Positive Emotions Broaden and Build

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Abstract

This contribution offers a review, comprehensive to date, of a fifteen-year research program on the broaden-and-build theory of positive emotions. Although centered on evidence that has emerged from Fredrickson's Positive Emotions and Psychophysiology Laboratory (PEP Lab), it features key findings from other laboratories as well. It begins with a description of ten representative positive emotions, alongside approaches for assessing them, both directly with the modified Differential Emotions Scale and indirectly through physiological and implicit measures. Next, it offers the seeds of the broaden-and-build theory, including work on the undo effect of positive emotions. It then reviews the state of the evidence for the twin hypotheses that stem from the broaden-and-build theory, the broaden hypothesis and the build hypothesis, including a focus on upward spiral dynamics. It touches next on new frontiers for the theory, including deeper investigations into the biological resources that positive emotions build as well as clinical and organizational applications. Finally, this contribution closes with a brief presentation of two offshoots from the broaden-and-build theory, namely, the upward spiral model of lifestyle change, and work on love as positivity resonance between and among people. Both are targets of increasing work in the PEP Lab.

Positive Emotions Broaden and Build

From its very start, psychology has harbored an inferiority complex. Despite the fact that behavioral scientists rely on the scientific method and strivings for valid and reliable measures just as fervently as do those working in the natural sciences, this complex persists. Psychology has too often played the social comparison game, looking up to the natural sciences and medicine, pressing its nose against the glass ceiling of these high-prestige enterprises, while trying to climb away from and distinguish itself from the humanities and other social sciences, claiming greater empirical validity and relevancy. The recent trend to rename academic departments of "Psychology" as departments of "Psychological Science" or "Psychology and Brain Science" may well reflect this insecurity (Kihlstrom, 2012).

One outward legacy of this deep-seated inferiority complex has been to stay clear of topics that fall under the umbrella of human behavior and experience that are deemed too soft, frivolous, or ethereal. However intriguing they may be, experiences marked by levity or delight were long ignored by psychologists, perhaps for fear that they might somehow spoil an outward impression of rigor or objectivity. For psychology to be taken seriously as a science, it seemed, required not only that it *be* rigorous and objective – by following the principles of the scientific method – but that is also *appear* rigorous and objective by tackling problems of grave nature, like mental illness, violence, or social ostracism.

It is true that emotion, a concept often cast as ethereal, was an early topic within psychology (e.g., James, 1884; Cannon, 1929). Yet emotional phenomena were eventually cordoned off in the zeitgeist of behaviorism, whose proponents cataloged them as

irrelevant and misleading epiphenomena (Skinner, 1974), and derided those who studied them as mentalists. Although a few unorthodox psychologists ventured off the beaten path to study emotions nevertheless (e.g., Silvan Tompkins, 1962, whose work inspired Paul Ekman, Carroll Izard, among others), emotions science did not emerge as an organized subspecialty until the mid 1980s, as marked by the formation of the *International Society for Research on Emotions* (ISRE) in 1984, the first multi-disciplinary professional association for scholars specializing in this area. It's fair to say that in the thirty years since, research on emotions has exploded.

Yet even decades after emotions became a rigorous and accepted topic of scientific inquiry, psychology's inferiority complex held sway to keep the focus on the most serious of emotions, namely fear, anger, sadness, and the like. Even disgust made its way to the fore (e.g., Rozin & Fallon, 1987). It was as if the light-hearted emotions within the human repertoire might somehow weaken the fibers of the cloak of rigor that has been so important for psychology to don. This is my sense of how psychology could exist as a science *for an entire century* before psychologists were allowed to take a close empirical look at positive emotions without jeopardizing their reputations.

I have had the good fortune to work on the leading edge of the new and amply rigorous science of positive emotions. Together with the students and collaborators who have worked with me in my *Positive Emotions and Psychophysiology Laboratory* (PEP Lab, first at the University of Michigan and now at the University of North Carolina at Chapel Hill), I have sought to create an evidence-based understanding of light-hearted moments, charting their variety, the ways they change how the human mind works, and how, little-by-little, they change people's lives. This was not an easy program of research to launch.

My first empirical work on positive emotions was in fact rejected countless times over the span of seven years before it saw publication (i.e., Fredrickson & Levenson, 1998). While serial rejections are never pleasant, this early resistance taught me important lessons both about scholarly precision and about resilience and persistence. The purpose of this chapter is to review the now longstanding PEP Lab research program on positive emotions, centered on my broaden-and-build theory, with discussion of relevant studies from other laboratories as well. I begin with a description of the various affective phenomena my collaborators and I target.

Ten Representative Positive Emotions

I set the stage for this review by briefly describing ten key positive emotions. This is by no means an exhaustive list. I choose to focus on these ten emotions not only because they are the targets of increasing research, but also because evidence from the PEP Lab suggests that these ten are experienced relatively frequently in people's daily life. With one important exception, I describe them in the order of their relative frequency, starting with the positive emotions people appear to feel most often, and moving on to those that they feel more rarely. The exception is love, which in our studies emerges as the most frequently experienced positive emotion. As described below, I see good reason to describe it last.

Like all emotions, positive emotions are brief, multi-system responses to some change in the way people interpret – or appraise – their current circumstances. When this multi-system response registers that circumstances are somehow bad for the self, a negative emotion arises, when it registers good prospects or good fortune, a positive emotion arises. To foreshadow the broaden-and-build theory, for each of these ten positive

emotions, I describe (a) the appraisal patterns that trigger it, (b) the broadened thought-action repertoire it sparks, and (c) the durable resources that it helps to build. Table 1 offers these in summary form across its first four columns.

Joy. Joy emerges when one's current circumstances present unexpected good fortune. People feel joy, for instance, when receiving good news or a pleasant surprise. Joy creates the urge to play and get involved, or what Frijda (1986) termed *free activation*, defined as an "aimless, unasked-for readiness to engage in whatever interaction presents itself" (p. 89). The durable resources created through play are the skills acquired through the experiential learning it prompts.

Gratitude. Gratitude emerges when people acknowledge another person as the source of their unexpected good fortune. Joy becomes gratitude, for instance, when awareness of one's own good fortune is combined with admiration for another person for thoughtfully going out of their way to create that good fortune (Algoe, in press). Gratitude creates the urge to creatively consider new ways be kind and generous oneself. The durable resources accrued when people act on this urge are new skills for expressing kindness and care to others.

Serenity. Also called contentment, serenity emerges when people interpret their current circumstances as utterly cherished, right, or satisfying. People feel serenity, for instance, when they feel comfortable, at ease in, or at one with their situation. Serenity creates the urge to savor those current circumstances, and integrate them into new priorities or values. The durable resources created through savoring and integrating include a more refined and complex sense of oneself and of one's priorities.

Interest. Interest arises in circumstances appraised as safe but offering novelty. People feel interest, for instance, when they encounter something that is mysterious or challenging, yet not overwhelming. Interest creates the urge to explore, to learn, to immerse oneself in the novelty and thereby expand the self (Izard, 1977; Silvia, 2008). The knowledge so gained becomes a durable resource.

Hope. Whereas most positive emotions arise in circumstances appraised as safe, hope is the exception. Hope arises in dire circumstances in which people fear the worst, yet yearn for better (Lazarus, 1991). People feel hope, for instance, in grim situations in which they can envision at least a chance that things might change for the better. Hope creates the urge to draw on one's own capabilities and inventiveness to turn things around. The durable resources it builds include optimism and resilience to adversity.

Pride. Pride emerges when people take appropriate credit from some socially-valued good outcome. People feel pride, for instance, when they accomplish an important goal (Tracy & Robins, 2007). Pride creates the urge to fantasize about even bigger accomplishments in similar arenas. The big dreams sparked by pride contribute to the durable resource of achievement motivation (Williams & DeSteno, 2008).

Amusement. Amusement occurs when people appraise their current circumstances as involving some sort on non-serious social incongruity. It can erupt, for instance, in the wake of a harmless speech error or physical blunder. Amusement creates urges to share a laugh and find creative ways to continue the joviality. As people follow these urges, they build and solidify enduring social bonds (Gervais & Wilson, 2005).

Inspiration. Inspiration arises when people witness human excellence in some manner. People feel inspired, for instance, when they see someone else do a good deed, or

perform at an unparalleled level. Inspiration creates the urge to excel oneself, to reach one's own higher ground or personal best. The durable resource it builds is the motivation for personal growth (Algoe & Haidt, 2009; Thrash & Elliot, 2004).

Awe. Awe emerges when people encounter goodness on a grand scale. People feel awe, for instance, when overwhelmed by something (or someone) beautiful or powerful that seems larger than life. The experience of awe compels people to absorb and accommodate this new vastness they've encountered. The durable resources awe creates are new worldviews (Shiota, Keltner, & Mossman, 2007).

Love. Love, which appears to be the positive emotions people feel most frequently, arises when any other of the positive emotions is felt in the context of a safe, interpersonal connection or relationship. I will offer a richer description of love later in this chapter, when I discuss positivity resonance as an offshoot of the broaden-and-build theory. For now, suffice it to say that as an amalgam of other positive emotions, love broadens thought-action repertoires both in an "all of the above" manner, and by creating momentary perceptions of social connection and self-expansion. Likewise, love builds a wide range of enduring resources, especially social bonds and community.

Assessment Approaches

My empirical approach has been to assess each of these positive emotions via people's self-reports of their own subjective experiences, whether in response to (a) an emotion induction presented in the laboratory, (b) a repeated end-of-day survey of their experiences over the past 24 hours, or (c) a questionnaire inquiring about their emotional experiences over the past two weeks. To do this, the PEP Lab uses a variant of the *modified Differential Emotions Scale* (mDES, see Appendix; Fredrickson, Tugade, Waugh, & Larkin,

2003) selected to fit the temporal frame of a given study design. The mDES[i] expanded on the *Differential Emotions Scale* (DES; Izard, 1977) to include a far wider set of positive emotions. I created the mDES to be a more encompassing measure of positive emotions than the more commonly used PANAS, which exclusively targets high activation positive affective states (Watson, Wiese, Vaidya, & Tellegen, 1999). Like the DES before it, the mDES uses a trio of emotion adjectives to capture each emotion. The fifth column in Table 1 presents the particular trio used in the mDES for each of the ten positive emotions in turn. Based on evidence that people are better at recalling peak emotional experiences than they are at aggregating across multiple affective episodes (Fredrickson & Kahneman, 1993; Kahneman, Fredrickson, Schreiber, & Redelmeier, 1993), we typically ask respondents to indicate "the *greatest amount* that you've experienced each of the following feelings" (response options: 0 = not at all; 1 = a little bit; 2 = moderately, 3 = quite a bit; and 4 = extremely). At times, however, we inquire about the frequency of experience, by asking respondents "How often did you feel _____?" (response options: 0 = never; 1 = rarely; 2 = some of the time; 3 = often; 4 = most of the time). Depending on our empirical approach, we ask respondents to think back to a particular laboratory procedure (e.g., a given film or activity), the past 24 hours, or the past two weeks. In all cases, each of 20 distinct emotions is represented by a trio of affective adjectives. Those for the positive emotions are supplied in Table 1 (researchers interested in using the mDES may download various versions from the PEP Lab website, www.PositiveEmotions.org). While at times my collaborators and I examine individual items of the mDES to explore the effects of specific emotions or laboratory inductions, most often we aggregate the 10 positive and 10 negative emotion items separately to create independent positive and negative emotion scores, respectively.

These scales yield high internal reliability, ranging from .82 to .94 (Cohn, Fredrickson, Brown, Mikels, & Conway, 2009; Fredrickson, Cohn, Coffey, Pek, & Finkel, 2008).

Beyond the explicit self-reports of emotion experience captured by the mDES, in our laboratory-based studies my PEP Lab regularly uses facial electromyography (EMG) to capture the frequency of Duchenne smiles, using a new data-reduction technique developed by former students Kareem Johnson and Christian Waugh (Johnson, Waugh, & Fredrickson, 2010). To further circumvent demand effects, we've also used a range of implicit measures of positive affect (e.g., lexical decision task, LDT, Niedenthal, Halberstadt, & Setterlund, 1997; affect misattribution procedure, AMP, Payne, Cheng, Govorun, & Stewart, 2005). We also deploy a version of Russell's Affect Grid (Russell, Weiss, & Mendelsohn, 1989) especially when in need of densely-repeated measures of emotion within a single laboratory visit. We modify the Affect Grid by revising the emotion adjectives that appear around the grid's perimeter to best fit our current empirical objectives. I direct readers interested in a deeper discussion of emotion measurement to a chapter Randy Larsen and I wrote on this topic for an edited volume on well-being (Larsen & Fredrickson, 1999).

