Estimation of set-points and range for

Subjective Wellbeing and Homeostatically Protected Mood

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We the undersigned declare that the above-named research project has been completed as described in the Application for Ethics Approval and in accordance with the ethics guidelines of Deakin University.

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LITERATURE REVIEW

1.1 Abstract

Subjective Wellbeing (SWB), which refers to people's own evaluation of their life, was long thought to be dominated by both cognition and affect. However, recent evidence shows that only three core affects, 'content', 'happy' and 'alert', termed Homeostatically Protected Mood (HPMood), explain 80% of variance in SWB. Subjective wellbeing demonstrates remarkable temporal stability and consistency across individuals and populations. Several theories have been proposed to explain this stability as personality, dynamic equilibrium level, adaptation level and homeostatic set-points. Recent evidence has ruled out personality and the personality based dynamic equilibrium model as the predictors of the SWB stability. Instead, it has been proposed that each person possesses a genetically determined set-point for SWB based on HPMood. The experience of SWB is normally held within a narrow range around the set-point by the homeostatic defence mechanisms. These include adaptation level, behavioural response regulation, and a system of cognitive buffers. Recently, set-points have been demonstrated to lie within a 71-90 range on a 0 to 100 point scale. The dependent variable for this demonstration was 'satisfaction with life as a whole'. It is hypothesised that set-points calculated using HPMood as the dependent variable will lie within the same range.

1.2 Introduction

The notion of happiness has been a part of public discourse for thousands of years, becoming the focus of attention in psychology and public policy in the last half - century. During this time, research on happiness largely focused on understanding the predictors of happiness and its stability. However, lack of agreement regarding the definition and the structure of happiness and its underlying components has considerably impeded the progress in this field.

This literature review outlines some of the conceptual inconsistencies and examines the evidence and theories relating to temporal stability of happiness and its major contributing factors.

1.3 Defining Happiness

Despite the proliferation of research on happiness, it has been noted that the term happiness has no clear definition and it is used interchangeably with many different concepts such as quality of life, wellbeing and life satisfaction (Diener, Scollon & Lucas, 2009; Cummins, 2013). In 1948, the term "wellbeing" was adopted by the World Health Organization, to describe prosperity across physical, mental and social domains of life (World Health Organisation, 1948). At first, the wellbeing construct was evaluated using objective measures, most commonly economic measures, such as Gross Domestic Product (GDP) (Wilson, 1972). However, it soon became clear that GDP is limited in that it does not reflect people's perceptions of their own wellbeing (Andrews & Withey, 1976; Campbell, Converse & Rodgers, 1976).

As a consequence of this realisation, an alternative viewpoint emerged, focusing on people's personal experience of their wellbeing, referred to as Subjective Wellbeing (SWB). Although this term has several meanings, it is commonly understood as a 'level of wellbeing people experience according to their subjective evaluations of their lives' (Diener & Ryan, 2009, p. 391). The key advantage of this approach is that it moved away from evaluating people's wellbeing against pre-determined objective criteria towards people's own appraisals of their lives.

1.4 The Composition of SWB

The two components considered to dominate SWB are cognition and affect. Cognition is thought to influence judgments of life satisfaction (LS) (Diener, Emmons, Larsen & Griffin, 1985), while affect is thought to comprise moods and emotions that together influence how one feels about their life (Diener, Suh, Lucas & Smith, 1999). Although most researchers agree that both of these components are important in the overall experience of SWB (Diener, 2006), there is a lack of agreement regarding their relative contribution to SWB (Busseri, Sadava & Decourville, 2007).

1.4.1 Cognitive Component of SWB

It is assumed that when people are asked how 'satisfied' they are with their life, they make cognitive comparisons of their current circumstances with aspects of life that are personally meaningful (Diener, Emmons, et al., 1985). The response scale is typically a single-item, known as Global Life Satisfaction (GLS), which asks people how satisfied they are with their 'life as a whole' (Campbell et al., 1976). Although this question is a reliable measure of overall LS (Campbell et al., 1976; Lucas & Donnellan, 2012), it is also understood that single-item measures are more susceptible to the influence of momentary affect and therefore are less reliable than multi-item measures (Schimmack & Oishi, 2005).

An alternative multi-item measure of LS has been developed, called the Satisfaction With Life Scale (SWLS; Diener, Emmons, et al., 1985). The SWLS comprises five synonymous statements each measuring overall LS. Thus, it is not surprising that it correlates most highly with GLS than any other measure of SWB, showing average correlations of .67

across two samples (Diener, Emmons, et al., 1985, p. 73). However, based on the considerable correlations of .51 with Bradburn's (1969) affective measure, SWLS also appears to have an affective content.

It has been proposed that this affective influence in LS measures is due to people's reliance on heuristics when answering global and abstract questions about their life (Schwarz & Strack, 1999). Heuristics have been described as a form of thinking which is fast, affective and prevalent in situations when exhaustive evaluation is impractical (Kahneman, 2011). Thus, given that both GLS and SWLS scales measure overall LS without any specific standards, they are more informative about how people feel about their life than how they think about it.

Alternative approach to LS measurement involves evaluating satisfaction with specific domains of life, such as family or health. Domain satisfaction measures are characterised by more well-defined assessment criteria and are therefore thought to be less influenced by affect (Schwarz & Strack, 1999). One such measure is the Personal Wellbeing Index (PWI; International Wellbeing Group, 2013). The PWI resulted from the systematic analysis of the most frequently measured domains in SWB research (Cummins, 1996). A summary of these domains and people's rating of their relative importance to their life yielded seven domains that explain unique variance in GLS. However, despite this more specific approach, the PWI is also found to be dominated by affect, accounting for 59% of its variance (Tomyn, 2008).

Another approach has been taken to measure the cognitive component of SWB which does not ask people to evaluate their life satisfaction per se. Instead, it asks them to compare their current circumstances against broad, but personally meaningful standards. This is measured using a Multiple Discrepancies Theory scale (MDT; Michalos, 1985). This scale is founded on Social Comparison Theory (Festinger, 1954), Cognitive Dissonance Theory

(Festinger, 1957) and Social Aspiration Theory (Lewin, Dembo, Festinger & Sears, 1944). Together these theories propose that people compare various aspects of their life to others, or to their own needs and wants. The MDT incorporates these perspectives by proposing that people's LS depends on the level of discrepancy between their current life and the life they want, think they need or deserve, significant others have, would expect in the future, have expected or have had in the past. However, despite this alternative approach, positive affect is found to account for 45% of variance in MDT scale (Blore, 2008). From this it may be concluded that SWB and LS are dominantly affective constructs and that designing a purely cognitive measure of SWB may be unachievable.

1.4.2 Affective Component of SWB

Designing a scale that would adequately measure the affective component of SWB has proved to be an even more challenging task. The earliest research into the affective nature of SWB came from Bradburn (1969) who proposes that the subjective sense of wellbeing depends on the balance between two mutually independent affects, positive (PA) and negative affect (NA). To test his theory, he designed the Affect Balance Scale (ABS; Bradburn, 1969) which allows the ratio of PA and NA to be calculated.

This scale has been criticised for its low reliability and content validity, resulting from poor item selection (Diener & Emmons, 1984; Watson, 1988). For example, the question: "During the past few weeks, did you feel proud because someone complimented you on something you had done?" is too specific, unnecessarily restricting the time and circumstance of the affective experience. The scale also includes double-barrelled questions, requiring people to unequivocally agree or disagree to two affects that can be perceived as having different meanings, such as "excited or interested" or "lonely or remote".

Another controversy involves Bradburn's (1969) conception of PA and NA as mutually independent dimensions, which implies that one can feel both happy and sad at the same time. He concludes this based on the very low correlations of .05 between PA and NA items. Although many researchers support this view of PA and NA as independent dimensions (Thayer, 1967; Andrews & Withey, 1976; Costa & McCrae, 1980), others suggest that this independence may result from biases inherent in rating scales and that more reliable scales would produce affective dimensions that are bipolar (Meddis, 1972; Russell, 1979). Thus, it became clear that an alternative method of measuring the affective component of SWB was required.

In 1980, Russell proposed a Circumplex Model of Affect as an alternative framework for understanding the structure of affective experience. Within the circumplex, affective dimensions are both mutually related and bipolar. The bipolarity of dimensions implies that affective states which lie opposite to each other on a single dimension are highly negatively correlated. To test his model, he conducted three studies in which he asked participants to arrange 28 commonly used affective terms in a circle according to their perception of similar and opposing affects. The results were consistent across all three studies, showing that most affects spread evenly around two bipolar dimensions, one relating to valence (Pleasure-Displeasure), the other to arousal (Activation-Deactivation). The model accounts for 70% of variance in the self-reported affect.

