1			
5. SWB 1	.11	.09	.14	.09	1		
6. SWB 2	.16*	.11	.15	.10	.75**	1	
7. SWB 3	.08	.10	.04	.07	.65**	.66**	1
8. SWB 4	.11	.11	.09	.10	.72**	.75**	.77**

**Correlation is significant at the 0.01 level.

*Correlation is significant at the 0.05 level.

In Table 42 the correlation coefficients between the same variable for the four time points were all significant. There was only one significant correlation coefficient between SWB and the frequency of PA (SWB2 and Frequency of PA1).

The correlation coefficients for the four time points for the time since PA and SWB are presented in Table 43.

Table 43

Correlation Coefficients Between Time Since Physical Activity and SWB for the Four-Time Points

	1.	2.	3.	4	5.	6.	7.
1. Time since PA 1	1						
2. Time since PA 2	.64**	1					
3. Time since PA 3	.62**	.74**	1				
4. Time since PA 4	.48**	.57**	.48**	1			
5. SWB 1	-.20*	-.26**	-.25**	-.09	1		
6. SWB 2	-.25**	-.31**	-.31**	-.16	.75**	1	
7. SWB 3	-.14	-.16*	-.26**	-.08	.65**	.66**	1
8. SWB 4	-.12	-.16*	-.22**	-.15	.72**	.75**	.77**

**Correlation is significant at the 0.01 level.

*Correlation is significant at the 0.05 level.

In Table 43 the correlation coefficients between the same variable for the four-time points were all significant. All but six correlations were significant and negative between time since PA and SWB for the four time points. The three of the four correlation coefficients between time since PA and SWB for the same time point were significant and negative.

In summary, the descriptive statistics showed that frequency of PA and time since PA remain relatively stable, whilst SWB increases across the four time points. The majority of correlations between time since PA and SWB were significant and negative, whilst one correlation was significant and positive between frequency of PA and SWB.

The next analysis will analyse estimations of growth in SWB, frequency and time since PA. This will be followed by an analysis of the extent to which change in PA predicts change in SWB.

12.4.1 Estimating growth in frequency of PA per week. The growth in frequency of PA was best described by a linear growth function with the variance freely estimated. This model provided an excellent fit for the frequency of PA data ($df = 3$; $\chi^2 = 2.58$; $p = .46$; RMSEA [90% CI] = 0.000 [0.000–0.129]; NFI = 0.997; CFI = 1.00). The mean scores provided in Figure 15 illustrate the stability of the frequency of PA per week across time.

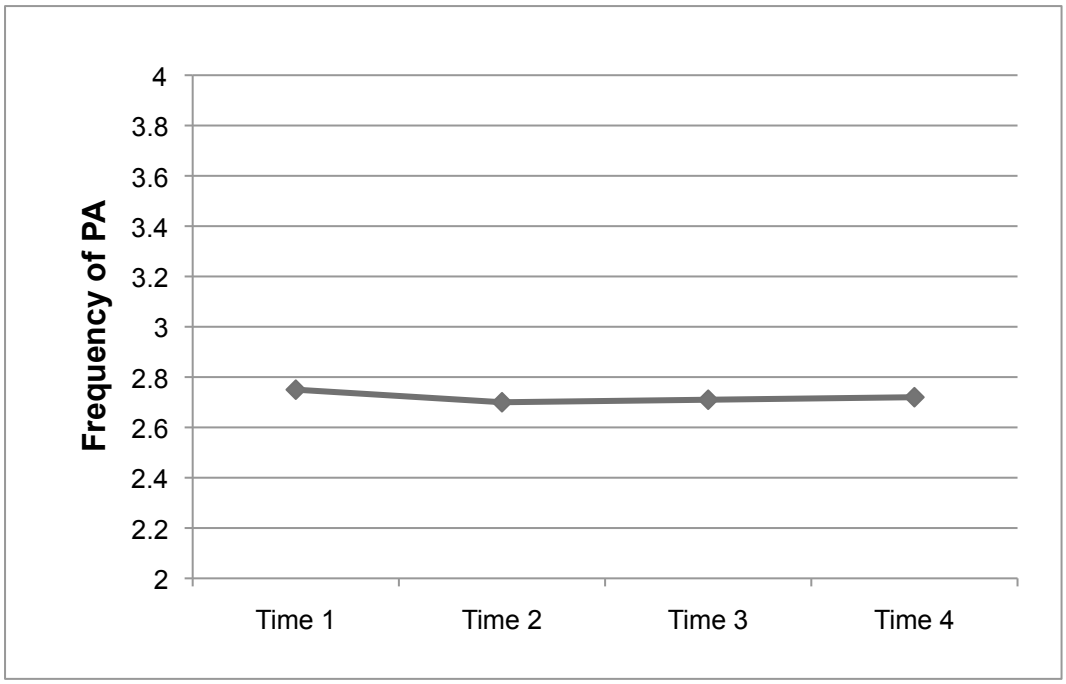

Figure 15. Mean level of frequency of Physical Activity per week across the four time points

From this analysis it may be concluded that the change in frequency of PA was best described by a linear growth function, as can be seen in Figure 15.

12.4.2 Estimating Growth in time since PA. A model with an optimal growth function with the variance freely estimated provided better fit for the time since PA data ($df = 3$; $\chi^2 = 1.58$; $p = .21$; RMSEA [90% CI] = 0.062 [0.000–0.235]; NFI = 0.994; CFI = 0.998) compared to a linear growth function ($df = 3$; $\chi^2 = 11.25$; $p = .01$; RMSEA [90% CI] = 0.135 [0.057–0.222]; NFI = 0.958; CFI = 0.968). The mean scores provided in Figure 16 illustrate the curvilinear change in time since PA across time.

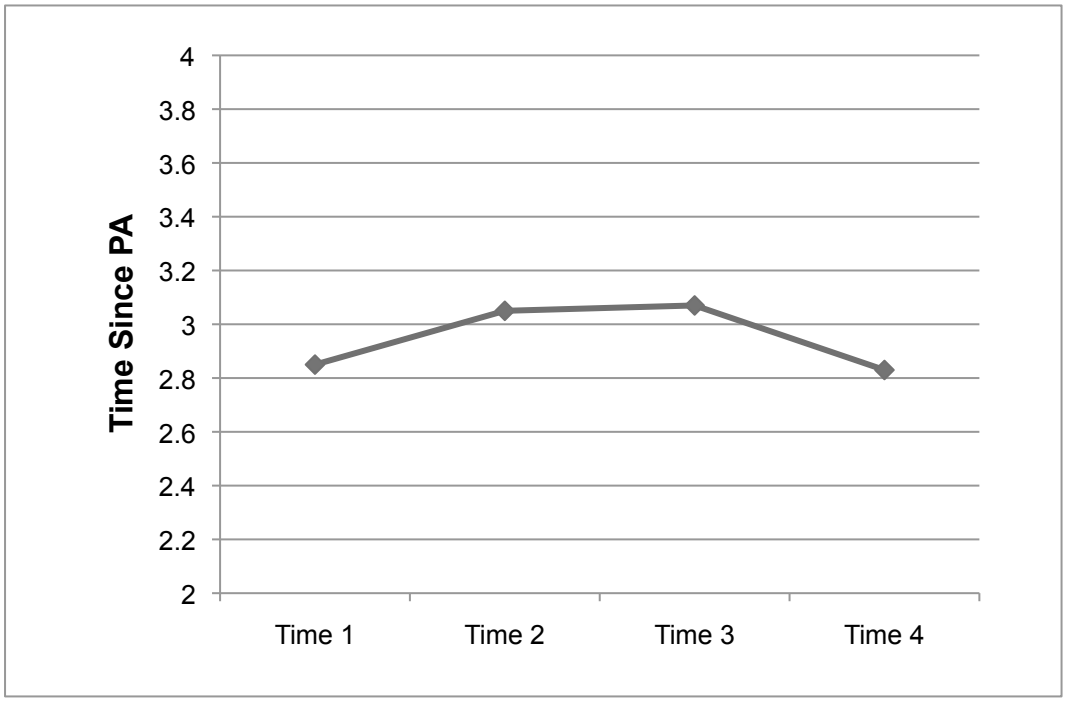

Figure 16. Mean level of time since PA across the four time points

From this analysis it may be concluded that the growth in time since PA was best described by an optimal growth function.

