

Well-being: towards an integration of psychology, neurobiology and social science

The study of well-being is a rapidly evolving field, and an exquisite example of a truly multidisciplinary endeavour. Two of the strongest strands have emerged from recent research on positive psychology and on social capital, but the field reaches well beyond these domains. We summarize some of the major themes that unite these different approaches and disciplines, highlighting both commonalities and controversies. The five themes on which we focus are: (i) evolution and development; (ii) the nature of well-being; (iii) well-being and capabilities; (iv) the relationship between health and well-being; and (v) the implications of the findings of the research for intervention strategies and public policies.

1. EVOLUTION AND DEVELOPMENT OF WELL-BEING

Much has been written on the evolution of negative emotions such as anger and fear, but the evolutionary origins of common mental disorders such as anxiety and depression, and of positive mental states, have only recently been explored. This belated exploration reflects the fact that evolutionary theory has been dominated by the concept of survival. The topics receiving most attention have been the fight and flight responses, with their concomitant negative emotions of anger and fear. The emphasis of the research has been on environmental threats and our strong in-built reactions to them. The evolutionary approach has recently been extended by psychiatrist Randolph Nesse to shed light on why anxiety and depression are so common in our species. Nesse argues that we are hard-wired to be permanently vigilant because, in survival terms, the failure to fight or flee could have such disastrous consequences. He describes this as the 'smoke detector' principle, whereby alarms are set at a level where they go off when there is no real problem (false positive response) to ensure that they will not fail when there is a real threat. Thus, in spite of the fact that few of us encounter truly life-threatening situations, high levels of anxiety in response to very mild forms of threat are commonplace. Nesse proposes that depression has its adaptive origin in the need of animals to disengage wasted effort in the pursuit of an unreachable goal, thereby creating an opportunity to seek and pursue a more attainable goal. This cessation of activity has become linked with negative affect that, in extreme cases, leads to depression (Nesse 2004).

But what about the evolutionary origins of positive emotions? Both Nesse and psychologist Barbara Fredrickson suggest that positive emotions are associated with situations that present opportunities rather than threats, and

with a strategy of approach rather than avoidance. The evolutionary benefits are that positive emotions, with their associated pursuit of opportunities, make the individual more attractive, thus increasing their social and thereby their reproductive success. In her 'broaden and build' theory of positive emotions, Fredrickson proposes that, in contrast to negative emotions which narrow the individual's repertoire of thoughts and actions (a valuable survival strategy), positive emotions such as joy, contentment and interest, have the effect of broadening the thought-action repertoire and of building resources for the future. This theory is supported by an elegant series of experiments using mood-induction techniques to examine the effects of positive, negative or neutral mood states on attention and problem-solving. These studies have confirmed that when individuals are in a positive emotional state their focus of attention is broader, and problem-solving is more flexible and creative, than when they are in a negative or neutral state (Fredrickson 2004). In his lucid summary of the evolution of positive emotions, Nesse concludes: 'Happiness and unhappiness are not ends, they are means. They are aspects of mechanisms that influence us to act in the interests of our genes' (Nesse 2004).

Having established that positive emotions are useful to individuals and for the continuation of the species, the question arises as to how and why individuals show such marked differences in their levels of emotional well-being. Neurobiologist Barry Keverne points to the extraordinarily protracted period of human brain development as the key to understanding individual differences. Most of our brain development occurs postnatally, with major changes and reorganization continuing until around puberty. Indeed, the development of our frontal lobes, which are responsible for such higher-level processes as planning and emotional control, continues until early adulthood. Keverne (2004) highlights the importance of the mother-infant bond in all mammalian species, since later well-being is profoundly influenced by the early social environment. The work of Meaney and colleagues, discussing mother-infant behaviour in rats (Francis *et al.* 1999; Meaney 2001), show that high levels of maternal licking, grooming and nursing are associated with a permanent increase in the concentration of glucocorticoid receptors in the hippocampus and prefrontal cortex. These changes in the circuitry of emotion regulation have the effect of decreasing responsiveness to stressors later in life. Such findings begin to underpin the observations that childhood and adult well-being are linked to the development of loving and trusting relationships early in life, whereas the absence of such relationships, as a result of parental neglect or abuse, is associated with later behavioural problems, psychiatric disorders and substance abuse (Leverich *et al.* 2002). Although many would argue that well-being and its polar opposite, psychiatric disorder,

