

Positive Emotions: Short-Term Mechanisms,
Long-Term Outcomes, and Mediating Processes

by

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Dedicated to all the little acts of civility, and cooperation, and understanding
and the people who do them every day.

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Finally I thank my parents, who taught me to love language and ideas, and to use my powers for good.

Foreword

This is a dissertation about positive emotions. It's a topic that tends to start fights, and a lot of them aren't necessary. I'll skip ahead and describe one of my core ideas here -- by preventing a common misunderstanding, it may save you some annoyance.

Encouraging positive emotions does not mean that my colleagues and I are devaluing negative emotions. I am not trying to wave away the vigilance that comes from anxiety, the strength that comes from anger, or the love and commitment expressed in grief. Negative emotions help regulate our attention, energy, and behavior in small ways throughout the day, and in large ways during unusual crises. It would indeed be Pollyannaish -- and in some cases simply cruel -- to suggest that there's something wrong with people for feeling bad.

Rather, I describe many ways in which positive emotions are constructive and restorative. They're not a simplistic cure for all life's ills or a one-step path to health and wisdom, but they do help. Positive emotions can be anything from whimsical cheeriness to intense interest to quiet contentment. Amid difficult situations or profound sadness, they can take the form of a sense of hope, a moment of peace, or a fond memory. Whatever the situation, they can help people unlock the resources to make new discoveries, care for themselves or change things for the better.

I'll discuss evidence that nearly everyone could benefit from a little more positive emotion. So as you continue reading, please remember: I am discussing the value of adding something to our lives -- not trying to take something away.

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ABSTRACT

Co-Chairs: Barbara L. Fredrickson and Phoebe C. Ellsworth

Positive emotions such as amusement, interest, and contentment lead people to broaden their repertoires of thoughts and actions, giving rise to exploration, reflection, learning, and relationship-building. Over time these behaviors lead to lasting resources, such as knowledge, coping skill, and supportive relationships. The benefits of positive emotions emerge slowly, but they endure, and help individuals thrive in both good times and bad.

This dissertation presents my work on the *broaden-and-build theory of positive emotions*, ranging from controlled lab research to a practical, field-tested intervention.

Chapter 2 describes research on positive affect and attentional allocation. Sixty undergraduate participants completed a visual search task either with or without added information. This information could improve future performance but might also be distracting. Only individuals low in positive affect benefited from the information, suggesting that positive affect may interfere with complex divided attention. However, I was not able to find a specific attentional or motivational mechanism, which makes the results difficult to interpret. I discuss advantages of the method used and potential improvements.

In Chapter 3, I analyze daily diary data on positive and negative emotions from 84 undergraduate participants. Mediation analysis suggests that positive emotions predict growth in life satisfaction specifically because they also predict growth in trait resilience. Positive emotions are not just pleasurable; they also help build resources for living well. Negative emotions cannot block these benefits, though positive emotions can neutralize negative emotions' harmful effects.

Chapter 4 describes a two-month controlled trial of a positive emotion intervention, in which 195 working adults (132 completers) were randomized to a seven-week course on loving-kindness meditation or to a waitlist. Meditators experienced increased day-to-day positive emotions, which predicted gains in

resources including social support, purpose in life, and physical health. These resources in turn predicted increased life satisfaction and reduced symptoms of depression.

These papers chronicle the maturation of the broaden-and-build theory. It now comprises precise laboratory research, environmentally validated theory-based predictions, and potential for real-life interventions. Although it continues to evolve, it is substantiated enough to become one of the foundational ideas for positive emotions research throughout the social sciences.

Chapter 1

Introduction

In every action we choose between two broad ways of being: In one, we can act with interest and attention, hoping to learn or enhance our skills; with open-minded creativity, trying out something new; with broadly-deployed attention that allows us to engage with multiple goals at once; or simply with a calm that allows us to appreciate the moment. The other way is to deploy skills and resources we already have, focus simply on getting the job done. This can be associated with pressure or anxiety, with pragmatism and conservation of resources, or simply with lack of interest or attention. Both approaches are part of humanity's evolutionary toolbox, and all people show some movement on the spectrum between them as they meet different challenges and opportunities. The difference between the two is in when and how they bear fruit.

The first of the two approaches is broader: a greater variety of actions, a wider range of attention, and a looser definition of success or accomplishment. Its time horizon is also broader: Creativity, exploration, and savoring can seem frivolous in the moment, but over time they help develop skills and resources. For example, if a computer programmer stops in the middle of a project to learn about a new algorithm or try out a new way of organizing code, her productivity will suffer. But if she frequently does this when the time and resources are available, her work will gradually improve – and when a real emergency arises, she may have learned ways of doing things that allow her to respond more quickly and efficiently than if she had not "fooled around" in the past. The same is true of emotion regulation skills, physical abilities, ways of looking at the world, and relationships with others: People who experience more positive emotions will become stronger, happier, more able, and better at functioning in their lives.

This is a broad and ambitious statement, and the rest of this dissertation will be devoted to bringing it down to earth – understanding how positive emotions achieve these effects, when and where they work, and how they can be harnessed. The framework for my research is the *broaden-and-build theory of positive emotions*, developed by Barbara Fredrickson (1998, 2001). This dissertation discusses the work I have done testing, refining, and contributing to it.

The Broaden-and-Build Theory

Broaden-and-build is a multipart model, offering an overarching explanation for the observed effects of positive emotions. The theory has two modules, referred to as "broaden" and "build." Yet these modules are themselves composites. The "broaden" theory draws together findings on the immediate, temporary effects of positive emotions in the realms of physiology, attention, motivation, and analytical and social cognition, by suggesting that they all share an abstract property of "broadening." The "build" theory draws together findings on the beneficial effects of frequent, prolonged positive emotions on job success, relationships, mental health, physical health, flourishing, and life satisfaction, by suggesting that all of these outcomes can result from broadened states.

Thus, the broaden-and-build theory seeks to connect three different levels of phenomena: subjective positive emotions, temporary cognitive / attentional / motivational states, and long-term life outcomes. The totality of work done on the theory can be described by two hypotheses for each module: a *model*, which provides a rubric for tying together varied phenomena, and a *hypothesis*, which proposes a relationship between two different levels.

The broaden model: There is a unipolar "breadth" axis that can be applied to many domains of function, including physiology, perception, attention, motivation, cognition, and social cognition. Low breadth describes an exclusive focus on salient, essential, or immediate information. "Broadening" or high breadth describes increased attention to peripheral information, holistic processing strategies, and long-term outcomes.

The broaden hypothesis: Experiencing a positive emotion leads to temporary broadening in many or all applicable domains.

The build model: Many forms of functioning can be conceptualized as personal resources, which are built up over time and which contribute to survival and flourishing when threats or opportunities arise. Resources include *psychological resources*, such as self-efficacy and coping skills; *cognitive resources*, such as reasoning skills and domain-specific knowledge; *physical resources*, such as effective immune functioning and proper stress regulation; and *relational resources*, such as intimate relationships and wide social

networks.

The build hypothesis: The more frequently a person experiences positive emotions, the higher their levels of personal resources are likely to be. This is because people are more likely to build resources while in broadened states.

Figure 1 presents a schematic of the broaden-and-build theory. Figure 2 is a more detailed diagram presenting a richer variety of phenomena and a more gradual process linking broaden phenomena to build phenomena.

