Government
Office for
Science

Foresight

Mental Capital and Wellbeing:

Making the most of ourselves in the 21st century

State-of-Science Review: SR-X2

Psychological Wellbeing: Evidence Regarding Its Causes and Consequences

Professor Felicia A. Huppert
University of Cambridge
Director, Well-being Institute

This review has been commissioned as part of the UK Government's Foresight Project, Mental Capital and Wellbeing. The views expressed do not represent the policy of any Government or organisation.

Summary

This review focuses on positive aspects of wellbeing, or flourishing. It examines evidence for the causes of positive wellbeing and also its consequences, including beneficial effects for many aspects of cognitive functioning, health and social relationships. The neurobiological basis of psychological wellbeing is examined and recent data on brain activation and neurochemical pathways presented. Individuals vary widely in their habitual level of psychological wellbeing, and there is evidence for a seminal role of social factors and the early environment in this process. It is often assumed that the drivers of wellbeing are the same as (but in the opposite direction to) the drivers of illbeing, but while this is true for some drivers, others have more selective effects. Future developments in the science of wellbeing and its application require a fresh approach – beyond targeting the alleviation of disorder to a focus on personal and interpersonal flourishing. A universal intervention approach is outlined which may both increase population flourishing and reduce common mental health problems.

1. Introduction

Psychological wellbeing is about lives going well. It is the combination of feeling good and functioning effectively. Sustainable wellbeing does not require individuals to feel good all the time; the experience of painful emotions (e.g. disappointment, failure, grief) is a normal part of life, and being able to manage these negative or painful emotions is essential for long-term wellbeing. Psychological wellbeing is, however, compromised when negative emotions are extreme or very long-lasting and interfere with a person's ability to function in his or her daily life.

The concept of feeling good incorporates not only the positive emotions of happiness and contentment, but also such emotions as interest, engagement, confidence and affection. The concept of functioning effectively (in a psychological sense) involves the development of one's potential, having some control over one's life, having a sense of purpose (e.g. working towards valued goals), and experiencing positive relationships.

Recent years have witnessed an exhilarating shift in the research literature from an emphasis on disorder and dysfunction to a focus on wellbeing and positive mental health. This paradigm shift has been especially prominent in current psychological research (e.g. Argyle, 1987; Diener, 1984; Kahneman, 1999; Ryff and Singer, 1998a; Seligman, 1991; 2002). But it has also captured the attention of epidemiologists, social scientists, economists and policy-makers (e.g. Huppert, 2005; Layard, 2005; Marks and Shah, 2005; Marmot et al., 1997; Mulgan, 2006). This positive perspective is also enshrined in the constitution of the World Health Organization, where health is defined as 'a state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity' (WHO, 1948). More recently, the WHO has defined positive mental health as '..a state of wellbeing in which the individual realises his or her own abilities, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to his or her community' (WHO, 2001).

This recent flowering of research on mental wellbeing has come about for a number of reasons, chief amongst them being:

1) The recognition that, since wellbeing is more than the absence of ill-being, it needs to be studied in its own right;
2) The need to distinguish between these approaches to improving psychological wellbeing:
   - treating disorder when it is present
   - preventing disorder from occurring
   - enhancing wellbeing (i.e. increasing flourishing);
3) Evidence that many of the drivers of wellbeing are not the same as the drivers of illbeing;
4) The strong possibility that, by increasing flourishing in the population, we might do more to reduce common mental and behavioural problems than by focusing exclusively on the treatment and prevention of disorder.

This review summarises what we know about the factors determining an individual's level of psychological wellbeing, and the effects of wellbeing on our perceptions, thoughts and behaviours, and on our physiology and health. It also explores how this knowledge may be utilised to improve wellbeing in individuals and in populations.

2. Relationship between positive emotions and cognitive processes

An impressive body of cross-sectional survey data shows: that happy people: tend to function better in life than less happy people; are typically more productive and more socially engaged; and tend to have higher incomes (Diener, 2000; Judge et al., 2001). Ryan and Deci (2001) point out that people high in happiness or subjective wellbeing tend to have attributional styles that are more self-enhancing and more enabling than those low in subjective wellbeing, suggesting that positive emotions can lead to positive cognitions which, in turn, contribute to further positive emotions.

Observational studies, particularly cross-sectional research, cannot of course establish the causal direction of the relationship between positive emotions and cognition. The most persuasive evidence comes from experimental studies. Research using mood induction techniques demonstrates unequivocally that positive mood states can enhance attention and other cognitive processes. Compared with individuals in negative or neutral mood states, subjects in a positive mood state have a broader focus of attention ('see the bigger picture') (Gasper and Clore, 2000; Fredrickson and Branigan, 2005), generate many more ideas (Fredrickson and Branigan, 2005), and are more creative and flexible in their thinking (Ashby et al., 1999; Bless et al., 1992; Murray et al., 1990).

Experimental social psychology is full of examples showing that positive emotional experiences have beneficial effects on the way people perceive and interpret social behaviours and how they initiate social interactions (e.g. Forgas, 2001; Isen, 1987). It has also been found that people experiencing positive emotions evaluate themselves and others more positively, make more lenient attributions, and behave in a more confident, optimistic and generous way in interpersonal situations (Forgas, 2002; 2006; Sedikides, 1995).

Positive emotions can be the consequence of certain cognitive or behavioural processes, as well as their cause. Extensive research, both experimental and observational, on goal pursuit shows that enhanced subjective wellbeing is associated with: goals being intrinsic, i.e. self-generated (e.g. Kasser and Ryan, 1996); progress towards a valued goal (Sheldon and Kasser, 1998); the pursuit of approach goals rather than

avoidance goals (Elliot et al., 1997); and the pursuit of goals congruent with personal values (Brunstein et al., 1998; Sheldon and Elliot, 1999). In addition, a large body of work shows that active participation in social activities and involvement in one's community is associated with high levels of happiness and life satisfaction (Argyle, 1987; Putnam, 2000; Helliwell, 2003; Helliwell and Putnam, 2005).

Taken together, the findings suggest that positive emotions lead to positive cognitions, positive behaviours and increased cognitive capability, and that positive cognitions, behaviours and capabilities in turn fuel positive emotions (Fredrickson and Joiner, 2002).

Positive emotions are not, however, beneficial for all cognitive processes. There is evidence that people in negative mood states are better at taking in the details of a situation, and that people who are sad, anxious or fearful are more conforming and less likely to break rules (e.g. Forgas 1998; 1999; Huppert, 2006). Bless and Fiedler (2006) suggest that the different cognitive styles engendered by positive and negative emotions are adaptive. That is, externally-driven behaviour or 'accommodation' (e.g. checking, conforming) is an appropriate response to perceived threat, whereas internally-driven behaviour or 'assimilation' (e.g. flexible or strategic thinking) is an appropriate response to perceived opportunity.

3. Neuroscience of psychological wellbeing

3.1. *Patterns of brain activation*

The emotion circuitry of the brain is complex, involving primarily structures in the prefrontal cortex, amygdala, hippocampus, anterior cingulated cortex and insular cortex. These structures normally work together to process and generate emotional information and emotional behaviour. Research has particularly focused on the prefrontal cortex which, unlike most other brain regions involved in emotion processing, shows asymmetric activation in relation to positive and negative emotions.

Davidson and his colleagues have reported large individual differences in baseline levels of asymmetric activation in prefrontal cortex, related to a person's typical emotional style. Individuals with a positive emotional style show higher levels of left than right prefrontal activation at rest (using EEG or fMRI), while those with a negative emotional style tend to show higher levels of right than left prefrontal activation at rest (Davidson, 1992; Tomarken et al., 1992; Urry et al., 2004). Davidson and colleagues have also reported that, independent of emotional style, induced negative mood increases relative right-sided activation, whereas induced positive mood increases relative left-sided activation (Davidson et al., 1990; Davidson, 2005).

Important links between child development and the appearance of individual differences in patterns of brain activation have also been reported. Although measures of baseline prefrontal asymmetry are stable in adults, they are not stable during early childhood (Davidson and Rickman, 1999). In a cohort of around 65 children, Davidson and Rickman examined prefrontal activation asymmetry over an eight-year period from 3-11 years of age, and found little evidence of stability. This is a period during which high levels of plasticity are likely to occur in the brain's emotional and cognitive circuitry, particularly in the prefrontal cortex which continues to undergo important developmental changes until puberty (Huttenlocher, 1990). Life events, parental influences and other environmental factors are likely to play a crucial role during this formative period in establishing or shifting patterns of prefrontal activation.

Of particular interest in the context of positive emotions and cognition is the neurobiological evidence that left and right frontal lobes play different roles in the processing of information. Spontaneous strategy production appears to depend critically on left prefrontal cortex, while error detection and checking processes appear to depend on right prefrontal cortex (Shallice, 2004; 2006). Evidence supporting this

differentiation, which is strikingly parallel to the processes of assimilation and accommodation referred to earlier, also comes from lesion studies and brain activation studies in normal adults (Reverberi et al., 2005; Rossi et al., 2001).