However, Russell's (1980) circumplex model did not settle the debate about the dimensionality of affect. Factor-analytic studies continued to show that PA and NA are the two dominant and independent affective dimensions (Zevon & Tellegen, 1982; Diener & Emmons, 1984; Watson, Clark & Tellegen, 1988), even though these researchers acknowledge bipolarity of the two dimensions and the importance of arousal or 'intensity' (Diener, Larsen, Levine & Emmons, 1985) in the experience of affect. To explain the relationship between PA, NA and arousal, Zevon and Tellegen (1982) claimed that PA and NA are best characterised as "descriptively bipolar but affectively unipolar dimensions". In this view, high PA and NA are proposed to reflect emotional arousal, while low PA and NA reflect absence of affective experience.

Following this conception, a scale was designed to measure PA and NA, called the Positive and Negative Affect Schedule (PANAS; Watson et al., 1988). PANAS showed high internal consistency reliability of .88, which was a significant improvement from Bradburn’s ABS (1969). However, the main critique of this scale is that it fails to measure affects that are low in activation, such as ‘happy’, ‘satisfied’ or ‘sad’(Russell & Carroll, 1999), which are of vital importance in measuring the overall SWB.

Towards the beginning of the new millennium, it became clear that the disagreement about the structure of affect cannot be resolved without defining the basic features of the affective experience. In doing so, Russell and Barrett (1999) proposed two fundamental elements of affect, prototypical emotional episode and core affect. Prototypical emotional episode refers to a distinct emotional experience, such as fear or love, which results from a mixture of core affect and response behaviour directed at an object of attention. Core affect, on the other hand, represents a most basic feeling that is not related to any object. It is conceived as a biologically determined, omnipresent and stable mood, although it can be altered during an emotional episode. Russell suggests that core affect represents an integral blend of two dimensions, valance and arousal, and it can be characterised as a single point on a circumplex (Russell, 2003).

The idea of core affect as an ever-present feeling that exists in all humans may be a missing piece of the puzzle in explaining the frequently reported stability of SWB (Cummins, 1995, 1998, 2003). Thus, Davern, Cummins and Stokes (2007) hypothesised that Core Affect may be a key predictor of SWB. They operationalised Core Affect as a minimum set of affects that would account for most variance in SWB. Out of 31 commonly used affective terms in the literature, only three affects, ‘content’, ‘happy’ and ‘excited’ accounted for 64%

of variance in SWB, which they claimed to best describe Core Affect. The findings were later replicated by Blore, Stokes, Mellor, Firth and Cummins (2011) and Tomyn and Cummins (2011) who substituted the adjective ‘excited’ with ‘active’ and ‘alert’, respectively, in order to better account for the arousal dimension of Core Affect. The three affects, ‘happy’, ‘content’ and ‘alert’ were found to best predict SWB, accounting for 80% of its variance (Tomyn & Cummins, 2011).

These three affects are named Homeostatically Protected Mood (HPMood; Cummins, 2010a). Similarly to Core Affect, HPMood is believed to be a biologically determined feeling influencing cognitive judgments about the self, momentary experiences, and even personality. However, the main difference is that, while Core Affect is seen as changeable by external circumstances, HPMood is considered to be a stable trait mood that exists independently from changes in one’s environment. The processes underlying HPMood will be explained in the section on Homeostasis Theory, which will be introduced following the summary of literature on the stability of SWB.

1.5 Stability of SWB

Since the earliest measures of SWB were made, significant test-retest correlations have demonstrated considerable temporal stability (Bradburn, 1969; Campbell et al., 1976). This has been demonstrated when measured daily (Diener & Larsen, 1984), monthly (Eid & Diener, 2004) and over many years (Headey & Wearing, 1989). As a recent example, repeated surveys of the Australian population found that the average SWB varied by only 3.2 points between 2001 and 2013 (Cummins et al., 2013).

In search for the sources of this stability, early studies found that demographic factors, such as gender, age, income and education only weakly predict SWB, accounting for less than 6% of its variance (Andrews & Withey, 1976; Palmore & Kivett, 1977). Before long, researchers postulated various idiosyncratic processes that might be driving this stability. The most prevailing theories proposed in explanation are adaptation level, personality, dynamic equilibrium level and homeostatic set-points.

1.5.1 Adaptation and SWB

According to Helson's (1964) Adaptation Level Theory, affective judgments are made relative to the neutral level of affectivity to which a person has adapted, called the Adaptation Level (AL). The AL can increase or decrease depending on the degree to which a chronic new stimulus is higher or lower than usually experienced. Consequently, when a person experiences a continued positive event which raises their AL, the new everyday experiences feel less pleasurable than before the event. Similarly, a drop in AL due to a lasting negative event makes ordinary experiences feel more pleasurable than usual.

The early empirical evidence for the AL came from Brickman, Coates and Janoff-Bulman (1978). They found that SWB levels for lottery winners and paralysed accident victims did not differ significantly from the controls when measured some time after the event. Although the sample used in this study was very small, comprising only 29 accident victims and 22 lottery winners, this study is widely cited as the leading evidence in support of the AL and its role in maintaining stable levels of SWB.

1.5.2 Personality and SWB

Research on monozygotic and dizygotic twins in the 1970's offers evidence that the stable component of personality is largely genetically determined (Loehlin & Nichols, 1976; Plomin & Rowe, 1977). In light of these findings and the evidence of temporal stability of SWB (Andrews & Withey, 1976; Palmore & Kivett, 1977), Costa and McCrae (1980) propose personality as the main predictor of SWB. Using Bradburn's Positive Affect (PA) and Negative Affect (NA) scales (ABS; Bradburn, 1969), they found that PA correlates significantly with broad dimensions of Extraversion, but not Neuroticism, while NA correlates significantly with Neuroticism, but not with Extraversion. In a subsequent study, they compared PA and NA responses to responses on personality measures obtained 10 years prior. Based on the over-time correlations of .23 between Extraversion and PA, and .39 between Neuroticism and NA they concluded that personality precedes and therefore predicts SWB 10 years later. By measuring over-time correlations, they claim to have ruled out the "mediating effect of temporary moods or states" on the relationship between personality and SWB (Costa & McCrae, 1980, p. 675).

Two major conceptual limitations of this study deserve to be mentioned. First, measuring personality traits prior to PA and NA does not confirm their temporal priority necessary to claim causation. It is equally plausible to assume that similar correlations could be obtained if the order of measurement was reversed. Second, it is not clear from the study what the authors consider as "temporary moods or states". If they refer to affective reactions to the immediate environment, then a single measurement of two constructs 10 years apart does not eliminate those effects, as is assumed in this study. These effects can only be estimated by measuring the changes in a single construct over time or by controlling for the changes in one's environment. Finally, it is important to note that in their study, between 85% and 95% of variance in PA and NA was unaccounted for by Neuroticism and Extraversion, suggesting that other factors may better predict PA and NA than personality.

In more recent times, Headey and Wearing (1989, 1992) proposed life events, in addition to personality, as an important predictor of SWB. Using data from four waves of an Australian Quality of Life Panel Study, they reported that both SWB and life events are moderately stable over time, with personality remaining unchanged over the period of 6 years (Headey & Wearing, 1989). Extraversion was found to correlate positively with PA and favourable life events, while Neuroticism correlated positively with NA and adverse life events. Additionally, after controlling for the effects of personality, life events accounted for 16-22% of variance in PA and NA.

To explain these results they proposed a Dynamic Equilibrium Model, which suggests that each person has “equilibrium” or a normal level of SWB and a normal pattern of events which can be predicted by stable personality traits. According to this model, changes in SWB occur when life events deviate from the normal pattern. These changes are believed to be short lived because life events are soon returned to their normal pattern by stable personality traits. However, this theory does not explain the process in which this return to equilibrium occurs. It is also important to note that, similarly to Costa and McCrae (1980), these authors assume that stable personality traits cause temporal stability of PA and NA without considering the possibility of a reverse causal pathway.

However, this conception of the relationship between personality and SWB is not surprising, considering the comparative paucity of research investigating the influence of genetics on SWB. The earliest evidence came from Tellegen et al. (1988). They compared monozygotic and dizygotic twins reared both apart and together on a measure of Wellbeing derived from the Multidimensional Personality Qustionnaire (WB-MPQ: unpublished). Over-time correlations of .48 and .52 were found in monozygotic twins reared apart and together, respectively, indicating strong genetic influence on SWB.