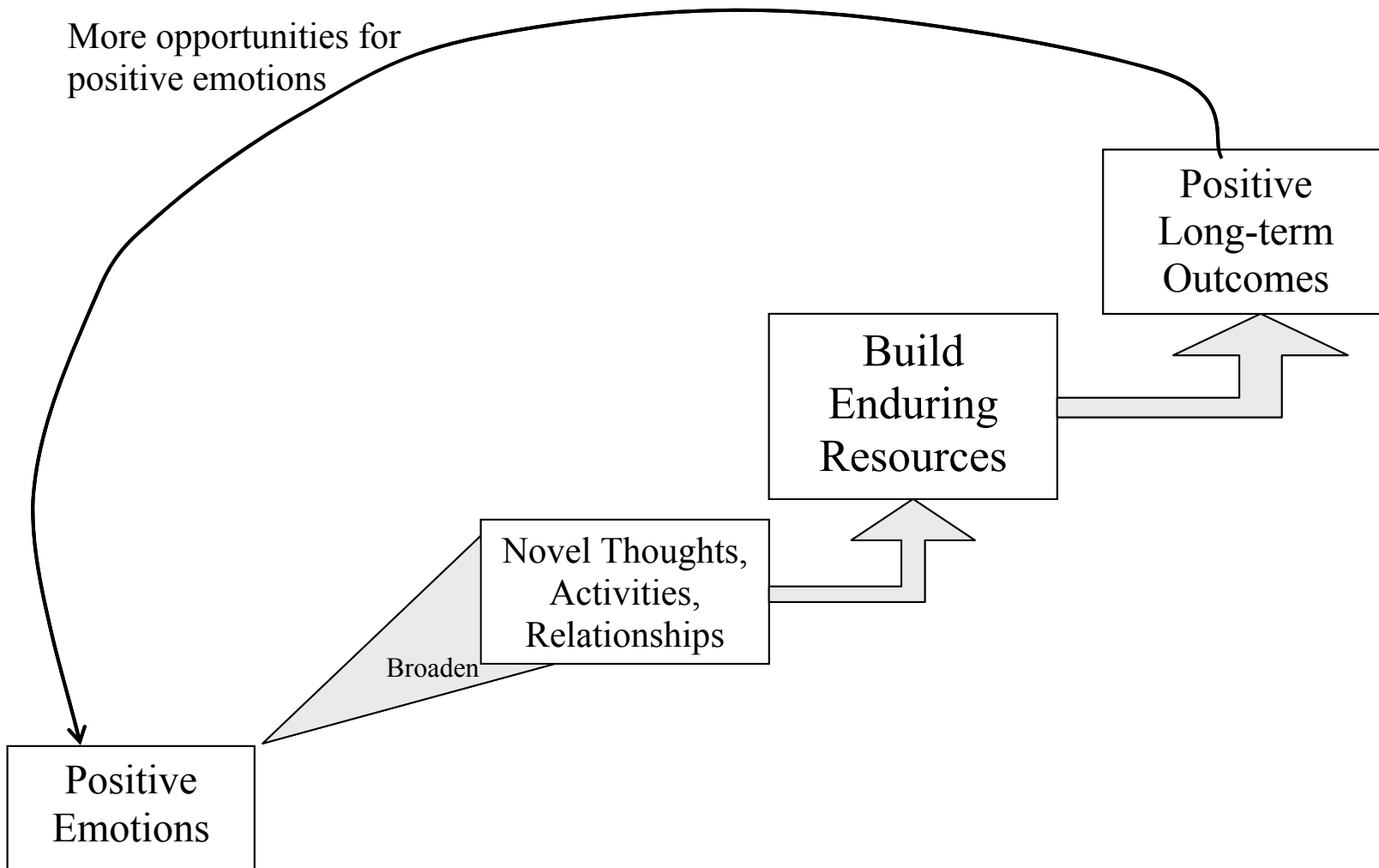


Figure 1-1: A schematic of the broaden-and-build theory

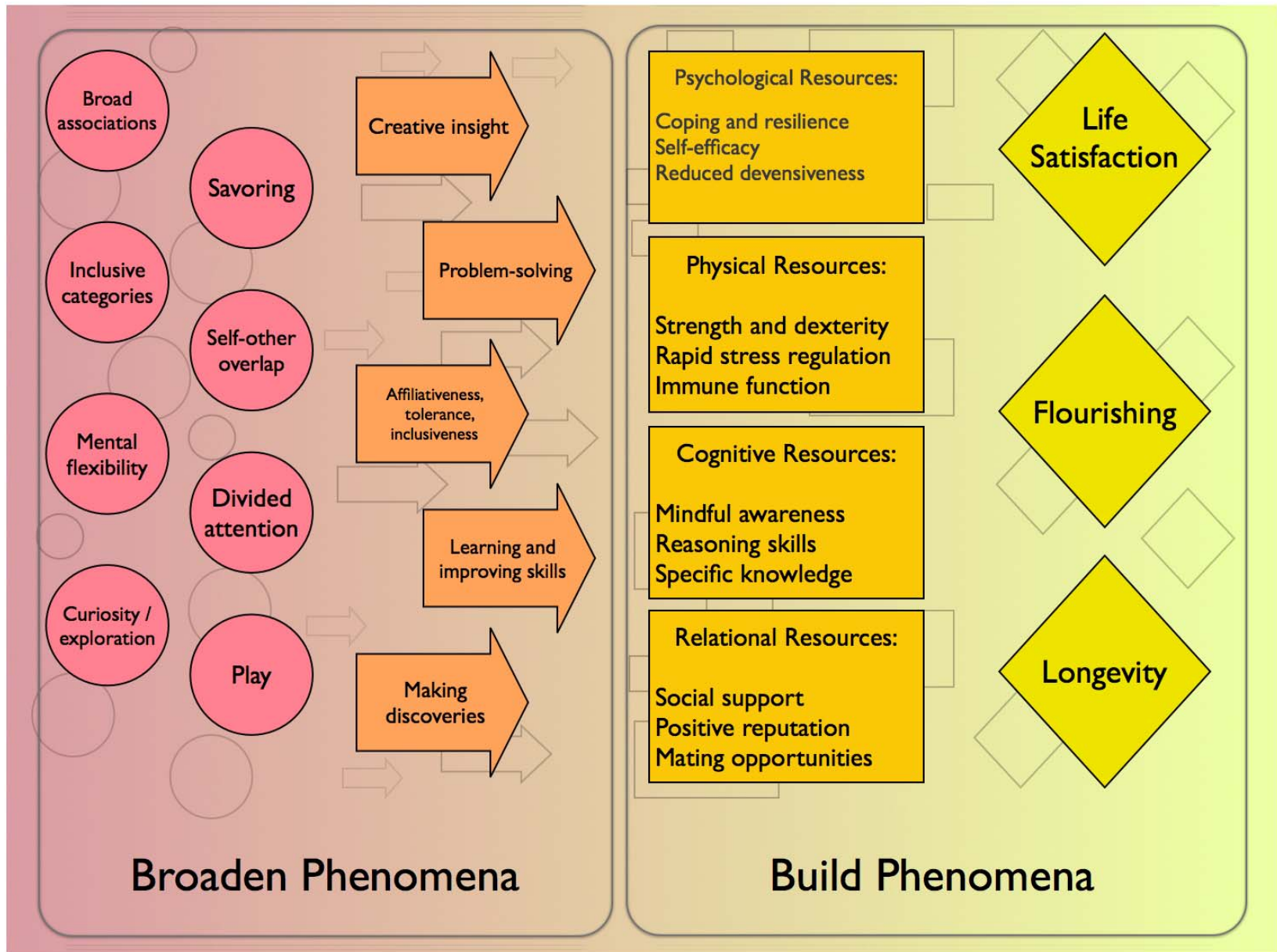


Figure 1-2: A variety of broaden phenomena and build phenomena. Many others are not explicitly pictured.

Background and Evidence for the Theory

Positive emotions: A functional view

Most theorists view emotions as states that facilitate appropriate responding to a given situation, by coordinating the organism's cognition, attention, motivation, and physiology, among other systems (Frijda, 1986; Frijda, Kuipers, & Schure, 1989; Lazarus, 1991; Levenson, 1994; Oatley & Jenkins, 1996; Tooby & Cosmides, 1990). For example, a person who feels fear becomes more likely to interpret ambiguous stimuli as threats (cognition), becomes hypervigilant to situational cues that might signal danger (attention), experiences a subjective desire to escape (motivation), and exhibits physiological arousal that paves the way for a fight-or-flight response. Each emotion can be construed as preparation for a specific type of behavior, referred to as its *specific action tendency*. These emotions are seen as evolved adaptations that helped our ancestors respond to certain recurring situations rapidly and well. For example, disgust evolved to facilitate expulsion or rejection, anger to facilitate confrontation, and fear to facilitate threat detection and escape.

We propose that the specific action tendency model -- created with negative emotions as prototypes -- is not entirely appropriate to positive emotions. Negative emotions chiefly occur when the individual encounters a problem. The problems our emotions evolved to deal with range from literal life-or-death threats (e.g., being chased by a predator), to extended threats to survival (e.g., scarce food supplies and a need to conserve energy), to evolutionarily significant threats to reproduction or reputation (e.g., being socially excluded or insulted) (Tooby & Cosmides, 1992). In each case, there is a threat that will carry a cost unless successfully addressed, and the accompanying emotion directs the individual's attention towards potential solutions.

Positive emotions, in contrast, seldom occur in response to a pressing threat. In the situations that evoke positive emotions, it is unlikely that evolution would have been able to shape a cohesive, stereotyped response. Emotions like amusement, pride, and love solve a different type of adaptive problem: how to act when a situation that doesn't present clear demands of its own. Thus, instead of being linked to specific action tendencies, positive emotions lead to broadened and more flexible repertoires of thoughts and actions (Fredrickson, 1998). Joy and amusement create the urge to play and be

creative, both physically and in the realm of ideas. Interest creates the urge to learn and explore, leading people to take in new, unusual information and invest energy in new experiences (Silvia, 2001). Contentment does not create an urge for action, but instead for savoring, extracting full enjoyment from one's past experiences and integrating them into a new view of the self and the world (Bryant, 2003; Lyubomirsky, Sheldon, & Schkade, 2005). The appraisal dimensions that are unique to positive emotions, such as interpersonal relationship, mastery, and spirituality (Tong, 2006), can also be seen as different domains in which people can think or act with fewer constraints than usual.

In order to have developed in this way, the effects of positive emotions need to be more than just good choices; they need to have enhanced the reproductive potential of those who experienced them, via improvements in status, attractiveness, social connectedness, survival skills, etc. In the short term, positive emotions might seem to be an evolutionary disadvantage, leading individuals to expend scarce resources on curiosity, introspection, and amusement, rather than on finding food or mates. In the long term, however, the broadened range of thoughts and actions linked to positive emotion gives rise to substantial adaptive benefits: Broadening builds enduring personal resources.

Among nonhuman mammals, play has a clear role in preparation for adulthood. For example, juveniles at play will throw themselves at flexible branches and catapult off in an unexpected direction. Adults show the same behavior, but only when being pursued by a predator (Dolhinow, 1987). Juvenile play, while an inefficient use of energy in the short term, builds enduring physical resources that assist in adult survival (Boulton & Smith, 1992; Caro, 1988). In humans and other animals, energetic physical play may also help children develop affect- and arousal-regulation mechanisms that make serious adult behavior possible (Panksepp, 1998). Childhood play also increases creativity (Sherrod & Singer, 1989), which may help fuel intellectual development. Social play, meanwhile, contributes to lasting relationships and learning social rules. Laughter appears to function as a social signal of openness to new, friendly interactions (broadening), which can lead to lasting social bonds and attachments (building; Gervais & Wilson, 2005). Shared amusement and smiles have many of the same effects (Lee, 1983; Simons, McCluskey-Fawcett & Papini, 1986, Keltner & Bonanno, 1997).