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are strongly under genetic influence, Keverne cites data from animal studies that demonstrate that the role of the early environment may be far greater than hitherto suspected. Taking advantage of natural variations in rodent maternal behaviour that can be seen across generations, Meaney took the offspring of anxious, emotionally reactive mothers and reared them with calm, stress-resistant mothers whose maternal behaviour is characterized by high levels of licking and grooming. When they reached maturity, these offspring resembled their adoptive mothers, not their biological mothers (Meaney 2001).

Clinical epidemiologist David Barker has conducted seminal research establishing the effects of intra-uterine and childhood development on physical health in late life. He has investigated adult populations on whom extensive data about early development are available. His findings reinforce the importance of the early environment in the development of physical well-being. Barker (2004) has shown, for example, that the nutrition of the mother during pregnancy (e.g. under conditions of starvation) markedly affects her offspring's birth weight and rate of development, which in turn are strong predictors of disorders such as diabetes and coronary heart disease later in life. These effects are independent of childhood social circumstances. Conversely, the health of the mother and an advantageous intra-uterine environment are associated with positive health outcomes for the offspring in later life.

Moving our focus to the other end of the human life-course, ageing has traditionally been seen as a process of physical and mental deterioration that was thought to be inevitable. The neuropsychologist Sonia Lupien challenges these views in her examination of the concept of successful ageing. One of the keys to understanding ageing is that while there are large individual differences early in life, these differences are exacerbated with advancing age. This phenomenon can give the impression of an average decline in biological, cognitive or social measures as people age, whereas in fact there is a marked decline in some individuals, but little or no deterioration in many others. Lupien & Wan (2004) also present startling evidence on the adverse effects of negative stereotypes of ageing upon the performance, confidence and physiological function of older people. These experimental studies, undertaken by Levy and colleagues at Yale University, demonstrate that older subjects show high levels of performance on cognitive tasks when previously exposed to positive images of ageing but substantial impairments when previously exposed to negative images of ageing (Levy *et al.* 2000; Levy 2001). Large differences were observed in the groups shown positive versus negative images despite the fact that these images were presented subliminally. These findings raise important questions about the extent to which many of the age-related problems that we currently encounter may be the consequence of our society's negative attitudes towards ageing and the elderly.

2. THE NATURE OF WELL-BEING

Although the concept of well-being encompasses positive physical, psychological and social states, most researchers focus on the psychological. Two of the papers in this issue make a clear distinction between two kinds of psychological well-being known as hedonic and eudaimonic well-being, a

distinction that dates back to Aristotle. Hedonic well-being refers to short-term pleasures of the kind elicited by the senses, or to more complex states such as sexual enjoyment or the excitement of watching a football game. This contrasts with longer-term positive states, which psychologist Martin Seligman divides into: (i) *a feeling of gratification* that arises when one is engaged in pursuing one's strengths, and the resultant feeling of 'flow'; and (ii) *a sense of meaning* that derives from pursuing goals in the service of something of wider significance than oneself (e.g. family or community, an ideology) (Seligman 2002). Psychologists Carol Ryff and Burt Singer (Ryff *et al.* 2004) contrast short-term positive emotions, such as happiness, with six dimensions of psychological (eudaimonic) well-being: autonomy, environmental mastery, self-acceptance, positive relations with others, personal growth and purpose in life. Seligman *et al.* (2004) cite evidence that a global measure of life satisfaction is associated with eudaimonic well-being (i.e. engagement and meaning) but not with hedonic pleasure, whereas Ryff *et al.* (2004) report that biological markers of health are associated with eudaimonic well-being but not with happiness. Thus, although we all seek pleasure, it is important to recognize that sustainable well-being is associated with utilizing our strengths, fostering our relationships and working towards socially desirable goals.