Brain activation studies have tended to focus either on emotion or on cognition. Where research is integrated, it is usually concerned with emotional disorders such as depression and anxiety. Future research will need to integrate more fully the neuroscience of cognition and emotion, and develop a more detailed understanding of the relationship between emotional and cognitive processes in distinct regions of the prefrontal cortex (dorsolateral, ventromedial, orbitofrontal), as well as other brain areas.

3.2. *Neurochemical effects*

Exposure to stressors activates the hypothalamic-pituitary-adrenal (HPA) axis, as evidenced by increased secretion of the stress hormone cortisol. However, individual differences in psychological wellbeing (including self-esteem and emotional style) can modulate stress-induced elevations in cortisol (Jacobs et al., 2007; Polk et al., 2005; Pruessner et al., 1999; Smyth et al., 1998).

Levels of cortisol secretion vary markedly throughout the day. A healthy pattern involves a post-awakening peak and a 20-fold decrease later in the day (Clow, 2004). Several studies have found that this healthy pattern is associated with high scores on measures of wellbeing (positive affect, optimism, psychological wellbeing), but not with scores on measures of illbeing (negative affect, pessimism, anxiety and fear) (Lai et al., 2005; Ryff et al., 2006; Steptoe and Wardle, 2005; Steptoe et al., 2007). Thus, the association between wellbeing and the cortisol cycle has been demonstrated not to be the inverse of the known association with stress or distress. Both positive and negative states are associated with the cortisol response, but independently of each other.

Another neurochemical associated with mental states is serotonin (5HT). Serotonin levels are reduced in depression, and most modern anti-depressant drugs, known as serotonin reuptake inhibitors (SSRIs), act by increasing the amount of serotonin available to brain cells. But what is the relationship between serotonin and positive mental states? In a study of 254 healthy adults who made daily ratings of their mood, Flory et al. (2004) found that serotonin level was related to positive mood averaged across seven days, but not to negative mood, although it was related to a measure of neuroticism. The authors conclude that deficiencies in serotonergic function may reflect the relative absence of positive mood – a suggestion that warrants further investigation. Together, these findings support the idea that mental wellbeing and illbeing have different neurobiological as well as behavioural effects.

Attempts to establish whether there is a specific hormone which increases in states of positive wellbeing mainly have focused on the mammalian hormone oxytocin. Oxytocin has long been known for its important role in childbirth and lactation, but experimental studies have also shown an independent effect on mother-infant bonding. After giving birth, animals to whom oxytocin antagonists have been administered do not exhibit typical maternal behaviour. By contrast, virgin females show maternal behaviour following administration of oxytocin (Kendrick, 2004).

Oxytocin is secreted by both males and females, and has been associated with the formation of monogamous pair bonds in prairie voles (Vacek, 2002). In humans, oxytocin is released during orgasm. One recent study shows that nasally administered oxytocin leads to a high degree of trust in a risky investment game (Kosfeld et al., 2005). Thus, there is some, limited, evidence that oxytocin may play a role on social bonding – an important component of overall wellbeing.

4. The development of psychological wellbeing

4.1. *Social factors and brain development*

People vary widely in their typical emotional style, that is whether they tend to feel generally positive or generally negative. The key to understanding individual differences in emotional style is the extraordinarily protracted period of human brain development. Unlike the other major organs of the body, our brain undergoes most of its development post-natally, and is exquisitely designed to respond to the environmental conditions in which a child happens to grow up. There appears to be a sensitive period in brain development up to around age two (e.g. Dawson et al., 2000), but major changes and reorganisation continue until puberty (Huttenlocher, 1990). Moreover, the development of our frontal lobes which are responsible for such high-level processes as planning and emotional control, continues until early adulthood (see Keverne, 2005; 2008).

In all mammalian species, later emotional wellbeing and cognitive capability are profoundly influenced by the early social environment. Of particular importance is the closeness of the bond between mother and infant. The body of research on human infants undertaken by Ainsworth and later investigators (e.g. Ainsworth and Bell, 1970; Maccoby and Martin 1983) provides evidence that, even in infancy, positive emotions are associated with positive cognitive and social behaviour that may provide a basis for resilience throughout life. This has been amply confirmed in an elegant series of experimental studies of rodents by Meaney and colleagues (Meaney, 2001), in which the underlying neurobiological mechanisms have been identified. High levels of maternal care (from either a biological or adoptive mother) produce a permanent increase in the concentration of glucocorticoid receptors in the hippocampus and prefrontal cortex of the brain (Liu et al., 1997; 2000), and are associated with resilience in stressful situations and high levels of learning and memory throughout life. In addition, good maternal care leads to the increased survival of hippocampal neurones (Bredy et al., 2003), which is associated with the maintenance of cognitive function into old age.

These studies have also shown that prolonged maternal separation leads to a lower density of sites for the neurotransmitter dopamine, and lasting changes in the responsiveness of dopamine neurons to stress and psycho-stimulus (Brake et al., 2004). Animals experiencing early maternal separation become readily addicted to psychostimulants which do not produce addiction in a normally-reared comparison group. This suggests a possible neurobiological basis for human individual differences in vulnerability to compulsive drug-taking.

Is recovery from an adverse early environment possible? Francis et al. (2002) showed that providing a socially stimulating environment during the peri-pubertal period in rodents completely reverses the effects of maternal separation on both endocrine and behavioural responses to stress, and eliminates the differences in hippocampal function and cognitive performance (Bredy et al., 2003; 2004). These findings provide support for the powerful effect of environmental factors both in setting enduring levels of emotional responsiveness and cognitive ability during the critical post-natal period, and in providing opportunities for remediation at a later stage in the life course.

Studies of both humans and primates show that the role of the father as well as the mother is important in the development of wellbeing. Having an absent, abusive or authoritarian father is associated with an increased risk of mental health problems in adolescence and early adulthood (e.g. Amato and Sobolewski, 2001), while a few studies have also shown the benefits of a positive fathering style (e.g. paternal warmth) on a child's wellbeing (e.g. Furnham and Cheng, 2000; Flouri and Buchanan, 2003).

On the other hand, Jorm et al. (2003) found that mental health outcomes were poor when the father showed a high level of affection but the mother showed a low level. A recent population-based study of women in mid-adult life (Huppert et al., Submitted) found that the experience of paternal warmth and

respect at an early age is associated with high levels of psychological wellbeing on most dimensions of the Ryff scale (Ryff, 1989) and that the influence of the father's parenting style was greater than the mother's.

4.2. *Genetic factors*

There can be no doubt that an individual's genotype also has an influence on the development of psychological wellbeing and resilience to stress. Recent research has shown that the short allele variant of the serotonin transporter (5-HTT) gene confers vulnerability to depression, but only when there are appropriate environmental triggers, while the long allele variant acts as a resilience or protective factor (Caspi et al., 2003; Kendler et al., 2005). More recently, this gene has been found to affect brain activation in those regions involved in processing emotion. In a study of healthy volunteers, half homozygous for the short allele and half homozygous for the long allele, the former group showed significantly increased resting cerebral blood flow in the amygdala and decreased blood flow in the ventromedial prefrontal cortex (Rao et al., 2007). The two groups had no psychiatric disorder and were similar in age, gender and personality. The observed effect on brain function may mediate a genetic susceptibility for mood disorders.

While research is advancing rapidly on genes which confer increased risk of psychological disorders, research is also needed to identify whether there are genes which increase the probability of psychological flourishing.

5. Are drivers of wellbeing the same as drivers of illbeing?

Many risk factors and vulnerability factors for mental illbeing have been identified, some operating at the individual level (e.g. genotype, mother-infant attachment, parenting style, adverse life events), others at the social level (e.g. poverty, unemployment, discrimination) (see also Foresight reviews on mental ill-health). An important question is whether the principal drivers of psychological wellbeing are the opposite of these risk and vulnerability factors, or whether wellbeing has different drivers. Several sources of evidence suggest that while some drivers are the same, others are not.

5.1. *Personality*

One of the strongest predictors (drivers) of our usual emotional style is personality, particularly the dimensions of extraversion and neuroticism. Extraversion (sociability) is strongly associated with a positive emotional style, while neuroticism is associated with a negative emotional style (e.g. Argyle and Lu, 1990; Diener et al., 1999). These mainly cross-sectional findings were confirmed in a 10-year longitudinal study by Costa and McCrae (1980). A number of longitudinal studies of mental illbeing have established the link between childhood or adolescent neuroticism and psychological distress later in life (Caspi et al., 1996; Kendler et al., 2006; Rodgers, 1990; van Os et al., 2001). On the other hand, the dimension of extraversion is not causally linked to psychological illbeing (e.g. Clarke et al., 1994; Neeleman et al., 2001; van Os et al.,2001). Thus, neuroticism appears to drive negative mood and common mental disorders, whereas extraversion drives positive emotional characteristics. Personality is related not only to how we feel but also to how well we function psychologically. The most widely used measure of positive psychological functioning is Ryff's scales of Psychological Wellbeing (Ryff, 1989) which covers the dimensions of autonomy, environmental mastery, personal growth, personal relations with others, purpose in life and self-acceptance. Cross-sectional studies have shown strong associations between psychological wellbeing and both extraversion and neuroticism (DeNeve and Cooper, 1998; Ruini et al, 2003; Vitterso and Nilsen, 2002). However, a recent longitudinal study using the Ryff scale, in which personality was measured three decades before the assessment of psychological wellbeing, shows a much larger effect of extraversion than of neuroticism (Abbott et al., 2008). Indeed, the effect of neuroticism on wellbeing was mediated entirely

through psychological distress; its effect on wellbeing entirely disappeared once psychological distress was controlled for.