Similar effects were reported by Lykken and Tellegen (1996a) who compared monozygotic twins over 10 years using the same Wellbeing scale. When over-time correlations were compared against the within-person variance it was concluded that 80% of variance in the stable component of SWB is genetically determined. In light of these important findings, the question becomes whether genes determine SWB by way of personality as proposed by Costa and McCrae (1980), or by way of Core Affect as proposed by Russell and Barrett (1999).

First researchers to study the relative contribution of personality and Core Affect to SWB were Davern et al. (2007). They also examined the predictive power of the cognitive component of SWB, frequently proposed to be its dominant predictor (Diener, Emmons, et al., 1985; Michalos, 1985). Using structural equation modelling they found that Core Affect and the cognitive component accounted for 90% variance in SWB with personality making no significant contribution. Furthermore, they found that the significant correlations between personality and SWB are considerably reduced or removed once the effects of Core Affect are controlled. This study was later replicated by Blore et al. (2011) and Tomyn and Cummins (2011) who found that Core Affect, later termed Homeostatically Protected Mood (HPMood), accounted for 66% and 80% of variance in SWB, respectively. Together these findings offer strong evidence that neither personality nor cognition is the dominant driver of SWB.

1.6 SWB set-point and homeostasis

On the basis of twin studies and circumstantial evidence, numerous authors have proposed that SWB possesses a genetically determined set-point (McGue, Bacon & Lykken, 1993; Lykken & Tellegen, 1996a), which promotes consistent levels of SWB over time. Such consistency led Cummins (1998) to propose that SWB is maintained within a narrow, positive set-point range by a homeostatic mechanism.

1.6.1 Homeostasis Theory of SWB

The SWB set-point, which homeostasis seeks to defend, is proposed to represent a constant level of mood affect, the Homeostatically Protected Mood (HPMood) (Cummins, 2010a). It is also proposed that when the experience of emotion causes variations in SWB, the defence mechanism of homeostasis is activated to return SWB to its set-point.

This defence mechanism utilises the following psychological processes: emotional adaptation, behavioural response and a system of cognitive buffers (Cummins & Wooden, 2013). The first of these processes is described previously in the section on adaptation. A homeostatic behavioural response occurs in the form of engagement or disengagement from an emotionally challenging situation (Cummins & Wooden, 2013). The final defence comes from cognitive buffers, which reflect positive cognitive biases described by Taylor and Brown (1988). These biases help maintain SWB within the set-point range by promoting the positive view of self and life in general. They manifest by increasing self-esteem, optimism and a sense of personal control.

When an emotional challenge overwhelms the homeostatic defence mechanism, SWB moves outside the set-point range. Outside this range, SWB ceases to be dominated by HPMood, and instead it becomes driven by emotional reactions to challenging circumstances.

1.6.2 Evidence against set-points

Over the last decade, Lucas and colleagues (Lucas, Clark, Georgellis & Diener, 2003, 2004; Lucas, 2005, 2007) have demonstrated significant long-term changes in SWB. Using large samples from the German Socio-Economic Panel Survey and the British Household Panel Study they found that people who experience divorce, death of a spouse, unemployment or long-term disability, experience a lasting decline in SWB. Although these authors do not refute the existence of SWB set-point, they claim that SWB does not always return to its pre-event level.

Taking this conclusion a step further, Fujita and Diener (2005) claim that set-points do change for some people. They support their claim by demonstrating that 24% of their sample experienced a significant change in LS over 17 years. Indeed, a number of other researchers have interpreted long-term change in SWB as evidence against set-points (Easterlin, 2005; Headey, 2008, 2010). However, the interpretive error made by these authors is that a measure of SWB is not a direct measure of SWB set-point. Thus, a change in SWB level over time cannot be interpreted as either a changing set-point or the absence of a set-point (Cummins, Li, Wooden & Stokes, 2014).

1.6.3 Evidence for set-points

The first direct evidence for set-points has only recently been published by Cummins et al. (2014). The data used in this study came from the first 10 consecutive waves of the Household, Income and Labour Dynamics in Australia Survey, which included responses to Global Life Satisfaction (GLS) question. The procedure involved the progressive removal of outlying scores for each person, based on their over-time mean. This revealed that GLS set-points lie within the 71-90 range, on a 0 to 100 point scale, and that the normal set-point-range for each person is around 18-20 points.

The GLS set-point for each person is proposed to reflect a level of HPMood (Cummins et al., 2014). Thus, it is reasonable to expect that, if the same analysis was conducted using HPMood scores, the set-points for both HPMood and GLS would lie within the same range. However, this hypothesis has not yet been tested. If the set-point range could be demonstrated to be the same for HPMood and GLS, this would support the proposition that HPMood represents a stable SWB set-point which promotes its stability.

1.7 Study aim and hypotheses

The aims of this study are twofold. First, to replicate the findings by Cummins et al. (2014) that the set-point ranges for GLS lie between 71 and 90 points on a 0 – 100 point scale. Second, to determine the set-point ranges for HPMood. The hypotheses are as follows:

1. It is hypothesised that SWB set-points will exhibit a normal distribution between 71 and 90 points.

    Rationale: This is simply a replication using a different sample.

2. It is hypothesised that the set-points for HPMood will lie within the same range as for SWB.

Rationale: According to the Homeostasis Theory, HPMood is the primary determinant of SWB. It is therefore expected that the HPMood and SWB set-points will lie within the same range.

CHAPTER 2:

EMPIRICAL REPORT

2.1 Abstract

During the last four decades, Subjective Wellbeing (SWB) was consistently found to lie above the scale mid-point, despite differences in population groups, measuring instruments and methodologies. When measured over many years SWB also shows remarkable stability across individuals and populations. While some researchers suggest that this stability is evidence for a SWB set-point, others reject this idea because of demonstrated changes in SWB over time. To consolidate findings on stability and change a Theory of SWB Homeostasis has been proposed. The theory proposes that each person has a set-point and that homeostatic processes normally hold their level of SWB within their set-point-range. However, variations in the level of SWB extending beyond the set-point-range reflect homeostatic failure, which occurs when life challenges overwhelm their homeostatic system. A recent analysis of longitudinal data by Cummins, Li, Wooden & Stokes (2014) has demonstrated that SWB set-points lie within a 71-90 range on a 0-100 scale, with an average set-point-range of 19 points for each person. These set-points are said to reflect the level of Homeostatically Protected Mood (HPMood), the basic psychological element that each homeostatic system protects. This study aimed to replicate the findings by Cummins et al. using their methodology on a different data set. The two dependent variables are Global Life Satisfaction (GLS) and HPMood. The procedure involved the iterative elimination of GLS and HPMood scores based on significant deviation from their over-time mean score. Participants completed between 5 and 10 surveys. Despite minor deviations from Cummins' et al findings, the results confirm that both GLS and HPMood set-points are normally distributed between 70.1 and 90 points, and that a normal set-point-range is 18.9 and 17.6 points for GLS and HPMood, respectively.

2.2 Introduction

Subjective Wellbeing (SWB) has been an important topic in psychology for over fifty years. Since the earliest measures of SWB were made, it was frequently found to be stable over time (Bradburn, 1969; Campbell et al., 1976). The temporal stability of average SWB was demonstrated despite the differences in measurement intervals, instruments (Diener & Larsen, 1984; Headey & Wearing, 1989; Eid & Diener, 2004) and population groups (Cummins, 1998, 2003). Remarkably, in most populations, average SWB was found to lie between 60 and 90 points on a 100 point scale (Veenhoven, 1994; Cummins, 1995, 1998, 2003).

In an attempt to identify the cause of this stability, researchers initially proposed personality traits as the answer (Costa & McCrae, 1980). Personality traits were considered to be the driving force behind SWB stability due to their grounding in genetics (Loehlin & Nichols, 1976; Plomin & Rowe, 1977). In particular, two personality traits, Extraversion and Neuroticism, were found to correlate with two basic elements of SWB, Positive and Negative Affect, respectively (Costa & McCrae, 1980). However, studies on twins in the 1990s led researchers to propose that SWB stability may be driven by a genetically determined set-point (McGue et al., 1993; Lykken & Tellegen, 1996b), which exists independently from personality traits.

Contrary to findings on SWB stability, many studies have demonstrated long-term change in SWB for people who experience divorce, death of a spouse, long-term unemployment or disability (Lucas et al., 2003, 2004; Lucas, 2005, 2007). These changes are frequently interpreted as changes in SWB set-points (Fujita & Diener, 2005; Headey, 2008), which led some researchers to propose that SWB set-points are flawed (Easterlin, 2005; Headey, 2010). However, while changes in SWB over time do occur, they do not translate into changes in people's SWB set-points. This is because larger variations in SWB have been found to occur for people whose means lie further away from the population mean (Cummins, 2003; Fujita & Diener, 2005).