12.4.3 Estimating Growth in SWB. A model with a linear growth function with variance freely estimated provided an excellent fit for the SWB data ($df = 2$; $\chi^2 = 4.77$; $p = .09$; RMSEA [90% CI] = 0.000 [0.000–0.035]; NFI =

0.999; CFI = 1.00). The mean scores provided in Figure 17 illustrate the linear increase in SWB across time.

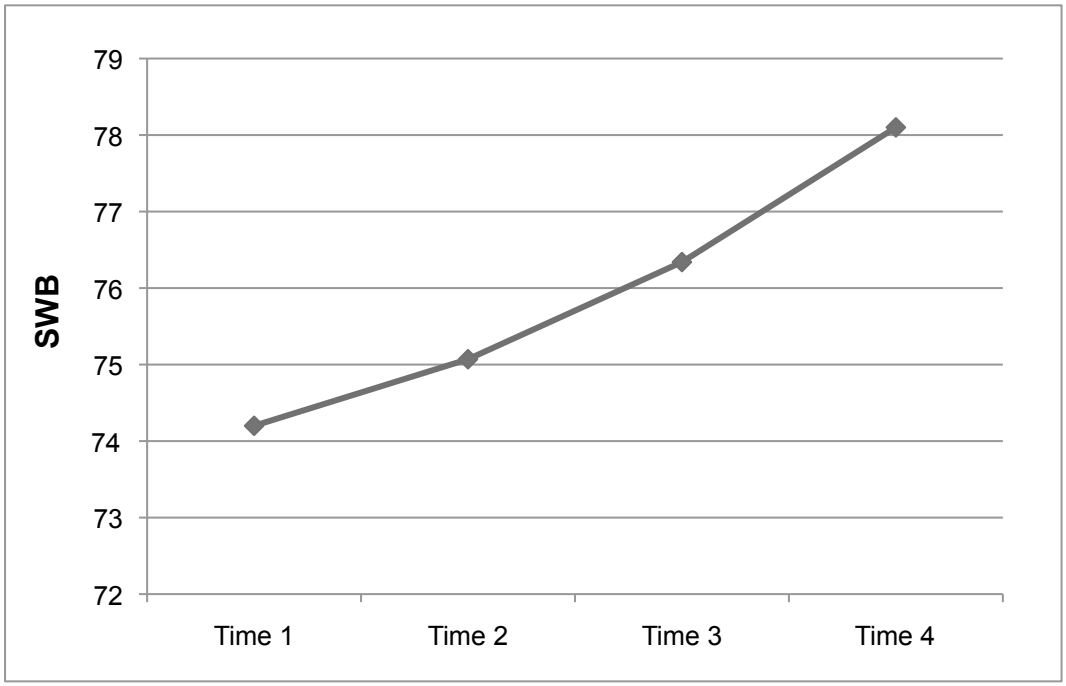

Figure 17. Mean level of SWB over the four time points

From this analysis it may be concluded that the growth in SWB was best described by a linear growth function.

12.4.4 Relationship between initial status and growth in frequency of PA and SWB. The next model tests whether the initial status and change factors for frequency of PA were related with initial status and change factors for SWB. This model provided an excellent fit to the data ($df = 20$; $\chi^2 = 18.40$; $p = .56$; RMSEA [90% CI] = 0.000 [0.000–0.064]; NFI = 0.985; CFI = 0.979). There was no statistically significant relationship between initial status factors and change factors for PA per week and SWB. Thus, the initial level of PA was not

associated with the initial level of SWB, and a change in frequency of PA was not associated with a change in SWB.

12.4.5 Relationship between initial status and growth in time since PA and SWB. The next model tests whether initial status and change factors for time since PA were related with initial status and change factors for SWB. This model provided an adequate fit to the data (df = 18; χ^2 = 26.38; p = .09; RMSEA [90% CI] = 0.055 [0.000–0.098]; NFI = 0.964; CFI = 0.988). There was a statistically significant and negative relationship between initial status factors (completely standardised $ß_1$ = -.27) between time since PA and SWB. Thus, initially higher levels of PA were associated with initially lower levels of SWB. Results also indicated that change in time since PA was not associated with a change in SWB.

In conclusion, two models were tested in which change for PA was related to change in SWB. Results indicated that the change in frequency and time since of PA was not associated with change in SWB.

CHAPTER THIRTEEN: STUDY FOUR DISCUSSION

The purpose of Study 4 was to explore the longitudinal relationships between SWB and the time since PA and frequency of PA. It was found that changes in both measures of PA were not related to change in SWB. A modest number of studies were identified which explored the long-term relationship between PA and indices of life satisfaction (Elavsky, et al. 2005; McAuley, et al., 2000; Morgan & Bath, 1998), with the results being equivocal. For example, the results in Study 4 are partially consistent with Morgan and Bath (1998) who investigated the longitudinal relationship between habitual levels of PA and wellbeing indices using a sample of participants' aged 65 and over. They found that outdoor/leisure activity did not significantly contribute to life satisfaction whilst indoor activity and walking did. In comparing the results of Morgan and Bath with Study 4, a limitation relates to the conceptualization and subsequent measurement of PA. In Study 4, PA was measured by participation in three different leisure activities (surfing, swimming or yoga). In comparison, Morgan and Bath more widely conceptualized this construct to include outdoor/leisure activities (e.g., gardening, house and car maintenance, cycling and swimming), indoor activities (e.g., housework, maintenance) and purposeful walking. Activities involving gardening, housework, and maintenance constitute incidental PA rather than purposeful leisure PA, and thus may be less comparable to the results in Study 4.

A literature search also identified two intervention studies exploring the longitudinal relationship between PA and satisfaction with life (Elavsky, et al. 2005; McAuley, et al., 2000). In the first of these, Elavsky and collegues (2005)

investigated whether PA enhanced the long-term quality of life in older adults. Participants engaged in either a six-month walking or stretching program and completed a battery of psychosocial measures at 1 and 5 years. The analysis indicated that there was no direct relationship between changes in PA and satisfaction with life. However, in comparing their results with Study 4, one limitation relates to the measurement of satisfaction with life. In Study 4 the PWI was used, which involves both cognitive and affective appraisals (Cummins, 2009), which is consistent with the conceptualization of SWB (Cummins & Nistico, 2002). In comparison, Elavsky and collegues used the Satisfaction with Life Scale (SWLS), which is suggested by its authors to contain only a cognitive appraisal of life satisfaction (Diener, et al., 1985). Commonly, in the PA literature, the SWLS is combined with an affective measure to represent SWB (e.g., Kim & Hatfield, 2004; Selkirk, 2008). Consequently, the absence of an affective measure suggests that this may not be as valid as a measure of SWB, and thus the results of Elavsky and collegues may be difficult to compare to the results in Study 4.

