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Upward spirals of positive emotions counter downward spirals of negativity: Insights from the broaden-and-build theory and affective neuroscience on the treatment of emotion dysfunctions and deficits in psychopathology

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ABSTRACT

This review integrates Fredrickson's broaden-and-build theory of positive emotions with advances in affective neuroscience regarding plasticity in the neural circuitry of emotions to inform the treatment of emotion deficits within psychopathology. We first present a body of research showing that positive emotions broaden cognition and behavioral repertoires, and in so doing, build durable biopsychosocial resources that support coping and flourishing mental health. Next, by explicating the processes through which momentary experiences of emotions may accrue into self-perpetuating emotional systems, the current review proposes an underlying architecture of state-trait interactions that engenders lasting affective dispositions. This theoretical framework is then used to elucidate the cognitive–emotional mechanisms underpinning three disorders of affect regulation: depression, anxiety, and schizophrenia. In turn, two mind training interventions, mindfulness and loving-kindness meditation, are highlighted as means of generating positive emotions that may counter the negative affective processes implicated in these disorders. We conclude with the proposition that positive emotions may exert a countervailing force on the dysphoric, fearful, or anhedonic states characteristic of psychopathologies typified by emotional dysfunctions.

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Human experience is dynamic as individuals continually adjust their behavior to the demands of day-to-day living. This need to adapt to changing and challenging circumstances is inevitable, a constant fact of life, out of which emotions arise (Lazarus, 1991). Emotions are a subset of affective phenomena (other subsets are moods, attitudes, and affective traits) distinguished as brief, multi-component response systems initiated by those changes in current circumstances that are appraised, either consciously or unconsciously, to be personally significant ("good for me" or "bad for me"). The loosely-coupled component systems of emotions include cascades of changes in

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subjective feeling states, physiological responses in both the brain and body, expressions evident on the face and in posture, as well as thought–action repertoires. These coordinated and cascading response tendencies are preserved in modern-day humans having been sculpted over millennia by natural selection to support efficient and appropriate responses to ancestrally recurrent opportunities (e.g., the kindness of others) and threats (e.g., the disdain of others). Various forms of perceived opportunity give rise to distinct positive emotions (e.g., joy, interest, contentment/serenity), whereas various forms of perceived threat give rise to distinct negative emotions (e.g., sadness, fear, anger). Although all emotions serve adaptive functions under certain circumstances, negative emotions, in particular, can become a source of dysfunction. To illustrate, the negative emotions of anger and fear each involve neural, cardiovascular, endocrine, and muscular changes, alongside changes in thought and action tendencies patterned from primitive urges to fight or flee. Such negative emotions also often co-occur with dysfunctional social interactions, which can perpetuate psychophysiological reactivity and trigger destructive behavior toward self and others. Conversely, positive emotions such as joy, amusement, hope, and awe – themselves multicomponent response systems – can serve as a bulwark against the stress of life; if cultivated intentionally, in contextually-appropriate ways, positive emotions can buffer against and undo the deleterious effects of stressful adaptational encounters and reduce the impact of future distress. Indeed, new scientific research on neuroplasticity suggests that positive emotional states may trigger lasting, durable changes in the structure and function of the brain (for a review, see Garland & Howard, 2009) which instantiate and promote further adaptive thoughts and behaviors.

The aim of this paper is to outline Fredrickson's broaden-and-build theory of positive emotions (Fredrickson, 1998, 2003; Fredrickson, 2009), and describe how core principles derived from this theory might be translated and applied to counter the pathogenic processes involved in certain clinical disorders. To this end, we review evidence that supports the broaden-and-build theory, drawing on data from both laboratory and intervention studies conducted with behavioral and neuroscientific methods. This theoretical overlay then frames a discussion of the dynamics of emotions and the interactions between transient emotional states and the development of enduring affective traits or styles; we speculate that affective plasticity, i.e., experience-dependent change in the neural circuitry of emotions, may be centrally important in understanding the causes of psychopathology as well as its remediation. In turn, we examine specific cognitive–emotional mechanisms implicated in three major clinical disorders that involve disturbances of affect – depression, anxiety, and schizophrenia – to illustrate possible targets for positive emotion-based therapies. Lastly, we touch on several interventions that cultivate positive emotions, and in so doing, may counter pathological emotion deficits and their consequences.

1. The broaden-and-build theory of positive emotions

Negative emotions have long been held to narrow the scope of people's attention and thinking and convincing empirical evidence for such constriction is mounting (Schmitz, De Rosa, & Anderson, 2009; Talarico, LaBar, & Rubin, 2004). To the extent that the narrowed cognition triggered by negative emotions supports the enactment of the specific action urges (e.g., fight, flight, spit), it is often taken as an evolved adaptation that aided the survival of human ancestors in circumstances that threatened life, limb, or social safety (Frijda, 1988). The broaden-and-build theory takes a complementary position and holds that positive emotions broaden individuals' thought–action repertoires, enabling them to draw flexibly on higher-level connections and wider-than-usual ranges of percepts, ideas, and action urges; broadened cognition in turn creates behavioral flexibility that over time builds personal resources, such as mindfulness, resilience, social closeness, and even physical health (Cohn, Fredrickson, Brown, Mikels, & Conway, 2009; Fredrickson, Cohn, Coffey, Pek, & Finkel, 2008; Waugh & Fredrickson, 2006). The incremental accrual of such cognitive, psychological, social and physical resources via positive emotions is theorized to have provided human ancestors with an evolutionary advantage by increasing their subsequent chances of survival. Importantly, unlike the transient nature of positive emotions, these resources are durable. Notably, the broaden-and-build theory unites hedonic well-being, or the experience of pleasurable emotions, with eudaemonic well-being, defined as the striving toward one's potential and purpose in life, which is facilitated by the accumulation of psychosocial resources (Kashdan, Biswas-Diener, & King, 2008) Thus, according to the theory and data, pleasurable positive emotions, although fleeting, can have a long-lasting impact on functional outcomes, leading to enhanced well-being and social connectedness. Put simply, positive emotions expand people's mindsets in ways that little-by-little reshape who they are.

A dozen years after its introduction, the broaden-and-build theory now rests on a strong empirical foundation constructed across multiple laboratories. For instance, experimentally induced positive emotions – relative to induced neutral and negative states – broaden the scope of people's visual attention, an effect shown through behavioral tests (Fredrickson & Branigan, 2005; Rowe, Hirsh, & Anderson, 2007), eye-tracking (Wadlinger & Isaacowitz, 2006) and now brain-imaging (Schmitz et al., 2009; Soto et al., 2009). Induced positive emotions also expand people's repertoires of desired actions (Fredrickson & Branigan, 2005), their creativity, (Rowe et al., 2007; Isen, Daubman, & Nowicki, 1987), and their openness to new experiences (Kahn & Isen, 1993), and critical feedback (Raghunathan & Trope, 2002). At the interpersonal level, induced positive emotions increase people's sense of “oneness” with close others (Waugh & Fredrickson, 2006), their trust in acquaintances (Dunn & Schweitzer, 2005), and their ability to recognize individuals of another race (Johnson & Fredrickson, 2005). The empirical evidence is mounting, then, that experienced positive emotions broaden people's attention and thinking in both personal and interpersonal domains.

A variety of prospective, correlational studies provide evidence consistent with the proposition that positive emotions, over time, build durable personal resources (Cohn et al., 2009; Fredrickson, Tugade, Waugh, & Larkin, 2003; Gable, Gonzaga, & Strachman, 2006; Stein, Folkman, Trabasso, & Richards, 1997; Waugh & Fredrickson, 2006). Even so, more conclusive evidence comes from a recent randomized controlled trial (Fredrickson et al., 2008) of an intervention selected to increase people's daily diet of positive emotions over the span of months, namely, loving-kindness meditation (LKM; described in more detail in a later section). This longitudinal field experiment, conducted with midlife working adults, demonstrated that, relative to a monitoring, wait-list control group, those randomly assigned to the 7-week LKM workshop over time reported increases in nine distinct positive emotions (amusement, awe, contentment, gratitude, hope, interest, joy, love, and pride). Remarkably, they also showed a threefold increase over the study period in the dose–response relationship between time spent meditating and its positive emotion yield, an effect that runs counter to the prediction of hedonic adaptation (Diener, Lucas, & Scollon, 2006). The observed increases in positive emotions persisted even on days on which study participants did not meditate, suggesting enduring gains in trait positive affect. These upward shifts in positive emotions in turn produced increases in a wide range of personal resources – including mindfulness, environmental mastery, positive relations with others, and reduced illness symptoms – gains which in turn produced increases in life satisfaction alongside reductions in depressive symptoms (Fredrickson et al., 2008). The various benefits of learning LKM were still evident at one-year follow-up (Cohn & Fredrickson, submitted for publication).