Seeds of the Broaden-and-Build Theory

The Undo Effect of Positive Emotions

I began my formal study of emotions as a post-doctoral fellow in the early 1990s, supported by the NIMH training grant on emotions led by Paul Ekman and Richard Lazarus. My intellectual curiosity about positive emotions was piqued by the simple fact that they were so rarely discussed in the existing empirical literature. Working with Robert Levenson at UC Berkeley, I became captivated by the two sentences Levenson had devoted

to positive emotions in a chapter he'd written on best practices for investigating whether specific discrete emotions carried unique autonomic signatures. In discussing the crucial issue of how to select an appropriate baseline against which to examine the physiological effects of distinct emotions, he wrote "…the evolutionary meaning of positive emotions such as happiness might be to function as efficient 'undoers' of states of ANS [autonomic nervous system] arousal produced by certain negative emotions. To test this hypothesis a reasonable baseline condition for the investigation of ANS concomitants of happiness would be one that produces a prior state of fear, anger or sadness." (Levenson, 1988, p. 25). Indeed, prior work by Levenson and colleagues had examined the autonomic effects of "happiness" assessed against the more commonly used baseline of neutral affect (Levenson, Carstensen, Friesen, & Ekman, 1991; Levenson, Ekman, & Friesen, 1990). Results of this earlier work showed essentially no autonomic signature whatsoever for this positive emotion, which seemed a puzzle.

So at the start of my post-doctoral fellowship, in the fall of 1990, Levenson and I designed an initial laboratory experiment to test this *undo hypothesis* (Fredrickson & Levenson, 1998). As Levenson had proposed, we examined the effects of positive emotions against the backdrop of a negative emotion, in this case fear. We did, of course, also include a prior neutral baseline to establish the effects of our fear induction. We used a short video clip that capitalized on a fear of heights, to create a common negative emotion in all participants, who were female students at the University of Berkeley. The clip showed a man inching along the outer ledge of a high-rise, hugging the side of the building; at one point he loses his footing, grasps at whatever he can and dangles high above traffic, struggling to keep from dropping to his certain death.

From pretesting we knew that this short clip, just 83 seconds long, was effective in inducing fear specifically. Participants in this experiment reported their own subjective experiences of emotion by manipulating a rating dial whose pointer moved on a continuous 180-degree scale, labeled from "very negative" (0) to "neutral" (~4.5) to "very positive" (9). During their pre-video resting baseline period, mean rating dial reports were near 5 (very slightly positive), whereas during this high-rise ledge clip participants' ratings dropped to about 3 (negative). More importantly for testing the undo hypothesis, participants also experienced significant cardiovascular reactivity to this video clip, with 3 of 4 cardiovascular measures showing significant change relative to resting baseline, namely, heart rate; finger pulse amplitude, an index of peripheral vasoconstriction; and pulse transmission time to the ear, a correlate of blood pressure. Pulse transmission time to the finger was also measured, but did not show significant change during the fear clip and so was not used within our aggregate index of cardiovascular recovery in this initial study.

We tested the undo hypothesis by randomly assigning participants to view one of four different short video clips immediately following the fear-inducing ledge clip. From pretesting, we knew that two of the four clips evoked two different positive emotions, amusement and contentment. These clips presented images of a puppy playing and ocean waves, respectively. A third was known to be neutral, eliciting no emotion whatsoever by presenting a 1990s-era computer screensaver, and a fourth was known to elicit sadness by showing a boy crying at the death of his father. Importantly, the two positive and the neutral clips, when viewed following a standard resting baseline, produce virtually no cardiovascular signatures whatsoever (Fredrickson, Mancuso, Branigan, & Tugade, 2000, Study 2). That is, there's no way that anyone could know, just by looking at the ensuing

physiological responses, whether someone were watching puppies, waves, or a simple screensaver. We chose sadness as an additional comparison condition because although it produces small increases in sympathetic activation (Fredrickson et al., 2000), unlike other negative emotions, it is not associated with any high-action motor program (Fredrickson & Levenson, 1998), like fight or flight that co-opts the sympathetic nervous system. Most often it is associated with inactivity or disengagement and as such, one might expect it, too, to speed cardiovascular recovery.

So although positive emotions do not appear to "do" anything to the cardiovascular system, when viewed against the backdrop of pronounced negative emotional arousal, the positive emotions clearly stood out in their ability to "undo" lingering cardiovascular activation. Compared to either those in the neutral condition, who took about 40 seconds to recover, or those in the sad conditions, who took about 60 seconds to recover, those in the amusement and contentment conditions showed the fastest cardiovascular recovery, recovering within about 20 seconds each (Fredrickson & Levenson, 1998, Study 1).

Across two subsequent experiments, conducted in my own newly-established laboratory at the University of Michigan, my students and I replicated this exact pattern of results using samples more diverse in age, gender, and ethnicity. We also used a more active and self-relevant way to induce the initial negative emotion by having participants prepare to deliver a speech on "Why you are a good friend" under considerable time pressure, which, they were told, would be videotaped for later evaluation by students in another study. We also instructed participants that there was a 50-50 chance that "the computer" would select them to give their speech or not. If "by chance" they were not selected to give their speech, a video clip would begin on the monitor that was placed

before them. In actuality no participants were asked to deliver their prepared speeches. This cover story was developed both to boost the anxiety of the speech preparation task and to justify the quick switch to an unrelated video clip. While our later experiments used the same clips to elicit amusement, contentment, neutrality, and sadness as the original Fredrickson-Levenson experiment, we expanded the array of cardiovascular measures we tracked to include beat-by-beat assessments of both systolic and diastolic blood pressure.

The speech task produced clear and pronounced experiences of anxiety, as indicated both by participants' self-reports of their subjective experience, and by significant changes across the entire set of 6 cardiovascular measures we tracked, each in the direction of heightened sympathetic arousal (Fredrickson, et al., 2000, Study 1, Samples 1 and 2). Notably, using different samples, different cardiovascular measures, and a different initial negative emotion from which to recover, two distinct positive emotions again yielded significantly faster recovery from the cardiovascular sequelae of negative emotions.

Using archival data that I'd collected in Levenson's lab at UC Berkeley, I also tested the undo hypothesis using a more spontaneous and ecologically valid pairing of negative and positive emotions. People vary in their responses to negative experiences. For whatever reasons, some people smile in the face of sadness and adversity whereas others do not. We explored whether those who smiled during a notably sad film clip (the funeral scene from Steel Magnolias, clipped prior to the humorous interchanges), would show faster cardiovascular recovery after the clip ended. Those who smiled at least once during the sad clip, the data suggested, recovered about 20 seconds faster than those who never smiled (Fredrickson & Levenson, 1998, Study 2).

Whereas Levenson had supplied the original hypothesis that launched our research on the undo effect of positive emotions, my contribution was to develop a time-based measure of cardiovascular recovery with fine-grained temporal resolution. As was standard in Levenson's lab, we had extracted second-by-second data on participants' responses during the resting baseline as well as during the film sequences they saw. Using these data, I calculated a confidence interval around each participant's baseline level of activation defined by their mean activation over the last 60-seconds of a 2-minute resting baseline period, plus and minus one standard deviation of that mean. This confidence interval was used to characterize each participants' own state of emotional quiescence. During the fear clip, all participants' responses moved out of this relaxed state, as would be expected with the experience of fear. Then, at the start of the randomly-assigned secondary video clips, I calculated the time, in seconds, for each participants' cardiovascular responses to return to within the confidence interval that represented their own relaxed state and remain within this interval for 5 of 6 consecutive seconds. I did this for each cardiovascular measure that had shown reactivity in response to the initial negative emotion and then aggregated the recovery times across distinct cardiovascular measures. This data reduction approach was, at the time, novel. Most investigators assessed recovery indirectly, by re-assessing the magnitude of a cardiovascular response some minutes later and then inferring recovery from any evident reductions in reactivity. Our more sensitive time-based measure of cardiovascular recovery preceded the later and eventually more sophisticated appreciation for affective chronometry, the investigation of the temporal course of emotion experiences (e.g., Davidson, 1998; Waugh, Hamilton, & Gotlib, 2010).

An offshoot of this early work on the undo effect of positive emotions emerged as an auxiliary branch of research on resilience. Using Block and Kremen's 14-item self-report measure of Ego-Resilience (ER89; Block & Kremen, 1996), we discovered that people who score higher on this index of trait resilience appear to spontaneously harness the undo effect of positive emotions to regulate their own negative emotional experiences. For instance, when faced with the same anxiety-producing speech preparation task, people who score higher on resilience showed significantly faster cardiovascular recovery. Moreover, their quicker recovery was mediated by their greater tendency to experience positive emotions in response to the task, intermixed with their anxiety (Tugade & Fredrickson, 2004, Study 1).

In a second study, by random assignment we had some participant reframe the speech preparation task as an interesting challenge to overcome versus a threat. Under the typical threat instructions, we replicated the effect wherein people who score higher on Block and Kremen's resilience measure showed faster cardiovascular recovery. By contrast, under challenge instruction, we found that people who scored lower on resilience show the same swift cardiovascular recovery as their high resilient counterparts. Moreover, their speedy recovery was mediated by the greater positive emotions they experienced in response to the task alongside their anxiety. Data from both studies bolster the undo effect of positive emotions by suggesting that positive emotions serve as useful resources for regulating negative emotional experiences in daily life. Beyond promoting cardiovascular quiescence, positive emotions have also been found to (a) help resilient people find positive meaning in difficult life circumstances (Tugade & Fredrickson, 2004, Study 3), (b) buffer against depressive symptoms and fuel post-crisis growth in the wake of

the September 11th, 2001 terrorist attacks (Fredrickson, et al., 2003), and (b) help people effectively recover from stress both in daily life and during bereavement (Ong, Bergeman, Bisconti, & Wallace, 2006).

The Birth of the Broaden-and-Build Theory

The transition in my own thinking from the undo effect to the broaden-and-build theory of positive emotions carries an interesting lesson about the importance of having an appropriate balance of positive to negative emotions for generative thinking. As my first work targeting positive emotions, my studies on the undo effect ignited my fascination with the evolutionary origins of these light-hearted states. Within the still new renaissance of emotions science, very little work targeted emotions with a pleasant subjective feel. This made positive emotions largely uncharted terrain, which presented my favorite kind of intellectual landscape. Although it's not always wise to toil in areas unplowed by others, it certainly provides vast areas to freely explore and ponder.

In our first musings about how existing emotion theory was perhaps unsuitable for the positive emotions, Levenson and I pointed out that the lynchpin theory that specific emotions activate specific action tendencies did not neatly extend to the positive emotions (Fredrickson & Levenson, 1998). The concept of specific action tendencies had become so central within emotions science because it simultaneously explained not only why emotions evoke bodily changes (to support specific action urges) but also why emotions exist (because these specific actions helped human ancestors survive specific and recurring threats to life and limb).

In the stretch of years during which our initial manuscript on the undo effect was repeatedly submitted and rejected, I had the opportunity to present my research at the ISRE meeting in 1996, held in Toronto. The invitation to present in this context was itself unprecedented because (at the time) ISRE meetings were open to members only and membership required having at least 5 publications within emotions research. Although I was starting my 2nd Assistant Professor position (having just moved from Duke University to the University of Michigan), I scarcely had 5 publications, let alone 5 publications on emotions. Motivated in part by the stringent membership rules of ISRE, a number of my peers had formed a parallel academic organization, the *Emotions Research Group*, or ERG, expressly as a forum for early-career emotions researchers to help cultivate and refine each other's work. As ERG gained momentum, the leadership at ISRE decided to make an exception to their standard membership requirement and deemed all members of ERG to be members of ISRE. In so doing, James Gross, then ERG President was invited to organize a symposium on "New Voices in Emotions Research" for the 1996 ISRE meeting. It was unprecedented for a collection of such junior researchers to have a reasonably large audience at this meeting. It was based on this symposium that Peter Salovey, then-editor of the new APA Journal, *Review of General Psychology*, invited those of us who presented to put together a Special Issue on emotions research for Volume 2 of his new journal.

Although our "New Voices" symposium was well received, it was not without sharp criticism. The sharpest of which, as I recall, was directed at me. After presenting my data on the undo hypothesis, I'd raised the possibility that the central concept of specific action tendencies simply didn't apply to the positive emotions. Whereas anger and fear spark the urge to fight or flee, respectively, alongside attendant autonomic activation, amusement

and contentment do not appear to evoke any particular actions or autonomic activation. What then, I wondered aloud, might be their evolved function? The function of positive emotions, I speculated, may well to undo the physiological aftereffects of negative emotions and I suggested that the data that I had presented reflected this undoing function.