The second study by McAuley and collegues (2000) investigated the longitudinal relationship between PA and SWB in a group of older adults. Participants engaged in either an aerobic activity or a stretching and toning group. SWB was again operationalised by the Satisfaction with Life Scale (SWLS) and two affective measures of happiness and loneliness. Results indicated a curvilinear improvement in SWB over the course of the intervention followed by a significant decline at the 6-month follow up. Frequency of PA was also shown to be a significant predictor of SWB. This provides the best evidence for a longitudinal relationship between PA and SWB.

While there are some consistencies between Study 4 and the three studies identified above, a difference relates to the age of participants. In Study 4 participants had a diverse age range (age: 18-73), compared to the three studies identified which only included participants aged either 60 or 65 and older (Elavsky, et al., 2005; McAuley, et al., 2000; Morgan & Bath, 1998). Research has shown that PA frequency (Sherwood & Jeffery, 2000), amount of strengthening exercise (Caspersen, Pereira & Curran, 2000), and aerobic fitness (Shvartz & Reibold, 1990) declines with age. Therefore, since older people engage in PA behaviour differently from younger adults it may be difficult to generalize the findings from Elavsky, et al. (2005), McAuley, et al., (2000) and Morgan and Bath, (1998) to the general population and also the findings in Study 4.

A further difference between Study 4 and Elavsky, et al. (2005), McAuley, et al. (2000) and Morgan and Bath, (1998) relates to the intensity of PA. In Study 4, PA was measured by participation in three different and relatively demanding activities (surfing, swimming, yoga). By comparison, the other studies included activities such as gardening, housework, walking, stretching and toning (Elavsky et al., 2005; McAuley et al., 2000; Morgan & Bath, 1998), which may be considered less demanding. As research has shown that the intensity is an important factor in determining wellbeing benefits through engagement in PA (Ekkekakis, et al., 2004; Ekkekakis, et al., 2000, Steptoe & Bolton, 1988; Steptoe & Cox, 1988), therefore, it may be difficult to compare Study 4 results with the results from these previous studies.

On the other hand, a number of authors have also suggested that the intensity of PA may need to be considered relative to the age and fitness of

participants (Shephard, 2001; Nelson et al., 2007) as a consequence of a decline in aerobic fitness with age (Shvartz & Reibold, 1990). This suggests that exercise such as walking, which may be low intensity for young to middle aged adults may be considered moderate to high intensity for older adults. Therefore, if PA intensity is considered relative to age, the intensity of activity in Study 4 may be comparable to the PA intensity from Elavsky, et al. (2005), McAuley, et al., (2000) and Morgan and Bath, (1998) as these studies used a sample of older participants.

Thus, the results in Study 4 and previous research suggest that the longitudinal relationship between PA and SWB is unclear. One study was found to be consistent with the results in Study 4 (Elavsky, et al. 2005), one was not (McAuley, et al., 2000), whilst another was only partially consistent (Morgan & Bath, 1998). Furthermore, there were a number of inconsistencies in the sample characteristics, the conceptualization and measurement of PA, and measures of life satisfaction, which make comparisons difficult.

Another interesting finding is the increase in SWB from below to above the PWI Normative range. A possible reason for this increase relates to seasonal change. Approximately three quarters of the sample originated from the northern hemisphere (United Kingdom, United States and Canada). Furthermore, Study 4 was conducted from mid January to late April, a change from mid winter to spring in the northern hemisphere. Other research has shown a negative relationship between negative affect with sunlight and temperature (Denissen, Butalid, Penke & van Aken, 2008), a negative relationship between recent cloud and satisfaction with life (Barrington-Leigh, 2008), and an association between winter months and seasonal depression (Oren & Rosenthal, 1992). Thus, the

improvement to SWB in Study 4 may be partially explained by the change in season from winter to spring for participants in the northern hemisphere.

The results in Study 4 also showed that the frequency of PA remained relatively stable over the same period. This is in contrast to other research, which has shown that the frequency of PA increases as the weather improves from winter to summer (Buchowski et al., 2009; Matthews, et al., 2000; Pivarnik, Reeves & Rafferty, 2003). One explanation for the relative stability of PA comes from Pivarnik, and collegues (2003) who found that the overall frequency of PA increased from the end of winter to summer. Interestingly, the increase in PA was not due to participants engaging in more of their favourite activity, but rather taking part in a second activity. In Study 4, participants were asked whether they participated in swimming, surfing or yoga. No other PA participation was assessed. Thus, in Study 4 it is plausible that as the weather improved participants engaged in additional activities, which were not measured. Furthermore, as additional PA was not measured, this may have also contributed to the non-significant longitudinal relationship between PA and SWB in Study 4.

One final limitation of Study 4 relates to participant attrition. From time point 1 to 4 approximately three quarters of the sample dropped out of the study. Analyses of time point 1 found that those who completed all four-time points had a greater SWB and frequency of PA per week compared to those who did not. This indicates that the findings in Study 4 are only representative of a sub sample of PA participants, particularly those engaging in PA at high levels, and having high levels of SWB. Consequently, this limits the generalisability of these findings.

In conclusion, the above results suggest that the longitudinal relationship between PA and SWB is complex. The results in Study 4 showed that change in PA was not associated with change in SWB. One study was consistent with the results in Study 4 (Elavsky, et al. 2005), one was not (McAuley, et al., 2000), whilst another was only partially consistent (Morgan & Bath, 1998). Furthermore, issues related to the conceptualization and measurement of PA, and measures of life satisfaction and SWB were identified as potential reasons for the non-significance in Study 4. Thus, further research is needed to clarify the longitudinal relationship between PA and SWB.

CHAPTER FOURTEEN: SUMMARY AND GENERAL DISCUSSION

This thesis has explored the relationship between Physical Activity (PA) and Subjective Wellbeing (SWB) in terms of homeostasis theory. SWB homeostasis is a theoretical model that explains the stability of SWB by proposing that homeostatic mechanisms attempt to absorb the impact of destabilising life events and therefore maintain SWB within a narrow range of operation (Cummins, 1998; Cummins & Nistico, 2002). In search of possible psychological mechanisms to explain the maintenance of the SWB homeostatic system, attention has been given to the role of protective buffers. SWB homeostasis suggests that the possession of protective buffers allows people to minimize the unwanted challenges they experience in their daily lives, which thereby protect and maintains SWB (Cummins, 2009). Throughout this investigation, it has been proposed that PA acts as a protective buffer, helping to maintain SWB within its 'set point range', and protecting SWB from homeostatic defeat.

Previous reports on the relationship between PA and wellbeing indices are consistent with PA working as a protective buffer. Research has almost inevitably shown a positive relationship between PA and SWB (Bartels et al., 2012; Hansson, 2009; Selkirk, 2008; Stubbe et al., 2007). Research using other measures of wellbeing show that those who regularly exercise are less likely to suffer depression (France, et al., 2004; Stephens, 1988; Weyerer, 1992), PA lessens depression symptomatology in previously sedentary individuals (Blumenthal et al., 1999; McDonald & Hodgdon, 1991) and that cessation of regular PA is associated with an increase in the likelihood of depression

(Baekeland, 1970; Morris et al., 1990; Szabo, 1995). A number of studies have also found that PA moderated the relationship between challenging life events and mood indices (Carmack et al., 1999; Harris et al., 2006; LaPerriere et al., 1990; Sigfusdottir et al., 2011). Viewed in terms of SWB Homeostasis, this research is consistent with PA operating as a resource to maintain SWB to within the 'set point' range and reduce the likelihood of homeostatic defeat.