Uniting the broaden-and-build theory with a systems approach to understanding complex emotion-related dynamics, Fredrickson and Losada (2005) suggest that the affective texture of a person's life – and

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their well-being more generally – can be represented by their positivity ratio, defined as the ratio of their positive to negative emotions experienced over time. Two lawful asymmetries between positive and negative emotions dictate that positivity ratios characteristic of optimal human functioning will surpass 1-to-1. First, *positivity offset* reflects that the modal human experience is a mild positive affect (Cacioppo, Gardner, & Berntson, 1999; Diener & Diener, 1996), and indeed, normal functioning has been characterized by positivity ratios of about 2-to-1 (Fredrickson & Losada, 2005; Schwartz et al., 2002). Second, *negativity bias*, often summed up as "bad is stronger than good" (Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001; Rozin & Royzman, 2001), implies that to overcome the sheer potency of negative emotions, positive emotions would need to outnumber them, perhaps by ratios appreciably higher than a typical positivity offset. Consistent with these well-documented asymmetries, Losada's (1999; Losada & Heaphy, 2004) nonlinear dynamic model of the broaden-and-build theory identifies 3-to-1 as the tipping point ratio, above which optimal functioning first emerges (for compatible views on positivity ratios, see Gottman, 1994; Larsen & Prizmic, 2008; Schwartz, 1997). Fredrickson & Losada (2005) tested and supported this hypothesized 3-to-1 ratio by comparing the positivity ratios of those classified as in flourishing mental health or not (Keyes, 2002). They suggest that above the 3-to-1 ratio, people experience the broaden-and-build effects of positive emotions in doses sufficient to spark flourishing dynamics, characterized by goodness, generativity, growth, and resilience. Below this ratio, people are thought to experience positive emotions in rates too low to support such optimal functioning, and may instead show emotional distress, social impairment, or the lack of fulfillment that Keyes (2002) calls languishing.

Inherent within the concept of positivity ratios is the principle that positive emotions counteract negative emotions. Whereas negative emotions prepare the body and mind for specific actions (e.g., fight, flight), positive emotions appear to dismantle or "undo" such preparation, an effect presumably linked to the broadened thought–action repertoires that accompany positive emotions. Fredrickson and colleagues have tested this "undo effect" of positive emotions in a series of laboratory experiments that first induced a negative emotion in all participants, and then randomly assigned subsets of participants to experience positive, neutral, or negative emotions immediately thereafter. Continuous measures of cardiovascular reactivity revealed that mild positive emotions – both amusement and contentment – can speed cardiovascular recovery from anxiety and fear (Fredrickson & Levenson, 1998; Fredrickson, Mancuso, Branigan, & Tugade, 2000).

Subsequent work identified the ability to self-generate positive emotions in the face of adversity as a key active ingredient within resilient coping. When faced with a stressor, people who score high on ego-resilience (Block & Kremen, 1996) experience more positive emotions than do their less resilient peers, even though the two groups experience negative emotions at comparable levels. This difference in positive emotions accounts for resilient people's greater ability to rebound from both adversity and cardiovascular reactivity, ward off depressive symptoms, and continue to grow (Fredrickson et al., 2003; Ong, Bergeman, Bisconti, & Wallace, 2006; Tugade & Fredrickson, 2004). Perhaps reflecting this greater ability to self-generate positive emotions, recent brain-imaging and behavioral studies show that when anticipating threats, people who score high on ego-resilience are more likely to maintain their focus on the present moment and worry less about future negative contingencies, differences that again predict faster recovery in self-reported affect and activity in brain areas known to reflect emotionality (i.e., the anterior insula; Waugh, Fredrickson, & Taylor, 2008; Waugh, Wager, Fredrickson, Noll & Taylor, 2008). Providing initial cause for intervention, a key laboratory experiment showed that when people who score low on ego-resilience are coached to positively reappraise a stressful situation as a challenge to be met and overcome, they too show faster cardiovascular recovery (Tugade & Fredrickson, 2004). This empirical evidence that positive emotions fuel resilience lays the groundwork for our proposal that learning to self-generate positive emotions may also benefit persons with disorders of affect regulation.

2. Emotional systems as spirals

The picture emerging from contemporary affective science portrays emotions as self-perpetuating emergent systems energized by reciprocal causal links between the cognitive, behavioral, and somatic mechanisms through which emotions are instantiated. Emotions can thus be seen as self-organizing systems that operate to maximize and maintain their own organization. For instance, sadness stemming from loss tends to co-occur with rumination on that loss coupled with behavioral withdrawal and fatigue, and these components can interact dynamically to produce subsequent sad feelings, leading to further rumination, withdrawal, and fatigue. Sadness can become further entrenched by spawning emotion-consistent appraisal tendencies to interpret new experiences in terms of loss and lack of control, a cognitive bias that may ultimately produce lasting negative beliefs about self and world. In turn, such negative beliefs, coupled with repeated experiences of sadness and isolation, create an ever-tightening gyre fueled by narrowed, socially isolating thought–action tendencies. In time, this dynamic process can lead to depression among susceptible individuals. As this cycle spirals further and further downward it can become self-destructive, leading to the loss of relationships, the relinquishing of commitments, and even desperate suicidal acts, a pattern all too familiar to clinicians who treat persons with emotional disorders.

For the purposes of this paper, we refer to such emotion-related dynamics as *downward spirals* to acknowledge the self-perpetuating and damaging cycles that can be triggered by negative emotions. Positive emotions also trigger self-perpetuating cycles, yet because they lead to optimal functioning and enhanced social openness, we refer to them as *upward spirals*. Prospective correlational research indicates that initial positive emotional experiences predict future positive emotional experiences, in part by broadening cognition, positive coping repertoires and increasing interpersonal trust (Burns et al., 2008; Fredrickson & Joiner, 2002). Thus, as positive emotions expand people's mindsets, behavioral repertoires, and social openness, these effects in turn may reciprocate in increased positive emotions, as one increasingly attends to opportunities to engage in pleasurable events and encounters. Note that upward and downward spirals are not mirror opposites that simply trade negative content for positive content. Rather, consequential structural differences set them apart. Whereas downward spirals lead to narrowed self-focus and rigid or stereotyped defensive behavior, upward spirals lead to increased openness to others and novel or spontaneous exploratory activity. In effect, upward spirals are more open, permeable, flexible and social than downward spirals. By engendering exposure to positive experiences (social and otherwise), positive emotions tend to accrete over time leading to more frequent positive emotions in the future. In so doing, positivity may develop a "life of its own." We propose that upward spirals of positive emotions may be keys to fostering resilience (Fredrickson et al., 2003; Tugade & Fredrickson, 2004) and countering the deleterious effects of the chronic negative moods observed among some persons with clinical disorders.

As we refer to upward and downward spirals for the remainder of this paper, we acknowledge that these concepts have parallels in other disciplines. Given our intent to integrate a broad array of knowledge from literatures that have developed in relative isolation from one another, we use the terms upward and downward spiral as a shorthand to refer to self-perpetuating, self-maximizing systems. In the field of cybernetics, this concept is known as a positive feedback loop, where the output of a circuit feeds back to become its own input in perpetuity or until dissolution of the system (Bateson, 1972).

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Among some physiologists, this concept is known as allostasis, or stability through change (McEwen & Wingfield, 2003; Sterling & Eyer, 1988), where biological adaptations to the environment result in a deviation of self-regulatory mechanisms from their normal mode of operation, a "resetting of the bias" that leads to increased sensitization to environmental stimuli and further adaptation. Spiral processes may also be reflected in the cognitive psychological concept of the schema, an automatized, associative network that encodes information in a self-reinforcing manner such that novel data incongruent with the extant schema are ignored or assimilated, leading to its further entrenchment (Lerner & Keltner, 2000). The commonality across these disparate concepts is the notion of multivariate processes whose components dynamically interact to produce and preserve their internal coherence. Out of these dynamic processes arise the emergent phenomenon of the system itself. Such self-organizing systems only change their structural configurations as a result of perturbation from an outside source. It is our contention that positive emotional experiences may provide this source with which to perturb a downward spiral and potentially tip the affective balance towards a self-sustaining positivity.

3. State-trait interactions drive affective plasticity

A core principle of the broaden-and-build theory is that repeated instances of positive emotions accrue into upward spirals of sustained well-being. This core principle parallels recent findings in affective neuroscience related to experience-dependent plasticity in the neural circuitry of emotions. This convergence between behavioral and brain sciences suggests that relationships predicted by the broaden-and-build theory may manifest on multiple and interpenetrating levels of analysis. We speculate that upward spirals may be partially mediated by affective plasticity in the brain. The discussion of affective plasticity that follows provides further rationale for harnessing positive emotion processes to promote change among persons struggling with emotion-related disorders.

Although the brains of infants and children are known to be plastic, undergoing massive spurts of neuronal development in response to stimulus exposure during critical periods (Mundkur, 2005), neuronal connections in the adult brain are also malleable to experience (e.g., Turlejski & Djavadian, 2002). Such plasticity may involve a whole host of structural changes to the brain, including changes in the strength of synaptic connections and the proliferation and arborization of neurons, which have been documented in the brains of adults exposed to a variety of enriching learning experiences. Neuroplastic changes have been shown to result from a diverse range of physical and mental forms of training, including practicing the violin (Elbert, Pantev, Wienbruch, Rockstroh, & Taub, 1995), juggling (Draganski et al., 2004), imaginary rehearsals of piano playing (Pascual-Leone, Amedi, Fregni, & Merabet, 2005), and memorizing taxicab routes (Maguire et al., 2000). Across these varied activities, a commonality can be gleaned: recurrent practice of novel responses and repeated experiences that "stretch" one beyond his or her previously established limits are associated with the development of potentiated synaptic connections and new neural growth.

The burgeoning field of affective neuroscience has located experience-dependent plasticity in the emotional circuitry of the brain (Davidson, Jackson, & Kalin, 2000). Plasticity resulting from exposure to emotionally enriching experiences or stressful environments may explain, in part, the variation in affective styles between and within individuals. Indeed, there are significant individual differences in affective chronometry, i.e., the speed at which individuals react to and recover from emotionally distressing experiences (e.g., Hemenover, 2003; Tong et al., 2009), as well as in magnitude of emotional reactivity. Inter-individual variation in affective responding is correlated with degree of prefrontal cortex (PFC) asymmetry, such that persons who evidence greater left PFC activation are more emotionally resilient relative to persons in whom right PFC activity predominates (Davidson, 1992, 1998, 2004a, 2004b). While these affective differences across individuals appear to follow somewhat stable trajectories over the life course, they can also be subject to change (Davidson, 2000, 2002; Fredrickson et al., 2008). Changes in affective style may occur when frequent and repeated invocation of emotional states leads to longer-lasting moods or emotional traits (Davidson, 2004a). Presumably, these affective changes parallel alterations in brain function, and we speculate that when such alterations in affective style and neural activity persist over time, they may be undergirded by neuroplasticity.