Similarly, the exploration prompted by the positive emotion of interest creates knowledge and intellectual complexity, and the savoring prompted by contentment produces self-insight and alters worldviews. Each of these phenomenologically distinct positive emotions shares the feature of augmenting individuals' personal resources, ranging from physical and social resources, to intellectual and psychological resources (see Cohn & Fredrickson, in press; Fredrickson, 1998; Fredrickson & Branigan, 2001, for more detailed reviews).

Importantly, the personal resources accrued during states of positive emotions are durable. They outlast the transient emotional states that led to their acquisition. These resources can be drawn on in subsequent moments and in different emotional states. The physically playful person will have greater stamina and skill when fleeing an attacker. The friendly, likable person will have the support of others if a rival makes a bid to exclude or defame them. The curious, inquisitive person will have calm attention and critical thinking when a pressing problem needs to be solved. Figure 1 represents this process: Positive emotions lead to broadening; frequent broadening allows people to build personal resources, and having resources for dealing with life's challenges and opportunities ultimately affects people in the most important areas of their lives, such as life satisfaction, mental health, and career achievement.

The broaden-and-build theory ascribes a *function* and a *mechanism* to positive emotions: Their function – the benefit that caused evolution to select for them – is to build enduring personal resources. The short-term mechanism that leads to these effects is broadening thought-action repertoires. Those of our ancestors who experienced the urges sparked by positive emotions – to play, explore, and so on – would have accrued more personal resources. When these same ancestors later faced inevitable threats to survival or security, their greater personal resources would have helped them triumph and remain in the gene pool. Initial evidence suggests that the broaden effect functions across several diverse cultures (Vaughn, Hejmadi, Otake, & Fredrickson, 2006), lending support to the theory that it originated in our evolutionary history.

The Broaden Hypothesis: Positive Emotions Broaden Perception, Thoughts, and Actions.

Visual Attention The most cognitively basic form of the broaden effect we have examined appears in global-local visual processing tasks. Participants are asked to sort

figures into two categories, one of which shares the figure's overall contours and one of which shares its local details (see Fig. 3a). Positive emotions, with their broadened focus, produce a preference for the global (overall) level, whereas negative emotions often produce a preference for the details. This pattern holds both for emotionally relevant traits like optimism and anxiety (Basso, Schefft, Ris, & Dember, 1996) and for emotional states induced through a variety of means (Brandt, Derryberry, & Reed, 1992, cited in Derryberry & Tucker, 1994; Fredrickson & Branigan, 2005; Johnson & Fredrickson, 2005). Wadlinger & Isaacowitz (in press), in a study that tracked participants' eye movement, found that induced positive emotion broadens visual search patterns, leading to increased attention to peripheral stimuli.

Behavior: In the domain of personally relevant behavior, Fredrickson and Branigan (2005) induced positive, negative, or no emotions in volunteer participants, and then asked them to step away from the specifics of the induction and list all the things they felt like doing. Participants induced to feel positive emotions listed *more* and *more varied* potential actions, relative to the neutral group; participants induced to feel negative emotions listed fewer potential actions than the neutral group. Similar research has shown that positive emotions produce more creative (Isen et al., 1987) and varied (Kahn & Isen, 1993) thoughts as well.

Social Cognition Broadened social attention takes the form of enhanced attention to others and reduced distinctions between self and other, or between different groups. Participants experiencing positive emotions report more overlap between their concept of themselves and their concept of their best friend (Waugh & Fredrickson, 2006; Waugh, Hejmadi, Otake, & Fredrickson, 2006), and become more imaginative and attentive regarding things they could do for friends (Otake, Waugh, & Fredrickson, in preparation). When a close relationship does not yet exist, induced positive emotions can increase trust (Dunn & Schweitzer, 2005), and may underlie the creation of a wide variety of bonds and interdependence opportunities (Cohn & Fredrickson, 2006; Gable, Reis, Impett, & Asher, 2004).

Figure 1-3: Three forms of broadening

3a) Visual: The participant is instructed to find the letter T as quickly as possible. It is present in both figures, but finding the first is facilitated by a broadened visual focus, while finding the second is facilitated by a narrowed (detail-oriented) focus (Johnson, 2005; Fredrickson & Branigan, 2005).

3b) Associative: In this item from the Remote Associates Test, the participant is asked to find a word that ties the three stimulus words together. Participants are more likely to find the answer (“jack”) while in a positive mood (Isen, Daubman, & Nowicki, 1987).

3c) Social-Cognitive: Caucasian individuals are typically *poor* at distinguishing a previously-learned Black face from a new one (solid box) and *good* at determining where a morphed series crosses from “more White” to “more Black.” Positive emotions cause them to recognize Black faces as well as White ones (Johnson & Fredrickson, 2005) and simultaneously become worse at identifying fine distinctions between race (Johnson, 2005).

L L L T
 L T
 L T
 L T T T

2a

What word links the following three words together?

Cracker
Union
Rabbit

2b

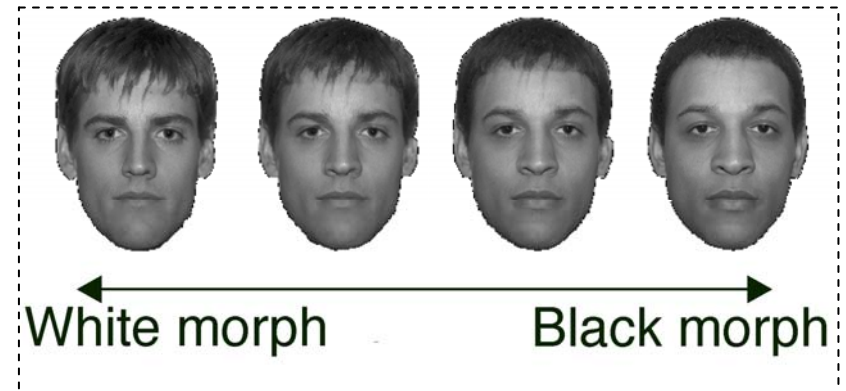
2c



Learning



Identification



Positive emotions also broaden social group concepts and break down an essentialized sense of “us versus them” (Dovidio, Gaertner, Isen, Rust, & Guerra, 1995). We have discovered the same result in a racial context: When we induce positive emotions in participants, people become less racially biased in their face perception, and simultaneously *worse* at perceiving physical differences between races (Fig. 3c) (Johnson, 2005; Johnson & Fredrickson, 2005).

Cognition, behavior, and task performance This is the most extensively researched, and also the most theoretically fractious, topic related to positive emotions. Part of my dissertation research will specifically focus on how positive emotion affects performance on a cognitive task, and whether the results can help reconcile the predictions of the broaden-and-build theory with those of other influential theories of emotion and cognition.

Some of the earliest work suggested that positive emotions evoke a broader range of associations than negative emotions or neutral states, and that they should lead to more widespread activation in any other cognitive network that becomes salient (Bower, 1981). Isen and colleagues have established that positive emotions produce patterns of thought that are notably unusual (Isen, Johnson, Mertz, & Robinson, 1985), flexible and inclusive (Isen & Daubman, 1984), and creative (Isen, Daubman, & Nowicki, 1987), while still remaining within rational and useful bounds. Many of their results involve the Remote Associates Test, which requires participants to discover a word that can be put into some relationship with each of a group of stimulus words (Fig. 3b). Because the relationship often involves secondary meanings of words or multi-step associations, it is considered a good measure of associative breadth, but also requires the participant to prune inappropriate associations and recognize the correct one. Broadening that lacks this capability for discrimination may be responsible for some features of psychosis brought on by schizophrenia, mania, or drug abuse (Kapur, 2003), but ordinary positive emotions do not seem to have these effects. Rowe, Hirsch, and Anderson (2007) replicated Isen’s findings that positive emotions improve performance on the Remote Associates Test, and found that this improvement was correlated with *decreased* performance on a visual task that required participants to narrow their range of attention, suggesting that visual-attentional broadening and cognitive broadening are evoked together and may share an

underlying mechanism.

Positive emotions also appear to facilitate problem solving on more complex and serious tasks, such as medical decision-making among doctors (Estrada, Isen, & Young, 1994, 1997), and on tasks that for which the participant has strong motivation (Aspinwall, 1998). However, this research stands alongside a variety of robust findings indicating that positive emotions harm performance on tasks requiring detailed thinking or analysis. People in positive moods show more susceptibility to weak, poorly reasoned arguments (Bless, Bohner, Schwarz, & Strack, 1990; Mackie & Worth, 1989), deficits in causal reasoning (Schwarz & Bless, 1991), and willingness to rely on racial and social stereotypes rather than individuating information (Macrae, Milne, & Bodenhausen, 1994).