However, very few studies have explored the relationship between PA and SWB. Furthermore, none of these studies investigated this relationship in terms of homeostasis theory. Consequently, these two limitations provided the impetus for this research.

14.1 Study Findings

14.1.1 Study 1 and Study 2. Study 1 and Study 2 investigated the cross-sectional relationship between PA and SWB in terms of SWB homeostasis theory. The majority of findings in Study 1 and Study 2 are consistent with PA operating as a buffer to SWB. This is corroborated by three findings in these studies.

The first confirmatory finding is a positive relationship between the frequency of PA and SWB. This is consistent with expectation. A further analysis showed that when personality and household income were co-varied the relationship between PA and SWB became non-significant. Although this second analysis reduces the likelihood of PA working as a protective buffer this does not completely discount it as a possibility. For example, it is possible that personality and household income influences PA, which in turn influences SWB.

However, as this is a cross-sectional study the direction of causality cannot be determined.

Similarly, in both studies the proportion of participants experiencing homeostatic defeat decreased with the frequency of PA. Moreover, the PA sample had a lower proportion of participants experiencing homeostatic defeat compared to the comparison sample. While these results appear to be consistent with PA working as a protective buffer, again, as this is a cross-sectional design, an alternate explanation may be that those who are depressed are less representative in the PA sample or less likely to engage in a high frequency of PA.

Finally, the proportion of participants experiencing homeostatic defeat increased with the time since PA. Interpreted in terms of homeostasis theory this suggests that the cessation of PA increased the likelihood of homeostatic defeat occurring. However, as suggested previously, the direction of causality cannot be determined. It is also possible that this relationship is explained by those who are depressed are less likely to have engaged in PA recently.

In conclusion, the majority of results in Study 1 and Study 2 are consistent with PA operating as a protective buffer to SWB. However, this evidence is weak and causality cannot be determined.

14.1.2 Study 3. The aim of Study 3 was to investigate whether PA acts as a protective buffer to SWB, by moderating the relationship between challenging life events and SWB. The results indicated that PA did not moderate this relationship. Within the context of homeostasis theory this suggests that engaging in greater amounts of PA would not protect SWB from the influence of

adverse life events. Thus, this result is not consistent with PA operating as a protective buffer to SWB.

However, as suggested in Chapter 11 there were a number of limitations in Study 3, which may explain the non-significant buffering effect of PA. For example, the measure of challenging life events did not assess the severity of the events. Consequently, the inability of this measure to delineate between minor and severe stress may account for the non-significance in Study 3. Similarly, the absence of a measure of PA intensity may have contributed to the non-significance in Study 3. Finally, the findings in Study 3 are in contrast to other research, which has found that PA moderated the relationship between challenging life events and mood indices (Carmack et al., 1999; Harris, et al., 2006; Sigfusdottir et al., 2011). Thus, considering the limitations in Study 3 and the disparity of findings compared to other research, a buffering effect of PA cannot be disregarded.

14.1.3 Study 4. The purpose of Study 4 was to explore the longitudinal relationship between PA and SWB. It was expected that, for PA to work as a protective buffer, change in the frequency or time since PA would be related to changes in SWB. However, no such relationship was evident. Again it is possible that limitations in Study 4 including participant attrition and the conceptualisation and measurement of PA could have been responsible for this negative result. On the other hand, a review of the literature suggests that the longitudinal relationship between PA and SWB is ambiguous. While one study was found to be consistent with the results in Study 4 (Elavsky et al., 2005), one was not (McAuley et al., 2000), whilst another was only partially consistent

(Morgan & Bath, 1998). The disparate methodologies, measurement of variables, and statistical analyses in these studies also add to the ambiguity of these results.

In conclusion, despite the non-significant longitudinal relationship between PA and SWB in Study 4, a longitudinal relationship between PA and SWB cannot be discounted. This is the consequence of study limitations as well as the inconsistency of results within the existing literature.

14.2 Summary of Results

As a whole, the findings presented above are not consistent with PA working as a protective buffer to SWB. While weak support was provided by Study 1 and Study 2 the cross sectional nature of the data suggest that only limited conclusions can be drawn from these findings.

The more methodologically robust studies 3 and 4 found no evidence that PA buffered the influence of challenging life events upon SWB and neither did they show a longitudinal relationship between PA and SWB. However, in spite of a lack of evidence supporting the protective buffer hypothesis, it cannot be discounted as a possibility.

In summary, across all four studies there were limitations related to the measurement of variables, sample characteristics and the inability to establish causality. This suggests that further research is needed to clarify the relationship between PA and SWB.

14.3 General Limitations

14.3.1 Causal direction. As noted by Dolan, Peasgood, and White, (2008) a problem for much of the research investigating the determinants of SWB

(including the current investigation) is the issue of causality. Consequently, there are two potential pathways that explain the findings of this thesis. The first pathway, consistent with the framework of the current thesis, is the protection hypothesis. This pathway suggests that engaging in PA improves mood and protects against homeostatic defeat. In support of the protection hypothesis PA interventions have shown that engagement in an exercise program can improve mood/affect (Cox et al., 2001; Mead et al., 2009; Reed & Ones, 2006).

In contrast, the findings in this thesis could be interpreted within the context of the inhibition hypothesis. This hypothesis reverses the relationship between PA and wellbeing indices by suggesting that participation in PA is the consequence of the presence or absence of depression. It has certainly been found that depression is associated with a number of related symptoms, including a low mood, lack of energy, and lack of pleasure (Antony et al., 1998; Henry & Crawford, 2005). Thus, people experiencing depression may lack the energy and motivation to engage in PA. Conversely, those without depression may have the surplus energy and motivation required to engage in regular PA (Birkeland, et al., 2009).

A third explanation for the relationship between PA and SWB may be that protection and inhibition work in conjunction. That is, the relationship may be bi-directional. High levels of PA improve SWB, and simultaneously, low SWB reduces the likelihood of participation in PA, thus creating a feedback cycle.

In conclusion, although the majority of research has explored and supports the protection hypothesis, a number of other plausible pathways exist. Consequently, future research is needed to help to clarify how PA and SWB are inter-related. This will help to unravel the pathways linking PA and

SWB/homeostatic defeat.

14.3.2 Sample. A further limitation relates to the sample characteristics for the four studies. Recruitment was through advertising on the Internet and completion of the questionnaire online. This limits the generalisability of the findings as access to the Internet is lowest for people who are older and with the lowest income (Australian Bureau of Statistics, 2011) and thus, these two groups may have been underrepresented for the four studies. A limitation may also relate to the personality characteristics of the sample. People who volunteer for research are generally more agreeable, open to experience, conscientious and extraverted than non-respondents (Dollinger & Leong, 1993; Rogelberg, et al., 2003). Thus, those who are low on these personality characteristics may be underrepresented within the four studies. Moreover, as stated previously, people who are depressed lack motivation and energy (Antony et al., 1998; Henry & Crawford, 2005) and thus may be less willing to fill out a questionnaire. Thus, people who are depressed may have been underrepresented within PA sample. It is therefore unlikely that the results in these four studies are a representative population sample.

14.3.3 Measurement of PA. It is notable that, across all four studies, PA behaviour was restricted to: surfing, swimming, and yoga. This does not take into consideration other PA behaviour so that the overall amount of PA engaged in per week could have been underestimated. Consequently, this may have also influenced the findings in all four studies.