To consolidate the evidence on stability and change of SWB, Cummins (2010b) proposed a Theory of SWB Homeostasis, which holds that SWB is maintained by a homeostatic mechanism within a narrow range around each person's genetically determined and stable set-point. This mechanism is analogous to body temperature homeostasis, in which a set-point represents a person's resting temperature level of 37 degrees Celsius. Similarly to the body temperature, each person's SWB moves within the narrow range around its set-point. This range is referred to as the set-point-range. Movements within this range signify normal functioning of a healthy homeostatic system which attempts to accommodate for changes in one's environment. However, each person's SWB can also move outside the set-point-range when life events are strong enough to defeat the homeostatic system. When this occurs, SWB becomes driven by the environment, which can either stimulate its return to the set-point-range or prolong its stay outside.

The first direct evidence for set-points and range has recently been published by Cummins et al. (2014). The data used in this study included responses to a Global Life Satisfaction (GLS) question over 10 consecutive years. The question asked: 'All things considered, how satisfied are you with your life?'. The procedure involved iterative elimination of each person's scores that deviated from their usual pattern over 10 years. Based on this method, they estimated that SWB set-points lie between 71 and 90 points on a 0-100 scale, and that each person's set-point-range is between 9 and 10 points on either side of their set-point.

The basic psychological element proposed to influence SWB originated from Russell's (2003) concept 'Core Affect', which was later defined by Cummins (2010b) as Homeostatically Protected Mood (HPMood). Both Core Affect and HPMood are conceptualised as genetically determined, stable mood, reflecting an integral blend of two dimensions, valance and arousal. The key difference between them is that, while it is proposed that Core Affect can be changed by affective reactions to the environment, such as fear or anger, HPMood remains stable over time despite changes in environment and our reactions to it.

HPMood can be brought into conscious awareness in situations when momentary affective experience is mild, such as when one is resting. It can also be brought into consciousness by asking people non-specific questions about themselves, in particular, how happy, content and alert they generally feel (Tomyn & Cummins, 2011). These three terms are selected from a list of commonly used affective terms, primarily because they explain most variance in SWB. Indeed, HPMood is found to be the one of the strongest predictors of SWB, accounting for up to 80% of its variance (Tomyn & Cummins, 2011).

Based on these strong correlations it was proposed that each person's SWB set-point, and ultimately stability of their SWB over time reflects people's stable HPMood level (Cummins et al., 2014). However, the relationship between SWB and HPMood over time has never been empirically tested. If Cummins' et al methodology was replicated using both GLS and HPMood scores, it is expected that GLS and HPMood set-points will lie within the same range. It is also expected that people's set-point-ranges for GLS and HPMood will also be the same. Such findings would support the proposition that SWB set-point reflects the HPMood level which promotes its stability.

2.2.1 Hypotheses

The hypotheses are as follows:

1. That GLS set-points will be normally distributed between 70.1 and 90 points on a 0-100 scale.

2. That HPMood set-points will be normally distributed within the same range as GLS set-points.
3. That the average set-point-range for people will be 19 points.
4. That the set-point-range for HPMood will be the same as for GLS.

Rationale: The first and third hypotheses test findings by Cummins et al. (2014) using a different sample. The second and forth hypotheses test the Theory of SWB Homeostasis, which states that HPMood is the fundamental component of SWB.

2.3 Method

2.3.1 Participants

Data are derived from the Australian Unity Wellbeing Index (AUWI) longitudinal surveys, which measure Subjective Wellbeing (SWB) of Australian population since 2001. Twice a year, a random sample of Australian population is interviewed over the phone. At the end of each interview respondents are invited to participate in a follow-up survey the following year. Those who agree are recruited for the longitudinal survey. A total of 25 longitudinal surveys have been conducted to date, comprising 5,921 people who completed two or more surveys.

Upon receiving approval from the Deakin University Human Research Ethics Committee in April 2013, the sample for this study was selected from the AUWI longitudinal data. Due to a high annual attrition rate only 78 participants completed all 10 surveys (see Table 1). Therefore, respondents who completed 5 or more surveys were included in the analysis. It was decided that five responses are a minimum number required for a reliable estimation of set-points for each person. This construction method resulted in an unbalanced sample. That is, the surveys completed by respondents are neither identical nor consecutive, and the total number of surveys completed varies from one respondent to another.

Table 2.1

Minimum number of surveys completed by participants over 10 years

Number of surveys completed over 10 years	Number of participants	% of total sample	Cumulative %
5	359	31.2%	31.2%
6	183	15.9%	47.1%
7	221	19.2%	66.3%
8	150	13.0%	79.3%
9	160	13.9%	93.2%
10	78	6.8%	100.0%
Total	1,151	100%	

The selected sample comprised 1,151 respondents, of which 660 were females and 491 were males. The age of respondents at recruitment ranged from 18 to 88 years (M=58.71; SD=12.88), with 95.3% of the sample being over 35 years of age.

2.3.2 Measures

Participants in the longitudinal survey received a questionnaire in the mail once a year. Each questionnaire comprised approximately 100 questions about various aspects of subjective life quality, followed by 15 demographic questions. Only responses to Global Life Satisfaction (GLS) and Homeostatically Protected Mood (HPMood) were used in this study.

2.3.2.1 Global Life Satisfaction

The GLS is a single-item asking "How satisfied are you with your life as a whole?". Participants are instructed to record their responses on a 0-10 response scale. The anchor points on the scale were changed during the course of the longitudinal survey from bipolar ("completely dissatisfied/completely satisfied") to unipolar ('not satisfied at all/completely satisfied"). This change improved the interpretation of the response scale without affecting the group mean (International Wellbeing Group, 2013).

2.3.2.2 Homeostatically Protected Mood

The HPMood measure comprises three questions. The two questions “How happy do you generally feel?” and “How content do you generally feel?” measure the valance of SWB evaluation and are asked across all 10 surveys. The third question measures the level of emotional arousal using, in various surveys, one of the three affects “alert”, “active” and “excited”. HPMood then comprises a combination of the two valence items plus which ever arousal item was used in the corresponding survey. In constructing HPMood, priority was given to the adjective “alert” based on the analysis by Tomyn (2008), which showed that out of the three affects, “alert” accounted for most of the unique variance in GLS. Responses are recorded on a 11-point scale, from 0 (Not at all) to 10 (Extremely).

2.3.3 Data Preparation

All GLS and HPMood scores are standardised to a 0-100 point scale for easier interpretation. All cases are examined for missing values and acquiescence response bias (International Wellbeing Group, 2013). Respondents who had less than 5 scores remaining due to missing values were excluded from the analysis. The 4 respondents missing GLS scores and 199 respondents missing HPMood scores were excluded. The social acquiescence bias is controlled by excluding 22 participants who scored 100 on GLS and 2 participants who scored 100 on HPMood, across all the surveys in which they participated. The final GLS and HPMood data-sets comprised 1,125 and 950 respondents with 7,674 and 6,341 responses, respectively.

2.3.4 Rationale

This analysis aims to estimate the distribution of set-points and average personal set-point-range for GLS and HPMood. Estimations are based on the process of iterative elimination of outliers, called data-stripping.

The analysis is based on the assumption that each person's GLS and HPMood responses comprise two kinds of scores as: (a) Scores that are representative of their true set-point-range and (b) Scores that lie outside their true set-point-range, referred to as outliers. The aim of this analysis is to progressively remove the scores (b) while retaining the scores (a). At the end of this process it is assumed that the residual scores are the best approximation of scores representing the set-point-range for each person.

Further assumptions underlying this method of set-point and set-point-range estimation are as follows.

Assumption 1:

The set-points and set-point-range can be estimated using the means and standard deviations (SD) derived from people's GLS and HPMood responses over the years. The extent to which these statistics will reflect each person's true set-point and set-point-range will depend on the extent to which their HPMood was under homeostatic control each time they completed the survey.

Explanation 1:

When scores are aggregated for people whose HPMood was under homeostatic control each time they completed the survey, they are expected to show a small variation from their true set-point. Thus, the mean and SD derived from such scores will closely reflect people's true set-point and set-point-range, respectively.

People who were in a condition of homeostatic failure at the time of making a response are expected to show that response as an outlier. The inclusion of outliers in an aggregate for that person will result in an increased SD and a mean that is higher or lower than their true set-point. The more frequently outliers are included in the aggregate for a person, the more severely their mean and SD will deviate from their true set-point and set-point-range.

Assumption 2:

For most people, most of their HPMood and GLS scores are expected to lie within their true set-point-range, with a smaller proportion of scores reflecting their outliers.