5.2. *Demographic factors*

Demographic characteristics also show some differential effects for wellbeing and illbeing. Women have substantially higher rates of symptoms (or diagnosis) of common mental disorders such as anxiety and depression than men, but the effect of gender is much less clear when it comes to mental wellbeing. Most large surveys show little evidence of gender differences (e.g. Donovan and Halpern, 2002; Helliwell, 2003). Some show higher scores for men (e.g. Stephens et al., 1999), while others show higher scores for women on some sub-scales such as those assessing social functioning (e.g. Huppert et al., 1989; Ryff and Singer, 1998b).

The association between age and mental wellbeing is also complex. Large surveys using single-item measures of wellbeing (e.g. overall rating of life satisfaction) usually find a U-shaped relationship with age: younger and older people tend to have higher wellbeing scores than the middle-aged, although there may be a decline in wellbeing among the very old (e.g. Clark and Oswald, 1994; Blanchflower and Oswald, 2008). Middle-aged adults also have the highest prevalence of common mental disorders (Singleton et al., 2001). Blanchflower and Oswald (2008) have shown that the U-shaped relationship holds across different cohorts and in many nations.

But a more complex picture emerges when wellbeing is assessed using more refined measures rather than a global single-item measure. For example, wellbeing improves with advancing age on measures such as sense of coherence (Stephens et al., 1999) and two of the Ryff scales (autonomy, environmental mastery) (Ryff and Singer, 1998b), although in the latter study individuals over 75 years were not included.

Interactions between age and gender have also been reported. Data from the British Health and Lifestyle Survey show that, compared to middle-aged and younger men, older men have the lowest number of symptoms of psychological distress, but also the lowest scores on a measure of positive psychological wellbeing. On the other hand, compared to other age groups, older women have the highest score on symptoms of psychological distress and also the lowest scores on positive wellbeing (Huppert and Whittington, 2003).

Being married is usually associated with higher life satisfaction and lower rates of psychological ill-health (see review by Dolan et al., 2008). But the direction of causation is not clear, since individuals with high levels of psychological wellbeing are more likely to get married (Diener, 2000). Some longitudinal studies have found that, while getting married is good for one's psychological wellbeing, *being* married may not be (e.g. Zimmermann and Easterlin, 2006). Two recent studies have shown that one dimension of wellbeing, autonomy, is higher among women who have been divorced or separated, compared with married or never-married women (Lindfors et al., 2006). There is also evidence, from both the US and the UK, that having children living in the household is not good for women's happiness (Kahneman et al., 2004), and that women have higher psychological wellbeing if children over the age of 16 have left home (Abbott et al., under review).

5.3. *Socio-economic factors*

Major socio-economic factors tend to have comparable effects on mental wellbeing and mental illbeing. In general, there is a social gradient whereby higher levels of income and socio-economic status are associated with higher levels of wellbeing and lower rates of disorder (e.g. Dolan et al., 2008; Ryff and Singer, 1998b), although this effect diminishes at progressively higher levels of income.

While most studies find higher educational qualifications protective against poor mental health, a few have found a reverse gradient for education (see Dolan et al., 2008; Fagg et al., 2008). For example, Chevalier and Feinstein (2006) found that men with a high level of education were more likely to be depressed than those with less education. They suggest that the increase in depression associated with the highest level of education may be an indication of the job-related stress of occupations requiring a degree. The reverse gradient for education could also reflect the role of education in raising expectations that may not have been fulfilled. Thus, raising educational attainment does not of itself guarantee that wellbeing will be improved.

Income inequality is associated with both wellbeing and psychological disorder. Higher national income inequality is linked to a higher prevalence of mental illness (e.g. Pickett et al., 2006) and lower scores on wellbeing measures (e.g. Alesina et al., 2004). The recent UNICEF report (2007) found that children's wellbeing across a range of measures was worst in the most unequal countries (UK and US). It should be noted that income inequality is at a historically high level in the UK (Orton and Rowlingson, 2007), with no evidence that this situation is changing. On the other hand, the causal mechanisms are not well understood; the most unequal countries also appear to be the most materialistic and to have the most individualistic (rather than communitarian) values, and these characteristics are known to be associated with lower psychological wellbeing (Kasser, 2002).

Unemployment has long been associated with the presence of mental health problems (e.g. Evans and Repper, 2000) and lower levels of life satisfaction (e.g. Winkelmann and Winkelmann, 1998). In many studies, the direction of causality cannot be ascertained, but data from some longitudinal studies demonstrate that people who started out relatively happy become unhappy after they were unemployed (e.g. Lucas et al., 2004). Contextual factors also influence the relationship between unemployment and wellbeing; where unemployment is normative (that is, in areas of high unemployment) the impact on individuals appears to be less (e.g. Clark, 2003; Shields and Wheatley Price, 2005), although the social impact may be very serious.

However, data from the British Health and Lifestyle Survey suggest that we may need a more nuanced approach to measuring the impact of unemployment. Survey measures of psychological distress usually combine responses to items about symptoms and about positive mood or functioning, the latter being reverse scored. In a study which looked separately at responses to these two types of items, it was found that unemployment was more strongly associated with the absence of positive wellbeing than with the presence of symptoms of psychological distress (Huppert and Whittington, 2003). In other words, unemployed people do not on average show evidence of mental health problems such as depression or anxiety; rather, they fail to flourish.

5.4. *Other drivers*

While demographic and socioeconomic factors are significant drivers of psychological wellbeing, they appear to account for only around 10% of the variation in psychological wellbeing between individuals (Argyle, 1999; Andrews and Withey, 1976), at least in economically-developed countries such as the UK and the US. Personality factors (extraversion and neuroticism) account for around twice as much of the variation between individuals (Abbott et al., 2008; Gutierez et al., 2005).

Lyubomirsky and her colleagues suggest that intentional activities, that is activities over which we have control, are also very important drivers of psychological wellbeing (Lyubomirsky et al., 2005; Sheldon and Lyubomirsky, 2006). These researchers divide intentional activities into three broad groups: (a) behaviours – such as taking regular exercise or being kind to others; (b) cognitions – such as interpreting events in a positive light or feeling gratitude; and (c) motivations – such as striving towards goals that reflect deeply-held values rather than being driven by external rewards. Lyubomirsky and her colleagues provide evidence of how such activities increase levels of happiness, although the amount of variation in psychological wellbeing explained by intentional activities has not thus far been quantified.

There may well be substantial leverage in developing interventions that change our behaviours, cognitions and motivations, as a method of improving psychological wellbeing. This is, after all, the basis for cognitive behaviour therapy (CBT) which has hitherto been used very successfully to reduce symptoms in individuals with mental health problems. Adapting such remediation techniques in the service of enhancing wellbeing for the majority of the population might also prove successful.

An illustration of this broader approach is the Pennsylvania Resiliency Program, based in large part on CBT techniques, which was developed for primary school children (Gillham and Reivich, 1999; Gillham et al., 2007). Starting in September 2007, this programme was applied to schoolchildren in three counties of the UK as part of the Young Foundation's Local Wellbeing Project. Training in the mindful awareness of sensations, thoughts and feelings ('mindfulness meditation') is another technique shown to have substantial benefits for both reducing distress and enhancing wellbeing in a range of groups, including people with a range of physical health disorders, and in medical students and prison populations (see Grossman et al., 2004 for a review and meta-analysis). The benefits of relatively short, CBT-based or mindfulness interventions (eight to 12 weeks) have been shown to persist for several years (Freres et al., 2001; Gillham et al., 2007; Miller et al., 1995), so these may prove to be cost-effective interventions.

6. Psychological wellbeing leads to better physical health

It has long been known that negative emotions are related to a higher prevalence of disease, but how strong is the evidence for a link between positive mental states and health? Evidence from both longitudinal and experimental studies shows that a positive emotional style has a beneficial effect on physical health and survival. In a famous longitudinal study, the Nun Study, it was discovered that the ageing nuns had all written brief autobiographies when they had entered the convent (generally around age 20), and these autobiographies were categorised according to the number of positive statements they contained. Danner et al. (2001) reported that nuns in the lower half of the distribution of positive statements died on average nine years sooner than those in the top category of positive statements. This finding is particularly remarkable because, from their early twenties, the lives of the nuns were as similar as human lives can be, so the difference in survival was not related to their lifestyle or circumstances in the intervening period, but to their positive emotions six decades earlier. Other longitudinal studies have confirmed the benefit of positive emotions for health and survival (Huppert and Whittington, 2003; Ostir et al., 2001).