Indeed, brain changes underlie the learning of maladaptive cognitive, emotional, and behavioral responses. Affective plasticity in the neurodevelopment of mood and anxiety disorders has been shown empirically (Carlson, Singh, Zarate, Drevets, & Manji, 2006). For example, stress-induced plasticity in the amygdala may undergird the pathogenic transition from normatively vigilant states to chronic and pervasive anxiety disorders (Rainnie et al., 2004; Shekhar, Truitt, Rainnie, & Sajdyk, 2005). From this perspective, repeated exposure to aversive stimuli causes chronic excitation of neurons connecting the PFC and the amygdala, which may lead to long-term potentiation of this neural circuitry. Regions of the PFC appear to provide top–down governance of the amygdala during stress appraisal. Indeed, a large corpus of research has identified this PFC–amygdala circuit as crucial to emotion regulation (for reviews see Davidson, Putnam, & Larson, 2000; Ochsner & Gross, 2005); indeed, it may be the substrate through which cognitive control of emotional experience occurs. Stress-induced neuroplastic changes in the PFC–amygdala circuit may reduce the tonic inhibition of the system (McEwen, 2003) such that previously nonthreatening stimuli come to elicit pathological anxiety reactions involving fear, neurohormonal cascades, and autonomic activation, in time producing further sensitization, in other words, a downward spiral.

During the downward spiral of stress sensitization, repetitive exposure to a stimulus (e.g., rejection from a peer) can come to elicit progressively more intense emotional and behavioral responses. Initially, psychosocial stressors may not evoke a major mood disorder episode. Instead stressors may progressively and covertly lower affective thresholds such that recurrence will eventually precipitate a full-blown episode (Post, 2007). Over time, repeated engagement of negative mood states may lead to a trait vulnerability to future relapse (undergirded by long-term, neuroplastic changes), as well as the seemingly spontaneous occurrence of dysphoric affective episodes without obvious stress triggers (Post, 2007). Clinical evidence for this phenomenon derives from large case registries of persons hospitalized for depressive or manic episodes, which show that the number of prior episodes predicts vulnerability to subsequent relapse (Kessing, Andersen, & Mortensen, 1998), and that although stressful life events are substantial risk factors for onset of major depressive disorder, with each repeated episode, the relationship between depression onset and stress precipitants is attenuated (Kendler, Thornton, & Gardner, 2000). Thus, when stress precipitates repeated episodes of dysregulated mood, negative affective states may begin to acquire a "life of their own" and accrue into self-perpetuating, downward emotional spirals.

If stress-precipitated negative emotions can contribute to recurring clinical mood disorders underpinned by neuroplastic changes in affective brain circuitry, might repeated positive emotions reverse this effect, resulting in upward spirals of progressively greater resilience to adversity? Indeed, this is a central tenet of the broaden-and-build theory: "The short-term cognitive and attentional effects of positive emotions are what lead to gradual, long-term growth" (Cohn et al., 2009). We speculate that evidence for the "build effect" of positive emotions – the finding that increasing people's daily experience of positive emotions augments their personal resources (Fredrickson et al., 2008) – may be mediated by neuroplastic changes to brain

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structure stemming from recurrent positive emotions. In much the same way that novel sensory experiences and learning new behaviors triggers neuronal growth in the brain (Draganski et al., 2004; Elbert et al., 1995; Jenkins, Merzenich, Ochs, Allard, & Guic-Robles, 1990; Nudo, Milliken, Jenkins, & Merzenich, 1996; Pascual-Leone et al., 2005), long-term potentiation of synaptic connections, arborization of neurons, or even neurogenesis might result from the neurochemical cascades triggered by positive emotions.

Evidence from lesion studies and experimental manipulation of dopamine levels suggests that the broadening effects of positive emotions on cognition and behavior may be partly mediated by dopamine release in the nucleus accumbens, striatum, and various cortical and limbic regions (for a review, see Mitchell & Phillips, 2007). These same brain regions are targeted by drugs that induce pleasant hedonic states via dopamingeric effects (e.g., cocaine and morphine), and chronic administration of such drugs can lead to neuroplastic changes to brain reward circuits, a downward spiral that decreases sensitivity to natural rewards and narrows behavioral repertoires to focus on the acquisition and use of drugs (Koob & LeMoal, 2005). Could repeated experiences of positive emotions have an opposite, upward spiral effect, increasing sensitivity to natural rewards and broadening cognitive–behavioral repertoires via beneficial neuroplastic changes to corresponding brain systems? To be clear, this supposition is purely speculative and is intended to stimulate future research. There is, however, initial empirical support for the speculation that repeated experiences of positive emotions may stimulate durable neurobiological changes.

A series of studies of maternal care in rats (Francis, Champagne, Liu, & Meaney, 1999; Liu et al., 1997) provided initial evidence that positively-valenced social learning experiences could lead to plasticity in the neural circuitry of emotion. This experimental research showed that nurturance and attachment behaviors expressed by rat mothers to their pups led to changes in hippocampal, amygdalar, and hypothalamic stress hormone receptors observed within their adult offspring. In turn, these experience-dependent neural changes among nurtured rat pups led to the genesis of new synaptic connections in the hippocampus (Liu, Diorio, Day, Francis, & Meaney, 2000). These novel findings paved the way for the study of positive emotion-induced neuroplasticity within the human brain.

To our knowledge, although there are no direct findings of positive emotion-induced changes in human brain structure, evidence is mounting that mental techniques intended to alter emotional experience can result in *sustained* changes in brain function. A number of trials of cognitive–behavior therapy and interpersonal therapy have revealed pre–post intervention changes in brain function in an array of cortical and sub-cortical regions (for a review see Frewen, Dozois, & Lanius, 2008). Mind training through meditation also appears to result in lasting changes in neural activity. Compared to a wait-list control group, individuals randomized to a mindfulness meditation intervention exhibited significantly greater left PFC activation in resting baseline brain activity and in response to a negative emotion induction procedure up to four months after the training period had ended (Davidson et al., 2003). Given the aforementioned evidence for the association between left PFC activation and dispositional positive affect, it appears as if repeated engagement of meditative states of mind can result in trait-level changes in brain activity that may instantiate positive affective style and more adaptive responding to negative or stressful events.

Similarly, a study by Lutz, Greischar, Rawlings, Ricard, and Davidson (2004) found marked alterations in resting baseline neural synchronization associated with long-term training in Buddhist loving-kindness meditation, a practice thought by some practitioners to promote a state of unconditional compassion and benevolence. The synchronization of brain activity found in some of the practitioners sampled, whose experience ranged between 10,000 and 50,000 h spent in meditation, was higher than any previously reported in the literature. Such increased neural synchrony was observed not only during the meditative state, but also when the practitioners were not meditating, suggesting that long-term evocation of positive emotions may induce lasting, trait-level changes in brain function possibly undergirded by neuroplasticity. Other suggestive evidence that mental training can result in durable neurobiological changes comes from a study of mindfulness meditation practitioners, who, relative to controls, evidenced significant improvements in attentional performance correlated with alterations in brain activity that were maintained 3 months after the end of formal meditation practice (Slagter et al., 2007a).

Although the work of Slagter et al. and Lutz et al. provide tentative support for the notion that meditation can lead to durable changes in brain function, neither study examined structural brain changes per se. However, structural MRI investigations comparing the brains of experienced meditators to control participants matched in sex, age, race, and years of education have found that years of meditation experience correlated with increased cortical thickness in brain areas where visceral attention (e.g. right anterior insula), self-awareness (e.g. left superior temporal gyrus), and regulation of emotional responding (e.g., orbito-frontal cortex and hippocampus) have been localized (Holzel et al., 2008; Lazar et al., 2005; Luders, Toga, Lepore, & Gaser, 2009). These empirical investigations suggest that the intentional induction of positively-valenced states of mind may stimulate structural alterations in brain areas that appear to instantiate positive emotions and emotional stability. The use of cross sectional designs, however, necessarily limits the possibility of causal inference. In other words, it remains plausible that these findings reflect pre-existing individual differences among those who self-select to engage in long-term meditation practices.

This limitation may be offset by three recent longitudinal studies that offer stronger evidence for neuroplasticity resulting from the intentional induction of positive mental states. A recent study of cognitive–behavioral therapy for women with chronic fatigue syndrome found increases in gray matter of the lateral prefrontal cortex after 16 sessions of cognitive–behavior therapy (CBT; de Lange et al., 2008). Similarly, among a sample of patients receiving interpersonal psychotherapy for the treatment of depression, those who exhibited a successful treatment response had significantly larger increases in a cellular biomarker of neuroplasticity, pCREB, compared to treatment nonresponders (Koch et al., 2009). Lastly, participants in a mindfulness-based stress reduction course who were highly stressed at baseline exhibited significant reductions in amygdala volume that correlated with decreases in perceived stress after eight weeks of meditation training (Hölzel et al., in press). Thus, evidence is building to support the notion that interventions that may tip people's affective balance in favor of positive emotions appear to stimulate neuroplasticity. Just as the pathogenesis of depression and anxiety appears to involve stress-induced alterations in fronto-limbic neuroplasticity (Calabrese, Molteni, Racagni, & Riva, 2009; Hercher, Turecki, & Mechawar, 2009; Holmes & Wellman, 2009), the remediation of such emotional disorders may be undergirded by changes within the neural circuitry of emotions.