14.4 Practical Implications

A number of organisations devoted to population health have used research investigating the psychological and physical benefits of engaging in PA to justify PA recommendations. For example, the World Health Organization (2010) developed the "Global recommendations on Physical Activity for Health" with the aim of providing policy makers information on the type and amount of PA considered beneficial for the promotion of good health and the prevention of non-communicable disease. This article cites both positive physical and mental health outcomes through engaging in PA, and further suggests regular PA for those 5 years and older. These recommendations are also reflected by a number of other public health organizations (Australian Government Department of Health & Aging, 2006; Department of Health, 2004; Pate et al., 1995). Thus, it appears that PA has been embraced by many public health organizations as a measure to promote health and prevent illness.

However, in light of the findings of the four studies and as shown throughout this thesis, there are many areas where the research is ambiguous and plagued with study limitations. For example, a systematic review by Lawlor and Hopker (2001) investigated evidence for the effectiveness of PA as an intervention in the management of depression. They found evidence that PA is effective in reducing symptoms of depression in the short term, however as a consequence of "a lack of good quality research" (p. 766) no strong conclusions could be drawn in terms of clinical populations. Consequently, the authors advised that health care providers "recommend more PA to their motivated clients, but this should not be standard treatment, particularly for those with severe disease" (p. 766). Thus, it is important not to overstate the psychological

benefits to engaging in PA or perceive PA as fix-all solution. Instead, the benefits of PA to wellbeing should be considered in the context of a multitude of other factors (i.e. social connectedness, achievement, financial resources, physical health), which are associated with improved psychological wellbeing.

14.5 Future Research

The majority of participants in the current thesis had a baseline SWB level within the expected set point range. However, there is also an absence of research, which has investigated the relationship between PA and SWB using a sample experiencing homeostatic defeat.

Such information may be crucial to an understanding of the circumstances in which PA may operate as a buffer to SWB. For example, the utility of PA may be in *returning* those experiencing homeostatic defeat to within the set point range rather than PA being a *maintaining* influence to SWB.

Motivation also appears as a factor that influences the relationship between PA and wellbeing indices. For example, Self-Determination theory has been used extensively to explore PA behaviour. This theory suggests that PA motivation lies on a continuum as some people engage in PA primarily for intrinsic reasons (e.g., enjoyment, meaning to life), others for extrinsic reasons (e.g., group membership or health outcomes), whilst others may lack motivation to participate (Vlachopoulos, Karageorghis & Terry, 2000). Additionally, those who were more intrinsically motivated to engage in PA had greater positive affect, satisfaction and enjoyment than those who did not (Vlachopoulos, et al., 2000). Consequently, future research may wish to test the hypothesis that PA

operates as a protective buffer to SWB for those who have high levels of intrinsic motivation.

14.6 Conclusion

The findings from the four studies in the current thesis are not consistent with the hypothesis that PA works as a protective buffer to SWB. Despite some significant cross-sectional relationships, it was also found that PA did not buffer the influence of challenging life events upon SWB, nor were longitudinal changes in PA related to change in SWB. As such, the extent to which PA contributes to psychological wellbeing is questioned. However, limitations across the four studies weaken this finding. It is suggested that, future research may wish to explore the protective buffer hypothesis using specific samples such as those who are depressed or have high levels of intrinsic motivation.

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APPENDIX A: SAMPLE ONE ETHICS APPROVAL

DEAKIN UNIVERSITY

Human Ethics Advisory Group – Faculty of Health,
Medicine, Nursing and Behavioural Sciences

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Memorandum

To	Professor Bob Cummins and Dr Peter Kremer School of Psychology	Date	11 February 2010
From	Secretary – HEAG-H Faculty of Health, Medicine, Nursing, and Behavioral Sciences		
Subject	HEAG-H 167/09: An exploration into surfing, wellbeing and the natural context.		

Approval has been given for Professor Bob Cummins and Dr Peter Kremer, School of Psychology, to undertake this project for a period of 1 year from 11 February 2010.

Approval has been given for Professor Bob Cummins and Dr Peter Kremer, School of Psychology to undertake this project with the modifications that were requested on the 11 February 2010.

The approval given by the Deakin University HEAG - H is given only for the project and for the period as stated in the approval. It is your responsibility to contact the Secretary immediately should any of the following occur:

- Serious or unexpected adverse effects on the participants
- Any proposed changes in the protocol, including extensions of time
- Any events which might affect the continuing ethical acceptability of the project
- The project is discontinued before the expected date of completion
- Modifications that have been requested by other Human Research Ethics Committees

In addition you will be required to report on the progress of your project at least once every year and at the conclusion of the project. Failure to report as required will result in suspension of your approval to proceed with the project.

HEAG-H may need to audit this project as part of the requirements for monitoring set out in the National Statement on Ethical Conduct in Human Research (2007).An Annual Project Report Form can be found at http://www.deakin.edu.au/research/admin/ethics/human/forms/ which you will be required to complete in relation to this research. This should be completed and returned to the Administrative Officer to the HEAG-H, Dean's office, Health, Medicine, Nursing & Behavioural Sciences, Burwood campus by Tuesday 23rd November, 2010 and when the project is completed.

Good luck with the project!

Steven Sawyer
Secretary
HEAG-H

Cc Markus Lorbergs

APPENDIX B: SAMPLE ONE PLAIN LANGUAGE STATEMENT

DEAKIN UNIVERSITY
PLAIN LANGUAGE STATEMENT AND CONSENT FORM

Plain Language Statement

Date:01/12/09

Full Project Title: An exploration into physical activity and subjective wellbeing homeostasis

Principal Researcher: Prof. Bob Cummins

Student Researcher: Markus Lorbergs

Associate Researcher(s): Dr Peter Kremer

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1. Your Consent

You are invited to take part in this research project.

This Plain Language Statement contains detailed information about the research project. Its purpose is to explain to you as openly and clearly as possible all the procedures involved in this project so that you can make a fully informed decision whether you are going to participate.

Please read this Plain Language Statement carefully. Feel free to ask questions about any information in the document. You may also wish to discuss the project with a relative or friend or your local health worker. Feel free to do this.

Once you understand what the project is about and if you agree to take part in it, you will be asked to sign the Consent Form. By signing the Consent Form, you indicate that you understand the information and that you give your consent to participate in the research project.

You will be given a copy of the Plain Language Statement and Consent Form to keep as a record.

2. Purpose and Background

The purpose of this project is to explore how wellbeing benefits can be gained through participation in physical activity. The research is being conducted as part of a Doctorate (Psychology) thesis.

A total ***of 300*** people will participate in this project.

Previous experience has shown that improvements to wellbeing have been achieved through a variety of leisure activities. However there has been little research related to the wellbeing benefits achieved through surfing, swimming and yoga. The current study aims to explore wellbeing benefits that are derived through participating in physical activity.

You are invited to participate in this research project because you either participate in surfing, swimming, or yoga, and are over the age of18. The link to this website may have been forwarded to you by a friend, or you may have viewed an advertisement and as such I retain no information regarding your address or other personal details.
The results of this research may be used to help researche***r Markus Lorbergs*** to obtain a Doctor of Psychology (Clinical) degree.

3. Funding

This research is entirely funded by Deakin University.

4. Procedures

Participation in this project will involve completion of a questionnaire online. The questionnaire will take no more than 20 minutes to complete. The questionnaire involves items related to personal wellbeing, sports motivations, as well as some demographic items (though nothing that will allow you to be identified). You will be encouraged to complete all items on the questionnaire, though you may omit some items if you do not wish to respond to them. If you wish to participate you may complete the online questionnaire at any time, and upon completion you will be requested to click on a button to submit it to the researcher.

5. Possible Benefits

Although the research findings have implications related to how sport and leisure activities improve wellbeing we cannot guarantee or promise that you will receive any benefits from this project.