A senior scientist in attendance challenged me with no small amount of emotion in his voice. He claimed that I had no basis to describe undoing as a function of positive emotions. At best, he argued, I could call it an "effect." Both his words and intonation hit me hard and I left the podium with less confidence and more doubts than I'd had when I approached it.

The unknown critic's words lingered with me for months.[ii] As I was preparing to write my contribution to the invited RGP Special Issue, I set my goal to develop a proper evolutionary argument for the function of positive emotions. I read the evolutionary psychologists of the day (particularly Barkow, Cosmides, & Tooby, 1992; Nesse, 1990; Tooby & Cosmides, 1990), and gathered up as many of the disparate strands of evidence that had then accumulated about positive emotions as I could find. This included work by Mihalyi Csikszentmihalyi, Alice Isen, and others. I puzzled over how my own evidence for the undo effect might fit together with Isen's work that showed that positive emotions "give rise to an enlarged cognitive context" (Isen, 1987, p. 222) and with Csikszentmihalyi's suggestion that flow, a form of positive emotion akin to interest, is marked by a momentary loss of self, and yet over time paradoxically augments the self (Csikszentmihalyi, 1990). Guided by the logic of evolutionary theorists, I paid close attention to the circumstances in which positive emotions occur, and the ancestrally recurrent problems of adaptation for which positive emotions might have served as a well-designed solution. Cataloging the

wide range of situations that evoked positive emotions made it clear to me that the simplistic pairing of negative emotions with survival and positive emotions with reproduction was inadequate. In the end, I also decided that the unknown critic was right. Undoing was unlikely to be the evolved function of positive emotions. It looked instead be the byproduct of a far more consequential function.

The function of positive emotions, as shaped over millennia by natural selection, I came to conclude, was to build an individual's resources for survival. The means by which this build function was achieved was by a momentarily broadened scope of awareness, creating a form of consciousness within individuals that included a wider array of thoughts, actions, and percepts than typical. This meant that negative and positive emotions alike came to be part of our universal human nature through selective pressures related to survival, albeit on vastly different timescales. Negative emotions carried adaptive significance in the moment that our human ancestors' experienced them as their associated action urges – e.g., to fight, flee, or spit – drove behaviors that saved life and limb. Positive emotions, by contrast, carried adaptive significance for our human ancestors over longer time-scales. Having a momentarily broadened mindset is not a key ingredient in the recipe for any quick survival maneuver. It is, however, in the recipe for discovery, discovery of new knowledge, new alliances, and new skills. In short, broadened awareness led to the accrual of new resources that might later make the difference between surviving or succumbing to various threats. Resources built through positive emotions also increased the odds that our ancestors would experience subsequent positive emotions, with their attendant broaden and build benefits, thus creating an upward spiral toward improved

odds for survival, health, and fulfillment. Figure 1 provides a graphic summary of this broaden-and-build theory of positive emotions.

This is what I offered as a new account of the evolved adaptive function of positive emotions in that RGP Special Issue (Fredrickson, 1998). It stated that positive emotions have been useful and preserved over human evolution because having recurrent, yet unbidden moments of expanded awareness proved useful for developing resources for survival. Little-by-little micro-moments of positive emotional experience, although fleeting, reshape who people are by setting them on trajectories of growth and building their enduring resources for survival. The broaden-and-build theory describes the form of positive emotions as to broaden awareness and their function as to build resources.

From the perspective of the freshly articulated broaden-and-build theory, the undoing effect of positive emotions was a by-product of the broaden effect. To the extent that positive emotions broadened an individual's accessible repertoire of thoughts and action urges, they would also serve to loosen the hold that any particular negative emotion might gain on an individual's mindset by virtue of its associated urge for specific action. One marker of the body's preparation for specific action is cardiovascular activation. If, by broadening people's mindsets, positive emotions can dismantle preparation for specific actions, they should also serve as efficient antidotes for the cardiovascular sequelae of negative emotions.

Another strand of evidence that swayed me from taking undoing to be the evolved function of positive emotions was the wide array of contexts in which positive emotions occur. If the undo effect captured the function of positive emotions, then the occurrence of positive emotions in contexts not characterized by prior negativity would need special

explanation. Given that most positive emotions are experienced independently from negative emotions, it seemed that should be the rule to be explained rather than the exception to the rule.

So the broaden-and-build theory was itself evoked by pointed criticism and my own initial negative emotional responses to it. Yet my wish to be open to that criticism and learn from it coaxed me to expand the scope of my thinking about positive emotions, which allowed me to discover more of their unsung value. The sharp words from that senior scholar at ISRE, then, became the irritating grain of sand that commanded my focus until it emerged as something more appealing and useful. Indeed I've come to view the development of the broaden-and-build theoretical framework as my pearl for having generated a string of hypotheses. It marked a turn away from near exclusive focus on the undo effect of positive emotions and toward a more encompassing focus on their abilities to broaden mindsets and build resources.

Evidence for the Broaden-and-Build Theory

The Broaden Hypothesis

The *broaden hypothesis*, drawn from the broaden-and-build theory, states that positive emotions, relative to negative emotions and neutral states, widen the array of thoughts, action urges, and percepts that spontaneously come to mind. This hypothesis was consistent with – and indeed inspired by – the extensive research program of the late Alice Isen and her collaborators. Isen and colleagues' work was exemplary for two reasons. First, she did not assume that positive and negative emotions were "opposites" and as such always compared the effects of positive emotions to the effects of neutral states in tightly controlled laboratory experiments. Second, bolstering generalizability, across studies she

and her colleagues used a wide range of techniques to induce positive emotions, ranging from having participants read a list of positive words, view cartoons or a short comedy clip, hear success feedback, or having them receive a small bag of candy as an unexpected gift. From Isen's experiments, we can conclude that people experiencing positive emotions show patterns of thought that are notably unusual (Isen, Johnson, Mertz, & Robinson, 1985), flexible and inclusive (Isen & Daubman, 1984; see also Bolte, Goschke, & Kuhl, 2003; Dreisbach & Goschke, 2004; and Compton, Wirtz, Pajoumand, Claus, & Heller, 2004;) , creative (Isen, Daubman, & Nowicki, 1987; see also Phillips, Bull, Adams, & Fraser, 2002; and Rowe, Hirsh, & Anderson, 2007), integrative (Isen, Rosenzweig, & Young, 1991), open to information (Estrada, Isen, & Young, 1997), forward-looking and high-level (Pyone & Isen, 2011), and efficient (Isen & Means, 1983; Isen, et al., 1991). Isen and colleagues' work also provides evidence that positive emotions broaden people's action urges, with experiments showing increased preferences for variety and openness to a wider array of behavioral options (Kahn & Isen, 1993; see also Renninger, 1992)

From the perspective of the broaden-and-build theory, I reasoned that the cognitive and behavioral effects of positive emotions that Isen and colleagues had previously uncovered were the downstream consequences of a more basic cognitive shift, one in which the boundaries of awareness stretch open a bit further during positive emotional experiences, enabling people to connect the dots between disparate ideas and thereby act creatively, flexibly, and with greater sensitivity to future time horizons. Although a slim amount of prior evidence supported the view that positive emotions broaden the scope of attention (see Basso, Schefft, Ris, & Dember, 1996; Derryberry & Tucker, 1992;each described in Fredrickson, 1998; see also Gasper & Clore, 2002), conclusiveness was limited

because this prior work did not include neutral comparison conditions. Noting this, my students and I set out to test the broaden hypothesis adopting methods from cognitive psychology that captured the breadth momentary awareness.

One experiment that I conducted in collaboration with Christine Branigan, for instance, used short film clips to induce positive, negative, and neutral states in University student participants using a between-participants design (Fredrickson & Branigan, 2005, Study 1). One strength of this work is that we tested the effects of two distinct positive emotions (amusement and contentment) and two distinct negative emotions (anger and anxiety), each relative to a neutral state. Our dependent measure of the scope of participants' attention was a variant of a global-local visual processing task, first developed by Navon (1977; see Figure 2). Immediately after viewing the randomly-assigned video clip, participants were shown a trio of figures and asked to choose which of two comparison figures (on the bottom) was most similar to the target figure (the top). While there are no right or wrong answers, one comparison figure always resembled the target figure in its global configuration (see lower left choice in each item shown in Figure 2), whereas the other comparison figure always resembled the target figure in its local detail elements (see lower right choice in each item shown in Figure 2). Past work had shown that personality traits associated with negative emotions – namely anxiety and depression – correlated with a bias to choose the local option, consistent with a narrowed scope of attention, whereas traits associated with positive emotions – namely subjective well-being and optimism – correlate with a bias to choose the global option, consistent with a broadened scope of attention (Basso, et al., 1996). Although our results for negative emotions were inconclusive, those for positive emotions clearly demonstrated that

temporary states of two distinct positive emotions broaden the scope of attention: Participants in both the amusement condition and the contentment condition chose the global option significantly more often than those in the neutral condition (Fredrickson & Branigan, 2005, Study 1).

In a second experiment that used the same sample and same five video clips to induce positive, negative, and neutral states, we examined the breadth of participants' action urges using a thought listing task (Fredrickson & Branigan, 2005, Study 2). Specifically, after the video clip ended, participants were asked to describe, in a word or two, the strongest emotion they felt while viewing the clip. Then, they were asked to step away from the specifics of the video clip and imagine being in a situation in which this particular emotion would arise, and then "*given this feeling*, please *list* all the things you would like to do *right now*." Participants were then given a form with 20 blank lines that began with "I would like to ____." We simply tallied the number of statements completed as an index of the breadth of participants' thought-action repertoire. Figure 3 presents the results. We found that positive emotions, relative to both the neutral state and the negative emotions, broadened people's repertoire of action urges. In this second experiment we also found marginal evidence that negative emotions, relative to the neutral state, narrowed people's repertoire of action urges (Fredrickson & Branigan, 2005, Study 2).

In later studies, again with University students, we used facial EMG to measure the frequency of participants' Duchenne (genuine) smiles during emotion inductions and related smile frequency to changes in their performance on cognitive tests of attentional breadth and attentional flexibility (Johnson et al., 2010). In the first of two studies, we examined facial EMG data while participants viewed one of several randomly-assigned

video clips known to elicit the positive emotions of joy or contentment, the negative emotions of anger or sadness, or emotional neutrality. The dependent measure in this study was a reaction-time based measure of global-local visual processing administered at baseline and then again following the emotion induction. In this task, participants were shown a large "T" (presented upright, inverted, or oriented toward the right or the left) made up of smaller images of the letter "T" (all also either upright, inverted, or oriented to the right or the left). Participants were to indicate, as quickly and accurately as possible, whether either the large or smaller letters were upright or inverted. Results showed that participants with frequent Duchenne smiles showed a significantly larger change (relative to their own baseline scores) in their bias toward global targets (Johnson et al., 2010, Experiment 1). In a second study, we used facial EMG to identify the Duchenne smiles emitted while participants read a series of 25 self-relevant statements written to induce elation, anger, or neutrality while listening to emotionally-consistent music. The dependent measure in this study was a covert attentional orienting task, developed by Posner (1980), again administered both at baseline and following the emotion induction. Participants' task was to respond, as quickly and as accurately as possible, to targets that appeared on either side of a central fixation point. On some trials these targets were uncued, whereas on other trials they were preceded by a brief visual cue that was either valid or invalid, meaning that it appeared either on the same or opposite side as the ensuing target, respectively. Changes in attentional flexibility were indexed by changes in the validity effect, calculated as the difference between reaction times to targets preceded by valid versus invalid cues. Results showed that participants with frequent Duchenne smiles showed the greatest increases in attentional flexibility (Johnson et al., 2010, Experiment 2).

Taken together, these two studies provide evidence that positive emotions, as indexed by the frequent expression of genuine (Duchenne) smiles, forecast broadened cognition, namely holistic processing and attentional flexibility. Notably, although, the randomly-assigned emotion induction did not predict cognitive shifts in either of these two experiments, these inductions did predict the frequency of Duchenne smiles. In turn, frequent Duchenne smiles predicted cognitive shifts. Importantly, our strategy of assessing cognitive processing at both baseline and following the emotion induction allowed us to conclude that smiling per se appears to drive the observed cognitive shifts rather than any stable personality traits associated with frequent smiling. So even in cases in which people's self-reported emotions do not forecast changes in the scope of their attention, we see that fleeting changes in facial muscle activity do. Smiling, then, doesn't just open the face, it also opens the mind.