Affective plasticity prompted by repeated experiences of positive emotions may exert durable, downstream facilitation of stress coping. A previously described, positive emotions speed cardiovascular recovery following negative emotional arousal (Fredrickson & Levenson, 1998), a cardiovascular "undo effect" more evident among resilient than non-resilient people (Tugade & Fredrickson, 2004). We speculate that positive emotion-induced cardiovascular adaptation may be regulated by cortical structures via parasympathetic influences of the vagus nerve on the heart, an inference drawn from experimental evidence that emotion regulation tasks alter regional cerebral blood flow (rCBF) in the PFC which correlates with vagally-mediated high-frequency heart rate variability (HF-HRV) (Lane et al., 2009). Other research has shown that biopsychosocial

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interventions associated with increased subjective well-being can lead to improvements in vagal regulation over time (Carney et al., 2000; Chang et al., 2008; Garakani et al., 2009; Garland, Gaylord, Boettiger, & Howard, in press; Kok et al., submitted for publication; Tang et al., 2009; Wu & Lo, 2008). For example, in a controlled trial participants randomized to a meditation training intervention exhibited increases in HF-HRV correlated with increased electroencephalographic activity in frontal midline brain structures after five days of training relative to persons randomly assigned to five days of relaxation training (Tang et al., 2009). After the training period, compared with those in the relaxation condition, participants in the meditation group also exhibited larger increases in rCBF in the anterior cingulate cortex (ACC), a cortical structure implication in autonomic regulation of cardiac activity (Critchley, 2009), and larger rCBF increases in the caudate, a brain region involved in dopaminergically-mediated reward, positive mood, and feelings of love (Aron et al., 2005). In light of recent between-group findings of apparent plasticity in brainstem structures that regulate cardiorespiratory function resulting from long-term practice of mindfulness meditation (Vestergaard-Poulsen et al., 2009), it appears that the induction of positively-valenced states of mind may alter neural structures that regulate the stress response. Such experience-dependent enhancements in autonomic nervous system responses to stress might plausibly be mediated by neuroplastic changes in PFC–amygdalar circuitry as well.

Although preliminary evidence is building, our proposition that recurrent positive emotions induce neuroplasticity remains speculative at present. Nevertheless, affective neuroscience lends support to the body of behavioral research indicating that episodes of positive emotions can be leveraged into upward spirals. In so doing, repeated induction of positive emotional states may gradually shift negative affective styles and potentially lead to the development of lasting positive dispositional traits.

4. Positive emotions may counter mechanisms of emotion-related disorders

If positive emotions broaden-and-build, undergirded by affective plasticity, then intentionally self-generating positive emotions may over time counter the entrenched cognitive–emotional mechanisms that underpin emotion-related disorders. We illustrate the potentially ameliorative effects of positive affective states on psychopathology through two prevalent clusters of clinical disorders, first depression and anxiety, and second, schizophrenia.

4.1. Depression and anxiety

Depression is an extraordinarily prevalent disorder, affecting one in five people in the United States (Kessler et al., 2005). Moreover, depression and anxiety co-occur in as many as 85 to 90% of cases of unipolar depressive episodes (Gorman, 1996). This degree of overlap may well reflect a common psychopathological endophenotype (Kendler, Neale, Kessler, Heath, & Eaves, 1992; Leonardo & Hen, 2006; Roy, Neale, Pedersen, Mathe, & Kendler, 1995), possibly subserved by the biased cognitive processing of emotionally-salient information indicative of downward spirals (Mineka, Rafaeli, & Yovel, 2002).

Depression is theorized to occur, at least in some cases, in response to a sense of hopelessness and helplessness following an event appraised as a significant loss (Lazarus, 1999) or failure (Nesse, 2000). Behaviorally, depression is marked by withdrawal and passivity (Abramson, Seligman, & Teasdale, 1978) and the impaired ability to initiate defensive actions. Cognitively, it is marked by self-denigration and pessimism as well as erroneous judgments, conclusions, and beliefs (Nelson, 1977). Affectively, depression may be marked either by emotional lability, as people cycle through periods of sadness, anxiety, anger, guilt or shame in the wake of their loss or failure, or by anhedonia, a decrease in the experience of pleasure. Physiologically, depression is known to disrupt neuroendocrine function (Plotsky, Owens, & Nemeroff, 1998). These various attributes of depression mutually reinforce one another through the damaging and self-perpetuating processes of downward spirals (Segal, Williams, Teasdale, & Gemar, 1996; Teasdale & Dent, 1987; Williams, Healy, Teasdale, White, & Paykel, 1990).

Similarly, anxiety is linked to perseverative cognition, a maladaptive process of maintaining a cognitive representation of the stressor in the absence of implementing adaptive coping behaviors (Brosschot, Gerin, & Thayer, 2006). Such perseveration may involve activation of working memory circuits including the prefrontal cortex, hippocampus, and extended amygdala, whereby computations about present environmental stimulus contingencies are colored by past aversively conditioned relations stored in explicit memory systems (LeDoux, 2002). PFC–amygdala circuitry may become impaired during psychopathological anxiety states, leading to amplified threat perception (Rauch, Shin, & Wright, 2003). Perseverative cognitive styles such as catastrophizing or rumination can also trigger downward spirals that exacerbate physiological and subjective experiences of anxiety. This process may undergird the physiological arousal and free-floating, psychological tension characteristic of generalized anxiety disorder. Protracted activation of this pathway can disrupt homeostasis of body systems through chronic cortisol- and catecholamine-mediated stress-responses (Thayer & Brosschot, 2005), which sensitize the individual to future stressors via allostatic mechanisms (McEwen, 2001, 2003, 2007).

Effects of the trait-like sensitization produced by downward spiral processes (depicted in Fig. 1) within individuals with depression and/or anxiety disorders is evidenced by their cognitive biases towards negatively-valenced stimuli and memories, through which they more rapidly detect, recall, and elaborate mood-congruent material over mood-incongruent or neutral material (Mathews & MacLeod, 2005; Mineka et al., 2002). Depressed or anxious individuals may thus be biased toward cognitive processing of objects, persons, and events that they construe as disappointing, upsetting, or frightening, while neglecting what is beautiful, affirming, or pleasurable. While anxious individuals tend to attend to negative information (e.g., MacLeod et al., 1986) depressed individuals tend to remember more negative than positive self-relevant information (Teasdale & Dent, 1987) and

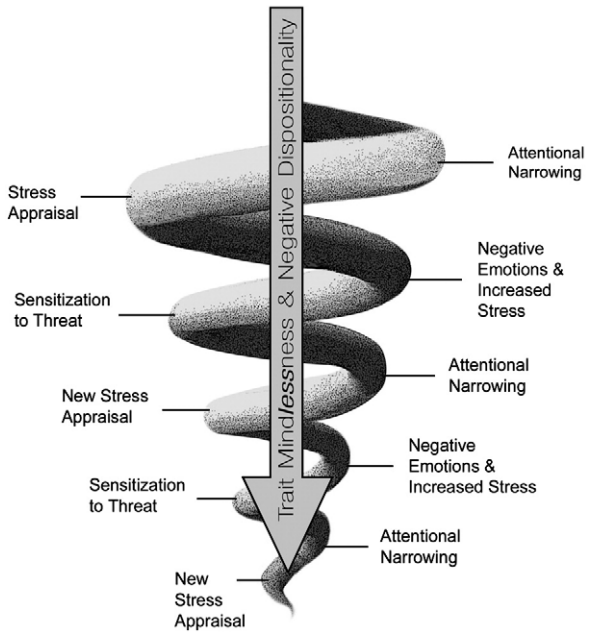

Fig. 1. Downward spiral of psychopathology (Garland, 2010).

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elaborate or ruminate on such negative information (Mathews & MacLeod, 2005; Mineka et al., 2002; Nolen-Hoeksema, 2000). Such information processing biases further perpetuate and reinforce dysphoria, fear, and self-loathing, creating a pathological affective balance that favors negativity over positivity. Indeed, clinical depression has been shown to be characterized by positivity ratios well below 1-to-1 (Schwartz et al., 2002).

Positive emotions may counter the pernicious effects of depression and anxiety disorders. Decades of research on affect-related processes have demonstrated that, within momentary experience, positive emotions are incompatible with negative emotions (Baron, 1976; Cabanac, 1971; Nolen-Hoeksema, 2000; Solomon, 1980; Wolpe, 1958). From the perspective of the broaden-and-build theory, this fundamental incompatibility reflects that the affective system cannot simultaneously be both narrowed and broadened (nor be both self-protective and self-expanding). Experimental evidence for the cardiovascular "undo effect" of positive emotions (Fredrickson et al., 2000) supports this view, as does the practice of systematic desensitization to treat the excessive sympathetic activation of anxiety disorders by pairing arousal with positive states of relaxation (Wolpe, 1958). Similarly, an affective balance that over time exceeds a 3-to-1 positivity ratio might also override and prevent the pathogenic effects of stressful life events on mood. Positive emotions may have ameliorative effects by undoing the cognitive narrowing provoked by negative emotions, evidenced by research showing that accessing positive constructs attenuates attentional biases to negative information (Smith et al., 2006). Additionally, positive emotions facilitate cognitive reappraisal, enabling individuals to find positive meaning in their negative circumstances (Tugade & Fredrickson, 2004). Hence, we speculate that the broadened cognition afforded by positive emotions may counter depressed and anxious thinking by facilitating sufficient attentional disengagement from negative stimuli to allow perception of the pleasant aspects of experience and the re-association of formerly negatively-construed events. Moreover, the broaden-and-build effects of positive emotions appear to facilitate effective coping in ways that, over time, reduce depressive symptoms and augment subjective well-being (Cohn et al., 2009; Folkman & Moskowitz, 2000; Fredrickson & Joiner, 2002; Stein et al., 1997).