Most theories that explain these detrimental effects of positive emotions do so by positing that positive emotions are associated, both phylogenetically and in individual experience, with successful and unthreatening situations, and that they evoke cognitive strategies that are consistent with that association. Various theories suggest that positive emotions evoke strategies that should be appropriate to goals that are near completion (Carver, 2003), simple problems that do not require effortful thought (Mackie & Worth, 1989), well-practiced tasks for which high-level heuristics will be successful (Schwarz, 2002), information that can be cognitively chunked rather than decomposed (Fiedler, 2001), or situations that are well-understood and do not require detailed scrutiny (Schwarz, 2001). In all these cases, positive emotions are generally expected to improve performance when a task can be addressed with creativity, associative thinking, or other “big-picture” approaches, or when the task actually is simple and amenable to readily available heuristics. However, positive emotions are expected to hurt performance if the task requires detailed and focused attention, complex or nonintuitive processing rules, or vigilance for potential errors.

These theories are not inconsistent with the broaden hypothesis, but they do call the build hypothesis into question: If positive emotions frequently harm task performance, how can they lead to cumulative benefits? One possibility is that these challenging, counterintuitive, or analytical tasks are a domain in which positive emotions are not appropriate, but that many life situations do not predominantly rely on detailed reasoning

and analysis. This idea is reminiscent not just of social psychology's famous "cognitive miser" findings (e.g., Fiske & Neuberg, 1990; Macrae, Milne, & Bodenhausen, 1994), but also of newer findings indicating that detailed, active cognition may be superior to implicit cognition for only a subset of problems (Dijksterhuis & Nordgren, 2006). Another possibility, however, is that a broadened mindset affects one's approach to the task as well as one's cognitive analysis of it. People in positive moods have displayed increased caution and thoroughness, relative to neutral moods, when they are led to think of the task as enjoyable (Martin, Ward, Achee, & Wyer, 1993; Martin, 2001), or when they are personally invested in it (Isen, 2001; Aspinwall, 1998). Induced positive emotion reduces susceptibility to potentially misleading anchoring heuristics (Estrada, Isen, & Young, 1994, 1997), increasing participants' willingness to consider new information in an unbiased fashion (but cf. Fiedler, 2001). Positive emotion can also be seen as a *resource* that helps people avoid or overcome detrimental self-serving biases: Participants who are placed in a positive mood are more willing to consider unsettling health information (Aspinwall & Brunhart, 1996; Reed & Aspinwall, 1994) and to accept feedback that describes them negatively but offers the chance to improve (Ragunathan & Trope, 2002). Among people facing serious, real-life health risks, optimistic expectations led to higher levels of preventative and health-promoting behavior (Salovey, Rothman, Detweiler, & Steward, 2000; Taylor, Kemeny, Aspinwall, Schneider, Rodriguez, & Herbert, 1992). This is relevant to problem solving because the behaviors studied were difficult or stigmatized (e.g., reducing unprotected sex among gay men at risk of HIV; giving up caffeine among women who were daily users). If positive emotions lead to careless or biased processing we would expect these individuals to unreflectively dismiss or generate reasons to ignore the health-related information (especially under one particular model, the Affect Infusion Model, Forgas, 2001).¹

A final issue that arises in comparing the predictions of the broaden-and-build model with that of other models of mood and cognition is that the broaden effect is, as yet, fairly underspecified. Its ability to describe a wide variety of attentional, motivational, and cognitive phenomena is a strength, but this also means that its predictions are often lacking in specificity. The general term "broadened thought" could apply to either vague, heuristic thinking or thorough, non-defensive exploration, and little has been done to

reconcile these opposing interpretations. What work there is suggests that *flexibility* and *openness* are important attributes of positive emotions' cognitive effects (Dreisbach & Goschke, 2004; Bless et al., 1996), and these effects can enhance or hinder performance depending on the task and the context. In particular, Bless et al. (1996) determined that while people in positive moods were devoting reduced attentional focus on an assigned task, they were using some of that attention to gather and process information that was being presented peripherally. Isen (2007) has found similar results, even when the positive mood does not reduce attention to the main task. The lab research I propose for my dissertation will attempt to refine our understanding of the effects of positive emotion on cognition, and also examine the hypothesis that positive moods can enhance performance on tasks benefiting from attention that is focused, yet also flexible or divided.

The research I have discussed in support of the broaden effect demonstrates substantial variety. But more importantly, the outcomes that depend upon these domains can make a substantive difference in what people learn, whom they befriend, and how they understand their lives. In other words, these *broadened* mindsets can lead people to *build* enduring resources.

The Build Hypothesis: Positive Emotions Create Lasting Resources

Although positive emotions are temporary and transient, they encourage a broadened range of actions, which over time builds enduring personal resources. There is overwhelming evidence that people who are happier show better functioning on a wide variety of measures and experience better life outcomes, including physical and mental health, successful coping, and longevity (for a review of 225 studies, see Lyubomirsky, King, & Diener, 2005). The research surveyed by Lyubomirsky, King, and Diener includes longitudinal studies indicating that happiness often precedes success and high functioning, rather than merely resulting from them.

This causal hypothesis is also consistent with developmental evidence: Securely attached children, whose behavior is characterized by contentment, curiosity, and caregiver love, also show more persistence, flexibility, and problem-solving ability than their peers. These advantages continue into adulthood (Mikulincer, 1997). Securely attached infants also engage in more independent exploration of new environments, and

by consequence develop superior cognitive maps of their environment (Hazen & Durrett, 1982).

These findings make the build hypothesis plausible, but they do not directly support it. Past research in our lab has found more direct support for the broaden-and-build theory. In a longitudinal study of college students coping with ordinary life problems (Fredrickson & Joiner, 2002), we found that state positive emotions correlated with the use of creative and broad-minded coping strategies, and that use of these strategies was an independent predictor of increased positive emotions five weeks later. Among college students meeting a new roommate for the first time, those who experienced high levels of day-to-day positive emotions were more likely to have built a close relationship with their roommate one month later.

The build hypothesis is also supported by research on health and emotions: People who experience high levels of positive emotions tend to experience less pain and disability related to chronic health conditions (Gil et al., 2004), fight off illness and disease more successfully (Cohen & Pressman, 2006; Ong & Allaire, 2005), and even live longer (Danner et al., 2001; Levy et al., 2002; Moskowitz, 2003; Ostir et al., 2000;). We believe that these findings may be explained by the ability of positive emotions to lift people out of stressed, narrowed states.

It is already established that the physiological changes that accompany negative emotions are beneficial for decisive, short-term action, but detrimental to long-term health (Sapolsky, 1999), and that there are benefits to properly regulating the stress response (McEwen & Seeman, 1999). We have explored whether positive emotions help with regulation, neutralizing the body's biochemical stress response once a threat is past. We exposed participants to an anxiety-provoking experience, ended the experience, and then showed them an emotional film clip, all while measuring their biological stress responses. Participants in the two positive emotion conditions (mild joy and contentment) recovered more quickly than those viewing a neutral clip, which recovered more quickly than those viewing a sad clip (Fredrickson, Tugade, Waugh, & Larkin, 2000, Study 1; see also Fredrickson & Levenson, 1998). When there was no stressor, none of the films had any biological effect (Fredrickson et al., 2000, Study 2). In other words, the positive films function specifically by *undoing* the physiological effects of an earlier stressor. People

who are high in trait resilience (Block & Kremen, 1996) also return to their physiological baseline more quickly, and we have found that they do so by self-generating positive emotions in the aftermath of the stressor (Tugade & Fredrickson, 2004).

These laboratory experiments can serve as a microcosm for the influence of emotions on coping, and of coping on health. Imagine that some individuals typically seek positive emotions to help them quickly bounce back from life's stressors, while others spend more time remaining physiologically activated and prepared to react, even after it is clear that they are no longer threatened. Over time, the latter group will accumulate more physiological wear and tear, and be more vulnerable to a wide range of stress-related illness (McEwen & Seeman, 1999; Kiecolt-Glaser, McGuire, Robles, & Glaser, 2002).

As yet, the research supporting the build hypothesis has been largely correlational and incidental. Two of the studies presented in this dissertation were able to test the hypothesis specifically and directly, and produced very strong evidence for its model.

Open Questions and Recent Progress

Unpacking the multiple definitions and hypotheses in the broaden-and-build theory highlights its importance and scope, but also the many areas left unexplored. When the broaden-and-build theory was first proposed, it offered a story that promised to connect a wide range of phenomena into a cohesive whole. The past ten years of research have confirmed many parts of the theory, fleshed out its overall structure, and begun to confirm its predictions about long-term growth. This section describes questions about the theory that have been addressed by the work in this dissertation.

Question 1: What form does broadening take in individual activities?

The strength of the broadening construct is that it draws together a large number of disparate phenomena. The effects of positive emotions on visual perception, physiological arousal, motivation, information processing, group categorization, and social affiliation are all captured by the concept of broadening (see Ashby, Isen, & Turken, 1999; Cohn & Fredrickson, in press). But the theory is less strong when it comes to making predictions about individual situations. For example, it is difficult to predict whether a broadened approach to relationships would lead to interacting with a wider network of acquaintances, to enlarging the scope of one's relationship with specific

individuals, or to going beyond one's routine with a significant other and developing a deeper relationship with that specific person. Similarly, the emotion of interest can lead one to become either a dilettante or a specialist, and both could be seen as broadening one's behavior beyond mundane, survival-oriented behavior.