Fredrickson's work characterizes positive emotions in a different way, focusing on the behaviours produced by different kinds of emotional triggers (Fredrickson 2004). For example, she differentiates between hedonic states such as joy, contentment and interest, and examines their effects on behaviour. While her empirical work employs mood induction techniques to produce short-term emotional states, she argues that the cumulative experience of positive emotions produces beneficial long-term consequences, since positive emotions provide the individual with the flexible mental resources to cope with adverse or challenging situations.

In an important extension of work on the psychology of positive emotions, neuroscientist Richard Davidson examines the patterns of brain activation that characterize individuals who have different affective styles, for example those who are generally positive or optimistic compared with those who are characteristically negative or pessimistic. Davidson (2004) reports that more positive individuals tend to show greater activation in the left prefrontal cortex than in the right, whereas the pattern is reversed for individuals who have a more negative affective style. Whether these differences are a direct reflection of difference in affect is unclear; they may reflect differences in cognitive style associated with the individual's affective style. Davidson has also found that an extreme form of the brain activation pattern observed in people with a positive affective style occurs during meditation, particularly among the most experienced practitioners. Moreover, the more active left than right pattern is associated with advantageous profiles of hormonal responses to stress and high levels of immune function. In experimental studies involving volunteers who were trained in meditation, beneficial effects were found on immune reactivity to the influenza vaccine, and the highest immune reactivity was found in those whose brains showed the largest left frontal activation.

There is also a large body of research that focuses on the relationship between our social connections (social capital) and well-being. This research often uses large-scale international surveys to investigate the socio-economic and demographic factors associated with subjective well-being, does not always differentiate between measures of happiness (hedonic well-being) and measures of life satisfaction (eudaimonic well-being). However, economist John Helliwell and political scientist Robert Putnam (2004) find that, on average, older people report very high levels of life satisfaction, but much lower levels of happiness. They also examine the effects of many socio-demographic and other variables, including the dimension of trust, and find that those individuals who have trust in others tend to have the highest levels of both happiness and life satisfaction.

The issue of the cultural relativity of measures of well-being is addressed by psychologist Robert Sternberg (Sternberg & Grigorenko 2004). This work extends the concept of well-being to include intellectual capabilities, and warns that an adequate interpretation of the results of cognitive measures requires an understanding of these measures in their social and cultural contexts, where different skills may be differentially prized. There is a commonly held view that our lives should be focused on the pursuit of happiness. This is challenged by both Nesse (2004) and Fredrickson (2004), who highlight the fact that we all experience misfortune, and the key to well-being is the balance between appropriate negative and positive emotions. Nesse (2004) points to the importance of considering the benefits of negative emotions and the drawbacks of positive emotions in certain circumstances. Fredrickson (2004) elucidates the role of positive emotions as a resource for effective coping when we are confronted with problems or challenges.

3. WELL-BEING AND CAPABILITIES

Sternberg and Grigorenko (Sternberg & Grigorenko 2004) advocate that we should regard intellectual capabilities as an aspect of well-being, and this view would hold equally for other types of capabilities, including social, physical or artistic capabilities. In Seligman's terminology, these capabilities are the strengths and talents whose pursuit results in engagement and flow, with the resulting feelings of gratification. Thus Sternberg appears to view capabilities as constituents of well-being, whereas Seligman *et al.* (2004) regard capabilities as a cause of well-being. The importance of Fredrickson's work is her demonstration that increased capabilities can also be a consequence of well-being. In the experimental studies of induced mood, she has shown that when in negative or neutral states, subjects tend to focus on detail, whereas in positive emotional states they see the bigger picture. Likewise, in neutral or negative mood states, subjects produce relatively few ideas, whereas in positive emotional states they produce many ideas and are more creative and flexible in their thinking. Her findings challenge the commonly held view that happy or contented people are unproductive or lacking in creativity. Fredrickson (2004) suggests that joy, rather than leading to aimless activity, fuels an urge to play, which encourages imagination and enhances social relationships. Similarly

contentment, rather than producing inactivity, fuels the desire to savour and integrate.