Explanation 2:

Subjective Wellbeing (SWB) in the Australian population is shown to be remarkably stable, varying by only 3.1 percentage points over 12 years (Cummins et al., 2014). SWB for each person was found to vary by only 10 percentage points from their average score over 10 years (Cummins et al., 2014). Therefore, for most people, a small number of extreme scores that differ from their normal pattern of scores are likely to reflect their outliers.

Assumption 3:

The process of data-stripping will achieve an estimation of GLS and HPMood set-point and set-point-range for each person.

Explanation 3:

The data-stripping process, as conceptualised by Cummins et al (2014), involves grouping people into categories based on similar personal means. The purpose of categories is to obtain a large enough sample of similar scores to better approximate the set-point and set-point-range for people in those categories. The width of 5-points is chosen as the smallest width that yields a reliable number of scores within each category. As only few people had a mean score below 45 points, their scores are aggregated into a single category (0-45).

At each iteration of data-stripping, a normative range is constructed within each category. The normative range is operationalised as two average personal SDs around the mean of raw scores in each category. Scores that lie outside this normative range are considered outliers, and are therefore eliminated.

As a consequence of each data-stripping iteration, some people will lose one or more of their scores. For those people, their mean and SD will also change. The extent to which their mean changes will determine whether their scores stay in the same category or get allocated to a new one. Once all the scores are re-allocated to the appropriate category based on each person's new mean, next iteration of data-stripping is conducted.

Each data-stripping iteration seeks to identify and remove outliers by comparing all the scores in each category against their new normative range. This process is repeated until no further outliers can be identified. People who lose more than half of their scores during any data-stripping iteration are excluded from further analysis because their residual scores, referred to as non-reliable residual scores, are no longer informative of their normal pattern of responses. Once all the outliers are removed from the data, the mean and normative range in each category will best approximate the set-point and set-point-ranges for people in those categories, respectively.

It should be noted that this method is less likely to identify true set-points and set-point-ranges for people whose scores lie within the lower range of categories. This is because people in these categories are likely to be in a condition of homeostatic failure more frequently, thus their respective categories are likely to comprise a greater number of outliers. Inclusion of outliers in the analysis influences the mean and normative range in each category, causing more scores that reflect people's true set-point-range to be eliminated. Thus, following data-stripping, scores that remain in these categories will comprise a mix of outliers and scores reflective of people's true set-point-range.

Assumption 4:

Following the final iteration of data-stripping, average set-point-range for people can be estimated based on average SDs in categories that comprise GLS and HPMood set-points. The range in which set-points are distributed can be estimated from categories with consistently low average SDs. This set-point distribution range will lie between 70.1 and 90 points on a 0-100 scale. Within this range set-points will be normally distributed around their median.

Explanation 4:

Theory of SWB Homeostasis proposes that people's GLS set-points are normally distributed within a population. Despite the differences in the level of people's genetically-determined set-points, those who maintain similar levels of homeostatic control are expected to show similar variation in their scores around their set-point (Cummins et al., 2014). Thus, average SDs in categories which comprise scores reflective of people's true set-point, can be used to estimate set-point-ranges for people. These categories can be determined based on the consistency in the low-level average SDs across a range of categories.

Since HPMood is proposed to be the primary determinant of GLS (Cummins, 2010b), people's set-point-ranges are expected to be the same for GLS and HPMood. Similarly, their HPMood set-points are expected to be normally distributed within the same range as GLS.

2.4 Results

Both data-cleaning and iterative data-stripping analyses were conducted separately for Global Life Satisfaction (GLS) and Homeostatically Protected Mood (HPMood). Data cleaning was conducted using SPSS version 22. Analyses were performed using STATA version 12.

Elimination of GLS and HPMood outliers was achieved with 5 and 6 iterations, respectively. Detailed changes in GLS and HPMood categories before and after each iteration are shown in Appendix Tables A1 and A2. A total of 1,201 GLS and 1,115 HPMood scores have been eliminated due to iterative data-stripping (see Table 2 and 3). Contributing to these scores are 1,092 GLS and 959 HPMood outliers and 109 GLS and 156 HPMood non-reliable residual scores. In Cummins' et al (2014) study, the non-reliable residual scores were identified as less than 4 scores remaining for each respondent, and were excluded after the last data-stripping iteration. In the present study, respondents who lost more than half of their initial scores were excluded from the analyses after each iteration. This was done to prevent them from influencing the mean and normative range of their respective categories throughout the analyses.

Table 2.2

GLS scores excluded over 5 iterations

GLS categories	Scores before 1st iteration (N)	Scores below 2x average SD in category (N)	Scores above 2x average SD in category (N)	Non-reliable residual scores (N)	Total scores excluded (N)	Scores remaining after 5th iteration (N)
0-45.0	215	24	29	7	60	164
45.1-50.0	138	8	5	3	16	111
50.1-55.0	175	18	8	4	30	103
55.1-60.0	344	20	7	0	27	293
60.1-65.0	467	52	7	5	64	274
65.1-70.0	640	93	21	5	119	377
70.1-75.0	1,008	160	38	36	234	775
75.1-80.0	1,488	78	178	32	288	1,457
80.1-85.0	1,178	76	55	11	142	1,123
85.1-90.0	1,219	37	110	3	150	972
90.1-95.0	516	58	0	3	61	429
95.1-100.0	286	10	0	0	10	395
Total	7,674	634	458	109	1,201	6,473

Table 2.3

HPMood scores excluded over 6 iterations

HPMood categories	Scores before 1st iteration	Scores below 2x average SD in category (N)	Scores above 2x average SD in category (N)	Non-reliable residual scores (N)	Total scores excluded (N)	Scores remaining after 6th iteration (N)
0-45.0	175	34	13	25	72	119
45.1-50.0	135	8	6	0	14	135
50.1-55.0	198	13	15	0	28	125
55.1-60.0	339	22	6	0	28	228
60.1-65.0	397	31	6	0	37	320
65.1-70.0	543	58	15	7	80	398
70.1-75.0	1,060	132	29	23	184	732
75.1-80.0	1,254	141	56	24	221	1,121
80.1-85.0	912	109	32	19	160	835
85.1-90.0	753	48	57	15	120	766
90.1-95.0	382	19	0	0	19	339
95.1-100.0	193	109	0	43	152	108
Total	6, 341	724	235	156	1,115	5,226

Tables 4 and 5 show mean and spread of GLS and HPMood scores in each category, before and after data-stripping. Most category means have demonstrated minor change of less than 1 point, apart from the lowest (0.0-45.0) and highest (95.1-100) categories which changed by 4.18 and 2.69 points, respectively. The mean increase in the lowest category is likely caused by the elimination of large number of outliers (see Column 6 in Table 2). Scores in the highest category are all 100. This reduced variance, referred to as a ceiling effect, is caused by close proximity of scores to the upper limit of the scale.

The last two columns in Tables 4 and 5 show the mean and the spread of SDs for each category. From these two columns, it is clear that the overall variance for each person has decreased in all GLS and HPMood categories following data-stripping. The distribution of average SDs across GLS and HPMood categories (Column 6 in Table 4 and 5), is depicted in Figures 1 and 2, respectively. In each Figure, upper and lower lines represent average SDs before and after data-stripping, respectively.

Table 2.4

Mean and spread of GLS scores before and after data-stripping

	Before the 1st iteration			After the 5th iteration		
GLS categories	Mean of GLS in category	Mean of SDs in category	SD of SDs in category	Mean of GLS in category	Mean of SDs in category	SD of SDs in category
0-45.0.0	36.23	16.41	6.49	35.24	8.14	2.76
45.1-50.0	48.26	16.30	8.40	47.75	11.60	5.07
50.1-55.0	53.20	15.67	7.95	53.59	8.35	2.68
55.1-60.0	58.34	15.00	4.67	58.53	12.52	2.52
60.1-65.0	63.28	15.18	6.78	63.39	9.25	2.68
65.1-70.0	68.14	14.01	6.25	68.81	6.70	2.09
70.1-75.0	73.06	9.84	5.00	73.95	5.29	0.43
75.1-80.0	78.31	7.59	4.79	77.61	4.25	1.50
80.1-85.0	83.05	7.28	3.72	83.27	4.92	0.62
85.1-90.0	87.83	6.96	3.92	87.39	4.40	1.43
90.1-95.0	92.66	6.45	2.12	93.22	4.89	0.64
95.1-100.0	97.03	5.52	1.80	97.62	4.13	1.58