We speculate that when individuals suffering from depression, anxiety or both, increase their positivity ratios, they may set in motion upward spiral processes that widen the arrays of possibilities that come to mind and enhance their coping potential. Tipping affective balance beyond the 3-to-1 ratio may also undo the impact of negative affect and result in salutary effects on mind and body. Indeed, self-generating more frequent positive emotions over the course of 7 weeks has been shown to reduce depressive symptoms in a randomized, controlled trial that tested a non-clinical sample (Fredrickson et al., 2008). Although this line of research has yet to be translated into clinical research targeting individuals with a range of depressive and anxiety disorders, such translation may now be warranted.

4.2. Schizophrenia

Schizophrenia is among the most devastating of all mental illnesses, resulting in societal costs of approximately 62 billion dollars, making it among the costliest mental or physical illness in the United States (Wu et al., 2005). Yet the impact of schizophrenia goes well beyond financial costs. The reality is that some individuals with schizophrenia lead lonely, isolated lives, without work, social or recreational outlets, or personal purpose. Within the broader population of individuals diagnosed with schizophrenia, there is a significant subgroup, i.e., those with negative symptoms, whose quality of life is especially compromised. The negative symptoms involve a variety of intertwined emotional and behavioral deficits, and include anhedonia (diminished pleasure), avolition (diminished motivation), asociality (diminished interest or desire for interpersonal relationships), alogia (diminished speech) and blunted affect (diminished expression of emotion) (Kirkpatrick, Fenton, Carpenter, & Marder, 2006). Current treatments for negative symptoms are based on only limited empirical research, lack a clear theoretical rationale, and have only modest efficacy (for a review, see Johnson et al., 2009). Negative symptoms of schizophrenia, then, remain a large, unmet treatment need.

The negative symptoms of schizophrenia have been identified at least since Kraepelin and Bleuler eloquently described schizophrenia nearly a century ago (Bleuler, 1908; Kraepelin, 1919). Kraepelin (1919), for instance, described negative symptoms as a "weakening of those emotional activities which permanently form the mainsprings of volition." Contemporary research on negative symptoms has illuminated the relationship between negative symptoms and increased morbidity, poor functional outcomes, and poor long-term prognosis (Bowie, Reichenberg, Patterson, Heaton, & Harvey, 2006a; Buchanan, 2007; Kirkpatrick, Buchanan, Ross, & Carpenter, 2001; Tek, Kirkpatrick, & Buchanan, 2001). Negative symptoms are also associated with cognitive impairments, poor quality of life, and poor social and vocational outcomes (Bowie et al., 2006a; Tek et al., 2001; Wagman, Heinrichs, & Carpenter, 1987). Additionally, individuals with negative symptoms have significant impairments in motivation, treatment adherence, social functioning and long-term outcome relative to others with schizophrenia (Bowie, Reichenberg, Patterson, Heaton, & Harvey, 2006b; Buchanan, 2007). Taken together, negative symptoms account for a significant amount of variance in long-term functioning and morbidity (Bowie et al., 2006b; Buchanan, 2007; Milev, Ho, Arndt, & Andreasen, 2005; Tek et al., 2001). Moreover, negative symptoms are not rare. As many as 80 percent of individuals with schizophrenia have at least moderate degrees of one or more negative symptoms (e.g., Andreasen & Flaum, 1991; Fenton & McGlashan, 1991; World Health Organization, 1973). Because negative symptoms are temporally stable (e.g., Herbener & Harrow, 2002; Pfohl & Winokur, 1982) and observed early in the course of the disorder, they are not solely a function of the chronic nature of schizophrenia (e.g., Arndt, Andreasen, Flaum, & Miller, 1995; Gelber et al., 2004; Gur et al., 1998; Walker, Grimes, Davis, & Smith, 1993).

Research has also pointed more clearly to the nature of the pleasure (anhedonia) and motivational (avolition) deficits in schizophrenia. Kring (1999) proposed that individuals with schizophrenia experience normal levels of pleasure, or *consummatory* pleasure, when directly engaged in enjoyable activities, but experience disturbances in the experience of pleasure related to future activities, or *anticipatory* pleasure; both self-report and fMRI studies indicate that schizophrenia patients have an anticipatory but not a consummatory pleasure deficit (Gard et al., 2007; Juckel et al., 2006). The anticipatory pleasure deficit is particularly acute with respect to motivated or goal-directed behavior in daily life and is linked with deficits in social functioning (Gard et al., 2007). Consistent with this view, individuals with schizophrenia have demonstrated deficits in motivated behavior in a reward learning paradigm (Heerey & Gold, 2007). Additionally, there is some evidence to suggest that individuals with schizophrenia have difficulty remembering positive emotional experiences (for review see Herbener, 2008).

It appears, then, that many of the negative symptoms of schizophrenia are characterized by a particular deficit within positive emotion systems. Specifically, the normative link between experienced pleasure and subsequent behavioral motivation appears to be severed. When positive emotion systems function normally, cues associated with behaviors and circumstances that people experience as pleasurable over time come to have incentive salience, defined as implicit, cue-triggered positivity. Put differently, "liking" a given experience precedes and produces subsequent cue-triggered "wanting" for that same experience, which in turn motivates repeat

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behavior (Berridge, 2007). Metaphorically speaking, cues associated with past pleasurable experiences (e.g., the name or sight of a friend) come to sparkle with psychological glitter dust that implicitly draws people toward that cue, often without conscious awareness. In this manner, past pleasurable experiences typically create strong impulses to repeat previously pleasurable behaviors. Although tightly intertwined aspects of reward, "liking" and "wanting" have separable neurological underpinnings: "liking" implicates opioids, whereas "wanting" implicates dopamine (Berridge, 2007).

This neuroscientific lens on positive emotion systems clarifies how pleasurable experiences come to foster nonconscious motivations. In non-clinical populations, people are typically motivated to repeat what feels good because liking leads to implicit wanting, which is undergirded by powerful dopaminergic pathways. Among individuals with schizophrenia with negative symptoms, however, the tie between opioid-based "liking" and dopaminergic "wanting" may be loosened, a speculation consistent with the finding of dysfunction in the ventral striatum during reward prediction in schizophrenia (Juckel et al., 2006). Looser coupling of this vital link may contribute to avolition and asociality.

While Kring and Moran (2008) have shown that people with schizophrenia can and do experience positive emotions in the moment, it may be that these experiences are sufficiently rare, brief, or not remembered and thus do not potentiate the upward spirals and longer-term "build effects" of positive emotions. Strikingly, many of the resources shown in non-clinical samples to increase with increases in self-generated positive emotions are implicated within the core deficits that comprise the negative symptoms of schizophrenia, namely, environmental mastery, pathways thinking, purpose in life, positive relations with others, and the ability to savor and anticipate pleasure (Fredrickson et al., 2008). Greater infusion of positive emotions may well be required to tip pathological affective ratios above the hypothesized 3-to-1 ratio and build these vital resources. Only above this ratio may positive emotions be frequent enough to unlock enduring behavioral changes in volition and sociality thought to be fueled by dopaminergic incentive salience.

We speculate that when individuals with schizophrenia learn to self-generate more frequent positive emotions, they trigger upward spiral processes that enable them to envision and anticipate with pleasure more possible courses of action. In turn, these broader thought–action repertoires may pave the way toward enhanced sociality and motivation. Indeed, this is part of the rationale underlying many effective psychosocial treatments for people with schizophrenia (Kopelowicz & Liberman, 1998). That is, treatments such as social skills training or day treatment groups include components that help individuals to meaningfully engage with other people, develop and sustain life goals, and increase social/emotional communication. Unfortunately, studies have yet to directly assess whether such programs provide opportunities for more frequent positive emotions. Of course, addressing the negative symptoms of schizophrenia is just one important factor in an illness that also typically includes deficits in cognition, distorted thinking, and the so-called positive symptoms of schizophrenia, including hallucinations and delusions. While current treatments address some of these other domains that are disrupted in schizophrenia, the negative symptoms remain most in need of new treatment approaches.

5. Generating a positive affective balance: interventions that raise positivity

We suspect that many mental health clients are not aware that positive emotions can be intentionally self-generated. They may mistakenly believe that, to be valid and meaningful, positive feelings must arise spontaneously, much in the same way that the negative emotions that plague them are triggered automatically from stimulus configurations in their external and internal environments. This folk psychology is misleading, however, in light of empirical findings that behavioral activation predisposes individuals to experience more positive events, which can then result in increased positive emotions (Gable, Reis, & Elliot, 2000). Thus, active pursuit of positive events can yield more frequent opportunities to experience positive emotions. In other words, positive emotions and their attendant upward spirals can be sought after, cultivated, and self-generated.

Behavioral activation is indeed a cornerstone of cognitive–behavioral therapy, one of the most effective and widely-used treatments for psychopathologies marked by deficits in emotions. The broaden-and-build theory of positive emotions complements and extends this rich therapeutic tradition by further unpacking the dynamics through which positive emotions promote well-being. Having established, in non-clinical samples, that daily experiences of positive emotions over time build people's psychosocial resources and life satisfaction, and reduce their depressive symptoms, it is now appropriate to translate these findings from basic science into clinical science. A key step in this process is to develop sustainable means through which people can reliably self-generate contextually-appropriate positive emotions. Interventions may raise overall positivity ratios through a number of possible mechanisms identified by basic psychological science: a) by decreasing the intensity/frequency of negative emotions or decentering from negative emotions; b) facilitating positive reappraisals of stressful life circumstances; c) triggering release of neurochemicals associated with reward and pleasure; d) triggering positive emotions through imagery or by accessing positive aspirations or memories; e) biasing attention towards positive experiences; and f) promoting behaviors (e.g., kind acts) associated with positive emotions.