The work on positive versus negative stereotypes of ageing, cited by Lupien & Wan (2004), supports Fredrickson's view of the impact of positive emotions or attitudes on human capabilities. Experimental studies show that following the subliminal presentation of age-positive words such as 'wise' or 'sage', older subjects perform at higher levels on tests of learning, memory and numerical ability. However, following the subliminal presentation of age-negative words such as 'senile' or 'decrepit', the performance of older people on these tasks is greatly reduced. It is noteworthy that in these studies, the performance of young subjects was unaffected by the presentation of age-positive or age-negative material.

The idea that we can use our intellectual capabilities to alter our state of well-being has been investigated by Davidson (2004). He has shown that a group of volunteers can be trained to use their cognitive resources to learn the Buddhist meditation technique of mindfulness, which appears to boost both subjective well-being and objective measures of well-being, including improvements in immune function.

4. RELATIONSHIP BETWEEN HEALTH AND WELL-BEING

There are two questions that need to be addressed under this heading: first, what is the nature of the relationship between physical health and subjective well-being; second, what is the causal direction of the effect? Does good physical health produce subjective well-being or does subjective well-being produce good physical health? It seems obvious that subjective well-being is reduced when our physical health is acutely or chronically compromised, and many studies report associations in the expected directions. For example, in large cross-national studies, Helliwell & Putnam (2004) find a strong relationship between a measure of physical health and subjective measures of happiness and life satisfaction. However, it is important to recognize that this measure of physical health is a self-rated item asking respondents to rate whether their health in general is excellent, very good, good, fair or poor. It is very likely that the strong association between this subjective rating and measures of happiness and life satisfaction reflects the individual's response bias. Their detailed examination of an impressive body of data shows that, in wealthier countries, happiness, life satisfaction and self-rated health all show an identical relationship to income, namely a small increase from the lowest decile of income and a levelling off after about the middle decile. By contrast, for poorer countries, although a similar pattern is seen for happiness and self-rated health, life satisfaction shows a large and progressive increase with increasing income, suggesting that there may be effects that are independent of response bias. Social and economic surveys of the kind described above rarely use objective measures of physical health, or even self-reported health problems. However, Helliwell & Putnam (2004) have examined well-being in relation to a WHO measure—the national average of healthy years of life expectancy. They report that far more of the national differences in subjective well-being is accounted for by self-reported health than by the objective measure of health,

although the objective measure accounts for approximately half of the variance in the subjective (self-rated) health measure.

In studies designed to assess physical health in an objective manner, the focus is almost always on physical health problems rather than physical vitality or physical thriving. This raises the problem of disentangling whether an observed relationship between physical health and subjective well-being might arise primarily because of an association between low scores on the well-being scale and poor physical health, rather than between high scores on the well-being scale and good physical health (Huppert 2004). This difficulty has arisen partly because the possible responses on most well-being scales cover the full range, from very positive to very negative, whereas most health scales concentrate on the negative end of the spectrum. To overcome this difficulty, it would be helpful to look separately at measures of positive and negative well-being, and also to ensure that there are adequate measures of physical thriving as well as the usual measures of physical problems. Such considerations also apply to the interpretation of data from studies using biological markers of health, such as those reported here by Ryff and colleagues (2004). Because the multi-dimensional scales that they use cover the full range of psychological well-being from very positive to very negative, it is difficult to know whether the associations they report arise from strong links between low well-being and adverse levels of the biological markers, or whether there are also links between positive well-being and beneficial levels of the biological markers.

Returning to the question of the causal direction of the relationship between well-being and health, the evidence from developmental biology, summarized in the papers by Keverne (2004) and Barker (2004), suggests that the experience of an advantageous early environment, including the early social environment, reduces the risk of physical health problems and mental disorders later in life. Several authors have also described the short-term benefits of positive emotions or positive attitudes on health-related physiological responses. These include Fredrickson's studies, which show that positive emotions reduce the duration of the cardiovascular response to stress (Fredrickson *et al.* 2000), and Davidson's demonstration that volunteers trained in meditation produce high levels of immunity to influenza (Davidson *et al.* 2003). These experiments provide confirmation of a causal pathway from subjective well-being to physical health. One can infer from these studies that individuals who experience frequent positive emotions might maintain a better level of health than individuals who experience positive emotions and positive attitudes more rarely.