Table 2.5

Mean and spread of HPMood scores before and after data-stripping

	Before the 1st iteration			After the 6th iteration		
HPM categories	Mean of HPM in category	Mean of SDs in category	SD of SDs in category	Mean of HPM in category	Mean of SDs in category	SD of SDs in category
0-45.0	35.90	11.97	6.42	40.08	7.28	2.06
45.1-50	47.75	13.59	6.51	47.88	9.81	3.87
50.1-55	53.01	12.33	4.58	53.20	7.52	2.17
55.1-60	57.65	13.69	5.16	57.92	9.51	2.06
60.1-65	62.55	12.45	5.39	62.79	8.73	2.92
65.1-70	67.95	9.98	4.94	67.98	6.21	2.05
70.1-75	72.87	9.24	4.13	73.25	5.33	1.40
75.1-80	77.76	7.86	4.22	78.10	4.45	1.48
80.1-85	82.61	7.06	3.79	83.07	4.12	1.20
85.1-90	87.37	5.74	2.98	87.22	3.66	1.10
90.1-95	92.76	6.29	2.49	92.83	4.86	1.32
95.1-100	97.31	3.91	1.86	100.00	0.00	0.00

Figure 2.1

Average SDs in GLS categories before and after data-stripping

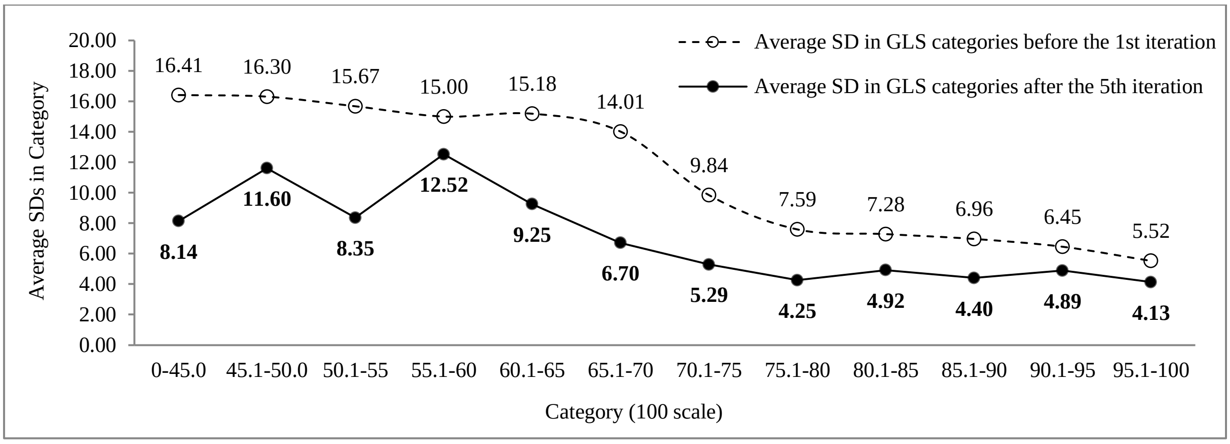
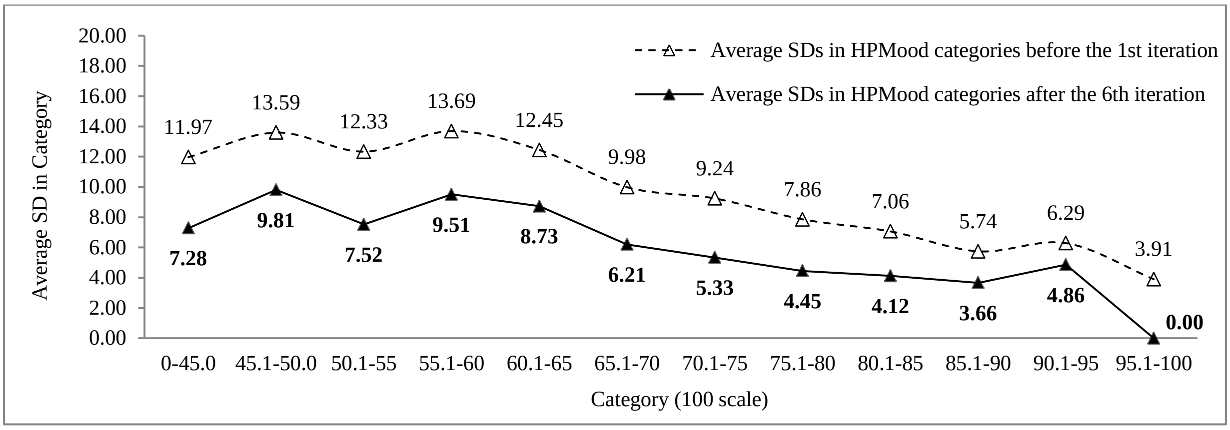


Figure 2.2

Average SDs in HPMood categories before and after data-stripping



Testing hypotheses 1 and 3:

That GLS and HPMood set-points will be normally distributed between 70.1 and 90 points on a 0-100 scale.

These hypotheses have been tested by determining the range of categories, which, following the final data-stripping iteration comprises: (a) majority of scores of people whose means are normally distributed around the median of this range and (b) consistent, low-level average SDs in each category.

Following data-stripping, majority of GLS (66.85% of the total) and HPMood scores (66.10% of the total) lie between 70.1 and 90.0 points (Column 7, Table 2 and 3). Outside this range, proportions of GLS and HPMood scores are: <70.1=20.41% and 25.35%, and >90.1=12.73% and 8.56%, respectively. The distributions of GLS and HPMood scores within the 70.1-90 range have become more normal following data-stripping (see Figures 3 and 4), each centring on a median of 80 points.

Figure 2.3

Distribution of GLS scores within the 70.1-90 range

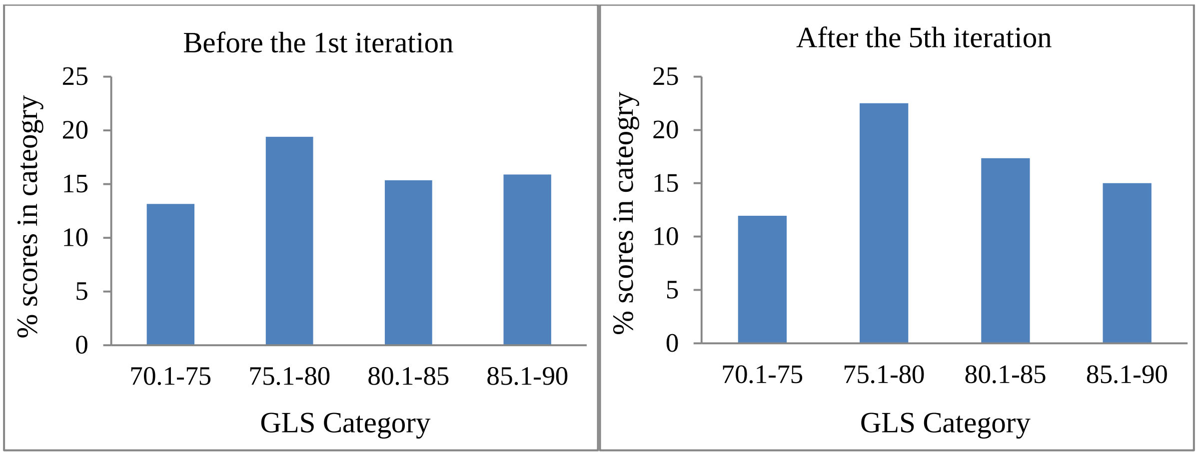
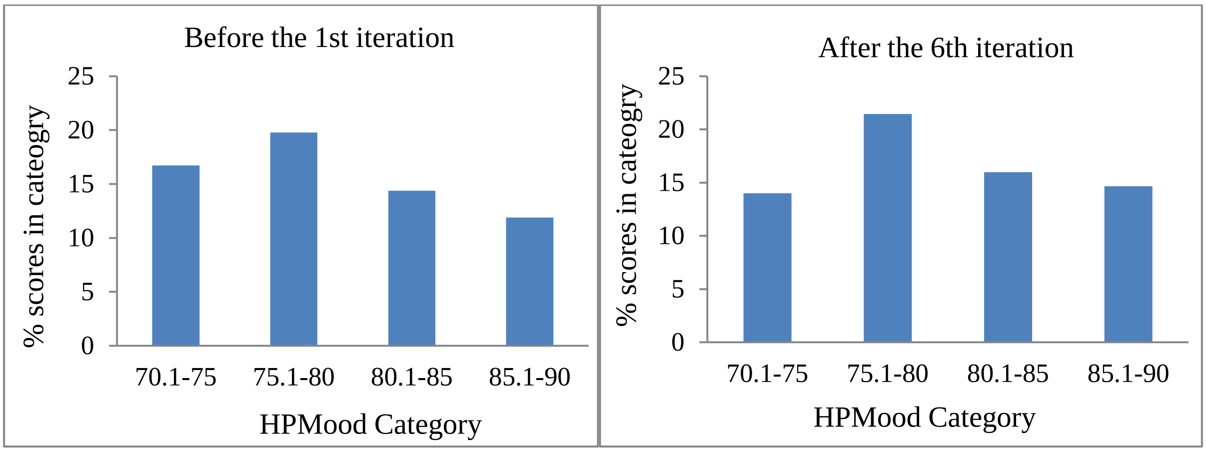