These failures to predict may not be due to a weakness in the theory. Broadening is amorphous by nature. Because positive emotions are linked to long-term development rather than short-term responses to threat, we should not expect the behavior they evoke to be particularly targeted or predictable. Furthermore, a key element of broadening appears to be greater autonomy in one's choices; this has been offered as a plausible explanation for the greater behavioral repertoires of people experiencing positive emotions (Fredrickson & Branigan, 2005) as well as for their unwillingness to engage with uninteresting and unrewarding laboratory tasks (Aspinwall, 1998; Martin, Ward, Achee, & Wyer, 1993). Past studies have succeeded by presenting simplified stimuli with forced choices (e.g., Dreisbach & Goschke, 2004; Johnson, 2005) or by observing behavior in situations that limit one's options (for example, Waugh, 2005, observed relationship formation among first-semester college students, many of whom had no social contact except for new acquaintances). Past researchers, often not working with the broaden model, have often noted that the apparent "inattentive" and "script-based" effects of positive emotions disappear when participants are made to believe that their experimental performance will have real consequences (Aspinwall, 1998; Isen & Reeve, 2005; Macrae, Milne, & Bodenhausen, 1994; Schwarz, 2002).

This is not to suggest that positive emotions produce inherently unpredictable behavioral effects, but rather that understanding their effects will require more attention to personal characteristics and situational contingencies than is required for negative emotions. Nonlinear dynamic models have had some success capturing this effect quantitatively (Fredrickson & Losada, 2005; Losada & Heaphy, 2004; Schuldberg & Gottlieb, 2002): Within an extended interaction, individuals experiencing negative emotions show relatively stable, cyclic patterns of behavior, while those higher in positive emotions show patterns that are more variable, adaptable, and multiply-determined, and thus less vulnerable to cycles of negativity. Thus, the unpredictability of positive emotions may be part of their adaptive value, and we should not expect domain-

general emotion theories to be able to predict precisely who an affiliative individual will spend time with or what topics an interested individual will explore. Knowledge about emotional positivity, or about specific positive emotions, will need to be combined with specific knowledge about relationship formation, interest and information seeking, and so forth. A corollary is that researchers must be conscientious about the contexts and affordances they create, as small differences can potentially lead to large changes in where and how participants allocate their broadened attention.

Chapter 2 (Positive Emotions and Attention Allocation) uses the "unpredictable broadening" perspective as a potential explanation for conflicting findings on the relationship between positive emotions and performance on cognitive tasks: Past studies have found that positive emotions make people either negligent or highly attentive, careless or cautious, and hurried or thorough (for reviews, see Abele, 1992; Aspinwall, 1998; Cohn & Fredrickson, in press; Martin & Clore, 2001). As in other domains, all these responses can be conceptualized as broadening. Rather than trying to find evidence for one set of effects and declare it the true broadened response, I tried to capture the amorphousness of broadening directly. Building on the work of Dreisbach & Goschke (2004; Dreisbach, 2006), I designed a task that required wide attention to varied stimuli in some situations and deliberate inhibition of that attention in others, and that linked both processes to real and motivating outcomes. I hypothesized that people in positive moods would show generally improved performance, deploying attention broadly or narrowly depending on the situation. The results indicated that positive affect is detrimental when the task provides information about multiple goals. However, but I failed to find evidence of attentional or strategic mediators for this effect, making it difficult to generalize results beyond the specific task. I discuss improvements to the procedure that will help clarify why these changes occur.

Question 2: Can we link short-term effects of positive emotion to actual resource-building in a cognitive performance context?

The broaden-and-build theory states that individuals develop resources gradually, as the result of many individual episodes of broadening. Nonetheless, it should be

possible to observe behaviors that both satisfy the definition of broadening and contribute to resource accrual. Some studies have been able to do this: For example, Raghunathan & Trope (2001) and Aspinwall and Brunhart (1996) have observed positive emotions leading to enhanced attention to accurate and useful (but sometimes unpleasant) information about the self; Johnson (2005) and Dovidio, Gaertner, Isen, Rust, and Guerra (1995) have produced increases in group inclusiveness or coalition-building; and Tugade & Fredrickson (2004) have enhanced physiological recovery following a stressor, which is likely to lead to reduced allostatic load and chronic health risk over time. However, studies of problem-solving or task-performance behavior have typically not uncovered similar steps towards resource-building; they instead find a direct association between broadened cognition and improved performance (e.g., Bless et al., 1996; Dreisbach & Goschke, 2004; Estrada, Isen, & Young, 1994, 1997; Isen, 2007).

Chapter 2 approaches this question by creating a context wider than the immediate task. As in nearly all real-life situations, participants simultaneously try to perform a focal task and make observations that will improve their performance on future rounds of the task. If positive emotions enhance the ability to pursue these concurrent goals, then they do not just lead to improved performance; they lead to improved learning and growth in competence as well. If this finding were replicable with more realistic tasks, then we would have a plausible process by which happier people build lasting skills. The results were inconclusive, but the methods developed continue to show promise.

Question 3: Can the broaden and build effects be linked specifically to emotions, as opposed to various positive traits or cognitions? Are high or elevated levels of positive emotion necessary?

Although the concepts of broaden and build are sometimes vague, the broaden-and-build theory makes specific predictions about how positive emotions relate to them. First, the theory conceptualizes positive emotions as part of everyday functioning, and broadening as a common aspect of attention and motivation that fluctuates over minutes or hours. This puts the theory squarely in the domain of affect, rather than general positive traits like optimism or evaluations like life satisfaction. Thus, the theory predicts

that gains in resources will be specifically linked to positive emotions, and not directly linked to other positive constructs. It also predicts that broadening and resource-building will not require extraordinary levels of positive emotion, but will be available to a large portion of the population.

Second, the theory predicts that broadening is a direct and inherent consequence of positive emotions, and should occur whenever positive emotions occur. This is in contrast to adaptation theories (e.g., Diener, Lucas, & Scollon, 2006; Parducci, 1995), which suggest that individuals rapidly adapt to most experiences, and increasingly intense stimulus is required to produce the same effect.

Chapter 3 ("Happiness Unpacked") examines this question by assessing day-to-day reports of positive emotion and their relationship to ego-resilience and life satisfaction. I predicted that positive emotions would predict growth in ego-resilience, but that life satisfaction, which is more general and cognitive, will not. I also predicted that individuals would not necessarily require an increase in positive emotions relative to baseline in order to produce a response. Both hypotheses were supported, suggesting that the broaden-and-build theory is relatively accurate in the particular constructs and mechanisms it considers.

Question 4: Does the theory need to include negative emotions?

Although broaden-and-build is a theory of positive emotions, it rests on a general theory of emotional valence: Negative emotions facilitate responding to a single and remediable threat, and positive emotions facilitate new and novel actions in response to opportunity. The theory is consistent with widespread findings that negative information, events, and emotions typically draw attention away from positive ones (Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001; Tversky & Kahneman, 1981) -- failure to respond to an immediate threat to survival or well-being has a much greater evolutionary impact than failing to grasp a particular opportunity to play, befriend, or reflect.

The mirror image of this relationship is seen when positive emotions occur after a stressor is resolved. Positive emotions speed recovery from the physiological effects of stress (Fredrickson & Levenson, 1998; Tugade & Fredrickson, 2004), which we interpret as evidence that the individual's state is broadening back to a normal range of attention

and function, after having trained its cognitive and physiological resources on the stressor.

Do these patterns indicate that the build effect will depend jointly on an individual's levels of positive and negative emotions? In **chapter 3**, I examine participants' reports of day-to-day emotional experience over the course of a month. These data do not directly capture moment-to-moment interactions between positive and negative emotions, but they can help determine the net effect of those interactions over longer timescales and in naturalistic situations. I predict that even over the course of a single day, emotional episodes are typically separated enough that an individual who experiences a positive emotion will have the opportunity to build resources even if negative emotions occur later. Thus, I hypothesized that positive emotions will predict increases in resources and improvements in life satisfaction, and that negative emotions will not interfere with this effect. The results support this conclusion -- in fact, positive emotions remain beneficial when negative emotions are high, but negative emotions cease to be detrimental when positive emotions are even moderately high. This does not just mean that the effects of positive emotions outweigh those of negative emotions; the results indicated that negative emotions ceased to exert any influence on outcomes once positive emotions were high. These findings cannot be generalized to populations experiencing severe, prolonged stress or clinical psychopathology, but they provide encouragement for future intervention research, even in populations that already suffer some impairment.

Another possibility is that negative emotions can have a "demolishing" effect, undoing previous resource-building. However, I reason that although negative emotional states mobilize resources that the individual built up in better times, and may lead to short-term exhaustion, these resources are not used up or permanently reduced. Thus, I hypothesized that day-to-day negative emotions will not predict changes in resources or life satisfaction. This prediction was supported in both **chapter 3** and **chapter 4** ("Open Hearts Build Lives"). These results, too, cannot be generalized to individuals with high levels of chronic stress or psychopathology, for whom negative emotions may augment known resource-demolishing processes such as job disruption, social support burnout, and allostatic load. In these populations, there may be more complex interplays between

positive emotions, negative emotions, resources, and outcomes.

Question 5: Is it possible to increase one's level of positive emotion long enough to build meaningful resources?

The particulars of the broaden-and-build theory require fine-grained analysis of controlled research situations, but the consummate test of its importance is whether we can increase individuals' positive emotions and observe improvements in real life outcomes. First, though, we need a method for inducing positive emotions that is robust enough to survive the distractions and difficulties of everyday life and that is not rapidly rendered neutral by adaptation or boredom.