By contrast, Helliwell and Putnam write 'We recognize that the causal link between health and subjective well-being is not uncontroversial, although we tend to the view that well-being is mainly an effect, not a cause, in this relationship' (Helliwell & Putnam 2004). In all probability, there is a reciprocal relationship between physical health and subjective well-being, even if the causal link from physical health to subjective well-being is harder to demonstrate experimentally. Longitudinal studies or a life-course approach are needed to establish conclusively the extent to which changes in physical health precede or follow changes in subjective well-being.

5. IMPLICATIONS FOR INTERVENTION STRATEGIES AND POLICIES TO IMPROVE WELL-BEING

Although the science of well-being is at a relatively early stage of its development, we believe that progress in some areas is already sufficient to propose intervention strategies at both an individual level and a public policy level. Psychologists have traditionally operated at an individual level, and the papers by Seligman *et al.* (2004), Fredrickson (2004) and Davidson (2004) all provide specific examples of interventions that have been used to enhance individual well-being. Building on the techniques developed in the field of cognitive behaviour therapy for the relief of psychological distress or psychiatric disorder, Seligman and colleagues instructed subjects to record, every day for one week, three good things that happened to them and why these good things occurred. Compared with a control group, individuals who completed this exercise were happier and less depressed even at the three-month follow-up (Seligman & Steen 2004). It is assumed that individuals learn to use these techniques in their daily life, following the intervention exercise. Similar methods were adopted by Fredrickson and colleagues, whose research showed the psychological benefits of actively finding meaning and long-term benefits in daily events, no matter whether those events were positive, neutral or negative (Fredrickson *et al.* 2004). Using the well-known technique of mindfulness training, Davidson has shown this intervention to have a beneficial effect on the immune system (Davidson *et al.* 2003). Although each of these examples has been used on an experimental basis to date and follow-up has been relatively short-term, the results suggest that they could begin to be applied more widely, with continuing long-term evaluation being strongly encouraged. The beauty of interventions that nurture positive emotions, attitudes and behaviours, is that they can potentially benefit the normal majority of people whose lives may not be as happy or fulfilled as they might wish. This contrasts with the usual approach of restricting interventions to the small minority of the population who already have a problem or are at high risk of developing a problem.

Some interventions are best administered at a universal level, through changes in social policy. The social and political environment is a major determinant of a society's level of well-being. The analysis by Helliwell and Putnam (2004) makes it clear that simply improving levels of income or GDP would not increase average well-being, since well-being is related to relative levels of income, not absolute levels. However, their analyses demonstrate that well-being is even more strongly related to social connectedness (marriage, family and workplace ties, civic engagement) and to trustworthiness and trust. Hence, they propose that society-wide increases in social capital could have an unambiguous and strongly positive effect on well-being.

Research on human development offers yet another approach to society-level interventions to improve well-being. The damaging effect on capability, confidence and health arising from negative stereotypes of ageing, reported by Lupien & Wan (2004), makes it clear that steps should be taken to reverse the negative stereotypes that are widely held in our culture. Making age discrimination illegal (which the UK will have to do by 2006 to comply with European directives) is a step in the right direction, but far

more is needed to change social attitudes. Science has a part to play in demonstrating that these negative stereotypes are outdated, since they fail to take account of the profound demographic changes in the extension of healthy, active life expectancy. The resulting increase in capability, independence and civic engagement that would result, is likely to benefit all age groups of society.

At the other end of the lifespan, developmental biology has demonstrated the profound impact of the early intra-uterine and postnatal social environment on brain development and adult health. Society-wide interventions to optimize foetal development and infant nurturing would produce very substantial benefits in physical, psychological and social well-being in children and adults. Although positive interventions at any stage in the life course can be shown to have beneficial effects on well-being, evidence presented here makes it plain that adequate nurturing at this early and most vulnerable stage of human development will undoubtedly produce the greatest and most long-lasting benefits.

