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**Positive emotions and cognition: developmental,  
neuroscience and health perspectives**

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## **Introduction**

While psychologists across diverse specialties have tended to focus on problems and dysfunction, there have always been a few who were more interested in human thriving – that is, in people feeling good or functioning well (Argyle, 1987; Bradburn, 1969; Jahoda, 1958; Winnicott, 1979). In 1998, during his Presidency of the American Psychological Association, Martin Seligman launched the Positive Psychology movement which brought together researchers who had already been asking questions such as why some people are happier or more resilient than others; why some people age more successfully than others, or what are the social or biological processes associated with positive emotional states. Seligman had, in short, recognised a readiness and eagerness to understand and promote positive mental states and positive behaviours, and interest in positive psychology is growing at an unprecedented rate. With this new approach comes the possibility of improving the lives of ordinary people, and not just of those with disorder or dysfunction. This conceptual shift is based on the growing recognition that positive health and well-being is more than the absence of disorder, that its determinants might not simply be the absence of risk factors for disorder, and that it deserves to be studied in its own right. Within social psychology in particular, Michael Argyle (1987) in Oxford, and Ed Diener (1984) in Illinois have done much to establish the study of positive affectivity as an important aspect of understanding everyday social behaviour.

This chapter reviews some of the recent developments in the field we now call positive psychology. It examines the causes and consequences of positive mental states from both the behavioural and neuroscience perspectives, and their implications for cognitive processes, including social thinking and social behaviour. The links between positive mental states, health and survival are also explored, along with a consideration of the underlying mechanisms.

### **Why the relative neglect of positive emotions?**

Much of psychology appears to have been influenced by the medical model prevailing in the Western world - that health is simply the absence of disease, and the related concept that good functioning is simply the absence of dysfunction. This view has been quite explicit in neuropsychology, where it was assumed that we would understand the normal functioning of the brain by studying brain disorders. Certainly much insight has been gained into the neural structures and processes underlying memory, language, motor skills and the like by studying patients with amnesia, aphasia and apraxia, but this approach has

shed little light on the mechanisms underlying above-average or exceptional performance. Similarly, in the area of mental health and emotional behaviour, the volumes of research findings on the negative emotions such as anger, fear, depression and anxiety tell us very little about happiness, love, contentment or compassion.

The influence of evolutionary theory has been another reason for the relative neglect of positive emotions. Evolutionary theory is dominated by the concept of survival and this has led behavioural scientists to investigate negative behaviours such as fight and flight, with their concomitant negative emotions of anger and fear. The focus has been on environmental threats and the strong in-built reactions to them. It is believed that we are hard-wired to be permanently vigilant because in survival terms, the failure to fight or flee could have such disastrous consequences. Despite the fact that most of us rarely encounter life-threatening situations, high levels of anxiety are commonplace in response to very mild forms of threat, and may result in clinically diagnosed anxiety disorders (Nesse, In press). Our physiological and behavioural responses are however, also governed by our evolution as highly social animals. Recent research shows that among humans, even fundamental physiological reactions to challenge and threat depend to a large degree on the social knowledge that individuals bring to a given situation (Blascovich & Mendes, 2000), and on the quality of our social relationships (eg Cohen et al, 2003a).

But what about the evolutionary origins of positive emotions? It has been suggested that positive emotions are associated with situations which present opportunities rather than threats, and with a strategy of approach rather than avoidance (Fredrickson, In press; Nesse, In press; see also Haselton and Ketelaar, this volume). It has also been suggested that the display of positive emotions in an individual is a signal to others that there is no threat in the environment. Thus, positive emotions have evolutionary benefits, since by pursuing opportunities and signalling that it is safe to approach, individuals displaying the positive emotions become more attractive to other members of the species, thereby increasing their reproductive success. In her "broaden-and-build" theory of positive emotions, Fredrickson (2001) proposes that in contrast to negative emotions which narrow the individual's repertoire of thought and action (a valuable survival strategy), positive emotions such as joy, contentment and interest, have the effect of broadening the thought-action repertoire and of building cognitive resources for the future. Recent work by cognitive social psychologists also suggests that positive and negative affective states

selectively trigger different information processing styles, consistent with evolutionary principles. Thus, positive affect facilitates the use of internalised strategies using knowledge structures (assimilative thinking), while negative affect promotes a focus on external, environmental information (accommodative thinking) (see Fiedler and Bless, this volume).