Investigators in other laboratories have also found evidence to support the broaden hypothesis. Wadlinger and Isaacowitz (2006), for instance, used an eye-tracking apparatus to record the location and duration of participants' gaze 60 times per second as they viewed a sequence of 25 arrays of images from the International Affective Picture System (IAPS). Each array included one central image and two peripheral images in various locations. Within any single array, images were of the same affective valence, but between arrays, the images were selected to evoke positive, negative, or neutral affect states. Using Isen's classic technique, by random-assignment, university student participants were induced to feel either a positive emotion or a neutral state by receiving a small bag of candy either before or after the eye-tracking task. Specifically, they were asked to take in the slide show "naturally, viewing whatever interests you – as if you were watching a television

show." Compared to those in the neutral control condition, participants in a positive emotional state changed the focus of their gaze more frequently, and spent more total time looking at peripherally-located images. These data suggest that positive emotions broaden the scope of people's visual attention.

In a conceptually related experiment, Rowe, Hirsch and Anderson (2007) examined the effects of positive and neutral states, induced through music, on breadth of visual and semantic attention. They found that relative to sad and neutral states, positive states not only increased the scope of semantic access on a remote associates test (replicating classic work by Isen et al., 1987) but also increased the scope of visuospatial attention on a flanker task. Moreover, within the positive emotion condition, Rowe and colleagues observed a significant association between the span of visuospatial attention and the span of semantic attention, suggesting that broadened visual attention undergirds broadened semantic access (Rowe et al., 2007).

Particularly compelling evidence for the broaden effect of positive emotions comes from an elegant brain imaging experiment conducted by Schmitz, De Rosa, and Anderson (2009). Their empirical approach rested on well-validated evidence from cognitive neuroscience that one particular brain area, the extrastriate fusiform face area (FFA), reliably responds to human faces, whereas a distinct brain area, the parahippocampal place area (PPA) reliably responds to place processing. They assessed the breadth of participants' field of view in visual cortical encoding by showing them a series of compound images that featured human faces in a central location surrounded by images of houses. Participants were asked to indicate whether the face in each compound image was male or female, while ignoring the house that surrounded the face. Positive, negative, or neutral

states were induced in alternating blocks using IAPS images. The physiological indicator of emotion-related changes in scope of participants' field of view was the changes in blood flow within the PPA. Consistent with the broaden hypothesis, results showed greater activation in the PPA in the positive emotion conditions, relative to the neutral condition, suggesting that when under the influence of positive emotions, participants can't help but take in more of the contextual surround. Notably, this study also found decreased activation in the PPA in the negative emotion condition, relative to the neutral condition, consistent with the hypothesis that negative emotions narrow people's field of view (Schmitz et al., 2009).

Intriguing evidence consistent with the broaden hypothesis has also emerged in studies of stroke patients with visual neglect due to lesions in their parietal cortex. These patients are unable to perceive and act on information presented within the visual field opposite the brain lesion. Using both controlled behavioral tasks as well as brain imaging, researchers discovered that when such patients listen to pleasant music, they overcome their loss of awareness. That is, they are temporarily able to see and act on information that simply doesn't register for them while not listening to music, or when listening to music they don't like (Soto et al., 2009).

Positive emotions have also been linked with better steering performance for participants in a driving simulator, consistent with the theory that broadened visual awareness contributes favorably to steering performance (Trick, Brandigampola, & Enns, 2012). Experiments also show that relative to negative emotions and neutral states, positive emotions are associated with better task switching, especially when encountering novel information (Wang & Guo, 2008).

Evidence also suggests that the broaden effect of positive emotions extends into the social domain. Relative to those experiencing neutral states, people induced to feel positive emotions expand their circle of trust (Dunn & Schweitzer, 2005). They are also more likely to form inclusive social categories (Dovidio, Gaertner, Isen, & Lowrance, 1995; Isen, Niedenthal, & Cantor, 1992) and common in-group identities such that they are more likely to see "them" as "us" (Dovidio, Isen, Guerra, Gaertner, & Rust, 1998). Likewise, Johnson and I found that under the influence of induced positive emotions the own-race bias in face perception disappears completely (K. J. Johnson & Fredrickson, 2005). Consistent with these data, Nelson (2009) found that, compared to those in neutral states or negative emotions, people experiencing positive emotions show greater perspective-taking and compassion for a person from a dissimilar cultural background. The experience of positive emotions also predicts the breadth of connection, assessed as self-other overlap, incoming college students feel with their new roommates, as well as greater perspective-taking in their understanding of their roommates' actions (Waugh & Fredrickson, 2006).

Beyond expanding the scope of people's visual, semantic, and social awareness, positive emotions also appear to broaden people's physical demeanor. In studies conducted with Melissa Gross, we used effort-shape and kinematic assessments to characterize people's body moments during different emotional states. Participants wore close-fitting exercise clothes with 31 lightweight spherical markers taped over anatomical landmarks and then engaged in a range of warm-up activities, In a large laboratory equipped with six motion capture cameras, each participant walked across the room as they relived positive, negative or neutral emotional memories (Gross, Crane, & Fredrickson, 2012). This study included two distinct positive emotions – joy and contentment – and

each was marked by a more expansive torso shape, compared to neutral, and a more extended neck and thorax, compared to sadness. Conceivably, an upright posture of the upper body and neck would enable a wider scope of visual information and more freedom of movement than a flexed spine. Expanded bodies may thereby support expanded mindsets and behavioral repertoires. These commonalities also raise the possibility of a common neurological source for the embodiment of the open hearts and open minds that are characteristic of positive emotions.

Boundary conditions of the broaden effect have been uncovered as well. Work by Gable and Harmon-Jones (2008) for instance, examined participants' reaction times to respond to global-local visual targets after viewing either neutral images or images of delicious desserts. Having found less global focus of attention after people view desserts these authors argue that approach-related positive affect reduces the breadth of attention, as people narrowly focus on obtaining the object of their desire. These data are consistent with the speculation that I have made that positive emotions are distinct from physical pleasures (Fredrickson, 2001). While both carry a pleasant subjective feeling state, I posit that only positive emotions broaden awareness. By consequence, then, it may be that only positive emotions (and not physical pleasures) are be capable of having a long-term impact on the accrual of personal and social resources. Possibly consistent with this reasoning, researchers who have tested for the broaden effect following the pleasures induced by massage therapy have found no evidence for it (Finucane & Whiteman, 2007). Of course, null results are inherently ambiguous, so my speculations about the psychological differences between positive emotions and physical pleasures await further and more rigorous empirical test.

The Build Hypothesis

Evidence that supports the broaden effect of positive emotions provides initial support for the broaden-and-build theory. The form of the experience of positive emotions, this evidence suggests, is expansive. Under the influence of positive emotions people have wider perceptual access, wider semantic reach, more inclusive and connected social perceptions, and more relaxed and expansive bodily comportment. While the connections between and among these various forms of the broaden effect await further investigation, the broaden-and-build theory posits that the function of the expansive form of positive emotions is to spur the development of resources, placing people on positive trajectories of growth (Fredrickson, 1998, 2001, 2005). Consistent with this *build hypothesis*, ample research has shown that people who experience and express positive emotions more frequently than others are more resilient (Fredrickson et al., 2003), resourceful (Lyubomirsky, King, & Diener, 2005), socially connected (Mauss et al., 2011) and more likely to function at optimal levels (Fredrickson & Losada, 2005; Mauss et al., 2011).

Extending beyond such correlational evidence linking positive emotion experience to resourcefulness and optimal functioning, prospective evidence more specifically links positive emotional experience with future increases in resourcefulness and optimal functioning. Notably, the broaden-and-build theory posits that positive emotions, although fleeting, accumulate and compound over time in ways that incrementally build people's enduring resources. As such, tests of the build hypothesis defy test within one-time laboratory studies, requiring instead the frequent recurrence of positive emotional experiences plus sufficient time for resources to accrue. A number of studies that have met these criteria have uncovered evidence consistent with the build hypothesis. My students

and I found, for instance, that daily experiences of positive emotions predict increases over time in trait resilience, which are in turn associated with improved life satisfaction (Cohn, et al., 2009). Relatedly, Gable and colleagues found that positive emotional exchanges between partners within close relationships prospectively predict increases in relational resources over a two month period (Gable, Gonzaga, & Strachman, 2006; see also Algoe, Fredrickson, Gable, & Akers, 2012). Studying a sample of multiple sclerosis patients, Hart and colleagues found that positive emotions predict increases in the ability to find benefit in adversity (Hart, Vella, & Mohr, 2008).

A key extension of the prospective correlational approach to testing the build hypothesis has been to explore whether an upward spiral dynamic is produced by reciprocal prospective relations between positive emotionality and increased personal resources. That is, just as experiences of positive emotions forecast increases in personal resources, personal resources may reciprocally forecast increases over time in positive emotions. This mutual influence represents the upward spiral, depicted in Figure 1, that leads to higher levels of well-being and functioning over time.

In an initial investigation into positivity-triggered upward spiral processes, Thomas Joiner and I examined the reciprocal relations between positive emotional experience and the psychological resource of broad-minded coping, which captures the degree to which people can step back from their current problems and approach them from a big picture perspective. Results revealed both that positive emotions predicted increases over time in broad-minded coping, and that broad-minded coping predicted increases over time in positive emotions. Further analyses revealed that these two variables serially influenced each other. That is, initial levels of positive emotionality predicted later levels of positive

emotionality in part through changes in broad-minded coping; likewise, initial levels of broad-minded coping predicted later levels of broad-minded coping in part through changes in positive emotionality (Fredrickson & Joiner, 2002).

Subsequent work has replicated and extended this initial evidence for an upward spiral dynamic between positive emotions and personal and social resources in multiple ways. Continuing my collaboration with Joiner's research team, we found that a more encompassing, factor-analytically derived index of positive coping showed the predicted reciprocal and serial relations with positive emotions over time as did an index of interpersonal trust (Burns et al., 2008). Exploring the benefits of mindfulness training, Eric Garland, Susan Gaylord and I also found support for upward spiral dynamics in the reciprocal relations among positive reappraisals, trait mindfulness, and emotional well-being (Garland, Gaylord, & Fredrickson, 2011). In a longitudinal assessment of 258 secondary school teachers, Salanova and colleagues found that positive emotions at work (indexed as flow and intrinsic motivation) were reciprocally related both to personal resources (indexed as self-efficacy beliefs) as well as to organizational resources (indexed as social support and clear goals) in an upward spiral dynamic (Salanova, Bakker, & Llorens, 2006; see related work on "gain cycles" described in Ouweneel, Le Blanc, & Schaufeli, 2011; Salanova, Schaufeli, Xanthopoulou, & Bakker, 2010, and Salanova, Llorens, & Schaufeli, 2011).

Taking a deeper look into how today's optimal functioning begets future increases in optimal functioning through the experience of positive emotions, Lahnna Catalino and I examined the prospective and reciprocal relations among flourishing mental health, positive emotionality, and the cognitive resource of mindfulness (Catalino & Fredrickson,

2011). We found that people who flourish stand apart from their non-flourishing peers in the magnitude of the positive emotional boost they get out of everyday pleasant events, such as helping others, interacting, playing, learning, and spiritual activity. These bigger "boosts" in day-to-day positive emotion forecast greater gains over time in the cognitive resource of mindfulness, which in turn predicts increased levels of flourishing in an upward spiral dynamic.

In our first attempt to investigate the physiological substrate of upward spiral dynamics, Bethany Kok and I looked at the prospective and reciprocal relations between positive emotionality and the physical resource of cardiac vagal tone (Kok & Fredrickson, 2010). Vagal tone is assessed as the very slight yet functional arrhythmia in heart rate associated with respiration, marked by a decrease in heart rate during exhalation relative to inhalation (Grossman, 1983). As a key measure of parasympathetic influence on the heart, vagal tone is of particular interest not only because it has been related to trait positive emotionality (Oveis et al., 2009), but also because of its strong ties to both physical and mental health (Porges, 2007; Thayer & Sternberg, 2006). That is, vagal tone functions as a personal physical resource with implications for both cardiovascular and metabolic functioning as well as emotional and social well-being. Supporting the upward spiral hypothesis, our results demonstrated that vagal tone prospectively predicted increases in positive emotions over the span of two months and, reciprocally, that these increases in positive emotions prospectively predicted increases in vagal tone (Kok & Fredrickson, 2010). Taking vagal tone as a marker of physical health, these data show that people can become physically healthier through their experience of positive emotions.