An important physiological mediator underlying the relationship between positive emotions, health and survival is likely to be the functioning of the immune system. This has been confirmed in experimental studies, such as those by Cohen and his colleagues. In one study, several hundred healthy volunteers were administered nasal drops containing a common cold virus, and monitored in quarantine. The investigators found that the more positive the participant's emotional style, the lower their risk of developing a cold. Negative emotional style, though, was not associated with developing a cold (e.g. Cohen et al., 2003a). Another study found that sociability was linearly related to decreased probability of developing a cold – an effect not accounted for by sociability-related differences in immunity (Cohen et al., 2003b). A study by Marsland et al. (2006) examined the relationship between emotional style and antibody response to the Hepatitis B vaccine. Participants with high scores on trait positive affect produced significantly more antibodies to the vaccine. There was no relationship between antibody response and either trait negative affect or depression.

The above studies assessed the emotional style of the participants but did not try to alter it. It is therefore difficult to be sure whether the individuals' positive characteristics were causally related to the outcome or whether there might be a common cause of both the characteristics and the outcome.

The direction of causality is much clearer in the classic study by Davidson et al. (2003). Using an intervention which increases positive mental states (mindfulness meditation), they reported that the meditation group produced a significantly greater antibody response than the control group to a subsequent influenza vaccine, measured some months later. Positive mood has also been shown to influence the cardiovascular response to stress. Fredrickson et al. (2000) exposed volunteers to a stressful task followed by a mood induction procedure. Subjects in a positive mood state showed much more rapid cardiovascular recovery from stress than those in a negative or neutral mood state. Prolonged reactivity to stress is harmful to immune function and to other physiological processes, while a rapid recovery from stress is beneficial for health. A study by Lai et al. (2005) directly investigated the effect of affect and optimism on the secretion of the stress hormone cortisol. Positive affect and optimism had somewhat different effects on the diurnal pattern of salivary cortisol secretion, but both were associated with a healthy pattern, compared to negative affect and pessimism.

In a recent, scholarly review of well-designed prospective and experimental studies, Pressman and Cohen (2006) conclude that there is firm evidence for a beneficial effect of positive emotions on physical health and survival, and that this effect may be independent of the level of negative emotion. Indeed, some of the studies cited above suggest that, in the general population, positive affect (or the lack of it) may exert a more powerful effect on health and physiology than the presence of negative affect. This startling conclusion may have hitherto been obscured by the focus on pathology which has dominated biomedical science. Pathology-oriented research used measures that failed to differentiate between the presence of negative experiences and the absence of positive experiences.

There are a number of pathways through which positive emotions can exert their beneficial effects on health. Evidence cited above supports the view that positive mental states can have direct effects on physiological, hormonal and immune function which, in turn, influences health outcomes. Behavioural and social factors may also mediate the link between positive emotions and health. Happier people tend to have healthier lifestyles (Watson, 1988), more friends, and also more positive interpersonal experiences (Diener et al., 1999). Thus, the health benefits of positive emotional states may not be directly attributable to positive feelings, but to health practices or social factors that are known to have beneficial effects on health and life expectancy.

The social factor that has been most studied in relation to health is that of receiving social support – well known to moderate or protect against physical and mental health problems (e.g. Brugha et al., 2005; House et al.,1988). More recent evidence has identified the powerful role of providing support to others. In a prospective study of hundreds of elderly couples, Brown and her colleagues (2003) found that mortality was greatly reduced in individuals who reported providing instrumental or emotional support, compared to those who did not, and this effect remained after adjustment for a host of potential health, behavioural and socio-demographic confounders. The investigators also found that receiving support had no significant effect on mortality once giving support was taken into account.

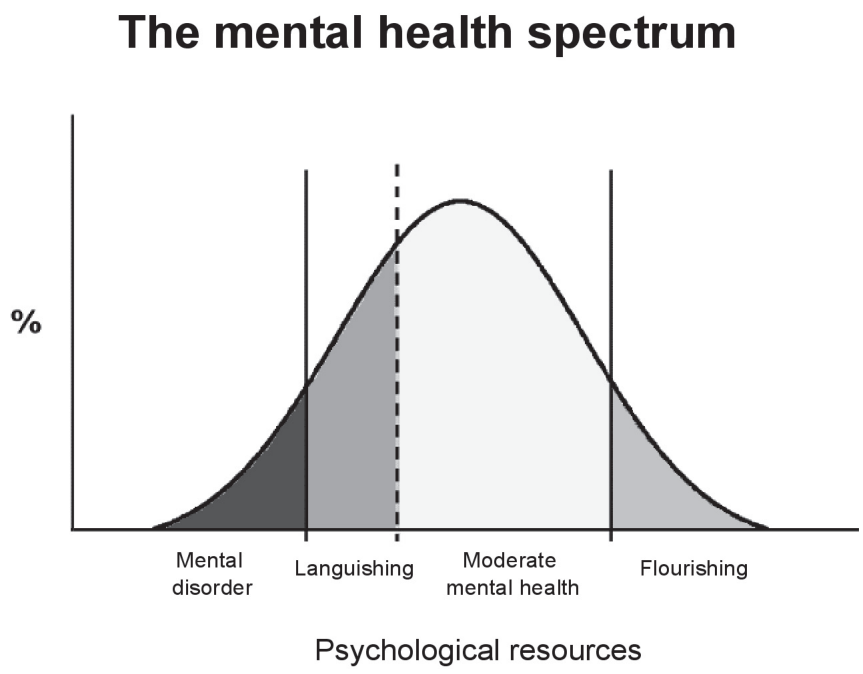
There is evidence from surveys that giving support in the form of volunteering may be associated with higher levels of psychological wellbeing. For instance, a study by Greenfield and Marks (2004) found that in older people, volunteering was associated with more positive affect and more meaning in life, but not with less negative affect. Policies that encourage people to give support to others (for example, in the form of volunteering or mentoring) are likely to have health benefits as well as personal and societal benefits.

7. The population perspective on mental wellbeing

According to the most recent available national survey, 16.4% of the UK population has some form of mental health problem (Singleton et al., 2001). But what percentage are mentally flourishing, that is enjoying a high level of psychological wellbeing? According to Keyes (2002a): 'flourishing individuals have enthusiasm for life and are actively and productively engaged with others and in social institutions' (p262). Data from the US suggests that only around 17% of adults are flourishing, while 11% are 'languishing' (Keyes, 2002b).

The term languishing refers to a condition in which a person's life seems empty or stagnant, 'a life of quiet despair', although they do not have mental illness (Keyes, 2002a, p210). Keyes has shown that 'languishers' are at greatly increased risk of depression and physical disorders including cardiovascular disease (Keyes, 2004). He also suggests that languishing may be highly prevalent among young people, many of whom are seeking ways to fill the void of their lives. Sex, drugs and alcohol are often used in this way, but these only deepen the void and make the person more dysfunctional. There are no UK data at present on the prevalence of flourishing or languishing. A schematic version of the mental health spectrum, from mental disorder to flourishing, is depicted in Figure 1.

Figure 1



Current mental health practice focuses on intervening only in the group with mental disorder. Some effort may also go into trying to prevent disorder in those who are at high risk (the 'languishing' group). However, evidence from epidemiology suggests that, if we use only this targeted approach, there will always be plenty of new cases of disorder, since the majority who develop disorder come from the general population; only a small percentage of the total who develop disorder are from the high risk group (Rose, 1992; 2008). While treatment and prevention have a crucial role to play in the short term, the Rose model suggests that the way to reduce the prevalence of common mental disorder in the long term is to intervene at the general population level (Huppert, 2005).

In support of this approach, there is evidence that the prevalence of any common disorder (hypertension, heart disease, depression, alcohol abuse and so on) is related to the average level of the risk factors or symptoms in the population. The higher the average, the greater the number of people with a disorder, i.e. who meet the criteria for diagnosis (Anderson et al., 1993; Academy of Medical Sciences, 2004; Puska et al.,

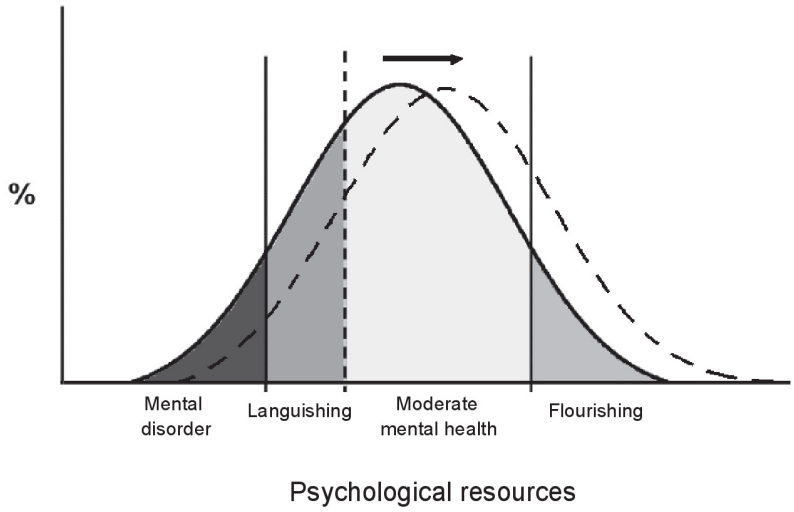
1998). As stated by Anderson et al. (1993): 'Populations thus carry a collective responsibility for their own mental health and wellbeing. This implies that explanations for the differing prevalence rates of psychiatric morbidity must be sought in the characteristics of their parent populations; and control measures are unlikely to succeed if they do not involve population-wide changes' (p475).