### **Developmental origins of positive emotions**

While such explanations for the evolutionary origins of positive emotions are plausible, we are on firmer ground when examining the developmental origins of positive emotions. The basic question is why do individuals show such marked differences in their levels of emotional well-being? The extraordinarily protracted period of human brain development is the key to understanding such individual differences. Unlike the other major organs of our body, our brain undergoes most of its development post-natally, and appears to be 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 2 (eg 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, 2004, In press).

In all mammalian species, later emotional well-being and cognitive capability appears to be profoundly influenced by the early social environment. Of particular importance is the closeness of the bond between mother and infant. Pioneering studies of mother-infant bonding showed that infants with secure attachment were more confident in exploring their environment and in responding to strangers than infants whose attachment was insecure (Ainsworth & Bell, 1970). The body of research of Ainsworth and later investigators (eg Maccoby & 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.

An elegant series of studies by Meaney and colleagues has taken our understanding of these processes to a deeper level. Meaney and his collaborators, using laboratory rats, have shown 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 of the brain (Liu et al., 1997, 2000). These changes in the circuitry of

emotion regulation have the effect of decreasing responsiveness to stressors later in life. They are also associated with improved learning and memory throughout life, presumably reflecting the important role of the hippocampus in memory processes. 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, while the absence of such relationships due to parental neglect or abuse, is associated with later behavioural problems, psychiatric disorder and substance abuse (Leverich et al., 2002).

To establish whether the beneficial effects of good maternal care stemmed directly from the mother's behaviour or was a reflection of her genetic make-up, Meaney took advantage of natural variations in rodent maternal behaviour which can be seen across generations. He took the offspring of neglectful, emotionally reactive mothers and reared them with calm, stress-resistant mothers whose maternal behaviour is characterised by high levels of licking and grooming. As adults, these offspring resembled their adoptive mothers, not their biological mothers (Meaney, 2001). Further studies show that maternal behaviour during the early postnatal period serves to programme the developing brain, including endocrine and neurotransmitter function, as well as emotional and cognitive function, and that these effects can be lifelong (Weaver et al., 2002, 2004; Brake et al., 2004).

In view of the strength of these findings, it is surprising that so many psychologists believe that individual differences in characteristics such as happiness and cognitive ability are primarily determined by our genes. This belief is based on heritability estimates that come from twin studies, which suggest that genes account for 50% or more of the variation in trait happiness (Lykken, 2000; Lykken and Tellegen, 1996). A detailed critique of the conclusions drawn from twin studies is provided by Huppert (in press). A major problem is that such studies tend to assume that both identical and non-identical twins experience the same family environment; they neglect the effect of the child's behaviour (influenced by the child's genes) on the parents' behaviour. Because of their genetic and hence behavioural differences, non-identical twins do not experience the same family environment. Non-identical twins have different genes and different environments, while identical twins have the same genes and (virtually) the same environment. As a result, twin studies routinely underestimate the importance of parental behaviour and the child's environment in emotional, social and cognitive development.

## **Positive emotions and cognition**

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, 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 well-being tend to have attributional styles that are more self-enhancing and more enabling than those low in subjective well-being, suggesting that happiness can lead to positive cognitions which in turn contribute to further happiness. Certainly there is a great deal of observational data showing that characteristically happy people tend to construe the same experiences and life events more favourably than unhappy people (Lyubomirsky & Tucker, 1998) and are less responsive to negative feedback (Lyubomirsky & Ross, 1999).