6. Possible Risks

There are no foreseeable risks for participating in this study, as you will simply be required to complete questionnaire items that assess your personal feelings, and motivations. However, in the unlikely event that you experience any form of discomfort or distress through participating in this study, you may call Lifeline (24hr crisis line) 131 114. You may choose to withdraw from this study at any time prior to submitting the questionnaire without any effects occurring for you.

7. Privacy, Confidentiality and Disclosure of Information

No personal identifying details will be recorded so as to ensure strict anonymity and confidentiality. In any thesis or publication, information will be provided in such a way that you cannot be identified.

The information collected during the study will be stored in hard-copy and computer files in secure storage for a minimum of 6 years, in accordance with Deakin University guidelines. Following this period hard-copy destroyed and the computer files deleted.

8. Results of Project

You are encouraged to contact the researcher at the completion of the study to be informed of the aggregate research findings. Aggregate results will be published in a thesis and it is anticipated that they will also for part of a publication in a psychology journal.

9. Participation is Voluntary

Participation in any research project is voluntary. **If you do not wish to take part you are not obliged to.** If you decide to take part and later change your mind, you are free to withdraw from the project at any stage before you submit your completed questionnaire. After you submit your questionnaire it will not be possible to withdraw from participation as there will be no way of identifying which questionnaire is yours. Any information obtained from you to date will not be used and will be destroyed.

Your decision whether to take part or not to take part, or to take part and then withdraw, will not affect your relationship with Deakin University.

Before you make your decision, a member of the research team will be available to answer any questions you have about the research project. You can ask for any information you want. Complete and submit the questionnaire only after you have had a chance to ask your questions and have received satisfactory answers.

If you decide to withdraw from this project, please do not submit your questionnaire.

10. Ethical Guidelines

This project will be carried out according to the *National Statement on Ethical Conduct in Human Research* (2007) produced by the National Health and Medical Research Council of Australia. This statement has been developed to protect the interests of people who agree to participate in human research studies.

The ethics aspects of this research project have been approved by the Human Research Ethics Committee of Deakin University.

11. Complaints

If you have any complaints about any aspect of the project, the way it is being conducted or any questions about your rights as a research participant, then you may contact:

Should you have any concern about the conduct of this research project, please contact the Secretary HEAG-H, Dean's Office, Faculty of Health, Medicine, Nursing and Behavioural Sciences, 221 Burwood Hwy, Burwood, VIC, 3125. Telephone: (03) 9251 7174, Email: ***hmnbs-research@deakin.edu.au***"

Please quote project number HEAG-H ***[number]***.

12. Reimbursement for your costs

You will not be paid for your participation in this project.

13. Further Information, Queries, or Any Problems

If you require further information, wish to withdraw your participation or if you have any problems concerning this project (for example, any side effects), you can contact the principal researcher Prof. Bob Cummins or the student researcher, Markus Lorbergs.

The researchers responsible for this project are:

Markus Lorbergs (student researcher), Deakin University, Faculty of Health, Medicine, Nursing, and Behavioural Sciences, School of Psychology, 221 Burwood Hwy, Burwood, 3125. Email: mlorb@deakin.edu.au.

Professor Bob Cummins (principal researcher), Deakin University, Faculty of Health, Medicine, Nursing, and Behavioural Sciences, School of Psychology, 221 Burwood Hwy, Burwood, 3125. Ph: 03 9244 6845.

Pleas indicate that have read and understand the terms of the Plain Language Statement by clicking the 'I Agree' button below:

I AGREE

I DO NOT AGREE

APPENDIX C: SAMPLE ONE QUESTIONNAIRE

The following is a list of the questionnaires for the Sample One online survey:

Section 1: Personal Wellbeing Index (PWI)
Thinking about your own life and personal circumstances please circle the number that best represents how satisfied you are with your life.

For each item below this scale will be used:

Very dissatisfied					Neutral					Completely satisfied
0	1	2	3	4	5	6	7	8	9	10

How satisfied are you with…

1. your life as a whole?
2. your standard of living?
3. your health?
4. what you are currently achieving in life?
5. your personal relationships?
6. how safe you feel?
7. feeling part of your community?
8. your future security?
9. your spirituality or religion?

Or (if you have no spiritual or religious beliefs) (tick box)

Section 2: How you generally feel (HPMood)
Please indicate how each of the following describes your feelings when you think about your life in general.

For each item below this scale will be used:

Not at all										Extremely
0	1	2	3	4	5	6	7	8	9	10

10. How content do you generally feel?
11. How happy do you generally feel?
12. How alert do you generally feel?

Section 3: What you expect to happen (Optimism)
How much do you agree with the following statements?

For each item below this scale will be used:

Disagree completely					Neutral					Strongly Agree
0	1	2	3	4	5	6	7	8	9	10

13. In uncertain times, I usually expect the best.
14. I'm always optimistic about my future.
15. Overall, I expect more good things to happen to me than bad.
16. Add these items to section 3

17. On the whole, I am satisfied with myself
18. I feel that I have a number of good qualities.
19. I am able to do things as well as most other people.
20. I feel that I'm a person of worth, at least on an equal plane with others.
21. I take a positive attitude toward myself.

Section 4: DASS-21

Please read each statement and circle a number from 0-10 which indicates how much the statement applied to you *over the past week*. There are no right or wrong answers. Do not spend too much time on any statement.

For each item below this scale will be used:

Not at all										Extremely
0	1	2	3	4	5	6	7	8	9	10

22. I found it hard to wind down
23. I was aware of dryness of my mouth
24. I couldn't seem to experience any positive feeling at all
25. I experienced breathing difficulty (eg, excessively rapid breathing, breathlessness in the absence of physical exertion)
26. I found it difficult to work up the initiative to do things
27. I tended to over-react to situations
28. I experienced trembling (eg, in the hands)
29. I felt that I was using a lot of nervous energy
30. I was worried about situations in which I might panic and make a fool of myself
31. I felt that I had nothing to look forward to
32. I found myself getting agitated
33. I found it difficult to relax
34. I felt down-hearted and blue
35. I was intolerant of anything that kept me from getting on with what I was doing
36. I felt I was close to panic
37. I was unable to become enthusiastic about anything
38. I felt I wasn't worth much as a person
39. I felt that I was rather touchy
40. I was aware of the action of my heart in the absence of physical exertion (eg, sense of heart rate increase, heart missing a beat)
41. I felt scared without any good reason
42. I felt that life was meaningless

Section 5: Personality

Please select a response option for each statement to indicate the extent to which *you agree* or *disagree* with that statement.

For each item below this scale will be used:

Disagree completely	Neutral	Strongly Agree

0 1 2 3 4 5 6 7 8 9 10

I see myself as:

43. Easily upset
44. Reserved
45. Open to new experiences
46. Sympathetic
47. Dependable
48. Anxious
49. Quiet
50. Complex
51. Warm
52. Self-disciplined
53. Calm
54. Introverted
55. Uncreative
56. Disorganised
57. Emotionally stable
58. Conscientious

Section 6: Motivation

Using the scale provided, please indicate how true each of the following statements is for you.

For each item below this scale will be used:

No at all true Somewhat true Very true

0 1 2 3 4 5 6 7 8 9 10

I participate in **(physical activity type: surfing swimming/yoga)**

59. because I enjoy it.
60. because it's a part of who I am.
61. because its an opportunity to just be who I am.
62. because I would feel ashamed if I quit.
63. but the reasons why are not clear to me anymore.
64. because I would feel like a failure if I quit.
65. but I wonder what's the point.
66. because what I do in this activity is an expression of who I am.
67. because the benefits of this activity are important to me.
68. because if I don't other people will not be pleased with me.
69. because I like it.
70. because I feel obligated to continue.
71. but I question why I continue.
72. because I feel pressure from other people to play.
73. because people push me to play.
74. because it's fun.
75. because it teaches me self-discipline.
76. because I would feel guilty if I quit.
77. because I find it pleasurable.
78. because I value the benefits of my activity.