Figure 2.4

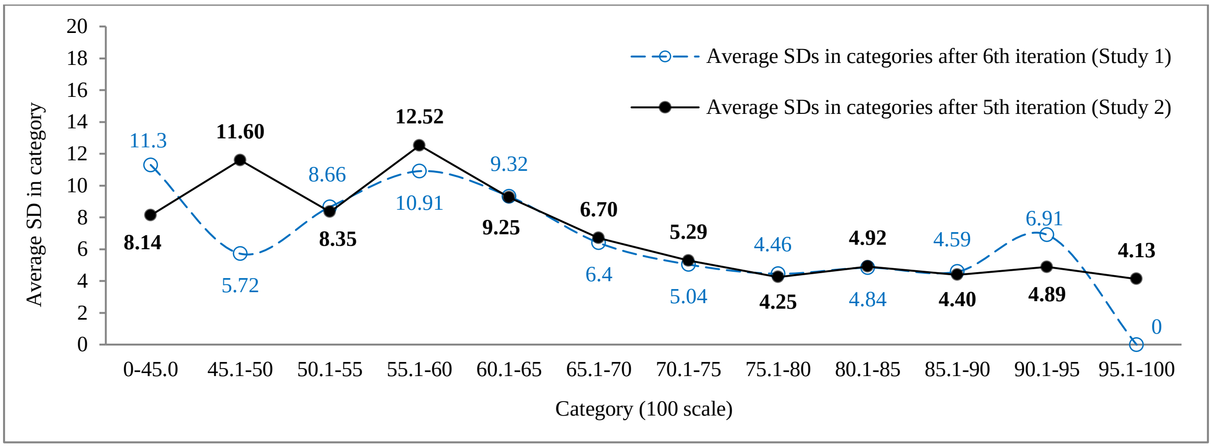
Distribution of HPMood scores within the 70.1-90 range



The GLS categories between 70.1 and 90 points in the present study (Study 2) show consistently low average SDs, which are remarkably similar to the ones demonstrated by Cummins et al (2014) (Study 1) (see Figure 5). In Study 1, average SDs in categories across this range vary by a maximum of 0.58 points, compared to 1.04 points in Study 2. The largest difference in average SDs between the same categories is 0.25 (in category 70.1-75).

Figure 2.5

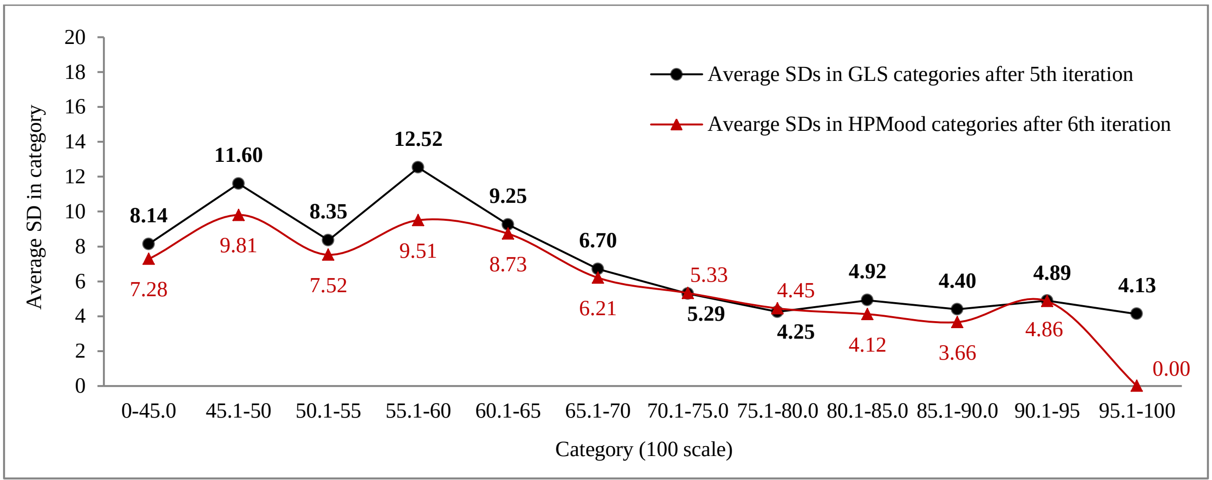
Average SDs in GLS categories in Study 1 and 2 compared



Average SDs within the 70.1-90 point range appear to be less consistent for HPMood than for GLS categories, varying by a maximum of 1.67 points (see Figure 6). These variations are largely produced by the very low average SDs in the highest two categories within the range.

Figure 2.6

Average SD in GLS and HPMood categories compared



Below the 70.1-90 point range, average SDs in GLS and HPMood categories appear to rise and fall in a random fashion. This pattern can be attributed to the presence of a large number of outliers in these categories even after data-stripping.

Above the 70.1-90 point range, average SD in HPMood categories shows similar random pattern as in categories below the range. While average SDs for GLS above 90 points appear to be both consistent and low in Study 2, they differ greatly from average SDs in Study 1 (see Figure 5).

Testing hypotheses 2 and 4:

That the average GLS and HPMood set-point-range will be around 19 points.

The average set-point-range is constructed using an average of the normative ranges of the four categories between 70.1 and 90 points. The resulting average set-point-range for GLS and HPMood are 18.9 and 17.6 points, respectively.

2.5 Discussion

The aims of this study were twofold. First, to replicate the findings from Cummins et al. (2014) by applying their methodology in a different sample. Second, to test whether the distribution of set-points and the average set-point-range for Homeostatically Protected Mood (HPMood) are the same as for Global Life Satisfaction (GLS). To address these aims, four hypotheses were proposed. The results offer support for each hypothesis, which will be discussed in turn.

As predicted by the first hypothesis, GLS set-points are found to lie normally distributed between 70.1 and 90 points, which is consistent with Cummins et al (2014). The results also support Cummins' et al assumption, that a normal distribution of GLS set-points within a restricted positive range of values may be interpreted as genetic diversity within a population. This distribution is also consistent with frequent reports of stable average SWB levels, lying above the scale mid-point (Veenhoven, 1994; Cummins, 1995, 1998, 2003).

However, unlike Cummins' et al. (2014) results, the upper bound of the GLS set-point distribution is less clearly defined based solely on the consistency of the average SD in categories. In the present study, average SDs appear to be consistently low even in categories above 90 points. However, when average SDs in the highest two categories are compared with those in Cummins' et al study, they were significantly less consistent than average SDs within the 70.1-90 point categories. Inconsistencies in average SDs above 90 points between the two studies lend support for the Theory of SWB Homeostasis, which suggests that SWB movements outside each person's set-point-range are strongly influenced by their environment. That is, people's environment largely determines the extent to which their SWB varies, and if and when it returns to their set-point-range. Thus, consistently low average SDs in categories above 90 points in the present study may be due people's environment rather than their homeostatic system.

Additionally, the proportion of scores above 90 points is much smaller than within each of the four categories between 70.1 and 90 points. This is also consistent with the Theory of SWB Homeostasis because movements outside people's set-point-range represent homeostatic failure, which is a less common condition in the Australian population than homeostatic control (Cummins et al., 2014). Together these findings lend cautious support to 90 points as representing the top of the GLS set-point distribution range.

The second hypothesis predicts that HPMood set-points will have the same distribution range as GLS set-points. In support of this hypothesis, the results show that similar to GLS scores, two thirds of HPMood scores lie normally distributed between 70.1 and 90 points around the median of 80. These results are consistent with the assumption that HPMood set-points are normally distributed within the population.

However, the pattern of average SDs for HPMood is a less reliable indicator of the limits of the set-point distribution range. This is because average SDs do not show a clear plateau between 70.1 and 90 points as demonstrated for GLS in the present and the original study (Cummins et al., 2014). Instead, following data-stripping, the average SDs in categories within the 70.1-90 point range gradually decrease as the categories means increase.

The difference in average SDs between the lowest (70.1-75) and the highest (85.1-90) HPMood category seems to contribute most to this pattern. The lowest category shows higher average SD than in any other category within the range. This is consistent with GLS average SDs both in the present and the original study. According to the Theory of SWB Homeostasis, the lower limit of each person's set-point-range is where homeostatic mechanism works hardest to protect their HPMood from drifting outside its optimal range of functioning (Cummins, 2010b). Thus, because this category lies in close proximity to the lower set-point-range limit for most people, it is likely that it has retained larger proportion of outliers even after data-stripping, resulting in average SDs being larger than in other categories of the range.