Long-lasting positive emotion inductions are not trivial to develop. Research indicates that people eventually adapt to even substantial changes in their life circumstances, and take them largely or entirely for granted. Some promise comes from research on episodic activities with personal relevance (Seligman, Steen, Park, & Peterson, 2005; Sheldon & Lyubomirsky, 2006, Tkach & Lyubomirsky, 2006), although even these can become inert if not approached with the appropriate attitude, intent, and timing (Sheldon & Lyubomirsky, 2004). **Chapter 4** reports on the effects of training working adults in loving-kindness meditation, a practice involving deliberate and mindful generation of warm, sympathetic feelings towards oneself and others. Because the positive emotions evoked by loving-kindness meditation are episodic, challenging, self-relevant, and widely applicable, we expected that they would not attenuate over the two months of the study. In fact, the effectiveness of the intervention gradually increased, with the meditation generating increasing positive emotion as participants gained experience with it. Nor were the benefits limited to episodes of meditation: meditation participants reported enhanced positive emotions throughout their daily experiences. This can be seen as another way in which the intervention remained interesting and vital.

Question 6: Can deliberately induced positive emotions create meaningful change?

Finally, **Chapter 4** reports on a prospective experimental study of a successful long-term positive emotion induction and its effects on personal resources and life outcomes. It measures personal resources, life satisfaction, physical health, and

depression symptoms before and after two months of training in loving-kindness meditation, and compares those values to a waitlist control group. This period is long enough to observe meaningful change, but short enough that we were able to gather fine-grained daily data and assess not just experimental effects, but a specific dose-response relationship between positive emotions and resources, and between resources and life satisfaction and depression. The results provided strong and specific support for the broaden-and-build theory, with daily positive emotion enhancing personal resources, which in turn enhanced life satisfaction and reduced symptoms of depression.

Overview

The broaden-and-build theory suggests that everyday experiences of amusement, joy, love, and curiosity are a fundamental part of how we function. They exist because they made the individuals who experienced them more successful humans. We have the option to make time for these emotions, evoke them, and savor them in our daily lives, and when we do so we create space for ourselves to learn, reflect, and grow. People whose lives do not seem inherently positive can benefit from finding sources of happiness: Temporarily counteracting the narrowed, crisis-response state that negative emotions create can make it possible to imagine solutions, invest in the future, or build social support, all of which may help solve their problems when short-term stress and anxiety have failed – or at least grant a temporary respite from the destructive effects of chronic stress, and help them carry on. Those whose lives do offer ample opportunities for positive emotions can also benefit: exploration, curiosity, and inclusiveness can make the difference between a pleasant life and one that reaches its full potential for achievement, knowledge, connectedness, or intimacy.

Our research has been an effort to connect this grand and hopeful view with specific responses to emotion, clear mechanisms for long-term effects, and established techniques for creating and assessing positive outcomes. The papers in this dissertation represent three approaches: an experimental study of how broadening manifests and how it leads to learning and growth; an observational study establishing that positive emotions build meaningful resources and exploring detailed effects of time, emotion change, and positive / negative interactions; and an intervention study that allows us to diagram the

entire path from positive emotions to life outcomes. Following these papers I will discuss what we have learned and where we can look next, in order to further refine the theory and fulfill the potential of the positive emotions it describes.

Chapter 2

Positive Affect Disrupts Effective Attentional Allocation on Complex Tasks

Abstract

People in negative moods often perform challenging tasks more accurately and thoroughly than those in positive moods. This may be because positive moods enhance autonomous motivation and attentional breadth; people in positive moods perform as well as those in negative moods when motivated to do so. We hypothesized that broadened and flexible attention may become an asset when focus on the immediate task must be balanced with improving future performance. Participants performed a task requiring rapid, detail-oriented responding, with half permitted to monitor additional information that could improve performance on future trials. This additional information improved performance, but only for those with low positive affect scores. Positive affect was unrelated to performance in the condition without additional information. Positive affect may disrupt the ability to affectively allocate attention among multiple goals. However, it is also possible that this particular task did not reward divided attention as intended. We discuss methods for obtaining a clearer assessment of participants' goals and strategies, which will help future studies clarify the mechanism behind this finding.

Introduction

Emotions are states in which physiology, cognition, and motivation are coordinated in a specific pattern: For negative emotions, often one relevant to immediate survival or problem solving, and for positive emotions, often one relevant to finding opportunities and building resources (Fredrickson & Cohn, in press; Martin & Clore, 2001; Tooby & Cosmides, 1990). Thus, it is no surprise that mood states, even when irrelevant to one's present circumstances, can influence performance on a wide variety of research tasks and everyday activities. A great deal of past research has attempted to broadly characterize the effects of positive and negative mood on performance, but results have been inconsistent. We report on a study designed to test one underlying aspect of performance, relating affect to an individual's allocation of attention across different aspects of a task, and discuss the potential of attention allocation to explain a variety of effects of emotion on task performance.

Positive and Negative Emotions

Many theories of emotions associate each emotion with a tendency towards a specific type of action (Frijda, 1986; Frijda, Kuipers, & Schure, 1989; Lazarus, 1991; Levenson, 1994; Oatley & Jenkins, 1996; Tooby & Cosmides, 1990), which reliably enhanced success or survival in an evolutionarily relevant situation. For example, fear increases physiological preparedness to expend energy and survive injury, and biases the individual to notice threatening stimuli or construe ambiguous stimuli as threatening, in order to facilitate rapid response to a threat. Depressed mood reduces energy expenditure, facilitates social withdrawal, and globally reduces motivation, which may have initially been an adaptation to unfriendly, resource-poor, or unrewarding environments (Keller & Nesse, 2005). By facilitating actions that have proved adaptive, without compelling them, emotions allow complex organisms to strike a balance between rapid, evolutionarily-tested responses to situations and more flexible or reflective ones.

More recent work has extended this approach to the positive emotions, which were previously seen as leading to very vague tendencies towards activation or relaxation (Fridja, 1986) and thus did not fit well into the specific action tendency model (Ekman, 1992; Lazarus, 1991). Fredrickson's *broaden-and-build* model of positive emotions (1998, 2001) suggests that because positive emotions are not evoked by a specific

problematic stimulus, they will not facilitate one specific pattern of behavior. The rapid, evolutionarily-tested response to a safe, pleasing, or exciting situation is to engage with new opportunities and develop resources for the future – a broadening of one's thought-action repertoire rather than a narrowing. Joy, for instance, is associated with the unrestrained and exploratory behavior of play. Physical play fuels neurological development and teaches critical skills in both animal and human infants (Dolhinow, 1987; Panksepp, 1998), while shared laughter and amusement lead to social bonds and attachments in both children and adults (Gervais & Wilson, 2005; Keltner & Bonanno, 1997, Lee, 1983). Similarly, feeling interest can lead to intellectual exploration that creates knowledge and cognitive complexity (Silvia, 2001), and contentment can prompt heightened awareness and savoring, which improve coping and mental health (Davidson et al., 2003; Segal, Williams, & Teasdale, 2001). One's survival rarely depends on play, exploration, and savoring, but it may well depend on social support, knowledge, and coping skills (see Fredrickson & Branigan, 2001 and Fredrickson & Cohn, in press, for a more detailed review). Negative emotions help mobilize resources in critical situations, but positive emotions help ensure that there will be resources to mobilize.

Mood and performance

There is now overwhelming evidence that people who regularly experience positive emotions experience better life outcomes than those who do not (for a review of over 200 studies, see Lyubomirsky, King, & Diener, 2005). Longitudinal evidence indicates that positive emotions often precede improvements in mental and physical health, high-quality relationships, and job success, as well as simply resulting from them. This evidence suggests that individuals who experience positive emotions would also do better at the everyday tasks that lead to long-term success, and there is indeed evidence that induced or naturally-occurring positive emotions are associated with psychological and behavioral responses that enhance mental health (Fredrickson & Joiner, 2002; Fredrickson, Tugade, Waugh, & Larkin, 2003; Raghunathan & Trope, 2002, Tesser, Martin, & Cornell, 1996), physical health (Aspinwall & Brunhart, 1996; Scheier & Carver, 2003; Tugade & Fredrickson, 2004), and relationship closeness (Aron, Norman, Aron, & McKenna, 2000; Gaertner, Dovidio, Isen, Rust, & Guerra, 1995; Waugh &

Fredrickson, 2006). However, findings on positive emotions and performance at job- or school-related tasks have been more mixed.

Isen and colleagues have established that positive emotions produce patterns of thought that are notably unusual (Isen, Johnson, Mertz, & Robinson, 1985), flexible and inclusive (Isen & Daubman, 1984), and creative (Isen, Daubman, & Nowicki, 1987), while still remaining within rational and useful bounds. Positive emotions also appear to facilitate problem solving on more complex and serious tasks, such as medical decision-making among doctors (Estrada, Isen, & Young, 1994, 1997), and on tasks for which the participant has strong motivation (Aspinwall, 1998). However, this research stands alongside a variety of robust findings indicating that positive emotions harm performance on tasks requiring detailed thinking or analysis. People in positive moods show susceptibility to weak arguments (Bless, Bohner, Schwarz, & Strack, 1990; Mackie & Worth, 1989), deficits in causal reasoning (Schwarz & Bless, 1991), and willingness to rely on racial and social stereotypes rather than individuating information (Macrae, Milne, & Bodenhausen, 1994).