The most decisive tests of the build hypothesis not only require longitudinal assessments together with measured (or presumed) positive emotional recurrence, but also the ability to randomly assign people to distinct emotional trajectories, and to link these emotional trajectories to longitudinal increments in resources. Together with my students, I made two initial attempts to reach this level of empirical rigor, yet each failed to provide the opportunity to test the build hypothesis experimentally because the interventions used, namely finding positive meaning in daily life events, did not reliably boost positive emotional experiences (e.g., see Footnote 3 in Cohn et al., 2009; see Footnote 3 in Fredrickson & Losada, 2005). With no differences in positive emotions between experimental groups, a causal test of the build hypothesis was not possible. In late 2004, while on the lookout for a more potent and reliable intervention to increase people's daily experiences of positive emotions, I was first exposed to loving-kindness meditation (LKM; Salzberg, 1995) in a faculty seminar on Integrative Medicine at the University of Michigan Medical School (led by Dr. Rita Benn). Emboldened by emerging empirical interest in the long-range effects of mind-training techniques (e.g., Davidson et al., 2003), and with grant support from NIMH, I launched an initial longitudinal field experiment of the effects of learning LKM on the experience of positive emotions and resource-building (Fredrickson, et al., 2008).

In the context of a workplace wellness program, we offered a 7-week meditation workshop to employees of a large computer company. The workshop was presented as an opportunity to learn techniques to "reduce stress." Two hundred and two volunteers completed an initial survey that assessed their life satisfaction, depressive symptoms and their status on a wide range of personal resources. They were then randomly assigned to

either our LKM meditation workshop or a monitoring waitlist control group. Over the next 9 weeks, both groups completed daily reports of their emotion experiences and meditation practice. About two weeks after the workshop ended, participants completed a final survey that reassessed their life satisfaction, depressive symptoms, and status on the same personal resources measured previously. At this same time, participants also provided a detailed account of the emotions they had experienced on that particular weekday (up to and including lunch) using the Day Reconstruction Method (DRM, Kahneman, Krueger, Schkade, Schwarz, & Stone, 2004).

First and most pivotally, our results showed that, compared waitlist participants, people randomly assigned to learn LKM did in fact experience increasing levels of positive emotions across the nine weeks of daily reporting. Figure 4 depicts this increase. Interestingly, we observed the predicted Time X Experimental Condition effect not only for our aggregate positive emotion score (computed from the mDES), but also for each of the nine specific positive emotions we assessed (inspiration was not yet an item on the mDES at the time of this study). In addition to random assignment to experimental condition, we found that individual effort, assessed as time spent meditating, also significantly predicted the daily experience of positive emotions, and did so increasingly over the nine weeks of assessment. Indeed, we observed that for participants in the LKM group, the dose-response relationship between the time they spent meditating and the positive emotional yield for their invested effort *tripled* over the course of the study. No comparable or inverse effects emerged for negative emotions whatsoever, suggesting that the effects of LKM are specific to positive emotions. Additionally, the DRM data revealed that the total number of hours spent in meditative activity over the previous 9 weeks predicted the amount of positive

(but not negative) emotions experienced on a typical weekday morning, especially when interacting with others.

The evidence that LKM reliably increased positive emotions was pivotal because it created the necessary platform from which we could test the build hypothesis. To do so, we combined a growth model for positive emotions with an SEM path analysis to test for mediation, as depicted in Figure 5, and tested it for each of the 18 resources assessed pre- and post-workshop. That is, we tested whether the slope of positive emotions predicted increases in resources (path B in Figure 5). We made our test of the build hypothesis more stringent by also requiring that any increase in resources produced by increasing positive emotions be consequential as evidenced by an increase in life satisfaction or a decrease in depressive symptoms (path C in Figure 5). Using these conjoint criteria, we found that 9 of the 18 resources we assessed provided support for the build hypothesis, including cognitive resources (i.e., mindfulness, pathways thinking, and the ability to savor the future), psychological resources (i.e., environmental mastery, self-acceptance, and purpose in life), social resources (i.e., social support received, and positive relations with others), and physical resources (i.e., a reduction in self-reported illness symptoms). These were the first experimental data to support the build hypothesis.

In subsequent work using this same longitudinal experimental design, my collaborators and I have added objective measures of physical resources, most notably by measuring cardiac vagal tone before and after people learn LKM. As noted previously, vagal tone has been related both to trait positive emotionality (Oveis et al., 2009) and to physical and mental health (Porges, 2007; Thayer & Sternberg, 2006). Our primary aim was to test the hypothesis that learning to self-generate positive emotions would serve to augment

vagal tone. In addition, because people with high vagal tone have been shown to be better able to regulate their attention and emotions (Porges, Doussard-Roosevelt, & Maiti, 1994), a secondary hypothesis was that these individuals would be poised to get the most out of their efforts to learn LKM.

Beyond extending our evidence for the build hypothesis into objective measures, this second field experiment on the effects of LKM allowed us to test whether the broaden effect of positive emotions accounts for its build effect. To do this, we added assessments of social connection following the daily reports of meditation practice and emotion experience. Specifically, participants called to mind their three longest social interactions of the day and, considering them as a set, rated how "in tune" and "close" they felt to the person/s in those interactions. Based on our previous evidence that positive emotions broaden people's felt social connections as indexed by perceptions of self-other overlap (Waugh & Fredrickson, 2006), we consider these daily ratings as offering an index of broadened social awareness.

Our results replicated the finding that participants randomly assigned to the LKM workshop effectively learned to self-generate increasingly more positive emotions in daily life. In addition, results showed that pre-workshop vagal tone moderated this effect, supporting our hypothesis that participants with higher vagal tone would experience the largest increases in positive emotions. Moreover, the upward slope in week-by-week positive emotions also predicted an upward slope in week-by-week reports of social connection. Plus, the two experimental groups differed in their change in vagal tone over the course of the study, with those in the LKM group, on average, showing a significantly larger increase. We tested the plausible causal pathways of this effect on vagal tone by

using a variant of a mediational, parallel process latent curve model. The overall model fit provided strong support for the build hypothesis, as well as for mediation by broadening and moderation by initial vagal tone. In other words, the upward slope in positive emotions accounted for the upward slope in broadened reports of social connection, and positive emotions and social broadening in turn mediated the effect of LKM on the increase in vagal tone, all of which was moderated by initial vagal tone. This is the first experimental evidence that supports both aspects of the broaden-and-build theory: that positive emotions build consequential resources, in this case, vagal tone, through the effect they have on broadened awareness, in this case, by making people feel closer, more connected, and in tune with others in daily life (Kok, Coffey, Cohn, Catalino, Vacharkulksemsuk, Algoe, Brantley, & Fredrickson, 2012).

In more recent experimental work, Kok and I tested whether a very minimal social connection intervention might produce similar effects on positive emotions and vagal tone as does the more intensive LKM workshop (Kok & Fredrickson, 2012). The intervention in this case was simply the two questions to which people were asked to respond concerning their longest social interactions of the day, as used in the previous study. Specifically, participants rated how "close to" and "in tune with" their interaction partners they felt each day for 49 consecutive days. We were inspired to test this very minimal intervention because our first longitudinal study that included these two questions daily was the first study in which we'd ever found that daily positive emotions increased for all participants – even for those within the waitlist control group, and this increase predicted an increase in vagal tone. I described these findings earlier, as reflecting an upward spiral between positive emotions and vagal tone (Kok & Fredrickson, 2010). To test whether merely

reflecting on social connections might *cause* upswings in positive emotions with attendant increases in vagal tone, we randomly assigned participants to reflect either on these two social connection questions, or on two placebo questions that inquired how "useful" and "important" their three longest tasks that day had been for them. As hypothesized, participants randomly assigned to the social connection condition reported significantly greater week-by-week increases in their positive emotions (with no parallel or opposing pattern for their negative emotions). In addition, experimental condition produced increases in vagal tone, an effect mediated by the upswing in positive emotions. As in our past work, we also found that initial levels of vagal tone moderated these effects, yet this time, participants with low vagal tone were the ones to experience the biggest positive emotion uplift from the intervention. We speculate that because low vagal tone is associated with lower social skill and lesser ability to regulate one's own attention and emotions, this very minimal intervention may have matched the skill levels for people low on vagal tone, but may have been too elementary, and therefore more frustrating, for those high in vagal tone (Kok & Fredrickson, 2012). In any case, in support of the build hypothesis, it appears that when people learn to self-generate more frequent positive emotions – either through meditation or through more elemental shifts in their attention – they launch themselves onto positive trajectories of growth

New Frontiers for the Broaden-and-Build Theory

Deeper Investigations into Biological Resources Built

Some of the latest evidence from my PEP Lab documents that people who can cultivate more frequent positive emotions can shift their characteristic cardiovascular patterns toward health, as indexed by increases in vagal tone (Kok et al., under review).

Inspired by these data, the PEP Lab is now engaged in testing whether people's efforts to increase their daily diets of positive emotions build other biological resources for health as well. In a project currently underway (funded by the National Institute for Nursing Research through the NIH initiative to advance the Science of Behavior Change), we are investigating whether, in addition to increasing vagal tone, a stable rise in positive emotions also yields enduring increases in tonic oxytocin levels, as assessed in urine samples gathered over a 24-hour period, and enduring reductions in systolic and diastolic blood pressure. Karen Grewen and Kathleen Light are key PEP Lab collaborators on this work. Previously, oxytocin could only be assessed reliably in humans from plasma or cerebral spinal fluid. Recent breakthroughs have led to new methods to assay oxytocin noninvasively, through enzyme immunoassay (EIA) of urine samples, a procedure pioneered by Grewen and Light (Grewen, Girdler, Amico, & Light, 2005; Grewen, Light, Mechlin, & Girdler, 2008; Light, Grewen, & Amico, 2005; Light et al., 2004). Our approach of collecting 24-hour urine samples as people behave normally in their home environments allows us to infer characteristic and presumably stable levels of oxytocin. We conceptualize higher tonic levels of oxytocin as a biological resource for health based on past evidence that higher oxytocin levels predict lower blood pressure and reduced stress.

In this same project, we also venture into social genomics by investigating whether a stable rise in positive emotions also produces reliable changes in gene expression, particular within genes related to the immune system's regulation of inflammatory processes. Our interest in inflammation was inspired by the cytokine theory of depression, which asserts that basal production levels of inflammatory mediators in peripheral tissues signal the brain to produce "sickness behaviors" including decreased positive affect and

motivation and increased negative affect and social withdrawal (Dantzer, 2001; Dantzer & Kelley, 2007). Steve Cole is a key PEP Lab collaborator on this work. Cole's pioneering bioinformatics approach to social genomics has linked the increased expression of pro-inflammatory cytokine genes to various circumstances replete with chronic negative affect, such as loneliness (Cole et al., 2007), social stress (Miller et al., 2008; Miller, Rohleder, & Cole, 2009), low socioeconomic status (Chen et al., 2009), and general social adversity (Cole et al., 2010). Our current work not only extends human social genomics into the domain of positive emotions, but also expands it from correlational to experimental designs, which will substantially enhance understanding of how people's patterns of emotion experience and expression may alter their patterns of gene expression, with attendant consequences for physical health. We are thus poised to discover whether to and what extent positive emotions function to build cellular resources.

Clinical and Organizational Applications

Putting the broaden-and-build theory to use with aims to alleviate psychological disorders or optimize organizational functioning has become a growing interest. One line of clinical application emerged following a presentation I made on the PEP Lab's first LKM field experiment to the Clinical Psychology Doctoral Program at the University of North Carolina – Chapel Hill. Noting that LKM increased people's ability to savor future events (Fredrickson et al., 2008), my UNC colleague and schizophrenia expert, David Penn suspected that it might also be particularly helpful for individuals experiencing the negative symptoms of schizophrenia. Unlike the positive symptoms of schizophrenia, which include hallucinations and delusions, negative symptoms involve a variety of intertwined emotional and behavioral deficits, including anhedonia (diminished pleasure),

avolition (diminished motivation), asociality (diminished interest in or desire for interpersonal interactions), alogia (diminished speech), and blunted affect (diminished expression of affect). Negative symptoms are especially vexing because they are resistant to treatment and greatly diminish the quality of life. Ann Kring, a schizophrenia researcher at UC Berkeley, has proposed that individuals with schizophrenia experience normal levels of positive emotions, or consummatory pleasure, when they directly engaged in enjoyable activities, yet suffer disturbances in the experience of positive emotions in relation to future activities, or anticipatory pleasure (Kring, 1999). Both self-report and fMRI data support this distinction (Gard, Kring, Gard, Horan, & Green, 2007; Juckel et al., 2006). Penn, together with David Johnson, a graduate student at that time, put Kring's proposal together with the PEP Lab's finding on savoring the future, and suggested that we collaborate to explore whether LKM, used as an adjunctive treatment to medication, could reduce negative symptoms for individuals with schizophrenia. To pilot this idea, we conducted an open trial across two LKM group-based workshops with 18 outpatients at the University of North Carolina Hospitals. Our results were promising. First, the overall attendance rate was 84%, which is remarkable for clients with negative symptoms who are known to have difficulties with motivation and social interaction. More importantly, however, clients showed significant improvements in their negative symptoms as well as their positive emotions and life satisfaction, all of which maintained at 3-month follow-up (Johnson et al., 2011; see also Johnson et al., 2009).