79. but I question why I am putting myself through this.
80. because it is a good way to learn things which could be useful to me in my life.
81. in order to satisfy people who want me to be involved in the activity.
82. because it allows me to live in a way that is true to my values.

Section 7: Background Information

83. When was the last time you **(physical activity type: surfing swimming/yoga)?**
    Today Yesterday 2-6 days 1-3 weeks 1 month 2-6 months more than 6 months
84. How many times each week do you usually **(physical activity type: surfing swimming/yoga)?**
    Less than once 1-2 3-4 5-6 7+
85. Do you currently have an illness or injury, which has prevented you from **(physical activity type: surfing swimming/yoga)** Yes/No
86. Age:___
87. Gender (please circle): Male Female
88. Country of residence:_____
89. Postcode/Zipcode/Zone_____

APPENDIX D: SAMPLE TWO ETHICS APPROVAL

DEAKIN UNIVERSITY

Human Ethics Advisory Group – Faculty of Health,
Medicine, Nursing and Behavioural Sciences

221 Burwood Highway,
Burwood Victoria 3125 Australia
Telephone +61 3 2517174
Facsimile +61 3 9251 7425
hmnbs-research@deakin.edu.au

Memorandum

To	Professor Robert Cummins School of Psychology	Date	23 November, 2010
From	Secretary – HEAG-H Faculty of Health, Medicine, Nursing, and Behavioral Sciences		
Subject	HEAG-H 131_2010: What is good for the body is good for the mind: An exploration into physical activity and subjective wellbeing homeostasis.		

Approval has been given for Professor Robert Cummins, School of Psychology, to undertake this project for a period of 3 years from 23 November, 2010 with the following conditions

Procedure:
(i) Please include a statement that reminds participants that submission of the survey implies consent.

Plain Language Statement:
(i) Please adjust section 1 so the PLS is consistent with an online survey.

The approval given by the Deakin University HEAG - H is given only for the project and for the period as stated in the approval. It is your responsibility to contact the Secretary immediately should any of the following occur:

- Serious or unexpected adverse effects on the participants
- Any proposed changes in the protocol, including extensions of time
- Any events which might affect the continuing ethical acceptability of the project
- The project is discontinued before the expected date of completion
- Modifications that have been requested by other Human Research Ethics Committees

In addition you will be required to report on the progress of your project at least once every year and at the conclusion of the project. Failure to report as required will result in suspension of your approval to proceed with the project.

HEAG-H may need to audit this project as part of the requirements for monitoring set out in the National Statement on Ethical Conduct in Human Research (2007).An Annual Project Report Form can be found at http://www.deakin.edu.au/research/admin/ethics/human/forms/ which you will be required to complete in relation to this research. This should be completed and returned to the Administrative Officer to the HEAG-H, Dean's office, Health, Medicine, Nursing & Behavioural Sciences, Burwood campus by **Tuesday 23rd November, 2010** and when the project is completed.

Good luck with the project!

Steven Sawyer
Secretary
HEAG-H

cc Markus Lorbergs, Dr. Peter Kremer

APPENDIX E: SAMPLE TWO PLAIN LANGUAGE STATEMENT

DEAKIN UNIVERSITY
PLAIN LANGUAGE STATEMENT AND CONSENT FORM

Plain Language Statement

Full Project Title: What's Good for the Body is Good for the Mind: An Exploration into Physical Activity and Subjective Wellbeing Homeostasis

Principal Researcher: Prof. Robert Cummins

Student Researcher: Markus Lorbergs

Associate Researcher(s): Dr Peter Kremer

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14. Your Consent

You are invited to take part in this research project.

This Plain Language Statement contains detailed information about the research project. Its purpose is to explain to you as openly and clearly as possible all the procedures involved in this project so that you can make a fully informed decision whether you are going to participate.

Please read this Plain Language Statement carefully. Feel free to ask questions about any information in the document. You may also wish to discuss the project with a relative or friend or your local health worker. Feel free to do this.

Once you understand what the project is about and if you agree to take part in it, you will be asked to click "I Agree" at the bottom of this page. By clicking "I Agree", you indicate that you understand the information and that you give your consent to participate in the research project.

15. Purpose and Background

The purpose of this project is to explore how wellbeing benefits can be gained through participation in physical activity. The research is being conducted as part of a Doctorate (Psychology) thesis.

A total ***of 250*** people will participate in this project.

Previous experience has shown that improvements to wellbeing have been achieved through a variety of leisure activities. However there has been little research related to the wellbeing benefits achieved through surfing, swimming and yoga. To address this gap the current study aims to investigate the relationship between physical activity and improvements in wellbeing over time.
You are invited to participate in this research project because you participate in surfing, swimming, or yoga, and are over the age of 18.
The results of this research may be used to help researche***r Markus Lorbergs*** to obtain a Doctor of Psychology (Clinical) degree.

16. Funding

This research is entirely funded by Deakin University.

17. Procedures

Participation in this project will involve completion of **four questionnaires** over the next **three months** (one per month). The entire process is conducted entirely online. The first questionnaire you will fill out today will take no longer than **10 minutes** to complete. Questionnaire 2, 3, and 4 are much shorter and will therefore take less than **5 minutes** to complete. The questionnaire involves items related to personal wellbeing, mood, as well as some demographic items (though nothing that will allow you to be identified). You will be encouraged to complete all items on the questionnaire, though you may omit some items if you do not wish to respond to them. Upon completion you will be requested to click on a button to submit it to the researcher. By submission of the survey this implies consent has been given.

At the end of the survey we will require you to record your email address. The purpose of recording your email address is so we can email you the link to the 2nd 3rd and 4th questionnaire in the coming weeks.

18. Possible Benefits

Although the research findings have implications related to how sport and leisure activities improve wellbeing we cannot guarantee or promise that you will receive any benefits from this project.

19. Possible Risks

There are no foreseeable risks for participating in this study, as you will simply be required to complete questionnaire items that assess your personal feelings, and motivations. However, in the unlikely event that you experience any form of discomfort or distress through participating in this study, you may call Lifeline (24hr crisis line) 131 114. You may choose to withdraw from this study at any time prior to submitting the questionnaire without any effects occurring for you.

20. Privacy, Confidentiality and Disclosure of Information

Your email address will be held on a separate database to your questionnaire/demographic responses so the information cannot be identified as coming from a particular individual email.
No other personal identifying details will be recorded so as to ensure strict anonymity and confidentiality. In any thesis or publication, information will be provided in such a way that you cannot be identified.
The information collected during the study will be stored in hard-copy and computer files in secure storage for a minimum of 6 years, in accordance with Deakin University guidelines. Following this period hard-copy destroyed and the computer files deleted.

21. Results of Project

You are encouraged to contact the researcher at the completion of the study to be informed of the aggregate research findings. Aggregate results will be published in a thesis and it is anticipated that they will also for part of a publication in a psychology journal.

22. Participation is Voluntary

Participation in any research project is voluntary. **If you do not wish to take part you are not obliged to.** If you decide to take part and later change your mind, you are free to

withdraw from the project at any stage before you submit your completed questionnaire. After you submit your questionnaire it will not be possible to withdraw from participation as there will be no way of identifying which questionnaire is yours. Any information obtained from you to date will not be used and will be destroyed.