Some of the strongest evidence for a relationship between the population mean and the prevalence of disorder comes from research on alcohol abuse. Using data from over 32,000 adults who participated in the Health Survey for England, Colhoun et al. (1997) showed that, across all the regions in England, mean alcohol consumption (excluding heavy or problem drinkers) was strongly correlated with the prevalence of problem drinking. Similar data have been reported across 52 population samples from 32 countries (Rose, 1992). We can conclude, therefore, that a small reduction in the mean consumption of alcohol among light or moderate drinkers will result in a substantial decrease in the prevalence of problem drinking. Moreover, this appears to be a more effective strategy than the commonly used approach of targeting binge and problem drinkers (see Academy of Medical Sciences, 2004). Put simply, a small change in drinking culture such that most people have one or two drinks fewer each week, will do more to reduce problem drinking than targeting the problem drinkers and trying to persuade them to change their habits.

Figure 2 shows how a small change in the average level of symptoms or psychological resources in the population can produce a large decrease in the percentage with disorder and in the percentage who are languishing. At the same time, a small shift could produce a large increase in the percentage who are flourishing. There is some evidence for a reduction in the prevalence of psychiatric morbidity being associated with a small decrease in population mean scores on a psychological symptom measure. This comes from a large observational study, the seven-year follow-up of the UK Health and Lifestyle Survey, in which a one-point decrease on the symptom scale was associated with a 6% reduction in clinically-significant disorder (Whittington and Huppert, 1996). What is needed now is to move from observational to intervention studies, to test whether interventions that produce small improvements in the population mean on measures of wellbeing will lead to substantial reductions in the number of people with mental health problems, as well as large increases in the number who are flourishing.

Figure 2

The effect of shifting the mean of the mental health spectrum



This model and its predictions apply where wellbeing and illbeing share the same drivers, and this review has shown that there are indeed many common drivers, ranging from parental warmth to societal levels of

income inequality. On the other hand, wellbeing has some distinct drivers not shared with illbeing. These include personality traits such as extraversion, positive styles of thinking, and intrinsic motivation. To the extent that these beneficial characteristics can be learned or taught at the population level (e.g. through school-based programmes or workplace initiatives), they represent additional ways to increase flourishing across the population, with resulting benefits for capability, productivity, relationships and health.

8. Conclusions

On the basis of the evidence reviewed here, including experimental research, survey data and longitudinal studies of representative population samples, the following conclusions may be drawn.

1) Psychological wellbeing is associated with flexible and creative thinking, pro-social behaviour and good physical health.

2) An individual's level of mental capital and psychological wellbeing is powerfully influenced by her/his early environment, particularly maternal care.

3) While an adverse early environment can produce lifelong impairments in behaviour and neurobiology, compensation is possible at later stages in the life course.

4) External circumstances affect our wellbeing, but our actions and attitudes may have a greater influence. Interventions that encourage positive actions and attitudes have an important role to play in enhancing wellbeing.

5) Targeting interventions to those with a disorder or at high risk may alleviate misery in the short term, but a universal approach could enhance the lives of ordinary people, not just those with pathology. A universal approach may also reduce the total number of people in the long term with common mental disorders.

6) The science of wellbeing which focuses on what makes people flourish, on human assets rather than deficits, is a promising new area of research. Advances in understanding the behavioural, biological and social pathways to wellbeing will benefit individuals, organisations and society.

References

Abbott, R.A., Ploubidis, G.B., Croudace, T.J., Kuh, D., Wadsworth, M.E.J. and Huppert, F.A. 2008. The relationship between early personality and midlife psychological well-being: Evidence from a UK birth cohort study. *Social Psychiatry and Psychiatric Epidemiology,* 28 April [epub ahead of print].

Abbott, R.A., Ploubidis, G.B., Croudace, T.J., Kuh, D., Wadsworth, M.E.J. and Huppert, F.A.. (Under revision) Women's psychological well-being in mid-life and its relationship to socio-economic conditions: Evidence from a British birth cohort. *British Journal of Health Psychology.*

Academy of Medical Sciences. 2004. *Calling time: The nation's drinking as a major health issue.* London: The Academy of Medical Sciences.

Ainsworth, M.D. and Bell, S.M. 1970. Attachment, exploration, and separation: Illustrated by the behaviour of one-year-olds in a strange situation. *Child Development,* 41:49-67.

Alesina, A., Di Tella, R. and MacCulloch, R. 2004. Inequality and happiness: Are Europeans and Americans different? *Journal of Public Economics,* 88:2009-2042.

Amato, P.R. and Sobolewski, J.M. 2001. The effects of divorce and marital discord on adult children's psychological well-being. *American Sociological Review,* 6:900-92.

Anderson, J., Huppert, F.A. and Rose, G. 1993. Normality, deviance and minor psychiatric morbidity in the community. *Psychological Medicine,* 23:475-485.

Andrews, F.M. and Withey, S.B. 1976. *Social Indicators of Well-Being: Americans Perceptions of Life Quality.* New York: Plenum Publishing Corporation.

Argyle M. 1987. *The Psychology of Happiness.* London: Routledge.

Argyle, M. and Lu, L. 1990. The happiness of extraverts. *Personality and Individual Differences,* 11:1011-1017.

Argyle, M. 1999. Causes and Correlates of Happiness. In D. Kahneman, E. Diener and N. Schwartz (Eds). *Well-being, the foundations of hedonic psychology.* New York: Russell Sage Foundation.

Ashby, F.G., Isen, A.M. and Turken, A.U. 1999. A neuropsychological theory of positive affect and its influence on cognition. *Psychological Review,* 106:529-550.

Blanchflower, D.G. and Oswald, A.J. 2008. Is well-being U-shaped over the life cycle? *Social Science and Medicine,* 66:1733-49.

Bless, H., Mackie, D.M. and Schwarz, N. 1992. Mood effects on encoding and judgmental processes in persuasion. *Journal of Personality and Social Psychology,* 63:585-595.

Bless, H. and Fiedler, K. 2006. Mood and regulation of information processing and behavior. In Joseph P. Forgas (Ed). *Affect in Social Thinking and Behavior,* 65-84. New York: Psychology Press.

Brake, W.G., Zhang, T.Y., Diorio, J., Meaney, M.J. and Gratton, A. 2004. Influence of early postnatal rearing conditions on mesocorticolimbic dopamine and behavioural responses to psychostimulants and stressors in adult rats. *European Journal of Neuroscience,* 19:1863-1874.

Bredy, T.W., Grant, R.J., Champagne, D.L. and Meaney, M.J. 2003. Maternal care influences neuronal survival in the hippocampus of the rat. *European Journal of Neuroscience,* 18:2903-2909.

Bredy, T.W., Zhang, T.Y., Grant, R.J., Diorio, J. and Meaney, M.J. 2004. Peripubertal environmental enrichment reverses the effects of maternal care on hippocampal development and glutamate receptor subunit expression. *European Journal of Neuroscience,* 20:1355-1362.

Brown, S.L., Nesse, R.M., Vinokur, A.D., Smith, D.M. 2003. Providing social support may be more beneficial than receiving it: results from a prospective study of mortality. *Psychological Science,* 14:320-327.

Brugha, T.S., Weich, S., Singleton, N., Lewis, G., Bebbington, P.E., Jenkins, R. and Meltzer, H. 2005. Primary group size, social support, gender and future mental health status in a prospective study of people living in private households throughout GB. *Psychological Medicine,* 35:705-14.

Brunstein, J.C., Schultheiss, O.C. and Grassman, R. 1998. Personal goals and emotional well-being: The moderating role of motive dispositions. *Journal of Personality and Social Psychology,* 75:494-508.

Caspi, A., Moffitt, T.E., Newman, D.L. and Silva, P.A. 1996. Behavioral observations at age 3 predict adult psychiatric disorders: Longitudinal evidence from a birth cohort. *Archives of General Psychiatry,* 53:1033-1039.

Caspi, A., Sugden, K., Moffitt, T.E., Taylor, A., Craig, I.W., Harrington, H.L., McClay, J., Mill, J., Martin, J., Braithwaite, A. and Poulton R. 2003. Influence of life stress on depression: Moderation by a polymorphism in the 5-HTT gene. *Science,* 301:386-389.