Most theories explain these detrimental effects by positing that positive emotions are associated, both phylogenetically and in individual experience, with successful and unthreatening situations. They thus evoke cognitive strategies that are appropriate to goals that are near completion (Carver, 2003), simple problems that do not require effortful thought (Mackie & Worth, 1989), well-practiced tasks for which high-level heuristics will be successful (Schwarz, 2002), or information that can be cognitively chunked rather than analyzed (Fiedler, 2001). In all these cases, positive emotions are expected to improve performance when a task can be addressed with creativity, associative thinking, or other “big-picture” approaches, or when the task is simple or solvable with readily available heuristics. However, positive emotions are expected to hurt performance if the task requires detailed and focused attention, complex or nonintuitive processing rules, or vigilance for potential errors.

Attempts to Reconcile Conflicting Findings

Several researchers have attempted to find an overarching frame that can explain why positive emotions sometimes appear beneficial and sometimes detrimental to cognitive tasks. Basic-process explanations have drawn on the behavioral variability and mental

flexibility associated with positive emotions. Bless et al. (1996) found evidence that individuals in a positive mood appeared more distractible on a focal task, but used some of their attention to perform better on a second, concurrent task. Similarly, Dreisbach (2006) and Dreisbach & Goschke (2004) found that when participants were required to switch rapidly between different tasks, positive affect increased ability to switch sets but decreased ability to maintain a single set in the face of confusing distractors or long intertrial intervals. These findings echo Fiedler's (2001) claim that positive emotions are more suited to forming connections between ideas than to detailed analysis.

A second approach has been to examine the motivational variability associated with positive emotions. Aspinwall (1998) and Isen (2001) argue that positive emotions make people less likely to focus their attention on any arbitrary task they are presented with, but not less able to focus their attention when they believe the task is enjoyable, important, or rewarding. This is confirmed by studies that have manipulated the participant's perception of a task's importance (Isen, 2007; Macrae, Milne, & Bodenhausen, 1994) or potential for enjoyment (Martin, Achee, Ward, & Wyer, 1993), without altering the task itself. It is possible, then, that many findings on mood and performance actually hinge on aspects of the task that had been considered irrelevant: Whether the task was interesting or tedious, whether the experimenter presented it as meaningful or insignificant, and whether there were perceived rewards for or consequences of performance.

Aligning Performance Research with Reality

Knowledge about mood and performance has serious implications for the contexts in which we work and learn. Most people would no doubt prefer to work in an environment conducive to happiness, camaraderie, and fulfillment, and the broaden-and-build theory also predicts that emotionally positive workplaces will foster continuous improvement and skill development. Workplaces that provide this atmosphere do show better outcomes (Harter, Schmidt, & Keyes, 2003; Staw, Sutton, & Pelled, 1994). Yet if positive emotions encourage rushed or lazy thinking or reduced standards for accuracy and detail, work outcomes would be expected to suffer. One might especially argue that low-skilled workers doing repetitive tasks, or workers in high-risk industries like nuclear power and law enforcement, should be kept in somber moods. Even Martin Seligman, a leading

proponent of positive psychology, has commented that when he flies he wants the air traffic controller to be a pessimist ("Frequently Asked Questions," 2007).

These conclusions may rest on an invalid generalization: the fact that lab studies have been able to produce a dichotomy between "detail-oriented" and "creative" tasks does not mean that the same division exists in the range of tasks performed in the real world. People who are sufficiently motivated can bring skill and grace to even seemingly routine jobs (Csikszentmihalyi, 1998; Wrzesniewski, McCauley, Rozin, & Schwartz, 1997), and people whose attention extends beyond their immediate tasks may be able to notice incipient problems or opportunities to improve the system. The present study tests this possibility by designing a detail-oriented performance task, similar to those used in many other studies, but adds a divided-attention component to determine the effects of positive emotions in situations that require attention to both focal and peripheral information.

The present study

In this study participants receive either a positive or a neutral mood induction, and then engage in a detail-oriented performance task, in which they search a large grid of letters for pairs of identical letters. Participants are randomly assigned to a version of this task that involves only speed and attention to detail, or to an identical task that also offers the opportunity to notice information that will be useful in future trials of the task. Both versions of the task are more tedious and information-poor than most real-life tasks, but the second condition adds a critical element of realism: Participants who are able to attend to the present goal but also notice other peripheral information may have an advantage over those who are excessively focused or excessively distracted. The procedure is based closely on that of Isen (2007), which found that positive affect improved participants' ability to notice images presented outside the grid without reducing performance on the letter search task. However, Isen's version presented task-irrelevant and relatively simple information at the periphery, whereas the present study presents complex information that is relevant to the task itself. This change is likely to make it more difficult for participants to optimally allocate attention between present and future goals, but it also makes the task a better model for real-life tasks at which individuals must perform well even as they learn about the task in order to perform better in the future (Isen's task, in contrast, can be seen as a model for a broader work context in

which individuals must focus on their jobs while maintaining some vigilance for unexpected problems or opportunities).

We hypothesize that:

H1) Following Isen (2007), positive mood will not reduce overall task performance.

H2) Positive mood will increase performance when participants have the opportunity to gather peripheral information for future use while performing the focal task. This will involve both:

H2a) increased attention to peripheral information, relative to neutral-mood participants, when the future task has greater value than the present task

H2b) decreased attention to peripheral information when the future task has less value than the present task.

H3) Positive mood will improve switching between rule sets.

H4) Positive mood will cause an increase in unintentional attention to peripheral information, even when the participant does not know this information will have value. The degree of increase will be in between what is seen when the information is known to be low-value and when it is known to be valuable.

H5) Positive mood will lead to a broader visual search pattern:

H4a) The pattern will cover a wider range than that seen in the neutral condition.

H4b) The pattern will be more parallel and less serial than that seen in the neutral condition

Method

Participants

Participants were 60 individuals recruited from the University of Michigan and the Ann Arbor, Michigan area. Participants received either course credit or a \$5 payment as compensation for participation. Eighty-eight percent of participants were 18 or 19 years old, with the remainder between 20 and 23. Fifty-eight percent were female. The sample was 61.7% non-Hispanic White, 10% Asian, 8.5% White or unspecified Hispanic, 5% Black, 3.5% multiracial, and 11.7% other or unspecified.

Measures

Affect grid: The Affect Grid (Russell, Weiss, & Mendelsohn, 1989) is a one-item measure in which participants rate their momentary affect on emotional valence (unpleasant – pleasant) and arousal (low arousal – high arousal).

Modified Differential Emotions Scale: The mDES (Fredrickson, Waugh, Tugade, & Larkin, 2003) asks participants to rate the extent to which they are experiencing 20 discrete emotions, including both high- and low-arousal pleasant and unpleasant emotions (e.g., amusement, contentment, anxiety, and sadness), on a zero to eight scale.

Stimuli

Induction videos: Participants were randomly assigned to watch one of two 2-minute videos: "laughing baby," an emotionally positive video in which a small child laughs at a parent's off-screen play, or "tiles," an emotionally neutral video in which two adults demonstrate how to tile a bathroom wall. Both videos were presented on the computer in a standard web browser screen, modified to remove "forward" and "back" buttons and other controls.

Letter grids: The 20 letter grids used in the study were produced by a computer randomization process. Each grid was 22x22 and contained 21-22 targets of each type (horizontal and vertical letter pairs), distributed randomly. Efforts were made to minimize overlap between pairs. Randomly occurring areas of high target density were allowed to occur, in order to prevent participants from learning to ignore the area around a target. Grids were displayed at a normal text size and occupied most of a standard 17" computer monitor.

Procedure

Participants came to the lab in groups of 2-4 and received informed consent information. The experimenter explained that they would have the opportunity to win a \$25 cash prize in a drawing, with their chances determined by their performance on the experimental task. Experimenters emphasized that the prize was real, and that the University of Michigan Institutional Review Board had certified that our consent form was accurate and did not involve deception. Participants were told that they would learn the rules for the task, watch a video, and then complete the task. Experimenters then conducted them to individual rooms where the remaining materials were presented on computers running Windows XP.

Participants were randomly assigned to view the positive or the neutral emotion induction. They completed an affect grid before and after watching the video, and then began the experimental task. In the task, participants saw one of the letter grids, and were instructed to click on horizontal pairs for five points apiece, with a reminder that the number of points they scored would determine their chances of winning a cash prize. After 30 seconds, they were told that they could no longer click on horizontal pairs but that vertical pairs were now worth 5 points apiece. Participants were randomly assigned to perform the vertical search on the same grid they had just seen (the *same-grid* task), or on a new grid (the *new-grid* task). After 30 seconds the grid disappeared and the round ended.