Your decision whether to take part or not to take part, or to take part and then withdraw, will not affect your relationship with Deakin University.

Before you make your decision, a member of the research team will be available to answer any questions you have about the research project. You can ask for any information you want. Complete and submit the questionnaire only after you have had a chance to ask your questions and have received satisfactory answers.

If you decide to withdraw from this project, please do not submit your questionnaire.

23. Ethical Guidelines

This project will be carried out according to the *National Statement on Ethical Conduct in Human Research* (2007) produced by the National Health and Medical Research Council of Australia. This statement has been developed to protect the interests of people who agree to participate in human research studies.

The ethics aspects of this research project have been approved by the Human Research Ethics Committee of Deakin University.

24. Complaints

If you have any complaints about any aspect of the project, the way it is being conducted or any questions about your rights as a research participant, then you may contact:

Should you have any concern about the conduct of this research project, please contact the Secretary HEAG-H, Dean's Office, Faculty of Health, Medicine, Nursing and Behavioural Sciences, 221 Burwood Hwy, Burwood, VIC, 3125. Telephone: (03) 9251 7174, Email: ***hmnbs-research@deakin.edu.au***"

Please quote project number HEAG-H ***[number]***.

25. Reimbursement for your costs

You will not be paid for your participation in this project.

26. Further Information, Queries, or Any Problems

If you require further information, wish to withdraw your participation or if you have any problems concerning this project (for example, any side effects), you can contact the principal researcher Prof. Robert Cummins or the student researcher, Markus Lorbergs.

The researchers responsible for this project are:

Markus Lorbergs (student researcher), Deakin University, Faculty of Health, Medicine, Nursing, and Behavioural Sciences, School of Psychology, 221 Burwood Hwy, Burwood, 3125. Email: mlorb@deakin.edu.au.

Professor Bob Cummins (principal researcher), Deakin University, Faculty of Health, Medicine, Nursing, and Behavioural Sciences, School of Psychology, 221 Burwood Hwy, Burwood, 3125. Ph: robert.cummins@deakin.edu.au

Pleas indicate that have read and understand the terms of the Plain Language Statement by clicking the 'I Agree' button below:

I AGREE

I DO NOT AGREE

APPENDIX F: SAMPLE TWO QUESTIONNAIRE

The following is a list of the questionnaires for the Sample TWO online survey:

Section 1: Personal Wellbeing Index (PWI)
Thinking about your own life and personal circumstances please circle the number that best represents how satisfied you are with your life.

For each item below this scale will be used:

Very dissatisfied					Neutral					Completely satisfied
0	1	2	3	4	5	6	7	8	9	10

How satisfied are you with…

1. your life as a whole?
1. your standard of living?
2. your health?
3. what you are currently achieving in life?
4. your personal relationships?
5. how safe you feel?
6. feeling part of your community?
7. your future security?
8. your spirituality or religion?

Or (if you have no spiritual or religious beliefs) (tick box)

Section 2: How you generally feel (HPMood)
Please indicate how each of the following describes your feelings when you think about your life in general.

For each item below this scale will be used:

Not at all										Extremely
0	1	2	3	4	5	6	7	8	9	10

9. How content do you generally feel?
10. How happy do you generally feel?
11. How alert do you generally feel?

Section 3: What you expect to happen (Optimism)
How much do you agree with the following statements?

For each item below this scale will be used:

Disagree completely					Neutral					Strongly Agree
0	1	2	3	4	5	6	7	8	9	10

12. In uncertain times, I usually expect the best.
13. I'm always optimistic about my future.
14. Overall, I expect more good things to happen to me than bad.
15. Add these items to section 3

16. On the whole, I am satisfied with myself
17. I feel that I have a number of good qualities.
18. I am able to do things as well as most other people.
19. I feel that I'm a person of worth, at least on an equal plane with others.
20. I take a positive attitude toward myself.

Section 4: DASS-21

Please read each statement and circle a number from 0-10 which indicates how much the statement applied to you *over the past week*. There are no right or wrong answers. Do not spend too much time on any statement.

For each item below this scale will be used:

Not at all										Extremely
0	1	2	3	4	5	6	7	8	9	10

21. I found it hard to wind down
21. I was aware of dryness of my mouth
22. I couldn't seem to experience any positive feeling at all
23. I experienced breathing difficulty (eg, excessively rapid breathing, breathlessness in the absence of physical exertion)
24. I found it difficult to work up the initiative to do things
25. I tended to over-react to situations
26. I experienced trembling (eg, in the hands)
27. I felt that I was using a lot of nervous energy
28. I was worried about situations in which I might panic and make a fool of myself
29. I felt that I had nothing to look forward to
30. I found myself getting agitated
31. I found it difficult to relax
32. I felt down-hearted and blue
33. I was intolerant of anything that kept me from getting on with what I was doing
34. I felt I was close to panic
35. I was unable to become enthusiastic about anything
36. I felt I wasn't worth much as a person
37. I felt that I was rather touchy
38. I was aware of the action of my heart in the absence of physical exertion (eg, sense of heart rate increase, heart missing a beat)
39. I felt scared without any good reason
40. I felt that life was meaningless

Section 5: Personality

Please select a response option for each statement to indicate the extent to which *you agree* or *disagree* with that statement.

For each item below this scale will be used:

Disagree completely	Neutral	Strongly Agree

0 1 2 3 4 5 6 7 8 9 10

I see myself as:

41. Easily upset
42. Reserved
43. Open to new experiences
44. Sympathetic
45. Dependable
46. Anxious
47. Quiet
48. Complex
49. Warm
50. Self-disciplined
51. Calm
52. Introverted
53. Uncreative
54. Disorganised
55. Emotionally stable
56. Conscientious

Section 7: Background Information

57. When was the last time you **(physical activity type: surfing swimming/yoga)?**
    Today Yesterday 2-6 days 1-3 weeks 1 month 2-6 months more than 6 months
58. How many times each week do you usually **(physical activity type: surfing swimming/yoga)?**
    Less than once 1-2 3-4 5-6 7+
59. Do you currently have an illness or injury, which has prevented you from **(physical activity type: surfing swimming/yoga)**Yes/No
60. Age:___
61. Gender (please circle): Male Female
62. Country of residence:_____
63. Postcode/Zipcode/Zone_____
64. In the last month has something happened to you causing you to feel happier or sadder than normal?
    Yes, happier Yes, sadder No
65. Can you please give me an idea of your household income over the past year?

Less than $15,000
$15,000 to $30,000
$31,000 to $60,000
$61,000 to $90,000
$91,000 to $120,000
$121,000 to $150,000

$151,000 to $250,000
$251,000 to $500,000
$500,000+
Declined to answer

Lastly you will need to create a unique code so you can access questionnaire 2, 3, and 4 in the coming weeks. Your code will be made up of two sources of information: your mother's maiden name and your birth day:

Please write in the box below the first **four letters** of your mother's maiden name (in lower case)

(for example if your mothers maiden name is Normsmith you would type "norm"

_____

If you do not know your mothers maiden name you can use the first four letters of a pets name or any other name you can remember.

If your mothers maiden name is less than four letters please type in the name followed by an x. (for example Lee would become "leex")

Please write in the box below your **birth day**

(for example if your birth date is 29/05/1976 you would type "29")

_____

You will need to remember this information to gain access to questionnaire 2, 3, and 4 in the coming weeks.

Email address:_____
(email is required so we can send you the link to questionnaire 2, 3 and 4)

Note: Section 6 (Background information) will only be included in the first questionnaire given to participants.