At the other end of the distribution, lower than average SD in the 85.1-90 point category seems to be caused by three factors. The first is a ceiling effect, resulting from the close proximity of scores to the upper limits of the measurement instrument. While this ceiling effect is difficult to estimate based on the data-stripping method employed, it is expected to approximate the ceiling effect for GLS in the present and the original study, because a 0-10 response scale was used in both studies.

The second, much stronger influence on the reduced HPMood variance in the 85.1-90 point category may be attributed to a 'homeostatic ceiling effect' (Cummins et al., 2014, p. 17), resulting from a close proximity of people's scores to the upper limit of their set-point-range. While the homeostatic ceiling effect is also expected to occur for GLS scores, it is likely to be much stronger for HPMood because HPMood is the basic steady-state that homeostasis seeks to protect (Cummins, 2010b).

The third cause of this skewed pattern of variance may be due to a narrower set-point-range for HPMood than for GLS. However, while HPMood set-point-range is expected to be of similar magnitude within all four categories, the results do not support this expectation.

These differences can be attributed to a greater proportion of outliers remaining in categories between 70.1 and 85 points compared to the highest (85.1-90) category. While remaining outliers cannot be determined using the current method, the following movements of scores in and out of HPMood categories within the set-point distribution range seem to suggest this trend. First, the 85.1-90 point category has lost *fewer* outliers (N=120) than other categories (eg. 70.1-75 points; N=184). Second, following elimination of outliers it has *gained* more scores from other categories (N=133) than any other category within the range (eg. 70.1-75 points; N= 9) (see Appendix Table 2). Finally, the 85.1-90 point category has lost similar number of scores below and above the set-point-range (see Table 2), compared to other three categories which have lost 2.5-4.5 times more scores below than above the range. Together these results suggest that categories between 70.1 and 85 points may appear to have wider set-point-ranges than the 85.1-90 point category causing them to retain more outliers below the set-point-range after data-stripping.

In summary of the second hypothesis, while there is more uncertainty in these results than in the GLS distribution in the original publication (Cummins et al., 2014), it is reasonable to conclude that the HPMood set-point distribution range has been confirmed to lie between 70.1 and 90 points.

Finally, the last two hypotheses predict that average set-point-ranges for both GLS and HPMood will be around 19 points. The estimate of 18.9 points for GLS set-point-range, which is identical to Cummins' et al (2014), clearly supports the study's third hypothesis. In terms of HPMood, the estimated 17.6 points for its set-point-range also supports the forth hypothesis, despite being slightly narrower than for GLS. Because HPMood is proposed to be the fundamental component of SWB driving its stability (Cummins, 2010b), the narrower set-point-range for HPMood is to be expected. However, it seems likely that the average set-point-ranges for both HPMood and GLS are overestimated due to the inclusion of outliers in the lower categories of the range even after data-stripping.

2.5.1 Limitations and Future Research

The major limitation of this study is the use of an unbalanced sample. Estimations of set-points and range would be more reliable if all participants completed equal number of surveys, or if biases resulting from an unbalanced sample were controlled. Another important limitation is a very old sample which is not representative of the Australian population. Finally, the distribution magnitude of set-points and set-point-ranges is clearly overestimated for both HPMood and GLS. In a future study, this variance could be reduced by asking participants whether, and to what extent has anything caused them to feel happier or sadder than normal. These responses could then be used to either correct or eliminate GLS and HPMood responses corresponding to major life events.

2.5.2 Conclusion

This study confirms that GLS and HPMood set-points within a general population sample are normally distributed between 70.1-90 points, and that each person's normal set-point-range is around 19 points. In other words, on a 0-10 response scale, most people's GLS and HPMood scores vary by less than one point on either side of their mean. These findings shows that for most people, most of the time, their homeostatic system is able to control most challenges, thereby maintaining SWB and HPMood within a very narrow range around their set-point. Finally, the study successfully replicates Cummins' et al (2014) findings and offers further support for the Theory of SWB Homeostasis, which proposes HPMood as the key driver of SWB stability.

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APPENDICES

Appendix A1: Changes in GLS categories before and after each iteration

	GLS categories before and after each iteration										
	1st iteration		2nd iteration		3rd iteration		4th iteration		5th iteration		
Categories	Scores in category before 1st iteration	b	a	b	a	b	a	b	a	b	Scores in category after 6th iteration
0-45.0.0	215	-27.00	-2.00	-33.00	11.00	0.00	0.00	0.00	0.00	0.00	164
45.1-50.0	138	-9.00	-2.00	-7.00	-9.00	0.00	0.00	0.00	0.00	0.00	111
50.1-55.0	175	-9.00	-10.00	-6.00	-5.00	-15.00	-27.00	0.00	0.00	0.00	103
55.1-60.0	344	-13.00	-3.00	-13.00	-45.00	-1.00	24.00	0.00	0.00	0.00	293
60.1-65.0	467	-35.00	-121.00	-25.00	-5.00	-4.00	-3.00	0.00	0.00	0.00	274
65.1-70.0	640	-51.00	-111.00	-15.00	95.00	-53.00	-128.00	0.00	0.00	0.00	377
70.1-75.0	1,008	-66.00	-3.00	-49.00	59.00	-94.00	-25.00	-25.00	-30.00	0.00	775
75.1-80.0	1,488	-96.00	156.00	-187.00	-88.00	-5.00	159.00	0.00	30.00	0.00	1,457
80.1-85.0	1,178	-77.00	35.00	-65.00	52.00	0.00	0.00	0.00	0.00	0.00	1,123
85.1-90.0	1,219	-37.00	-32.00	-113.00	-65.00	0.00	0.00	0.00	0.00	0.00	972
90.1-95.0	516	-4.00	65.00	-57.00	-91.00	0.00	0.00	0.00	0.00	0.00	429
95.1-100.0	286	-9.00	28.00	-1.00	91.00	0.00	0.00	0.00	0.00	0.00	395
Total	7,674	-433.00	0.00	-571.00	0.00	-172.00	0.00	-25.00	0.00	0.00	6,473.00

Note: a = Number of scores re-allocated into different categories due to changes in personal means; b = Number of outliers and non-reliable residual scores excluded from category;

Appendix A2: Changes in HPMood categories before and after each iteration

	HPMood categories before and after each iteration												
	1st iteration		2nd iteration		3rd iteration		4th iteration		5th iteration		6th iteration		
Categories	Scores in category before 1st iteration	b	a	b	a	b	a	b	a	b	a	b	Scores in category after 6th iteration
0-45.0.0	175	-24.00	0.00	-15.00	8.00	-27.00	4.00	-6.00	4.00	0.00	0.00	0.00	119
45.1-50.0	135	-7.00	-10.00	-2.00	-4.00	0.00	31.00	-5.00	-3.00	0.00	0.00	0.00	135
50.1-55.0	198	-6.00	5.00	-4.00	7.00	-13.00	-51.00	-2.00	-1.00	-3.00	-5.00	0.00	125
55.1-60.0	339	-18.00	-85.00	-7.00	-7.00	-3.00	4.00	0.00	0.00	0.00	5.00	0.00	228
60.1-65.0	397	-20.00	-22.00	-8.00	-7.00	-7.00	-6.00	-2.00	-5.00	0.00	0.00	0.00	320
65.1-70.0	543	-32.00	-17.00	-20.00	-42.00	-28.00	-11.00	0.00	5.00	0.00	0.00	0.00	398
70.1-75.0	1,060	-66.00	-101.00	-39.00	9.00	-73.00	-49.00	-6.00	-3.00	0.00	0.00	0.00	732
75.1-80.0	1,254	-64.00	42.00	-82.00	25.00	-60.00	22.00	-15.00	-1.00	0.00	0.00	0.00	1,121
80.1-85.0	912	-42.00	71.00	-32.00	-10.00	-36.00	56.00	-50.00	-34.00	0.00	0.00	0.00	835
85.1-90.0	753	-57.00	78.00	-58.00	17.00	-4.00	0.00	0.00	38.00	-1.00	0.00	0.00	766
90.1-95.0	382	-19.00	-28.00	0.00	4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	339
95.1-100.0	193	-9.00	67.00	-17.00	0.00	-52.00	0.00	-74.00	0.00	0.00	0.00	0.00	108
Total	6,341	-364.00	0.00	-284.00	0.00	-303.00	0.00	-160.00	0.00	-4.00	0.00	0.00	5,226

Note: a = Number of scores re-allocated into different categories due to changes in personal means; b = Number of outliers and non-reliable residual scores excluded from category;