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REFERENCES

- Barker, D. J. P. 2004 The developmental origins of well-being. *Phil. Trans. R. Soc. Lond. B* **359**, 1359–1366. (doi:10.1098/rstb.2004.1518.)
- Davidson, R. J. 2004 Well-being and affective style: neural substrates and biobehavioral correlates. *Phil. Trans. R. Soc. Lond. B* **359**, 1395–1411. (doi:10.1098/rstb.2004.1510.)
- Davidson, R. J. (and 10 others) 2003 Alterations in brain and immune function produced by mindfulness meditation. *Psychosom. Med.* **65**, 564–570.
- Francis, D. J., Diorio, J., Liu, D. & Meaney, M. J. 1999 Non-genomic transmission across generations of maternal behavior and stress responses in the rat. *Science* **286**, 1155–1158.
- Fredrickson, B. L. 2004 The broaden-and-build theory of positive emotions. *Phil. Trans. R. Soc. Lond. B* **359**, 1367–1378. (doi:10.1098/rstb.2004.1512.)
- Fredrickson, B. L., Mancuso, R. A., Branigan, C. & Tugade, M. 2000 The undoing effect of positive emotions. *Motivation and Emotion* **24**, 237–258.
- Fredrickson, B. L., Brown, S. Cohn, M. A., Conway, A., Crosby, C., McGivern, M. & Mikels, J. 2004 Finding positive meaning and experiencing positive emotions builds resilience. In S. Brown (Chair). The Functional Significance of Positive Emotions, Symposium presented at the Annual Meeting of the Society for Personality and Social Psychology, Austin, Texas, January.
- Helliwell, J. & Putnam, R. D. 2004 The social context of well-being. *Phil. Trans. R. Soc. Lond. B* **359**, 1435–1446. (doi:10.1098/rstb.2004.1522.)
- Huppert, F. A. 2004 A population approach to positive psychology: the potential for population interventions to promote well-being and prevent disorder. In *Positive psychology in practice* (ed. P. A. Linley & S. Joseph), pp. 693–709. Hoboken, NJ: Wiley.
- Keverne, E. B. 2004 Understanding well-being in the evolutionary context of brain development. *Phil. Trans. R. Soc. Lond. B* **359**, 1349–1358. (doi:10.1098/rstb.2004.1517.)
- Leverich, G. S., Perez, S., Luckenbaugh, D. A. & Post, R. M. 2002 Early psychosocial stressors: relationship to suicidality and course of bipolar illness. *Clin. Neurosci. Res.* **2**, 161–170.
- Levy, B. 2001 Eradication of ageism requires addressing the enemy within. *The Gerontologist* **41**, 5.
- Levy, B., Hausdorff, J., Hencke, R. & Wie, J. 2000 Reducing cardiovascular stress with positive self-stereotypes of aging. *J. Gerontol. Psychol. Sci.* **B55**, 205–213.
- Lupien, S. J. & Wan, N. 2004 Successful aging: from cell to self. *Phil. Trans. R. Soc. Lond. B* **359**, 1413–1426. (doi:10.1098/rstb.2004.1516.)
- Meaney, M. J. 2001 Maternal care, gene expression, and the transmission of individual differences in stress reactivity across generations. *A. Rev. Neurosci.* **21**, 1161–1192.
- Nesse, R. M. 2004 Natural selection and the elusiveness of happiness. *Phil. Trans. R. Soc. Lond. B* **359**, 1333–1347. (doi:10.1098/rstb.2004.1511.)
- Ryff, C. D., Singer, B. H. & Love, G. D. 2004 Positive health: connecting well-being with biology. *Phil. Trans. R. Soc. Lond. B* **359**, 1383–1394. (doi:10.1098/rstb.2004.1521.)
- Seligman, M. 2002 *Authentic happiness*. New York: Free Press.
- Seligman, M. E. P. & Steen, T. 2004 Making people happier: a randomized controlled study of exercises that build positive emotion, engagement, and meaning. Unpublished manuscript, University of Pennsylvania.
- Seligman, M. E. P., Parks, A. C. & Steen, T. 2004 A balanced psychology and a full life. *Phil. Trans. R. Soc. Lond. B* **359**, 1379–1381. (doi:10.1098/rstb.2004.1513.)
- Sternberg, R. J. & Grigorenko, E. L. 2004 Intelligence and culture: how culture shapes what intelligence means, and the implications for a science of well-being. *Phil. Trans. R. Soc. Lond. B* **359**, 1427–1434. (doi:10.1098/rstb.2004.1514.)