Observational studies, particularly cross-sectional ones, cannot of course establish the direction of causality, so it is not clear whether positive cognitions and behaviours are the consequence of happiness or its cause, or whether both are influenced by a third factor such as temperament. Longitudinal research can go some way towards establishing causal relationships, but the most persuasive evidence comes from experimental studies. Research using mood induction techniques demonstrates unequivocally that positive mood states can enhance attention and problem solving. 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 & Clore, 2000) and generate many more ideas in problem-solving tasks (Fredrickson & Branigan, 2005). 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 the way they initiate social interactions (eg Forgas, 2001; Isen, 1987). It has also been found that people experiencing positive affect 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; Sedikides, 1995; see also Forgas, this volume). Thus it is clear from the experimental research on induced mood, that happiness or other positive emotions can have a direct effect on cognitive performance, cognitive appraisal and social relationships. Such findings support Fredrickson’s ‘broaden-and-build’ theory of positive emotions which proposes that the frequent experience of positive affect broadens cognitive processes and builds enduring coping resources which lead to later resilience (Fredrickson, 2001; 2004; In press). Trope and colleagues have also suggested that

positive emotions can act as a resource or buffer when we have to confront unpleasant tasks or information (Trope et al., 2001; Trope, this volume).

Positive emotions can be the consequence of certain cognitive/behavioural processes, as well as their cause. Extensive research on goal pursuit shows that enhanced subjective well-being is associated with goals being intrinsic, ie self-generated (eg Kasser & Ryan, 1996), with progress towards a valued goal (Sheldon & 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 & 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 & Putnam, 2004; In press). 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 & Joiner, 2002). The recognition of this upward spiral (and its reverse) forms the basis of cognitive therapy (Beck, 1979).

## **Do positive emotions have a down side?**

Most research on positive emotions emphasises their beneficial effects for cognitive processes and interpersonal relationships, often contrasting these effects with the disadvantages of negative emotions. However, if we take an evolutionary perspective, we can assume that natural selection has shaped our capacities for both happiness and sadness, and that each is beneficial in certain situations, but may equally produce disbenefits in other situations. The evolutionary psychiatrist Randolph Nesse (2004; In press) points out that by focusing almost exclusively on the disadvantages of negative states and the benefits of positive states, there has been a near total neglect of “diagonal psychology”, which also considers the dangers of unwarranted positive emotions and the benefits of negative emotions in certain situations. His model is depicted in Figure 1.

Evidence in support of the off-diagonals (the shaded squares in Fig.1) comes from a number of sources. For example, positive affect is often inappropriate in situations of loss or bereavement, and may lead an observer to conclude that the person is insensitive or uncaring. Thus in some situations, negative affect is a more appropriate response, and experiencing disappointment, sadness or grief may be beneficial for one’s longer term well-being and social relationships.

There is also an extensive literature on affect as a source of information (Damasio 1994; Clore & Storbeck, this volume), which suggests that recognising our negative feelings is just as important as recognising our positive feelings. For example, negative affect such as frustration or even mild depression can play a valuable role in signalling that a goal is unattainable and that it is time to pursue a different goal.

A variety of experimental studies using mood induction techniques provide important illustrations of the validity of considering a ‘diagonal psychology’. As mentioned earlier, positive affect has many benefits for judgement and decision making, including seeing the bigger picture (Gasper & Clore, 2002; see Clore & Storbeck, this volume), in generating more ideas and being more creative and flexible in thinking (Ashby, Isen & Turken, 1999; Bless et al., 1992; Fredrickson & Branigan, 2005; Murray et al., 1990). On the other hand, there is evidence that people in negative mood states are better at taking in the details of a stimulus or environment, and are more conforming and less likely to break rules (eg Forgas 1998, 1999), although the latter applies to dysphoric mood states rather than

anger (see Clore & Storbeck, this volume for a review of the effects of specific negative emotions).