Extending from these promising initial data on schizophrenia, I have worked with Eric Garland and colleagues to articulate more precisely how the upward spiral dynamics triggered by positive emotions might be used to counter the downward spiral dynamics of

negativity that characterize a number of emotion dysfunctions and deficits in psychopathology (Garland & Fredrickson, in press; Garland et al., 2010). Emotions, we point out, are self-organizing systems that operate to maximize and maintain their own existence. Despair, for example, triggers narrowed, ruminative and pessimistic patterns of thought alongside behavioral withdrawal and sluggishness, thought-action tendencies that serve to increase the odds that despair will continue and exacerbate in a self-destructive cycle. Positive emotions, by contrast, trigger broadened, curious, and optimistic patterns of thought together with more spontaneous and energetic behavior. These thought-action tendencies increase the odds that people find positive meaning in their future circumstances in ways that seed further positive emotions that decrease stress, provide emotional uplift, and support resilience. Figure 6 depicts this process. We propose that upward and downward spirals are not mirror opposites. Beyond their differences in valence and direction, upward spirals are more open, permeable, flexible, and social than downward spirals. These distinctions may thus make positive emotion, and the broadened thought-action repertoires and upward spirals they trigger, linchpins in the prevention and treatment of the inertia often observed among those with clinical disorders, particularly depression and anxiety.

The broaden-and-build theory has also been applied within organizations with an eye toward creating workplace climates that foster innovative ways to build more sustainable business practices that both promote workers' health and inspire their productivity (Vacharkulksemsuk, Sekerka, & Fredrickson, 2011). As just one example, in a study of workers from a broad range of organizations with their immediate supervisors, Carson and colleagues found that the positive emotions that supervisors have at the

intersections of their work and family lives cross over to create similar positive experiences for their subordinates. This positive contagion effect was found to be mediated by subordinates' perceptions of greater autonomy in setting their work schedules, and ultimately led to improvements in their job performance (Carlson, Kacmar, Zivnuska, Ferguson, & Whitten, 2011). Another, massive organizational intervention, based in part on broaden-and-build principles, is now underway in the U.S. Army, under the auspices of the army-wide Comprehensive Soldier Fitness initiative (Cornum, Matthews, & Seligman, 2011). Training soldiers in basic skills associated emotional fitness, including the ability to increase the frequency and duration of positive emotions is part of the Army's overall efforts to build greater resilience to the inevitable adversity and trauma that soldiers experience during deployment to warzones (Algoe & Fredrickson, 2011; see also Luthans, Vogelgesang, & Lester, 2006).

Offshoots from the Broaden-and-Build Theory

The Upward Spiral Theory of Lifestyle Change

A current overarching goal of my PEP Lab is to investigate whether and how positive emotions alter people's bodily systems and nonconscious motives in ways that ultimately reinforce lifestyle change, defined as sustained adherence to positive health behaviors. The U.S. National Cancer Institute recently put forth the question "Why don't more people alter behaviors known to increase the risk of cancers?" (NIH RFA-CA-11-011). The need to address this question is enormous, given that the American Cancer Society estimates that 62% of all cancers could be prevented altogether through lifestyle change. Yet the question has long defied a rigorous and satisfying answer because too often we've assumed that knowledge is power. People *know* that their daily behavioral choices – about

their physical activities and intake of food, tobacco, and alcohol – accumulate and compound to set their risks for cancer and other chronic diseases that shorten lives. Armed with this knowledge, millions resolve to make changes each year. Yet most attempts at lifestyle change fail because knowledge is not powerful enough to override implicit nonconscious desires.

An intriguing association between positive emotions and lifestyle change first emerged in my lab when my former student and collaborator Michael Cohn conducted a follow-up to our initial study (Fredrickson et al., 2008) of the effects of learning how to self-generate more frequent positive emotions through LKM. Our results, presented in Figure 7, showcase the substantial power of positive emotions to predict sustained behavior change: Individuals one standard deviation above the mean in their positive emotional response to their newly-adopted health behavior of LKM were ~4.5 times more likely to main that behavior 15 months later, compared to those one standard deviation below the mean (Cohn & Fredrickson, 2010). The extent of people's early positive emotional reactivity to LKM was the sole psychological predictor of whether, more than one year later, they voluntarily choose to continue meditating as a regular habit.

These and other data inspired me to develop a new theoretical offshoot of the broaden-and-build theory, one that I call the *upward spiral model of lifestyle change*. This model states that positive emotions can both knit people to new positive health behaviors and also raise their overall psychological propensity for a suite of wellness behaviors. Positive emotions achieve what New Year's resolutions cannot by motivating sustained adherence to health behaviors by the carrot of flexible, nonconscious desire rather than the whip of rigid, conscious willpower. The upward spiral model of lifestyle change expands

on the broaden-and-build theory substantially by articulating key roles for (a) nonconscious motives sparked by positive emotions; (b) a range of wellness behaviors through which individuals become more active, curious, and socially engaged, and ultimately healthier and more resilient; and (c) individual differences in mutable resources, both biological (e.g., oxytocin, cardiac vagal tone, inflammation) and psychological (e.g., resilience, other-focus, mindfulness), that predispose certain people to successful long-term lifestyle change by moderating the positive emotion yield of their wellness behaviors.

The spiral frame of this new model rests on evidence that the relations between emotions and lifestyle-relevant resources is reciprocal. For example, whereas Co-Investigator Cole's past work suggests that negative emotionality prompts pro-inflammatory processes, experimental work by Eisenberger and colleagues documents the reverse causal pathway, from inflammation to affect (Eisenberger, Inagaki, Rameson, Mashal, & Irwin, 2009). Specifically, these investigators randomly assigned healthy adult volunteers to receive either an inflammatory challenge (i.e., an injection of endotoxin) or a placebo injection. Those under the influence of endotoxin reported increased feelings of social disconnection, which in turn increased depressed mood. In line with the cytokine theory of depression, this and other work suggests that inflammation by itself can alter the affective properties of social and other wellness behaviors. Evidence for such reciprocal and mutual influence can explain the downward spiral dynamic that emerges between negative emotions and negative health behaviors that can lead to the further entrenchment of inflammation-related chronic diseases, such as type II diabetes, cardiovascular disease (both hypertension and stroke) and arthritis.

Preliminary evidence supports my hypothesis that an opposing upward spiral dynamic can emerge between positive emotions and positive health behaviors. As described earlier, a range of biological and psychological resources – namely vagal tone, oxytocin, resilience, other-focus, and mindfulness – not only predict enhanced positive emotions, but also have been shown to increase with enhanced positive emotion (Burns et al., 2008; Cohn et al., 2009; Fredrickson et al., 2008; Holt-Lunstad, Birmingham, & Light, 2008; Kok & Fredrickson, 2010; Oveis et al., 2009; Waugh & Fredrickson, 2006). This reciprocal causality sets the stage for upward spiral processes to unfold that can further reinforce adherence to positive health behaviors.

Another key driver of the upward spiral dynamic between positive emotions and positive health behaviors posited by the upward spiral model is the nonconscious incentive salience, or "wanting" that any past pleasant experience engenders. This aspect of the theory stems from recent advances in behavioral neuroscience that unpacks the complex reward system into separate "liking" and "wanting" systems, fueled by opioid and dopamine activation, respectively (Berridge, 2007). Over time, "liking" a given activity – the situated experience of positive affect – precedes and produces cue-triggered "wanting" for that same activity – which in turn motivates decisions to repeat that activity, even nonconsciously. Through such dopaminergic Pavlovian learning, cues associated with past pleasant experiences gain nonconscious incentive salience and become intrinsically alluring as if covered in eye-catching glitter dust. In the case of drug addictions, "wanting" becomes decoupled from "liking" as addicts attempting recovery experience intense cravings triggered by behavior-related cues (e.g., drug paraphernalia) even though the drug no longer provides pleasure (Robinson & Berridge, 2003). The novel premise of the

upward spiral model is that the same nonconscious, biologically-based processes that underlie people's unbidden cravings to enact unhealthy lifestyles can be harnessed to foster similar, yet positive cravings to enact healthy lifestyles, making cues to positive health behaviors sparkle with incentive salience that nonconsciously prompts behavioral adherence. Whereas both physical pleasures and positive emotions carry the pleasant subjective feel that sparks nonconscious incentive salience, or "wanting," as I suggested earlier, it appears that only positive emotions – and not pleasures – broaden cognition. As such, positive emotions appear to have unique psychological properties beyond triggering approach-related motivation. Perhaps most significantly, positive emotions, in widening people's awareness, engender flexible and creative behavioral choices rather than rigidly-pursued behavioral addictions.

Figure 8 provides a conceptual depiction of the upward spiral model. This new model incorporates the broaden-and-build theory as the outer loop of a dual-layered spiral. This layer, as this chapter has shown, rests on the now substantial evidence that positive emotions broaden cognition and build resources. The inner loop of the dual-layered spiral incorporates Berridge's perspectives on liking versus wanting and positions nonconscious motives rooted in positive emotions (as distinct from physical pleasures) as key drivers of flexible – and therefore sustainable – decisions to maintain wellness behaviors. Tethering the outer and inner loops together, the model posits that certain biological and psychological resources, known to be built up through repeated experiences of positive emotions also serve to increase the subsequent positive emotion yield of a range of wellness behaviors. According to the upward spiral model, to the extent that a new wellness behavior evokes positive emotions, engaging in that behavior generates both (a)

cue-triggered nonconscious motives that shape subsequent behavioral decisions, represented by the inner loop depicted in Figure 8, and (b) increases in key biological and psychological resources that boost the subsequent positive emotion yield of that wellness behavior, as represented by the outer loop of the spiral, and most critically, by the causal arrow that runs between the inner and outer loops (see Figure 8). The PEP Lab has a series of longitudinal studies underway (supported by NINR and NCI) to test this new theoretical offshoot of the broaden-and-build theory.

Positivity Resonance: Broaden-and-Build in Sync with Others

Back in my initial presentation of the broaden-and-build theory (Fredrickson, 1998), I included love as one of four positive emotions featured, the others being joy, interest, and contentment. Love is complex, however, in that most theorists acknowledge that love is not a single emotion and that people experience varieties of it (e.g., romantic or passionate love vs. companionate love vs. nurturant love vs. attachment love). Moreover, love experiences need to be distinguished from love relationships. Whereas the latter might last a lifetime, the former, my focus here, last only moments. Back in 1998, I adopted a perspective on love that I'd found in Carroll Izard (1977) work, that love is comprised of any other positive emotion that is felt in the context of people's connections with others. As Izard put it, "acquaintances or friends renew your interest by revealing new aspects of themselves and the resulting increase in familiarity (deeper knowledge of the person) brings joy [and contentment]. In lasting friendships or love relationships this cycle is repeated endlessly." (1977, p. 243).[iii] So as I forecast in earlier and in Table 1, my initial theorizing on broaden-and-build processes presented love as an "all of the above" positive emotion. To the extent that love triggered the more specific moments of interest,

contentment, joy, and the like, it also broadened people's thought-action repertoires and build their enduring personal resources, particularly their social bonds.

Viewing love as any positive emotions shared between two or more people is a reasonable initial description of love to be sure. Looking back, however, I see that it does not go nearly far enough to fully describe what happens in those potent interpersonal moments of shared positivity. In my most recent theorizing on love (Fredrickson, in press), I add two further defining attributes of this most ubiquitous and consequential positive emotion, in addition to shared positivity. These are biobehavioral synchrony and mutual care.

Biobehavioral synchrony refers to the mirroring across people's behaviors, bodies, and brains that each moment of shared positive emotional connection creates. Studying the nonverbal gestures of two people just getting to know one another, Tanya Vacharkulksemsuk and I have found that nonverbal behavioral synchrony is a key mechanism through which self-disclosure produces an embodied sense of rapport (Vacharkulksemsuk & Fredrickson, 2012). Studying changes in oxytocin within parents and their infants engaged in face-to-face play, Ruth Feldman and colleagues have discovered that positivity-infused behavioral synchrony – the degree to which a mother, through eye contact and affectionate touch, laughs, smiles, and coos in time together with her infant – predicts a synchrony between the oxytocin surges evident within both her and her infant. The same pattern of oxytocin synchrony also emerges for fathers and their infants (Feldman, Gordon, & Zagoory-Sharon, 2010). Another indication of biological synchrony can be drawn from the brain imaging work of Uri Hasson and colleagues. Using fMRI of people's brains while either telling or listening to an engaging story, Hasson and colleagues

find widespread brain coupling between speaker and listener, especially during emotional moments and for pairs for whom communication is particularly effective (Hasson, 2010; Hasson, Nir, Levy, Fuhrmann, & Malach, 2004; Stephens, Silbert, & Hasson, 2010). It appears, then, that when people share a positive emotional state, they also share gestural, biochemical, and neural patterns. A biobehavioral unity or oneness unfolds.