Chevalier, A. and Feinstein, L. 2006. *Sheepskin or Prozac: The Causal Effect of Education on Mental Health.* IZA Discussion Papers 2231, Institute for the Study of Labor (IZA).

Clark, A . and Oswald, A. 1994. Unhappiness and unemployment. *The Economic Journal,* 104:648-659.

Clark, A. 2003. Unemployment as a social norm: Psychological evidence from panel data. *Journal of Labour Economics,* 21:323-351.

Clarke, L.A., Watson, D. and Mineka, S. 1994. Temperament, personality and the mood and anxiety disorders. *Journal of Abnormal Psychology,* 1:103-116.

Clow, A. 2004. Cortisol as a biomarker of stress. *Journal of Holistic Healthcare,* 1:10-14.

Cohen, S., Doyle, W.J., Turner, R.B., Alper, C.M. and Skoner, D.P. 2003a. Emotional style and susceptibility to the common cold. *Psychosomatic Medicine,* 65:652-7.

Cohen, S., Doyle, W.J., Turner, R., Alper, C.M. and Skoner, D.P. 2003b. Sociability and susceptibility to the common cold. *Psychological Science,* 14:388-395.

Colhoun, H., Ben-Shlomo, Y., Dong, W., Bost, L. and Marmot, M. 1997. Ecological analysis of collectivity of alcohol consumption in England: Importance of average drinker. *British Medical Journal,* 314:1164-1168.

Costa, P.T. and McCrae, R.R. 1980. Influence of extraversion and neuroticism on subjective well-being: Happy and unhappy people. *Journal of Personality and Social Psychology,* 38:668-678.

Danner, D., Snowdon, D. and Friesen, W. 2001. Positive emotions in early life and longevity: Findings from the Nun Study. *Journal of Personality and Social Psychology,* 80:804-813.

Davidson, R.J., Chapman, J.P., Chapman, L.P. and Henriques, J.B. 1990. Asymmetrical brain electrical activity discriminates between psychometrically-matched verbal and spatial cognitive tasks. *Psychophysiology,* 27:238-543.

Davidson, R.J. 1992. Emotion and affective style: Hemispheric substrates. *Psychological Science,* 3:39-43.

Davidson, R.J. and Rickman, M. 1999. Behavioral inhibition and the emotional circuitry of the brain: Stability and plasticity during the early childhood years. In L.A. Schmidt and J. Schulkin (Eds). *Extreme fear and shyness: Origins and outcomes,* 67-68. New York; Oxford University Press.

Davidson, R.J., Kabat-Zinn, J., Schumacher, J., Rosenkrantz, M., Muller, D., Santorelli, S.F., Urbanowski, F.. Harrington, A., Bonus, K. and Sheridan, J.F. 2003. Alterations in brain and immune function produced by mindfulness meditation. *Psychosomatic Medicine,* 65:564-570.

Davidson, R.J. 2005. Well-being and affective style: neural substrates and biobehavioral correlates. In F.A. Huppert, N. Baylis and B. Keverne (Eds). *The Science of Well-being,* 107-139. Oxford: Oxford University Press.

Dawson, G., Ashman, S.B. and Carver L.J. 2000. The role of early experience in shaping behavioural and brain development and its implications for social policy. *Development and Psychopathology,* 12:695-712.

DeNeve, K.M. and Cooper, H. 1998. The happy personality: A meta-analysis of 137 personality traits and subjective well-being. *Psychological Bulletin,* 124:197-229.

Diener, E. 1984. Subjective well-being. *Psychological Bulletin,* 95:542-575.

Diener E. 2000. Explaining differences in societal levels of happiness: Relative standards, need fulfilment, culture and evaluation theory. *Journal of Happiness Studies,* 1:41-78.

Diener, E., Suh, E.M., Lucas, R.E. and Smith, H.L. 1999. Subjective well-being: Three decades of progress. *Psychological Bulletin,* 125:276-302.

Dolan, P., Peasgood, T. and White, M. 2006. *Review of research on the influence of personal well-being and application to policy making.* London: DEFRA publications.

Dolan, P., Peasgood, T. and White, M. 2008. Do we really know what makes us happy? A review of the economic literature on the factors associated with subjective well-being. *Journal of Economic Psychology,* 29:94.122.

Donovan, N. and Halpern, D. 2002. *Life satisfaction: The state of knowledge and implications for Government.* Prime Minister's Strategy Unit. Available www.strategy.gov.uk/2001/futures/attachments/ls/paper.pdf.

Elliot, A.J., Sheldon, K.M. and Church, M.A. 1997. Avoidance personal goals and subjective well-being. *Personality and Social Psychology Bulletin,* 23:915-927.

Evans, J. and Repper, J. 2000. Employment, social inclusion and mental health. *Journal of Psychiatric and Mental Health Nursing,* 7:15-24.

Fagg, J., Curtis, S., Stansfeld, S.A., Cattell, V., Tupuola, A.-M. and Arephin, M. 2008. Area social fragmentation, social support for individuals and psychosocial health in young adults: Evidence from a national survey in England. *Social Science and Medicine,* 66:242–254.

Flory, J.D., Manuck, S.B., Matthews, K.A. and Muldoon, M.F. 2004. Serotonergic function in the central nervous system is associated with daily ratings of positive mood. *Psychiatry Research,* 129:11.19.

Flouri, E. and Buchanan, A. 2003. The role of father involvement in children's later mental health. *Journal of Adolescence,* 26, 63-78.

Forgas, J.P. 1998. On feeling good and getting your way: Mood effects on negotiating strategies and outcomes. *Journal of Personality and Social Psychology,* 74:565-577.

Forgas, J.P. 1999. On feeling good and being rude: Affective influences on language use and request formulations. *Journal of Personality and Social Psychology,* 76:928-939.

Forgas, J.P. 2001. *The Handbook of Affect and Social Cognition.* Mahwah, New Jersey: Erlbaum.

Forgas, J.P. 2002. Feeling and doing: Affective influences on interpersonal behavior. *Psychological Inquiry,* 13:1-28.

Forgas, J.P. 2006. Affective influences on interpersonal behavior: Towards understanding the role of affect in everyday interactions. In J.P. Forgas (ed). *Affect in Social Thinking and Behavior,* 269-290. New York: Psychology Press.

Francis, D.D., Diorio, J., Plotsky, P.M. and Meaney, M.J. 2002. Environmental enrichment reverses the effects of maternal separation on stress reactivity. *Journal of Neuroscience,* 22:7840-7843.

Fredrickson, B.L., Mancuso, R.A., Branigan, C. and Tugade, M. 2000. The undoing effect of positive emotions. *Motivation and Emotion,* 24:237-258.

Fredrickson, B.L. and Joiner, T. 2002. Positive emotions trigger upward spirals toward emotional well-being. *Psychological Science,* 13:172-5.

Fredrickson, B.L. and Branigan, C. 2005. Positive emotions broaden the scope of attention and thought-action repertoires. *Cognition and Emotion,* 19:313-332.

Freres, D.R., Gilham, J.E., Reivich, K.J. and Shatte, A.J. 2001. *Preventing depressive symptoms in middle school students: The Penn Resiliency Program.* International Journal of Emergency Mental Health.

Furnham, A. and Cheng, H. 2000. Perceived parental behaviour, self-esteem and happiness. *Social Psychiatry and Psychiatric Epidemiology,* 35:463-470.

Gasper, K. and Clore, G.L. 2000. Do you have to pay attention to your feelings to be influenced by them? *Personality and Social Psychology Bulletin,* 26:698-711.

Gillham, J..E. and Reivich, K.J. 1999. Prevention of depressive symptoms in school children: A research update. *Psychological Science,* 10:461-462.

Gillham, J.E., Reivich, K.J., Freres, D.R., Chaplin, T.M., Shatté, A.J., Samuels, B., Elkon, A.G.L., Litzinger, S., Lascher, M., Gallop, R. and Seligman, M.E.P. 2007. School-based prevention of depressive symptoms: A randomized controlled study of the effectiveness and specificity of the Penn Resiliency Program. *Journal of Consulting and Clinical Psychology,* 75:9-19.

Greenfield, E.A. and Marks, N.F. 2004. Formal volunteering as a protective factor for older adult's psychological well-being. *Journals of Gerontology,* Series B: *Psychological Sciences and Social Sciences,* 59B:258-264.

Grossman, P., Niemann, L., Schmidt, S. and Walach, H. 2004. Mindfulness-based stress reduction and health benefits: A meta-analysis. *Journal of Psychosomatic Research,* 57:35-43.

Gutierrez, J.L.G., Jimenez, B.M., Hernandez, E.G. and Puente, C.P. 2005. Personality and subjective well-being: big five correlates and demographic variables. *Personality and Individual Differences,* 38:1561-1569.

Helliwell, J.F. 2003. How's Life? Combing individual and national variations to explain subjective well-being. *Economic Modelling,* 20:331-360.