In general, positive emotions and negative emotions appear to be associated with different styles of processing information. Fiedler contrasts these two approaches to information processing in terms of the Piagetian concepts of assimilation and accommodation. Assimilation involves imposing internalised structures onto the external world, whereas accommodation involves modifying internal structures in accordance with external conditions. Importantly, Fiedler proposes that both styles of information processing have their adaptive consequences, and that there are circumstances when it is more adaptive for an individual to be internally driven and other circumstances where it is more adaptable for them to be externally driven (see Bless & Fiedler, this volume).

An excellent illustration of the adaptive value of negative affect is seen in a recent series of experiments by Forgas (In press) which investigated the susceptibility to misinformation in studies of eyewitness memory, based on the well known studies of Loftus (1979; Wells & Loftus, 2003). Loftus has shown that people are easily misled and report erroneous memories after being exposed to incorrect post-event information (Loftus, 1979), by being asked questions that contain misleading information about the original event. Following autobiographical mood induction tasks (positive, negative or neutral) Forgas' subjects were asked a series of questions about complex photographic or naturalistic scenes which they had been exposed to earlier in the testing session. Forgas found that positive mood increased the tendency to incorporate misleading details into memory, while negative mood decreased this tendency. These data are consistent with evidence cited earlier that positive moods promote the kind of constructive, assimilative information processing style that facilitates the incorporation of misleading detail, while negative moods promote a stimulus-bound, accommodative style of information processing (Fiedler et al, 1991; see Bless & Fiedler, this volume). However the importance of the Forgas study is its demonstration that negative affect has a beneficial effect on certain situations which are highly relevant to real life.

### **Positive emotions and patterns of brain activation**

The emotion circuitry of the brain is complex, involving primarily structures in the prefrontal cortex, amygdala, hippocampus, anterior cingulate cortex and insular cortex. These structures normally work together to process and generate emotional information and

emotional behaviour. Research has particularly focussed on the prefrontal cortex, since it shows very large differences in the activation of left and right sides in relation to positive and negative emotions. Davidson and his colleagues from Wisconsin are the most active researchers in this field. They have reported that induced positive and negative affective states shift the symmetry in prefrontal brain electrical activity; negative affect increases relative right-sided activation whereas positive affect increases relative left-sided activation (Davidson et al., 1990). They have also reported large individual differences in baseline levels of asymmetric activation in prefrontal cortex which are related to dispositional affective style (trait affect). Individuals with a positive affective style show higher levels of left than right prefrontal activation at rest (using EEG or fMRI), while those with a negative affective style tend to show higher levels of right than left prefrontal activation at rest (Davidson, 1992; Tomarken et al., 1992; ). Further studies have shown that greater left than right prefrontal activation is associated with increased reactivity to positively valenced emotional stimuli (Tomarken et al., 1990; Wheeler et al., 1993), increased ability to recover from negative affective challenge (Jackson et al., 2003), better voluntary suppression of negative affect (Jackson et al., 2000), and higher scores on scales measuring psychological well-being (Urry et al., 2004). Davidson has interpreted these findings as showing that the left and right prefrontal cortex (PFC) play differential roles in emotional processing. The recent paper by Urry et al. (2004) suggests that there are hemispheric differences in goal-directed tendencies (approach versus avoidance) beyond those captured by positive or negative affect. They propose that the left PFC is active in response to stimuli that evoke the experience of positive affect because these stimuli induce a fundamental tendency to approach the source of stimulation.

Important links have also been reported between child development and the appearance of individual differences in patterns of brain activation. Although measures of baseline prefrontal asymmetry are stable in adults, Davidson and Rickman (1999) have shown that they are not stable during early childhood. In a cohort of around 65 children, they examined prefrontal activation asymmetry over an 8-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 circuitry, particularly in the prefrontal cortex which is still undergoing important developmental changes at least until puberty (Huppenlocher, 1990). Life events, parental influences and other environmental factors are likely to play a crucial role during this period in establishing or shifting patterns of prefrontal activation. This is in accord with the rodent studies of Meaney and his co-

workers referred to earlier, which demonstrate not only that aspects of the early postnatal environment have a profound influence on shaping the structure and function of the brain, but that partial or even complete compensations for the damaging effects of adverse early environment is possible, following appropriate interventions around the time of puberty (Bredy et al., 2003, 2004; Francis et al., 2002)