Like all emotions, love sparks motivational changes. Beyond the thought-action tendencies associated with whichever particular positive emotion is at that moment shared, love motivates mutual care. Each person, in a moment of shared positivity, becomes momentarily invested in the other's well-being. This is an idea I draw from crossing emotions science with relationship science. The momentary experience of love brings an urge to focus on the other person, holistically, with care and concern for his or her well-being, a motive that momentarily eclipses any tendency toward self-absorption. And this caring motive is mutual, reflected back-and-forth between the two. Whereas relationship scientists cast caring and responsive investment in the well-being of another for his or her own sake as a hallmark of intimate and loving relationships (Hegi & Bergner, 2010; Reis, Clark, & Holmes, 2004), I see mutual care as a momentary state that rises and falls in step with changes in context and emotion.

I call this trio of occurrences *positivity resonance* (Fredrickson, in press). Within moments of interpersonal connection that are characterized by this amplifying synchrony – of shared positive emotions, biobehavioral synchrony, and mutual care – resource-building positivity resonates between and among people. This back-and-forth reverberation of positive emotional energy sustains itself – and can even grow stronger – until the momentary connection inevitably wanes.

Indeed, I posit sensory and temporal connection as a fundamental precondition for moments of positivity resonance to emerge (Fredrickson, in press). Neither abstract nor mediated, connection like this is physical and unfolds in real-time, as gained through eye contact, touch, shared voice, or mirrored body movements.

Eye contact appears to be especially powerful (Farroni, Csibra, Simion, & Johnson; Niedenthal, Mermillod, Maringer, & Hess, 2010). Eye contact, studies show, is necessary for facial mimicry to unfold (Schrammel, Pannasch, Graupner, Mojzisch, & Velichkovsky, 2009), and facial mimicry, in turn, is needed to accurately decode what another person is feeling (Maringer, Krumhuber, Fischer, & Niedenthal, 2011). According to Niedenthal and colleagues' *Simulation of Smiles (SIMS) model* (Niedenthal et al., 2010), brain coupling mediates the effect of facial mimicry on decoding accuracy, whereas eye contact moderates the effect.

Extending the ideas on embodied cognition presented in the SIMS model, I have proposed that the evolved adaptive function of spontaneous and genuine smiles – what have been termed Duchenne smiles – goes beyond what other theorists have suggested. Following Darwin (1872), Ekman and colleagues contend that such smiles evolved as an outward expression of a person's otherwise unseen inner subjective state (Ekman, Davidson, & Friesen, 1990). An opposing view shifts the focus onto the recipient of a smile, and proposes that smiles evolved not because they provided readouts of positive emotional states, but instead because they evoked positive emotions in those who meet a smiling person's gaze (Owren & Bachorowski, 2003; see also Gervais & Wilson, 2005). Maintaining the focus on the person who meets the smiler's gaze, the embodied cognition perspective of the SIMS model suggests that, through neural simulation, smiles tune an observer toward a

better understanding the smiler's subjective experience and motives (Niedenthal et al., 2010). Each of these accounts of the function of genuine smiles seems viable, albeit I've argued that each remains incomplete by remaining anchored too exclusively within an individual-level psychology.

Stepping up to the dyadic level, in which both the smiler and the smile recipient play equal and important roles, I have proposed that the function of Duchenne smiles is to create a moment of intersubjectivity characterized by positivity resonance, as reflected by the trio of love's features: a now shared positive emotion, biobehavioral synchrony, and an orientation toward mutual care (Fredrickson, in press). Harkening back to the broaden-and-build theory, to the extent that positivity resonance builds resources in individuals and in dyads, genuine smiles may have evolved to spur positive psychosocial development and improved physical health in individuals, relationships, and indeed whole communities. Casting love as a moment of positivity resonance, then, offers a detailed evolutionary perspective on how genuine smiles do good both within the body and within society.[iv]

Recalling the recent evidence (from my PEP Lab) that shows that positive emotions improve physical health, as indexed by increases in cardiac vagal tone, *through people's experiences of social connection* (Kok et al., under review), leads me to speculate that love, defined as a form of social connection marked by positivity resonance, may perhaps be the most generative and consequential of all positive emotions. That is, I hypothesize that love broadens and builds to a greater degree than other, individually-experienced positive emotions. Love, then, may not be just another positive emotion. By virtue of being a single state, distributed across and reverberating between the brains and bodies of two (or more)

individuals, love's ability to broaden mindsets and build resources may have substantially greater reach.

Closing Comments

The science of positive emotions has matured greatly since the 1990s, when I first began work in this area. This maturity is reflected in the emergence of the first and second edited volumes devoted exclusively to empirical research on positive emotions, namely the *Handbook of Positive Emotions*, edited by Michele Tugade, Michelle L. Shiota, and Leslie Kirby, forthcoming from Guilford Press, and the *Dark and Light Sides of Positive Emotions*, edited by June Gruber and Judith Moskowitz, forthcoming from Oxford University Press. It has been equal parts gratifying and humbling to see that the broaden-and-build theory has offered one generative framework for sustained empirical contributions in this now-active area of emotions science.

Perhaps the most pivotal nudge that the broaden-and-build perspective has offered the field is to fully untether our collective scientific imagination about the value of positive emotions. Evidence for the broaden and undo effects of positive emotions demonstrates that fruitful advances can be made by looking beyond the emotional rewards that good feelings bring. Likewise, evidence for the build effect of positive emotions shows that it pays to look beyond the experiential moment to understand the function of these positive states over the long-term. Now, new theorizing about positivity resonance suggests that we may also need to look beyond the familiar individual-level psychological processes to better grasp the full potential of positive emotions.

To be sure, the empirical discoveries made thus far about positive emotions raise many more questions. Additional empirical work is still needed. We have only the

slimmest empirical literature, for instance, on the neuroscience of positive emotions (for exemplary contributions see work by Adam Anderson's lab at the University of Toronto and Tor Wager's lab at the University of Colorado at Boulder). We also need to expand further into epigenetics, to chart how positive emotional processes build cellular resources (social genomics pioneer Steve Cole collaborates with my PEP Lab in this area). We also need far more work on the differences and similarities in the ways positive emotions shape, and are shaped by, distinct cultures around the globe (for exemplary contributions, see work by Jeanne Tsai's lab at Stanford University and Shigehiro Oishi's lab at the University of Virginia; see also Lee, Lin, Huang, & Fredrickson, 2012). Finally, although many of the momentary and downstream effects of positive emotions are beneficial, we can't assume that they are exclusively or invariably so. Additional studies are needed to explore the boundary conditions of the benefits of positive emotions as well as their potential dark sides (For exemplary work in this vein, see work by June Gruber's lab at Yale University; see also McNulty & Fincham, 2012; Vincent, Emich, & Goncalo, in press).

When I consider the current cadre of creative and impeccably-trained early-career scientists who have already devoted considerable empirical attention to the science of positive emotions, I feel confident that the light-hearted aspects of human experience will never again be cast out of psychological science. With continued application of the most rigorous empirical approaches, our empirical understanding of positive emotions will broaden and build and perhaps even yield discoveries important enough to rid psychology of its long-held inferiority complex once and for all. Time and data will tell.

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Table 1. Ten Representative Positive Emotions

Emotion Label	**Appraisal Theme**	**Thought-Action Tendency**	**Resources Accrued**	**Core trio in mDES item**
Joy	safe, familiar, unexpectedly good	play, get involved	skills gained via experiential learning	*joyful, glad, or happy*
Gratitude	receive a gift or benefit	creative urge to be prosocial	skills for showing care; loyalty; social bonds	*grateful, appreciative, or thankful*
Serenity (a.k.a., Contentment)	safe, familiar, low effort	savor and integrate	new priorities; new views of self	*serene, content, or peaceful*
Interest	safe, novel	explore, learn	knowledge	*interested, alert, or curious*
Hope	fearing the worst, yearning for better	plan for a better future	resilience; optimism	*hopeful, optimistic, or encouraged*
Pride	socially valued achievement	dream big	achievement motivation	*proud, confident, or self-assured*
Amusement	non-serious social incongruity	share joviality, laugh	social bonds	*amused, fun-loving, or silly*
Inspiration	witness human excellence	strive toward own higher ground	motivation for personal growth	*inspired, uplifted, or elevated*
Awe	encounter beauty or goodness on a grand scale	absorb and accommodate	new worldviews	*awe, wonder, amazement*
Love	any/all of the above in an interpersonal connection	any/all of the above, with mutual care	any/all of the above, especially social bonds	*love, closeness, or trust*

Figures

Figure 1. The broaden-and-build theory of positive emotions. (adapted from Fredrickson & Cohn, 2008, Figure 48.1).

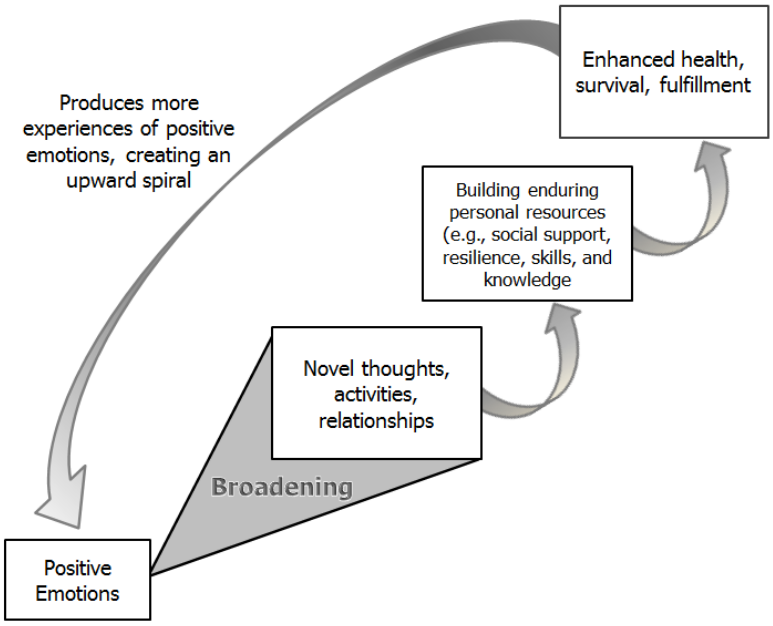
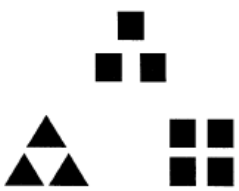
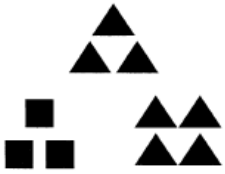


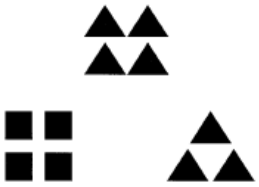
Figure 2. Sample global-local items used to test the broaden hypothesis (adapted from Fredrickson & Branigan, 2005, Figure 1).



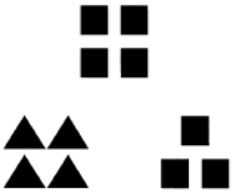
1a. Global-Local Item #13



1b. Global-Local Item #9



1c. Global-Local Item #4



1d. Global-Local Item #1

Figure 3. Thought-action repertoire size by emotion condition. Note: Penguins and Nature elicited amusement and contentment, respectively. Witness and Cliffhanger elicited anger and fear, respectively. Sticks elicited no particular emotion whatsoever. (adapted from Fredrickson & Branigan, 2005, Figure 3)

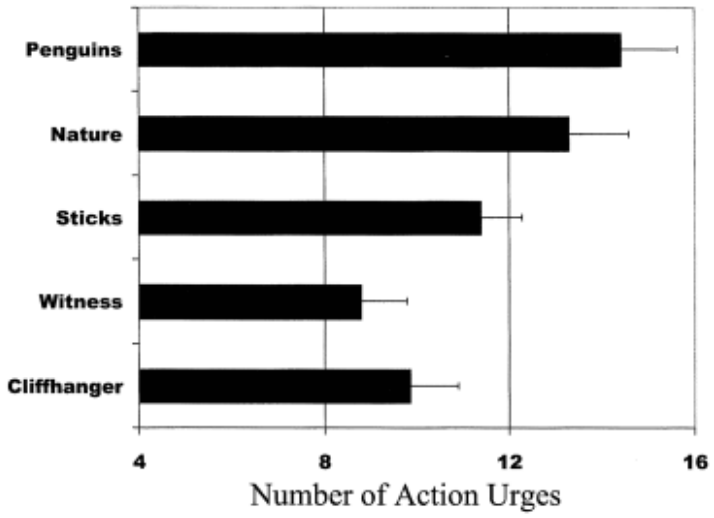


Figure 4. Week-by-week positive emotions by experimental condition. Note: Meditation training centered on loving-kindness meditataion. Positive emotions were computed as the mean across all positive states on the mDES, rated on a scale from 0-4. (adapted from Fredrickson et al., 2008, Figure 2).