Helliwell, J. and Putnam, R.D. 2005. The social context of well-being. In F.A. Huppert, N. Baylis and B. Keverne (Eds). *The Science of Well-being,* 435-459. Oxford: Oxford University Press.
House, J.S., Landis, K.R. and Umberson, D. 1988. Social relationships and health. *Science,* 214:540-545.

Huppert, F.A., Walters, D.E., Day, N. and Elliott, B.J. 1989. The factor structure of the General Health Questionnaire (GHQ-30): A reliability study on 6317 community residents. *British Journal of Psychiatry,* 155:178-185.

Huppert, F.A. and Whittington, J.E. 2003. Evidence for the independence of positive and negative well-being: implications for quality of life assessment. *British Journal of Health Psychology,* 8:107-122.

Huppert, F.A. 2005. Positive mental health in individuals and populations. In F.A. Huppert, B. Keverne and N. Baylis (Eds). *The Science of Well-being,* 307-340. Oxford: Oxford University Press.

Huppert, F.A. 2006. Positive emotions and cognition: developmental, neuroscience and health perspectives. In Joseph P. Forgas (Ed). *Affect in Social Thinking and Behavior* 235-252. New York: Psychology Press.

Huppert, F.A., Ploubidis, G., Abbott, R., Kuh, D., Richards, M., Wadsworth, M. and Croudace T. (Submitted) *Parental practices predict psychological well-being in midlife: Life course associations among women in the 1946 British birth cohort.*

Huttenlocher, P.R. 1990. Morphometric study of human cerebral cortex development. *Neuropsychologia,* 28:517-527.

Isen, A.M. 1987. Positive affect, cognitive processes and social behaviour. In L. Berkowitz (Ed). *Advances in Experimental Social Psychology,* 20, 203-253. New York: Academic Press.

Jacobs, N., Delespaul, P., Derom, C., van Os, J., Myin-Germeys, I. and Nicolson, N.A. 2007. A momentary assessment study of the relationship between affective and adrenocortical stress responses in daily life. *Biological Psychology,* 74:60-66.

Jorm, A.F., Dear, K.B., Rodgers, B. and Christensen, H. 2003. Interaction between mother's and father's affection as a risk factor for anxiety and depression symptoms - evidence for increased risk in adults who rate their father as having been more affectionate than their mother. *Social Psychiatry and Psychiatric Epidemiology,* 38:173-179.

Judge, T.A., Thoresen, C.J., Bono, J.E. and Patton, G.K. 2001. The job satisfaction-job performance relationship: A qualitative and quantitative review. *Psychological Bulletin,* 127:376-407.

Kahneman, D. 1999. Objective happiness. In D. Kahneman, E. Diener and N. Schwartz (Eds). *Well-being: The Foundations of Hedonic Psychology.* New York: Russell Sage Foundation.

Kahneman, D., Krueger, A.B., Schkade, D., Schwarz, N. and Stone, A.A. 2004. A survey method for characterizing daily life experience: The Day Reconstruction Method (DRM). *Science,* 306:1776-1780.

Kasser, T. and Ryan, R.M. 1996. Further examining the American dream: Differential correlates of intrinsic and extrinsic goals. *Personality and Social Psychology Bulletin,* 22:280-287.

Kasser, T. 2002. *The high price of materialism.* Cambridge: MIT Press.

Kendler, K.S., Kuhn, J.W., Vittum, J., Prescott, C.A. and Riley, B. 2005. The interaction of stressful life events and a serotonin transporter polymorphism in the prediction of episodes of major depression: A replication. *Archives of General Psychiatry,* 62: 529-35.

Kendler, K.S., Gatz, M., Gardner, C.O. and Pedersen, N.L. 2006. Personality and major depression: A Swedish longitudinal, population-based twin study. *Archives of General Psychiatry,* 63:1113-1120.

Kendrick, K.M. 2004. The neurobiology of social bonds. *Neuroendocrinology,* 16:1007-1008.

Keverne, E.B. 2005. Understanding well-being in the evolutionary context of brain development. In F.A. Huppert, N. Baylis and B. Keverne (Eds). *The Science of Well-being,* 35-56. Oxford: Oxford University Press.

Keverne, E.B. 2008. *Neurobiology of Wellbeing: A life course perspective*. Foresight Mental Capital and Wellbeing Project. London: Government Office for Science.

Keyes, C.L.M. 2002a. Promoting a life worth living: Human development from the vantage points of mental illness and mental health. In R.M. Lerner, F. Jacobs and D. Wertlieb (Eds). Promoting Positive Child, Adolescent and Family Development: *A Handbook of Program and Policy Innovations,* 4:257-274. CA: Sage.

Keyes, C.L.M. 2002b. The mental health continuum: From languishing to flourishing in life. *Journal of Health and Social Behaviour,* 43:207-222.

Keyes, C.L.M. 2004. The nexus of cardiovascular disease and depression revisited: The complete mental health perspective and the moderating role of age and gender. *Aging and Mental Health,* 8:266-274.

Kosfeld, M., Heinrichs, M., Zak, P.J., Fischbacher, U. and Fehr, E. 2005. Oxytocin increases trust in humans. *Nature,* 435:673-676.

Lai, J.C.L., Chong, A.M.L., Ho, S.M.Y., Siu, O.T., Evans, P.D., Ng, S.H., Chan, P., Chan, C.L.W. and Ho, R.T.H. 2005. Optimism, positive affectivity, And salivary cortisol. *British Journal of Health Psychology,* 10:467-484.

Layard, R. 2005. *Happiness: Lessons from a New Science*. New York: Penguin.

Lesch, K.P., Bengel, D., Heils, A., Sabol, S.Z., Greenberg, B.D., Petri, S., Benjamin, J., Muller, C.R., Hamer, D.H. and Murphy, D.L. 1996. Association of anxiety-related traits with a polymorphism in the serotonin transporter gene regulatory region. *Science,* 274:1527-1531.

Lindfors, P., Berntsson, L. and Lundberg, U. 2006. Factor structure of Ryff's psychological well-being scales in Swedish female and male white-collar workers *Personality and Individual Differences,* 40:1213-1222.

Liu, D., Diorio, J., Tannenbaum, B., Caldji, C., Francis, D. and Freedman, A. 1997. Maternal care, hippocampal glucocorticoid receptors and hypothalamic-pituitary-adrenal responses to stress. *Science,* 277:1659-1662.

Liu, D., Diorio, J., Day, J.C., Francis, D.D. and Meaney, M.J. 2000. Maternal care, hippocampal synaptogenesis and cognitive development in rats. *Nature Neuroscience,* 3:799-806.

Lucas, R.E., Clark, A.E., Georgellis, Y. and Diener, E. 2004. Unemployment alters the set point for life satisfaction. *Psychological Science,* 15:8-13.

Lyubomirsky, S., King, L. and Diener, E. 2005. The benefits of frequent positive affect: does happiness lead to success? *Psychological Bulletin,* 131:803-855.

Maccoby, E.E. and Martin, J.A. 1983. Socialization in the context of the family: parent-child interaction. In P.H. Mussen and E.M. Hetherington (Eds). *Handbook of child psychology: vol. 4. Socialization, personality, And social development 4th ed.,* 1-101. New York: Wiley.

Marks, N. and Shah, H. 2005. A well-being manifesto for a flourishing society. In F.A. Huppert, N. Baylis and B. Keverne (Eds). *The Science of Well-being,* 503-533. Oxford: Oxford University Press.

Marmot, M., Ryff, C.D., Bumpass, L.L., Shipley, M. and Marks, N.F. 1997. Social inequalities in health: next questions and converging evidence. *Social Science and Medicine,* 44:901-10.

Marsland, A.L., Cohen, S., Rabin, B.S. and Manuck, S.B. 2006. Trait positive affect and antibody response to hepatitis B vaccination. *Brain, Behavior and Immunity,* 20:261-269.

Meaney, M.J. 2001. Maternal care, gene expression, And the transmission of individual differences in stress reactivity across generations. *Annual Reviews of Neuroscience,* 21:1161-1192.

Miller, J.J., Fletcher, K. and Kabat-Zinn, J. 1995. Three-Year Follow-up and Clinical Implications of a Mindfulness Meditation-Based Stress Reduction Intervention in the Treatment of Anxiety Disorders. *General Hospital Psychiatry,* 17:192-2009.

Mulgan, G. 2006. *Good and bad power, the ideals and betrayals of government.* London: Allen Lane.

Murray, N., Sujan, H., Hirt, E.R. and Sujan, M. 1990. The influence of mood on categorization: A cognitive flexibility interpretation. *Journal of Personality and Social Psychology,* 59:411-425.

Neeleman, J., Ormel, J. and Bijl, R.V. 2001. The distribution of psychiatric and somatic ill health: Associations with personality and socioeconomic status. *Psychosomatic Medicine,* 63:239-247.

Orton, M. and Rowlingson, K. 2007. *Public attitudes to economic inequality.* York: Joseph Rowntree Foundation.