A range of interventions might be drawn from positive psychology to address clinical disorders via the aforementioned mechanisms, including treatments based on developing or deploying character strengths or increasing kind acts (for reviews, see Lyubomirsky, Sheldon, & Schkade, 2005; Seligman, Rashid, & Parks, 2006; Seligman, Steen, Park, & Peterson, 2005). Similarly, positive psychological interventions might be fruitfully used as adjuncts to more traditional forms of CBT. One such intervention is Broad Minded Affective Coping (BMAC; Tarrier, 2010), a technique that employs mental imagery to evoke positive memories of past experiences of happiness or enjoyment. In so doing, BMAC is thought to evoke the positive emotions associated with positive memories via the generation of positive appraisals. Although there are a number of extant interventions that might generate positive emotions to ameliorate emotion dysfunctions in psychopathology, here we describe the two approaches we know best, each based on a specific form of mind training.

5.1. Mindfulness meditation

Meditation and mindfulness, which are perhaps best known as elements of Buddhist spiritual practice, have also proven to be fruitful topics within clinical psychology as means to address destructive negative emotions (Baer & Krietemeyer, 2006; Kabat-Zinn, 2003; Segal, Williams, & Teasdale, 2002; Wallace & Shapiro, 2006). In particular, feelings of fear, sadness, and anger may be alleviated by the *practice* of mindfulness meditation, which involves self-regulation of a metacognitive, attentional *state*: a nonreactive, non-evaluative monitoring of moment-by-moment cognition, emotion, perception, and sensation without fixation on thoughts of past and future (Garland, 2007; Kabat-Zinn, 1982; Lutz, Slagter, Dunne, & Davidson, 2008). Although within Buddhism the construct of mindfulness subsumes a number of other processes (including remembering the objects of attention and the metaphysical insight of the absence of a reified self), as construed by modern psychology the *practice* of mindfulness is thought to engender the *state* of mindfulness characterized by a metacognitive, decentering awareness. Decentering, alternately

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termed reperceiving (Shapiro, Carlson, Astin, & Freedman, 2006), is defined as the process of disidentification from thoughts, emotions, and sensations, and is hypothesized to lessen the impact of potentially distressing mental content (Segal et al., 2002). As such, mindfulness practice is thought to attenuate emotional bias of stimulus perception by facilitating non-evaluative contact with phenomenological experience (Brown, Ryan, & Creswell, 2007), resulting in an awareness of stimuli with fewer distortions and less reactivity related to emotional valence (Bishop et al., 2004).

Seen through the lens of broaden-and-build theory, the state of mindfulness is a form of broadened cognition. Thus, to the extent that the practice of mindfulness leads to broadened awareness, by virtue of the reciprocal links between emotions and cognition (Fredrickson & Joiner, 2002), we speculate that mindfulness practice may also trigger positive emotions. Recent data from both healthy adult and mood-disordered populations are beginning to offer support for this speculation. For instance, mindfulness training led to increases in positive affect among a sample of community adults relative to participants randomly assigned to a wait-list control group (Nyklíček & Kuijpers, 2008). Similarly, a longitudinal, quasi-experimental study found that intensive mindfulness training led to increases in positive affect that were maintained at a one-month follow-up and were correlated with increases in dispositional mindfulness (Orzech, Shapiro, Brown, & McKay, 2009). Among a sample of patients with comorbid recurrent depression and rheumatoid arthritis, a randomized controlled trial found that mindfulness training increased positive affect to a significantly greater extent than cognitive–behavior therapy and an education control (Zautra et al., 2008). Additional evidence of the link between mindfulness training and positive emotion is likely to be found as more researchers include measures of positive emotion in outcome studies of mindfulness-based interventions.

If mindfulness practice, which has been shown to enhance attentional processes (Brefczynski-Lewis, Lutz, Schaefer, Levinson, & Davidson, 2007; Carter et al., 2005; Jha, Krompinger, & Baime, 2007; Slagter et al., 2007; Slagter, Lutz, Greischar, Nieuwenhuis, & Davidson, 2009), engenders positive emotions, it may do so by inducing the broadened attentional state of mindfulness, which in turn may lead to generative and flexible thinking styles. In partial support of this proposed therapeutic mechanism, increases in positive affect observed among a community sample participating in mindfulness-based cognitive therapy were associated with increases in two facets of mindfulness closely linked to broadened attention: acting with awareness and observing sensory and perceptual experience (Schroevers & Brandsma, 2009). When cultivated over time, the expansive attentional state generated by the practice of mindfulness may yield positive emotions such as compassion, love, gratitude, confidence, and contentment which in turn engender optimism and resilience. For the remainder of this section, we outline a number of possible mechanisms by which mindfulness practice may generate positive emotions via upward spiral processes (depicted in Fig. 2).

We speculate that the broadened awareness characteristic of both mindfulness and positive emotions disrupts psychopathological schemata and attenuates negative emotions, thereby augmenting adaptive appraisals and increasing the positivity ratio. The disruption of maladaptive schemas through mindfulness may in turn reduce cognitive distortions and reactions that would otherwise result in either anxiety-based avoidant coping or the depressive attitudes of learned helplessness (Garland, 2007); indeed, the predictive effect of mindfulness on future well-being in the face of impending stressors has been shown to be partially mediated by decreased threat appraisals and decreased avoidant coping (Weinstein, Brown, & Ryan, 2009). Teasdale and colleagues (e.g., 1995, 2002) suggest that mindfulness practice disrupts psychopathological schemas and prevents relapse into future depressive episodes by evoking a metacognitive state in which distressing thoughts and feelings are seen as ephemeral, unreal, and dis-identified from the self. During the gradual, developmental practice of mindfulness, one learns to work with negative emotions in this metacognitive context and decenter from fixed or schematized narratives about self and world, resulting in nonreactivity to difficult mental contents and greater cognitive, emotional, and behavioral flexibility (Shapiro et al., 2006). Shapiro et al., (2006) suggest that "through reperceiving brought about by mindfulness, the stories (e.g. about who we are, what we like or dislike, our opinions about others, etc.) that were previously identified with so strongly become simply 'stories'". Disidentification from narratives of helplessness and catastrophe allows for the possibility of selecting new narratives that are more congruent with reality and well-being. Thus, the mental shifts of reperceiving or decentering may afford a fundamental psychological suppleness, facilitating the flexible selection of cognitive appraisals; when we "reflect upon them with greater objectivity, we have the opportunity to rediscover and choose values that may be truer for us. In other words, we become able to reflectively choose what has been previously reflexively adopted" (Shapiro et al., 2006).

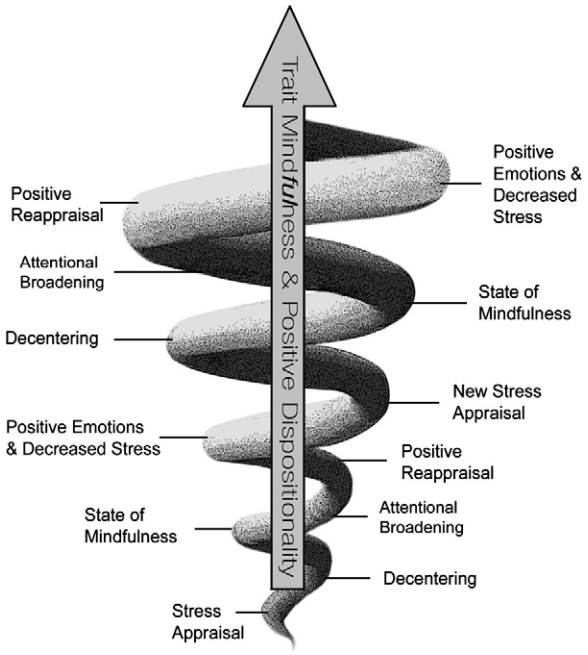

Fig. 2. Upward spiral of flourishing (Garland, 2010).

In this sense, the state of mindfulness may be an intrinsic and central element within meaning-based coping, one that facilitates positive reappraisal (Garland, Gaylord, & Park, 2009), and in so doing generates positive emotions with their attendant upward spirals that may unravel psychopathologies marked by emotion dysfunctions and deficits. Positive reappraisal is the adaptive process through which stressful events are re-construed as benign, valuable, or beneficial (Lazarus & Folkman, 1984), a coping strategy that is associated with improved mental and physical health outcomes (Carver et al., 1993; Himelein & McElrath, 1996; Major, Richards, Cooper, Cozzarelli, & Zubek, 1998). For individuals to re-construe their appraisal of a given event as positive, they must first disengage and withdraw from the initial appraisal into a transitory metacognitive state that attenuates semantic evaluations associated with the event. According to the mindful coping model (Garland et al., 2009), when a given event is appraised as a threat or loss that exceeds one's capabilities, an individual may initiate an adaptive response by decentering from this stress appraisal into the state of mindfulness. This state is characterized by broadened attention and increased cognitive flexibility. From the vantage point of this expanded, metacognitive state, individuals can then more easily reappraise their circumstances and redefine or reframe them as meaningful or even beneficial.