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, In press). Evidence for this differentiation, which is strikingly parallel to the processes of assimilation and accommodation referred to earlier, comes from both lesion studies and brain activation studies in normal adults. In a problem-solving task, patients with left or right prefrontal lesions were shown a series of cards containing geometric figures and asked to work out the rule governing the location of the different figures. Patients with left lateral frontal lesions were impaired in abstracting the relevant rule, while patients with right lateral prefrontal lesions showed normal performance on this task (Reverberi et al., 2005). In a study of normal subjects, Rossi et al. (2001) used trans-cranial magnetic stimulation (TMS) to mimic the effects of cortical lesions. Subjects were asked to make recognition judgements for each of 96 magazine pictures, half of which they had been shown previously. Performance on this task is known to be determined by the effectiveness of strategies used at the time of encoding, and the ability to differentiate between old and new pictures at the time of retrieval. Consistent with the hypothesis that the left frontal cortex plays a crucial role in strategy production and the right frontal cortex is vital for checking and monitoring, the study found that performance was impaired if TMS was presented to the left frontal cortex at encoding or to the right frontal cortex at retrieval. Subjects made over 40% false positive responses when TMS was presented to the right frontal cortex at retrieval, suggesting that the criteria for recognition responses were excessively lax.

On the basis of the evidence available to date, a consistent picture is emerging which suggests a strong association between, on the one hand, positive emotions, internally driven behaviour and left frontal activation, and on the other, negative emotions, externally driven behaviour and right frontal activation. However, at present, studies tend to focus either on affect or on cognition, but future research will need to make more explicit links

between affective and cognitive neuroscience. They will also need to develop a more detailed understanding of the affective/cognitive processes in distinct regions of the prefrontal cortex (dorsolateral, ventromedial, orbitofrontal), as well as other brain areas.

### **Positive emotions and health**

It has been known for a long time that negative emotions are related to a higher prevalence and severity of disease, but how strong is the evidence for a link between positive emotions and health? And if there is a link, what might be the pathways from positive emotions to health – biological, cognitive, social? In this section, when we refer to positive and negative emotions, we generally mean enduring or long-term emotional states, which we can regard as trait-like affect or affective style, although some of the research also examines the effects of affective states.

There are many large scale correlational studies of the association between positive affect (questions about happiness or life satisfaction) and physical health status, but the latter is usually measured in terms of self-reported health rather than more objective measures of disease or functional ability. Although positive affect and self-reported health are highly positively correlated (eg Helliwell, 2003; Donovan & Halpern, 2002), these correlations may be spurious because there is evidence that people high in positive affect tend to under-report symptoms of illness (eg Cohen et al, 2003b). Cross-sectional studies in general do not provide a firm basis for concluding that positive emotions influence health, because we cannot establish the direction of causality; in particular, an observed relationship could be predominantly the result of physical health influencing affective state. For this reason, the most persuasive evidence comes from longitudinal studies which examine the influence of affective traits on subsequent health outcomes, or from experimental studies which investigate the effect of affective states on physiological functioning.

In a prospective longitudinal study of a large, representative British population sample, Huppert and Whittington (2003) found that the probability of survival over a 7-year interval was related to positive well-being (positive emotions and attitude) at baseline seven years earlier. Positive well-being was measured in terms of the number of positively worded items endorsed on the General Health Questionnaire (GHQ-30 of Goldberg, 1978), a widely used and well validated mental health questionnaire. This relationship held even when adjustments were made for sociodemographic factors, baseline physical health and lifestyle, and baseline measures of blood pressure and respiratory function. Interestingly,

scores on the negatively worded items were not strongly associated with subsequent survival. A similar separation between the effects of positive and negative mental states was reported by Ostir et al (2001) who were examining the predictors of stroke in an elderly population sample. Using the positively worded items of a depression screening scale (the CES-D), they found that lower positive scores at baseline were associated with a greater risk of stroke over the six-year follow-up, even when adjustments for other health-related conditions were made. The negatively worded items were not associated with the incidence of stroke, and controlling for scores on the negatively worded items did not reduce the association of positive well-being with stroke.