Ostir, G.V., Markides, K.S., Peek, M.K. and Goodwin, J.S. 2001. The association between emotional well-being and the incidence of stroke in older adults. *Psychosomatic Medicine,* 63:210-215.

Pickett, K.E., James, O.W. and Wilkinson, R.G. 2006. Income inequality and the prevalence of mental illness: A preliminary international analysis. *Journal of Epidemiology and Community Health,* 60:646-647.

Polk, D.E., Skoner, D.P., Kirschbaum, C., Cohen, S. and Doyle, W.J. 2005. State and trait affect as predictors of salivary cortisol in healthy adults. *Psychoneuroendocrinology,* 30:261-272.

Pressman, S.D. and Cohen, S. 2006. Does positive affect influence health? *Brain, Behavior and Immunity,* 20:175-181.

Pruessner, J.C., Hellhammer, D.H. and Kirschbaum, C. 1999. Low self-esteem induced failure and the adrenocortical stress response. *Personality and Individual Differences,* 27:477-489.

Puska, P., Vartiainen, E. Tuomilehto, J., Salomaa, V. and Nissinen, A. 1998. Changes in premature deaths in Finland: successful long-term prevention of cardiovascular diseases. *Bulletin of the World Health Organisation,* 76:419-425.

Putnam, R.D. 2000. *Bowling alone.* New York: Simon and Schuster.

Rao, H., Gillihan, S.J., Wang, J., Korczykowski, M., Sankoorikal, G.M., Kaercher, K.A., Brodkin, E.S., Detre, J.A. and Farah, M.J. 2007. Genetic variation in serotonin transporter alters resting brain function in healthy individuals. *Biological Psychiatry,* 2 May [Epub ahead of print].

Reverberi, C., Lavaroni, A., Gigli, G.L., Skrap, M. and Shallice, T. 2005. Specific impairments of rule induction in different frontal lobe subgroups. *Neuropsychologia,* 43: 460-472.

Rodgers, B. 1990. Behaviour and personality in childhood as predictors of adult psychiatric disorder. *Journal of Child Psychology and Psychiatry,* 31:393-414.

Rose G. 1992. *The strategy of preventive medicine.* Oxford: Oxford University Press.

Rose, G. 2008. *Rose's strategy of preventive medicine*. 2nd Edition Revised. Oxford: Oxford University Press.

Rossi, S., Cappa, S.F., Babiloni, C., Pasualetti, P., Miniussi, C., Carducci, F., Babiloni, F. and Rossini, P.M. 2001. Prefrontal cortex in long-term memory: An 'interference' approach using magnetic stimulation. *Nature Neuroscience,* 9:948-952.

Ruini, C., Ottolini, F., Rafanelli, C., Tossani, E., Ryff, C. D. and Fava, G.A. 2003. The Relationship of Psychological Well-Being to Distress and Personality. *Psychotherapy and Psychosomatics,* 72:268-275.

Ryan, R.M. and Deci, E.L. 2001. On happiness and human potentials: A review of research on hedonic and eudaimonic well-being. *Annual Reviews of Psychology,* 52:141-166.

Ryff, C.D. 1989. Happiness is everything, or is it? Explorations on the meaning of psychological well-being. *Journal of Personality and Social Psychology,* 57:1069-1081.

Ryff, C.D. and Singer, B.H. 1998a. The contours of positive human health. *Psychological Inquiry,* 9:1-28.

Ryff, C.D. and Singer, B. 1998b. Middle age and well-being. *Encyclopaedia of Mental Health,* 2, 707-719. New York: Academic Press.

Ryff, C.D., Love, G.D., Urry, H.L., Muller, D., Rosenkranz, M.A., Friedman, E.M., Davidson, R.J. and Singer, B. 2006. Psychological well-being and ill-being: Do they have distinct or mirrored biological correlates? *Psychotherapy and Psychosomatics,* 75:85-95.

Sedikides, C. 1995. Central and peripheral self-conceptions are differentially influenced by mood: Tests of the differential sensitivity hypothesis. *Journal of Personality and Social Psychology,* 69:759-777.

Seligman, M. 1991. *Learned optimism.* New York: Knopf.

Seligman, M. 2002. *Authentic happiness.* New York: Free Press.

Shallice, T. 2004. The fractionation of supervisory control. In M.S. Gazzaniga (Ed). *The Cognitive Neurosciences III,* 943-956. Cambridge, Mass: MIT Press.

Shallice, T. 2006. Contrasting domains in the control of action: The routine and the non-routine. In M. Johnson and Y. Munakata (Ed). *Attention and Performance XXI Processes of Change in Brain and Cognitive Development.* New York: Oxford University Press.

Sheldon, K.M. and Kasser, T. 1998. Pursuing personal goals: Skills enable progress but not all progress is beneficial. *Personality and Social Psychology Bulletin,* 24:1319-1331.

Sheldon, K.M. and Elliot, A.J. 1999. Goal striving, need satisfaction, And longitudinal well-being: The self-concordance model. *Journal of Personality and Social Psychology,* 76:482-497.

Sheldon, K.M. and Lyubomirsky, S. 2006. How to increase and sustain positive emotion: The benefits of expressing gratitude and visualizing best possible selves. *Journal of Positive Psychology,* 1:73-82.

Shields, M. and Wheatley Price, S. 2005. Exploring the economic and social determinants of psychological well-being and perceived social support in England. *Journal of the Royal Statistical Society Series A,* 168:513-537.

Singleton, N., Bumpstead, R., O'Brien, M., Lee, A. and Meltzer, H. 2001. *Psychiatric morbidity among adults living in private households, 2000.* London: The Stationery Office.

Smyth, J., Ockenfels, M.C., Porter, L., Kirschbaum, C., Hellhammer, D.H. and Stone, A.A. 1998. Stressors and mood measured on a momentary basis are associated with salivary cortisol secretion. *Psychoneuroendocrinology,* 23:353-370.

Stephens, T., Dulberg, C. and Joubert, N. 1999. Mental health of the Canadian population: A comprehensive analysis. *Chronic Diseases in Canada,* 20:118-126.

Steptoe, A. and Wardle, J. 2005. Positive affect and biological function in everyday life. *Neurobiology of Aging,* 26, S1:108-112.

Steptoe, A., Gibson, L.E., Hamer, M. and Wardle, J. 2007. Neuroendocrine and cardiovascular correlates of positive affect measured by ecological momentary assessment and by questionnaire. *Psychoneuroendocrinology,* 32:56-64.

Tomarken, A.J., Davidson, R.J., Wheeler, R.E. and Doss, R.C. 1992. Individual differences in anterior brain asymmetry and fundamental dimensions of emotion. *Journal of Personality and Social Psychology,* 62:676–687.

UNICEF, 2007. The state of the world's children 2007. *Women and Children: The double dividend of gender equality.* The United Nations Children's Fund (UNICEF) Report.

Urry H.L.; Nitschke J.B.; Dolski I.; Jackson D.C.; Dalton K.M.; Mueller C.J.; Rosenkranz M.A., Ryff C.D., Singer B.H. and Davidson R.J. 2004. Making a Life Worth Living: Neural Correlates of Well-Being. *Psychological Science,* 15:367-372.

Vacek, M. 2002. *What can voles teach us about monogamy?* American Scientist online – High on Fidelity, May-June.

van Os, J., Park, S.B.G. and Jones, P.B. 2001. Neuroticism, life events and mental health: evidence for person-environment correlation. *British Journal of Psychiatry,* 178:s72-s77.

Vitterso, J. and Nilsen, F. 2002. The conceptual and relational structure of subjective well-being, neuroticism and extroversion: once again, neuroticism is the important predictor of happiness. *Social Indicators Research,* 57:89-118.

Watson, D. 1988. Intraindividual and interindividual analyses of positive and negative affect: Their relation to health complaints, perceived stress and daily activities. *Journal of Personality and Social Psychology,* 54:1020-1030.

Whittington, J.E. and Huppert, F.A. 1996. Changes in the prevalence of psychiatric disorder in a community are related to changes in the mean level of psychiatric symptoms. *Psychological Medicine,* 26:1253-1260.

Winkelmann, L. and Winkelmann, R. 1998. Why are the unemployed so unhappy? Evidence from panel data. *Economica,* 65:1-15.

World Health Organization. 1948. *Preamble to the Constitution of the World Health Organization.* [This definition remains unchanged]. Geneva: World Health Organization.

World Health Organization, 2001. *The world health report - Mental Health: New Understanding, New Hope.* Geneva: World Health Organization.

Zimmermann, A.C. and Easterlin, R.E. 2006. Happily Ever After? Cohabitation, Marriage, Divorce, And Happiness in Germany. *Population and Development Review/Blackwell,* 32:511-528.

All the reports and papers produced by the
Foresight Mental Capital and Wellbeing Project may be downloaded from the Foresight website
(www.foresight.gov.uk).
Requests for hard copies may also be made through this website.

First published September 2008.

The Government Office for Science.