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Although reappraisal has recently been conceptualized as antithetical to mindfulness due to the supposition that reappraisal requires identification with and aversion toward the original stress appraisal (Chambers, Gullone, & Allen, 2009), we contend that the state of mindfulness is a key mechanism that makes reappraisal possible. Chambers et al. (2009) highlight a fundamental difference between mindfulness and reappraisal: reappraisal alters the content of consciousness while mindfulness alters one's relationship to those contents. While we agree with this characterization, we contend that mindfulness and reappraisal are not diametrically opposed poles along a single continuum, but rather represent different but complementary stages of the emotion regulation process. Micro-analytic research on the unfolding of online emotion regulatory processes over time is needed to resolve these differing conceptions of the relationship between mindfulness and reappraisal. Although the bulk of controlled research on mindfulness-based interventions to date has identified salutary effects on persons with *subclinical* depression and anxiety symptoms, we speculate that mindfulness practice may engender a mindful state that facilitates the generation of positive reappraisals in the face of acute and chronic stressors, thereby undoing the stress reactions that so often precipitate relapse into full-blown mood and psychotic episodes. Although randomized controlled trials are needed to test this hypothesis, empirical data and theoretical rationale (for a review, see Garland et al., 2009) support the proposed relationship between mindfulness practice, positive reappraisal, and clinical outcomes.

If positive construal is the natural outcome of mindfulness practice, then mindfulness-based therapies would naturally lead to increased positive reappraisal. Even so, novel mindfulness-oriented interventions could capitalize on this naturalistic process by combining standard mindfulness practices with explicit cognitive restructuring techniques oriented toward benefit finding and positive reappraisal. By explicitly teaching mindfulness skills and cognitive restructuring techniques in tandem, the natural facilitation of positive reappraisals afforded by standard mindfulness exercises could be leveraged further. Novel clinical interventions could promote reappraisal by explicitly training clients to first engage in mindfulness of the breath to decenter from psychopathological schema into a broad-minded, flexible mode of awareness, and then to use Socratic questioning to generate positive reappraisals of challenging life events (e.g., "How has dealing with this situation made you a stronger person? How can you learn something from this situation? Is there a blessing in disguise here?"). This description is necessarily an oversimplified, linear sketch of a potentially complex, recursive, and multi-leveled process that would likely involve numerous iterations of mindful decentering and reappraisal within and across multiple treatment sessions. During this iterative clinical process, clients could be taught to oscillate back and forth between decentering and reappraisal until depressogenic or catastrophic appraisals abate and new, adaptive appraisals are constructed and accepted as valid. The ultimate goal of such a therapeutic process would be to help the client to re-construe his or her life challenges as meaningful opportunities for growth or sources of benefit.

Empirical research indicates that positive reappraisal can be trained; experimental induction of benign interpretational bias, that is, the tendency to interpret ambiguous experiences as innocuous or even beneficial, has been shown to result in significant reductions in trait-level anxiety (Mathews, Ridgeway, Cook, & Yiend, 2007). By teaching clients to practice mindfulness skills (e.g., mindful breathing techniques) in the face of a stressor, they may more easily detach from maladaptive appraisals of helplessness and exaggerated threat, thereby facilitating empowering construals that reduce negative affect and encourage effective problem solving. This situationally-specific use of mindfulness practice to augment positive reappraisals as a means of coping with stress would complement the developmental process of cultivating and embedding mindfulness principles into all aspects of one's life. In this manner, mindfulness meditation can be integrated into cognitive therapy to augment cognitive restructuring. Although mindfulness-based cognitive therapy (MBCT) incorporates the principles of mindfulness-based stress reduction within the frame of cognitive therapy (Segal et al., 2002), it does not focus on changing thought content, nor is it directly aimed at cultivating positive emotions. In contrast, the approach we outline above unites complementary aspects of mindfulness practice, CBT, and broaden-and-build principles, targeting both the process (via mindfulness training) and content (via cognitive restructuring) of consciousness. This hybridized therapy (see Garland et al., 2009) may unravel the self-perpetuating "depressive interlock" schemata of the downward spirals that maintain mood disorders (Teasdale et al., 1995) and trigger opposing upward spirals of positive emotions that we propose would broaden negativistic thinking and facilitate meaning-based coping.

We acknowledge that positive reappraisal may be only one of the mechanisms through which mindfulness practice induces positive emotions, and that this process may involve other cognitive pathways as well. In addition to diffusing negative emotions by disrupting depressogenic schema and facilitating positive reappraisal, mindfulness practice may engender positive emotion via focusing attention on pleasurable, beautiful, rewarding, or meaningful objects and events. Mindfulness-based stress reduction (MBSR) includes exercises designed to increase awareness of and attention to positive events. Such exercises may amplify enjoyment of perceptual and sensorimotor experience like sensate-focus techniques, which focus attention on the sensory components of a sexual experience to bypass or disrupt evaluative processing and lead to the intensification of pleasure (Masters & Johnson, 1970). Controlled clinical trials of sensate-focus training demonstrate that individuals can learn to attend to the sensory quality of experiences to increase pleasure and improve response (Heiman & Meston, 1998), while laboratory experiments indicate that individuals can be trained to selectively attend to positive stimuli as a means of regulating emotions (Wadlinger & Isaacowitz, 2008). It is possible that learning to mindfully attend to and savor positive events may offset the negativity bias observed among persons with emotion-related disorders, leading to increased positive emotions and behavioral activation.

The positive emotions generated through mindfulness practice may also arise from enduring changes in brain function. For example, Davidson et al. (2003) observed significantly greater asymmetrical left anterior prefrontal cortex activation, a known neural correlate of approach-related positive emotions, among participants of a mindfulness-based intervention compared to persons to a wait-list control group. Hypothetically, meditation may induce pleasant hedonic states via increased secretion of neurochemicals that mediate positive affect (e.g., vasopressin and beta-endorphin) (Newberg & Iversen, 2003) as well as through autonomic nervous system activity which may stimulate the lateral hypothalamus and median forebrain bundle, resulting in euphoric feelings and elevated serotonin (Newberg & Iversen, 2003), a neurotransmitter whose connection to depression is well known.

5.2. Loving-kindness meditation

Although most empirical work on meditation has to date centered on mindfulness meditation, being particularly interested in positive emotions, we have been drawn to investigate loving-kindness meditation (LKM), a related concentration practice in which people intentionally cultivate warm and caring feelings in both mind and body, and direct them toward themselves and others (Salzberg, 1997). Whereas mindfulness meditation involves training one's attention toward the present moment in an open-minded (nonjudgmental) way, LKM involves training one's emotions toward warm and tender feelings in an open-hearted way. Individuals are first asked to focus on their heart region and contemplate a person for whom they already feel warm and

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tender feelings (e.g. a child, trusted caregiver, or friend). They are then guided to extend these warm, body-based feelings first to themselves and then to an ever-widening circle of others. LKM may thus cultivate broadened attention alongside positive emotions, which, according to the broaden-and-build theory, go hand in hand.

LKM involves verbalized aspirations and visualizations designed to cultivate positive emotions in both mind and body. Within this context of positive emotions, the positive aspirations in LKM may inculcate the practitioner with optimistic internal and external attributions, and in so doing, induce a more general positive interpretational bias. By self-generating and directing kind and compassionate emotions towards self and others, this technique may "reprogram" deeply engrained negative beliefs. While initially the phrases traditionally used in LKM ("May I/they feel safe. May I/they feel happy. May I/they feel healthy. May I/they live with ease.") may come across as saccharine or altogether ersatz to the client, these phrases are best viewed as wishes or yearnings, rather than forced and unrealistic affirmations. Approached in this flexible and open manner, repetition can bring habituation and a gradual owning of these aspirations as one's own, alongside feelings of compassion and positive emotions. Ultimately, clients need to find a way to make these phrases resonate as sincere and heartfelt, so that they come to reflect plausible and genuine wishes for themselves and others. This is especially important in light of recent experiments that find that forced positive affirmations backfire for individuals with low self-esteem (Wood, 2009). We also see the temporal focus of LKM as vital. Whereas past research has found that positive memories are ineffective in regulating sad mood for depressed and formerly depressed individuals (Joormann, Siemer, & Gotlib, 2007), the positive aspirations of LKM target the present and future, not the past, and thereby may avoid creating sharp contrast effects that may inadvertently highlight deteriorating well-being. More generally, psychotherapy utilizing LKM may need to be reinforced through cognitive–behavioral therapy homework exercises, such as having the client keep a log of their own altruistic or caring actions and experiences that provide evidence for the veracity of positive aspirations that are the centerpiece of LKM. In non-clinical samples, realistic positive views of the self have been empirically demonstrated to generate positive emotions and stop ruminative, negativistic thinking (Koole, Smeets, van Knippenberg, & Dijksterhuis, 1999).

The imagery techniques inherent in LKM may also engender positive sentiments through nonverbal means. Mental images arise when previously encoded perceptual information is accessed through direct recall or novel recombination of experienced objects and events and can exert potent effects on neurobiology and behavior (Kosslyn, Ganis, & Thompson, 2001), as well as emotions (Holmes & Mathews, 2005). Such is the case in posttraumatic stress disorder (PTSD), in which intrusive imagery associated with a traumatic event elicits powerful feelings of fear, anger, and disgust (Holmes, Grey, & Young, 2005). Intrusive negative imagery also characterizes other psychopathological conditions, like depression and psychosis (for a review, see Brewin, Gregory, Lipton, & Burgess, 2010). Possibly through similar mechanisms, the intentional self-generation of positive imagery can also lead to marked alterations in affective systems, as reflected in self-reported positive emotions as well as in increased activity in neural regions implicated in emotion regulation and emotional experience, including the anterior cingulate, orbito-frontal, insular cortices (Damasio et al., 2000). Training in positive imagery induction has been shown to increase positive interpretation bias of ambiguous events (Holmes, Mathews, Dalgleish, & Mackintosh, 2006) and buffer against mood deterioration (Holmes, Lang, & Shah, 2009). Moreover, psychotherapies that include a substantial positive imagery component (e.g., imagery rescripting) have been shown to reduce anger, guilt, and shame among PTSD patients (Arndt et al., 1995) and decrease depression among patients with major depressive disorder (Brewin et al., 2009). Given the tight interconnection between internal imagery and emotions, we suggest that the visualizations often involved in LKM can foster positive emotional states that may lead to improved clinical outcomes among persons with emotion-related dysfunctions.