A related finding has been reported in the famous Nun Study (Danner et al., 2001). A group of ageing nuns had all written brief autobiographical sketches when they entered the convent (generally around age 20), and these sketches were recently found and categorised according to the number of positive statements they contained. It was reported that nuns in the lower half of the distribution of positive statements died on average 9 years sooner than those in the top category of positive statements. This finding is all the more remarkable because from their early twenties, the lives of the nuns were as close to identical 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.

It has been postulated that one of the physiological mediators underlying the relationship between positive affect and survival is the functioning of the immune system. For example, high levels or prolonged secretion of the stress hormone cortisol is damaging to immune function. Davidson and colleagues have shown that individuals with a positive affective style have a higher level of immune function than those with a negative affective style (Rosenkrantz et al., 2003). They have gone on to demonstrate that an intervention which increases positive emotions is associated with enhanced functioning of the immune system (Davidson et al., 2003). This intervention involved training volunteers in the techniques of mindfulness meditation, then giving them a 'flu vaccine and examining how strong an antibody response they mounted to the vaccine. Six months after vaccination, the meditation group had produced almost twice as many antibodies as the control group, providing strong support for the notion that positive emotional states can boost immune function.

Experimental studies have also confirmed that positive emotions can have a beneficial effect on physical health. For example, Cohen et al (2003b) assessed several hundred healthy volunteers for their tendency to experience positive and negative emotions, and subsequently gave them nasal drops containing a cold virus, and monitored them in quarantine for the development of a common cold. They found that the higher the level of positive emotional style, the lower the risk of developing a cold. Negative emotional style was not associated with colds, and the association of positive style and colds was independent of negative style.

Most experimental studies however, manipulate emotions rather than disease. For example, Fredrickson et al (2000) exposed volunteers to a stressful task (preparing to explain to a panel of judges “Why I am a good friend”), following a mood induction procedure. Measures of cardiovascular reactivity were made during the stressor and for a short time later. Cardiovascular measures such as heart rate and blood pressure did not differ significantly between the groups during this stressful task, but the subjects in the positive mood state showed a much more rapid recovery than those in a negative or neutral mood state. Prolonged reactivity to stress is known to be harmful, while a rapid recovery from stress is beneficial for health. A similar finding in a group of older adults has been reported by Levy et al (2000), showing high levels of cardiovascular reactivity to stress following exposure to negative age stereotypes, but reduced stress reactivity with positive age stereotypes,.

A recent, scholarly review of well designed prospective and experimental studies (Pressman & Cohen, In press) concludes 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 affect. However, this review also cites studies that show deleterious effects of positive emotions on physical health, which occur when the level of arousal is very high.

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 emotional states can have direct and usually beneficial effects on physiological, hormonal and immune function which in turn influence health outcomes. The magnitude and direction of these effects appears to be related to the level of affective arousal, such that very high levels of

happiness or excitement can produce physiological effects which are comparable to those produced by negative affect (see Pressman & Cohen, In press).

There is also evidence that positive emotions produce indirect effects on health through their effects on cognition and behaviour. For instance, in the study by Fredrickson et al. (2000) cited above, no differences in cardiovascular reactivity were reported during the stressful task although the positive emotion group recovered more rapidly. The authors do however report that there were differences in cognitive appraisal during the stressful task; all subjects felt stressed, but those in a positive mood also regarded it as an interesting challenge. This mood-related cognitive appraisal may have been the pathway through which positive affect led to faster recovery from stress.

Behavioural and social factors may also mediate the link between positive emotions and health. Happier people tend to have healthier lifestyles (Watson, 1988), and in the social realm, they tend to have 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 (eg social support) that are known to have major effects on health and life expectancy.