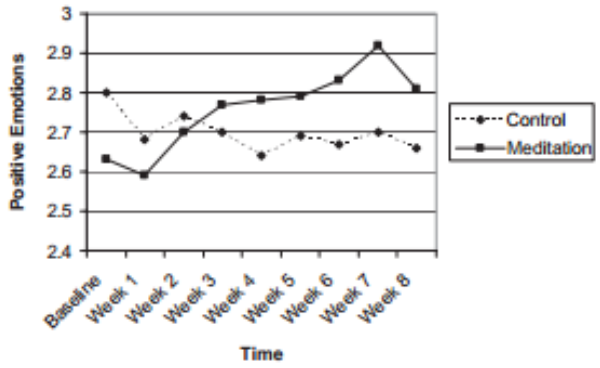


Figure 5. Combined latent trajectory and path-analysis model used to test the build hypothesis in the context of meditation training. Avg. daily pos. emo. = Average daily positive emotions; PE = positive emotions; SWLS = satisfaction with life. Paths labeled B and C are central to tests of the build hypothesis, whereas those labeled A and D serve as statistical controls. (adapted from Fredrickson et al., 2008, Figure 3).

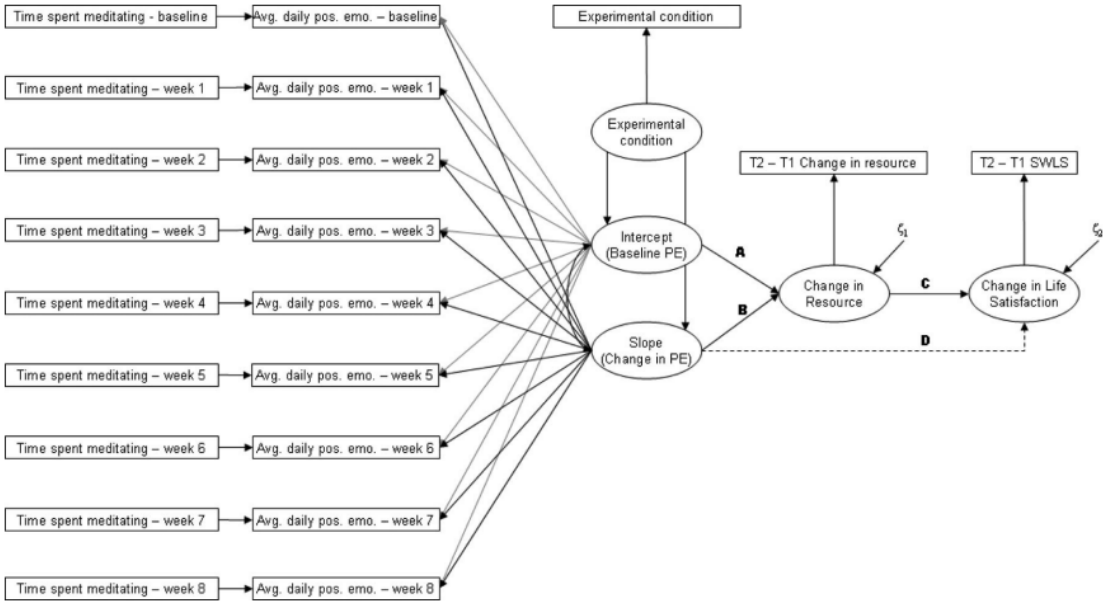


Figure 6. Upward spirals of positive emotions that can counter downward spirals of negativity (adapted from Garland et al., 2010, Figure 2).

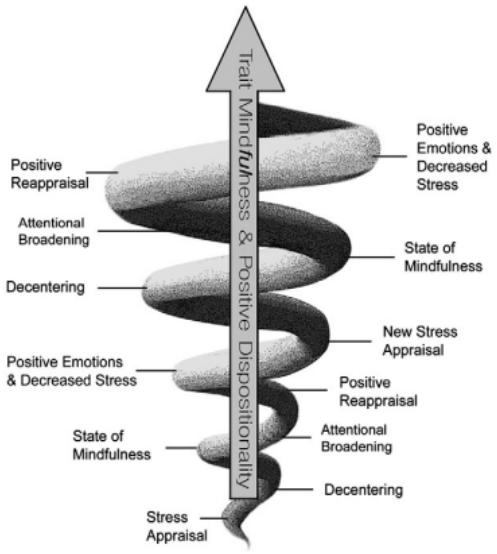


Figure 7. Early positive emotional reactivity to meditation training predicts continued meditation at 15-month follow-up. (adapted from Cohn & Fredrickson, 2010, Figure 1).

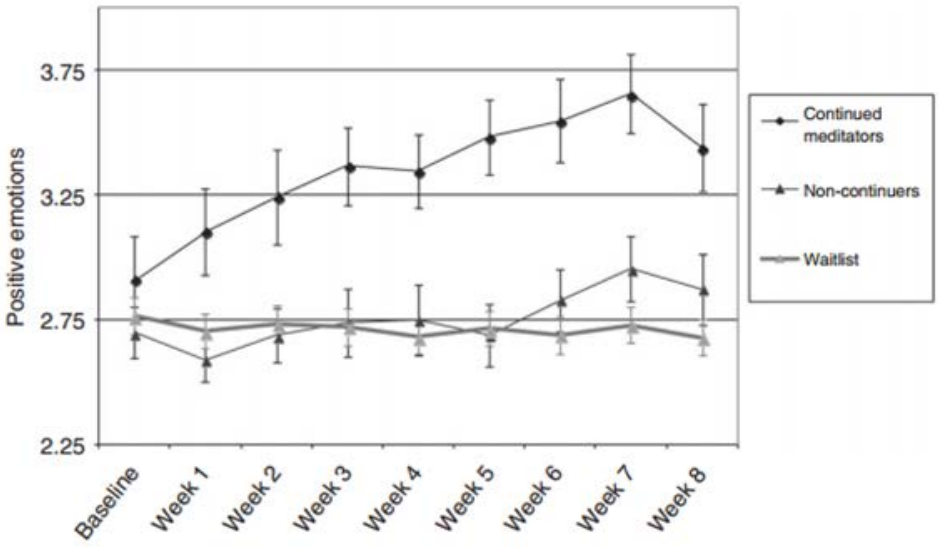
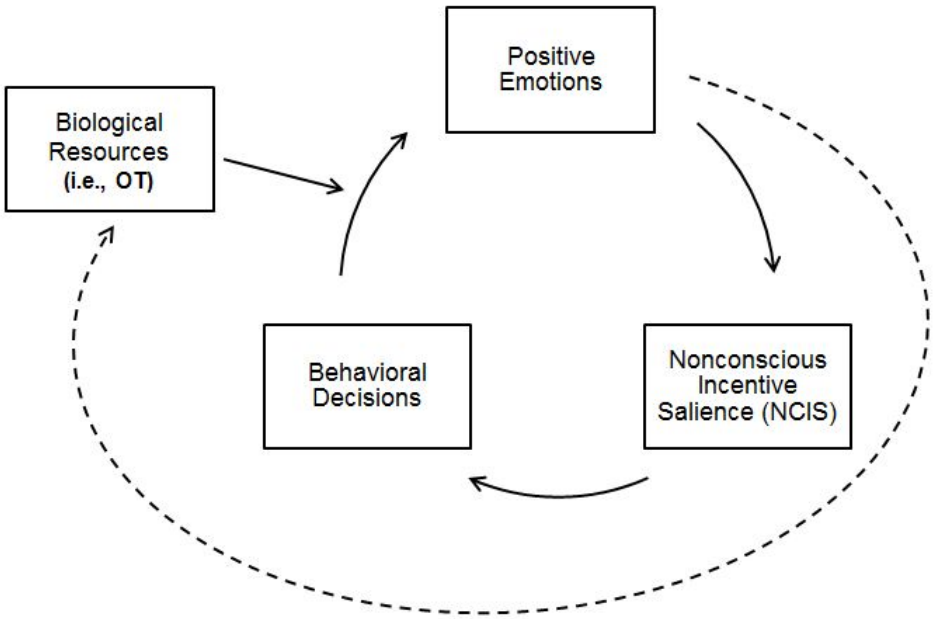


Figure 8. The upward spiral model of lifestyle change.



Appendix

modified Differential Emotions Scale (mDES)

Instructions: Please think back to how you have felt during the past twenty-four hours. Using the 0-4 scale below, indicate the *greatest amount* that you've experienced each of the following feelings.

Not at all	A little bit	Moderately	Quite a bit	Extremely
0	1	2	3	4

_____ 1. What is the most **amused, fun-loving**, or **silly** you felt?
_____ 2. What is the most **angry, irritated**, or **annoyed** you felt?
_____ 3. What is the most **ashamed, humiliated**, or **disgraced** you felt?
_____ 4. What is the most **awe, wonder**, or **amazement** you felt?
_____ 5. What is the most **contemptuous, scornful**, or **disdainful** you felt?
_____ 6. What is the most **disgust, distaste**, or **revulsion** you felt?
_____ 7. What is the most **embarrassed, self-conscious**, or **blushing** you felt?
_____ 8. What is the most **grateful, appreciative**, or **thankful** you felt?
_____ 9. What is the most **guilty, repentant**, or **blameworthy** you felt?
_____ 10. What is the most **hate, distrust**, or **suspicion** you felt?
_____ 11. What is the most **hopeful, optimistic**, or **encouraged** you felt?
_____ 12. What is the most **inspired, uplifted**, or **elevated** you felt?
_____ 13. What is the most **interested, alert**, or **curious** you felt?
_____ 14. What is the most **joyful, glad**, or **happy** you felt?
_____ 15. What is the most **love, closeness**, or **trust** you felt?
_____ 16. What is the most **proud, confident**, or **self-assured** you felt?
_____ 17. What is the most **sad, downhearted**, or **unhappy** you felt?
_____ 18. What is the most **scared, fearful**, or **afraid** you felt?
_____ 19. What is the most **serene, content**, or **peaceful** you felt?
_____ 20. What is the most **stressed, nervous**, or **overwhelmed** you felt?

Based on Fredrickson, 2009 and Fredrickson, Tugade, Waugh, & Larkin, 2003. Scoring: Use single items to assess specific emotions, or create overall positive and negative emotion scores by computing the mean of 10 positive and 10 negative emotions, respectively. Instructions can be modified to assess emotions in response to specific incidents (e.g., laboratory manipulations or episodes recalled using the Day Reconstruction Method). Scale can be modified to capture emotions experienced over the past two weeks by changing the instructions to "how often have you've experienced…," the items to "How often have you felt ___?" and the response options to 0 = never; 1 = rarely; 2 = some of the time; 3 = often; 4 = most of the time.

Footnotes

[i] In my book, *Positivity* (2009, Crown), written for a general audience I refer to the mDES as the Positivity Self Test. The website that accompanies that book, www.PositivityRatio.com, offers a free version of this test along with on-line tools for tracking people's changes in positivity, negativity, and positivity ratios over time.

[ii] The 1996 Toronto meeting was my first ISRE meeting, and as a junior scholar, I did not recognize many senior scholars by sight. I had the chance to give a keynote on my positive emotions research a decade later at the 2006 ISRE meeting, and asked if anyone in the audience was or knew of this "unknown critic" because I wished to thank him personally. No one came forward, so the mystery continues. If you can help me solve this mystery, please do.

[iii] Note that interest and joy were the only two positive emotions about which Izard wrote. He did, however, describe a low arousal state of "mild or receptive joy" that I think is better characterized as contentment or serenity.

[iv] Although for simplicity I've depicted positivity resonance here as a property of dyads, I see it as equally able to account for communal experiences of shared positivity, or what Haidt and colleagues refer to as an innate *hive psychology* which periodically propels humans to lose themselves enjoyably in a much larger social organism, like the crowd at a football game, music festival, or religious revival (Haidt, Seder, & Kesebir, 2008). Through physical co-presence and behavioral synchrony, positivity resonance thus can spread from dyads to whole crowds or communities (e.g., Fowler & Christakis, 2008).