Initial support for the benefits of LKM emerge from recent studies that have shown salutary effects in relatively healthy adult samples. For instance, empirical research has demonstrated that LKM is associated with reduced negative affect and increased positivity towards self and others (Hutcherson, Seppala, & Gross, 2008). Furthermore, an advanced form of LKM, "non-referential compassion," which focuses on generating feelings of compassion and loving-kindness without reference to a specific being, has been shown to enhance neural synchronization (Lutz et al., 2004) and activate emotion regulation circuits in the brain (Lutz, Brefczynski-Lewis, et al., 2008). Lutz et al. (2008a,b) used fMRI to compare the brain activity of novices engaged in LKM and an emotionally-neutral yet relaxed state to the brain activity of expert practitioners (who had meditated for >10,000 h) engaged in meditation on non-referential compassion and a "non-meditative state without specific cognitive content and with a lack of awareness or clarity of the mind." The researchers concurrently examined neural activity during emotional human vocalizations (positive, neutral, or distressed) designed to generate empathy in participants. Results suggested a significant 3-way interaction in which the greatest limbic response (and hypothesized empathic response) resulted from expert meditators hearing distressed vocalizations during non-referential compassion meditation. This study suggests that forms of meditation focused on generating loving-kindness and compassion may recruit brain areas associated with empathy towards others, which could play a role in building relationships. In fact, it may be that empathy is one of the psychological resources built by the accumulation of positive emotions induced during repeated practice of LKM.

Fredrickson et al. (2008) recently conducted a randomized controlled trial on the effects of learning LKM in a 7-week workshop using a non-clinical sample of 141 participants. Results from the study confirmed that the LKM group experienced significantly more positive emotions over the course of the study compared to the control group, a necessary step for testing the build effect, of the broaden-and-build theory. The amount of time participants spent meditating also predicted small but reliable increases in positive emotions in daily life over 7 weeks as well as during social interactions on an ordinary workday several weeks later. Longitudinal analyses revealed that these subtle increases in positive emotions significantly predicted increases in consequential personal resources, including mindfulness, savoring events in the future, hope, environmental mastery, self-acceptance, purpose in life, social support, positive social relations, and lower physical illness symptoms. These resources in turn predicted increases in life satisfaction and reductions in depressive symptoms (Fredrickson et al., 2008).

In particular, Fredrickson et al. (2008) found that LKM increased people's self-reported ability to savor future pleasant events, an ability implicated in the anhedonia characteristic of the negative symptoms of schizophrenia. As such, increasing positive emotions with LKM should enhance anticipatory pleasure as well as other personal resources, and thereby partially ameliorating the negative symptoms of anhedonia, avolition, and asociality. Inspired by this possibility, we conducted a pilot study of the effects of LKM as an adjunctive treatment to medications for individuals with schizophrenia with negative symptoms (Johnson et al., submitted for publication, see also Johnson et al., 2009). We conducted two six-week groups with outpatients ($N = 18$) at University of North Carolina Hospitals. Results were promising. The overall attendance rate was 84%, which is encouraging for clients with negative symptoms who may have difficulties with motivation and desire for social relationships that necessarily develop in such a group setting. Moreover, clients showed changes from baseline to post treatment and follow-up that indicated significant and large effect size reductions in total negative symptoms

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and anhedonia. We observed a significant, medium–large effect size increase in positive emotions through 3-month follow-up. We also observed medium effect size increases in consummatory pleasure (i.e., liking), life satisfaction, savoring future events (i.e., wanting), and decreases in avolition through 3-month follow-up, and small effect increases sizes for psychological well-being. Our preliminary data from this open pilot trial suggests that LKM may be an effective means of ameliorating negative symptoms in schizophrenia, in part through increasing positive emotions which in turn boost resources. Of course, for the promise of this intervention approach to be more fully realized, it must be tested systematically in a larger sample of people diagnosed with schizophrenia. Nevertheless, preliminary findings suggest the potential for change in negative symptoms, which have remained largely intractable to extant treatments.

Once clients are able to experience a sense of contentment, self-compassion, and empathy, treatment can utilize these positive emotions to broaden attentional focus and thought–action repertoires. The therapeutic goals of achieving social connectedness and improving interpersonal functioning will be more attainable when the client's attention has been broadened from a "local," egocentric focus to a more global orientation. Because positive emotions impel persons to think more creatively and engage in novel behaviors (Fredrickson & Branigan, 2005; Rowe et al., 2007), when feeling positively about self and others, clients may show more interest in learning new skills and have more motivation to put these skills into practice. Indeed, empirical observation indicates that positive emotional experiences during therapy sessions may facilitate skill acquisition (Rudd et al., 2001). Ultimately, learning to self-generate positive emotions through LKM may also lead to more positive affective balance, which eventually surpasses the 3-to-1 positivity ratio tipping point. Higher positivity ratios may in turn override transient negative emotions and buffer against future stress-induced episodes of dysphoric mood.

From the perspective of the broaden-and-build theory, psychosocial interventions designed to augment well-being by leveraging positive emotions hold the promise of reducing symptoms and boosting resources among individuals with various emotion-related disorders. Through novel, positive experiences, mental training, and engaging in new behaviors, clients can learn to self-generate positive emotions, which in time and undergirded by neuroplastic processes may alter their enduring brain circuits and compensate for constitutional or learned vulnerabilities (Davidson, Jackson, & Kalin, 2000; Garland & Howard, 2009).

6. Conclusion

Positive emotions are not mere epiphenomena. They broaden thought and action repertoires, increase mental flexibility, augment meaning-based coping, and motivate engagement in novel activities and social relationships. Importantly, positive emotions, although transient, have lasting consequences; they build durable personal resources whose accrual triggers further positive emotions, leading to self-sustaining upward spirals of well-being. Conversely, when negative emotions accrete into downward spirals of defensive behavior, focus on threat, and feelings of inefficacy, these self-destructive, vicious cycles can lead to impoverished life experiences, and potentially, devastating psychopathology. The structural differences between upward and downward spirals are largely incompatible, and thus positive emotions may exert a countervailing force on the dysphoric, fearful, and anhedonic states characteristic of persons with emotion-related disorders. Hence, upward spirals can counter downward spirals. A key research question remains: what intensities and frequencies of positive emotions are required to perturb downward spirals into equipoise, or even to spiral upward?

Although this question awaits empirical testing, evidence from behavioral and brain sciences suggests that repeated activation of even mild emotional states may ultimately alter emotional traits, a transformational process that we speculate is undergirded by sustained changes in brain function and structure. Hence, interventions that foster positive emotions may remediate clinical disorders by shifting affective styles toward resilience. This dispositional shift appears to involve processes such as down-regulation of negative emotion via decentering, cognitive reappraisal of adversity as meaningful, and the savoring of pleasant life events.

The process of savoring may well be a linchpin to the upward spiral. To understand this bold statement, consider the fact that our everyday human experience can potentially access an infinitely complex universe, and yet an individual can only attend to a limited set of details at any one moment. Bateson (1972), one of the progenitors of cybernetics, asserted that ordinary awareness could not usually perceive the rich, interconnected complexity of the environment because intentionality and desire organizes the contents of consciousness in a linear, cause-effect fashion. According to Bateson, "conscious sampling of data will not disclose whole circuits but only arcs of circuits cut off from their matrix by selective attention" (Bateson, 1972). Thus, our narrative-conceptual distinctions, or punctuations, delimit and therefore create phenomenological experience (Keeney, 1983). Depending on how people attend to the components of their experience, different phenomenological realities are constructed. Consistent with this view, appraisal accounts of emotions hold that the emotional quality of any given circumstance springs from the locus of attention and subsequent patterns of interpretation.

This fundamental experiential principle is evidenced by research showing that attending to painful stimuli heightens the subjective intensity and unpleasantness of pain (Miron et al., 1989). And just as focusing on aversive stimuli increases the negative valence of one's experience, attending to pleasant features of the environment can lead to greater experiences of positivity. To illustrate, increased attention to the sensory experience of eating chocolate has been shown to elevate consummatory pleasure (LeBel & Dubé, 2001). Importantly, the active ingredient here is not chocolate, but rather the ability to savor the present moment. Unlike negativity, which frequently stems from rumination about the past or worry about the future, positive emotions flow naturally from a nonjudgmental focus on the present. Indeed, inherent within the notion of a lawful *positivity offset* is the recognition that most moments are indeed positive. As such, bringing increased awareness to the richly woven and unfolding tapestry of life experiences allows one to draw out innumerable gilded threads. The smiling face of a passerby, the song of a bird perched in a nearby tree, the trill of insects on a warm summer evening, a tiny flower blossoming from a crack in a sidewalk, the laughter of children, or even the ever-constant companion of one's own breath can become sources of wonder and delight to savor.

In contrast to negative emotions, which narrow the scope of attention and result in a rigid, scripted focus on what is threatening and harmful, positive emotions broaden one's focus to include what is beautiful, affirming, and life-giving. Thus, people can intentionally increase their positivity ratios by learning to widen the attentional lens to encompass more of the pleasurable, interesting, and meaningful experiences in life, making the painful and dissatisfying ones smaller by comparison. In so doing, people can learn to self-generate upward spirals that resonate within themselves and between themselves and others to increase their odds of flourishing.

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