An important conclusion that arises from reviewing studies of positive emotion and health, is that there is a major gap in the research. While there is strong evidence for a relationship between positive emotions and the absence of disorder, or a reduced severity or duration of disorder, there appears to be a dearth of research on the relationship between positive emotions and good health. This is primarily because studies rarely attempt to measure positive health – being really well. For major advances in our understanding of positive emotions and their effects on health, we need to develop both survey measures and biological markers of good health. Measures of vitality are the closest thing we have at present to survey measures of good health, but it is not clear whether vitality is primarily a measure of physical health or of psychological health. On the biological side, it is not yet known whether there are any specific patterns of physiological, hormonal or immune responses that are characteristic of positive health rather than the absence of health problems, although it has been suggested that a particular diurnal pattern of secretion of the stress hormone cortisol (low on awakening, rapid but moderate rise in the morning, low in the evening) may prove to be a useful indicator of good health (Thorn et al., 2004).

## **Concluding remarks**

The positive psychology movement has been very effective in drawing the attention of the research community to the need to develop a better understanding of positive emotions, attitudes, appraisals and values (Keyes, 2002a; Linley & Joseph, 2004; Seligman, 2002; Snyder & Lopez, 2001). However, within the domain of emotions, care must be taken to recognise that positive emotions are not always beneficial and that negative emotions are not always detrimental, and hence to pursue a 'diagonal psychology' (Nesse, 2004, In press).

More broadly, when examining the relationship between positive emotions and cognition, there is a need to establish whether specific positive emotions are associated with different forms of information processing, in the same way that different negative emotions are associated with different socio-cognitive processes and behaviours (Clore & Storbeck, this volume). In her elegant studies using induced mood techniques, Fredrickson routinely compares high and low arousal positive moods (joy, contentment) with high and low arousal negative moods (anger, sadness) and a neutral condition, but to date there are no reports of differential effects on cognitive processing of the different types of positive moods. In future studies of behaviour, health and affective neuroscience, there is a case for paying more attention to possible differences in the role of energetic positive emotions such as happiness and joy, compared with low energy positive emotions such as tranquillity, relaxation and contentment.

In relation to effects on physical health, it is difficult at present to make direct links between the cognitive effects of emotions and their health effects. However, the evidence for differences in underlying neurological activation for positive and negative emotions, and the information processing styles associated with them, may provide a mechanism for understanding the differential effects of positive and negative emotions on physical health. This is an area which is ripe for further investigation.

Most researchers and practitioners of positive psychology tend to take an individualistic approach, focusing on those attributes of an individual that are related to their subjective well-being ( happiness, optimism, competence, self-realisation). However, it is clear that the way in which an individual relates to others and to their society is a key component in

their subjective well-being, and should accordingly play a larger role in mainstream positive psychology. This has been explicitly stated by Keyes (2002). While the value of social connectedness and social support for physical and mental well-being has been known for a long time, further research is needed on the relative contribution of individual versus inter-personal characteristics to subjective well-being.

The crucial role that personal relationships and social networks play in establishing and maintaining a sense of well-being may be linked to an evolutionary perspective, pointing to the importance of sociability and acceptance in survival and reproduction. It has been suggested that the dominant focus of modern consumer societies on the fulfilment of individual needs and desires is at odds with the basic human need for a sense of belonging. Indeed, it could be argued that much consumption in modern industrialised societies is driven precisely by unsatisfied belongingness and identity needs, as more and more products are marketed not in terms of their real utility values, but in terms of their symbolic identity values. This is of course a futile enterprise, since material consumption ultimately cannot satisfy these deep-seated social needs, and this may account for the absence of increased well-being despite ever-increasing materialism and consumption.

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**Fig. 1** The concept of ‘diagonal psychology’ (Nesse 2004, In press), that is, the idea that we need to consider the benefits of negative affect and the costs of positive affect (shaded boxes) as well as the more commonly studied benefits of positive affect and costs of negative affect.

	<b>Benefits</b>	<b>Costs</b>
<b>Positive affect</b>	✓	?
<b>Negative affect</b>	?	✓