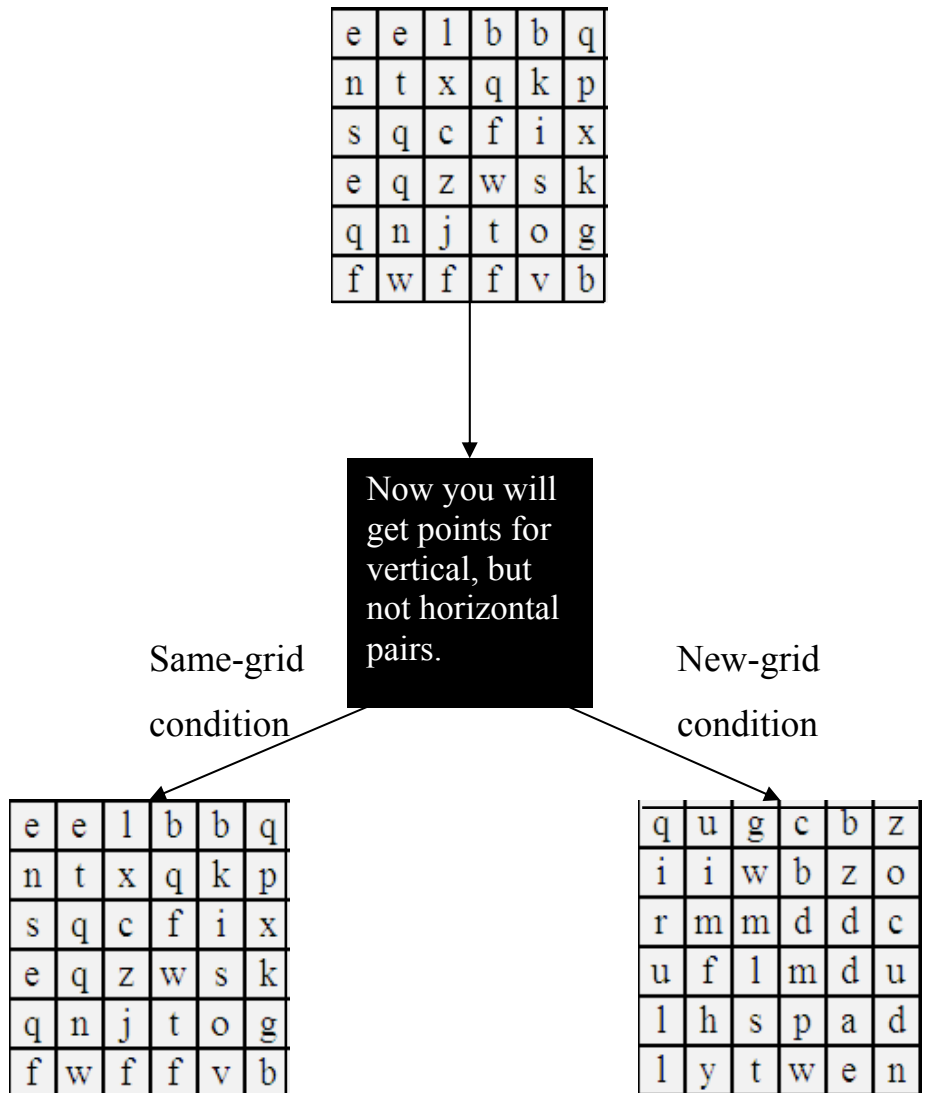
Participants then received full instructions: They were told that in each round they would have 30 seconds to click on horizontal pairs, and then 30 seconds to click on vertical pairs. Participants continued with the same task they had done in round 1 (either same-grid or new-grid) and were explicitly informed at the beginning of each round whether they would either see the same grid for both searches, or two different ones.

At the beginning of each round they were told how many points each type of pair would be worth. The possible point values for horizontal and vertical pairs, respectively, were 5-5, 6-4, 4-6, 9-1, and 1-9. To prevent differences in motivation between rounds, the sum of horizontal and vertical values was always 10.

Participants were informed that every three rounds there would be a "micro-break." During these periods, an image appeared on the screen for 1s. These images were selected based on pretests to have the same valence as the initial induction, and to be approximately neutral on the arousal scale. Every fourth round, they completed an additional self-report using the Affect Grid. The task ended after 10 rounds.

On the final round, participants were informed that the rules would change: Those who had been in the new-grid condition were now told that they would see the same grid for the horizontal and vertical searches, and those in the same-grid condition were told that the grid would be replaced with a new one.

Figure 2-1: The grid search task



During the first part of the round, participants search for horizontal pairs of letters. They have been told that they will later search for vertical pairs of letters.

In the top grid, participants would receive points for clicking on the "ee" pair in the upper left. At that time, they might also notice the vertical "qq" pair beneath it. Participants in the same-grid condition would be able to click the "qq" pair during the vertical search phase. Participants in the new-grid condition would see a different grid and would not be able to use their knowledge about the pair. Participants are told repeatedly which condition they are in.

After this round, participants responded to several questions evaluating the task. They then responded to two versions of the mDES, one asking them to recall their emotions during the task and one asking how they felt at the present moment. They were then debriefed and paid.

Results

Manipulation Check

Emotion induction

Participants who watched the "laughing baby" video rated their affective states as more positive and more aroused than those who watched the "tile laying" video (valence: $F(1,55)=5.81, p=.019$; arousal: $F(1,55)=24.16, p<.001$). These scores were also significant when controlling for baseline scores. There were no differences in valence on the mid-task affect grids.

Both the baby and the tile groups rated their post-video affect as moderately pleasant ($M=5.6$ and 6.6 , respectively, on a 0-8 scale). However, the baby group rated their arousal level as above neutral ($M=4.9$), while the tile group reported below-neutral arousal ($M=2.7$).

Valence ratings showed strong negative skew. Of 60 participants, 46 chose pleasantness scores of 6, 7, or 8, and only 11 reported scores of neutral or below (median=7).² The pre-induction affect grid was similarly skewed, with a median pleasantness rating of 6.5.

At the end of the study, participants retrospectively reported on their experience of 11 positive and 8 negative emotions while watching the video. Participants who watched the baby video reported having felt more positive emotions ($F=35.87, p<.001$), and no difference in negative emotions ($F=1.39, p=.24$). In ratings of their emotions at the end of the study, elevated positive emotions remained as a trend ($F=2.88, p=.10$), although this is at odds with the lack of difference in mid-task valence ratings. The emotions subscales showed good internal consistency (positive emotions $\alpha=.88$, negative emotions $\alpha=.86$).

Participants who saw the baby video reported higher levels on all eleven positive emotions (amusement, wonder, contentment, happiness / joy, gratitude, hope / optimism, interest, love, pride, amazement, and compassion) than those who viewed the tiles video. Differences were significant under a Bonferroni correction for multiple comparisons ($\alpha=.0045$), except for interest ($p=.05$). The induction also demonstrated specificity: Reports of the positive emotions expected to be associated with the baby video (amusement, joy, love, and compassion) were higher than the other positive emotions, specifically among participants who saw the baby video (a two-way interaction between video and type of positive emotions: $F(1,55)=24.05, p<.001$).

Task Performance

To determine whether participants in the same-grid condition actually used the opportunity to search for vertical targets during the horizontal phase, we compared scores between the groups. Scores were marginally higher in the same-grid condition ($F(1,59)=3.54, p=.07, \eta^2=.07$), but were not significantly higher on either horizontal ($F(1,59)=2.80, p=.10$) or vertical pairs ($F(1,59)=.87, p=.36$) separately. The difference between horizontal and vertical scores also did not differ between the two conditions ($F=1.14, p=.29$), nor did the raw number of pairs found when ignoring point value ($F=.73, p=.40$).

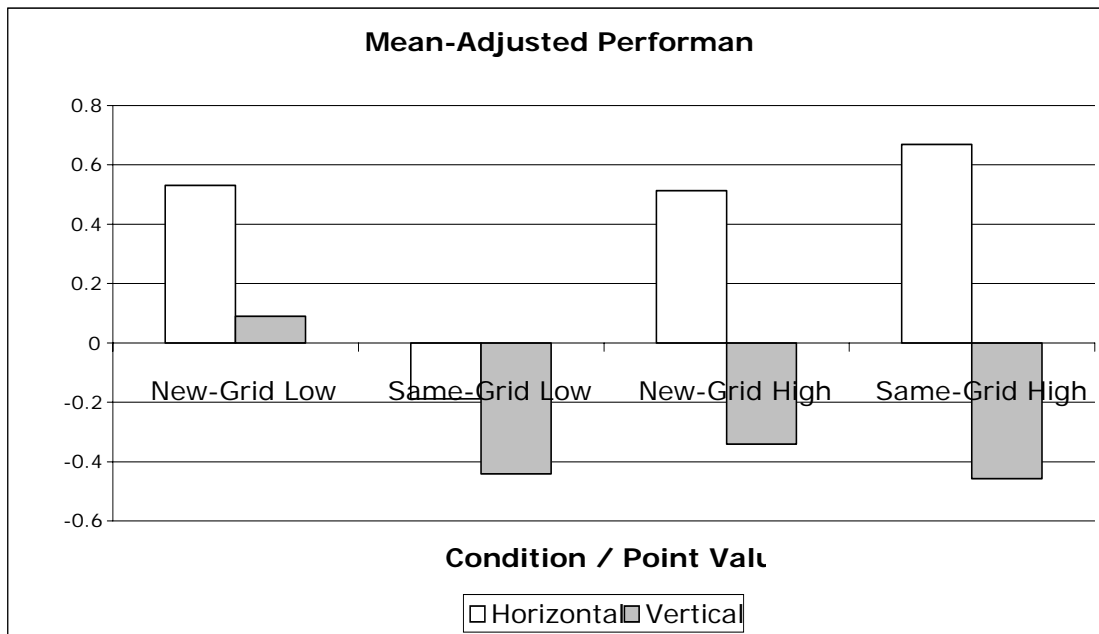
We examined the results for differences between conditions that were dependent on point value. Figure 2 shows the number of targets found for each condition, target type, and point value. Number of targets found is adjusted for the group mean, to account for the different overall performance between groups. When point values were low, participants in the same-grid condition found fewer targets, suggesting that they were directing their attention towards more valuable targets. That is, when horizontal targets were low-value they used the horizontal round to find vertical targets they could click on in the subsequent vertical round, and when vertical targets were low-value they inhibited attention to them and gave horizontal targets their full attention during the horizontal round. These differences between groups were significant: For low-value horizontal targets, $F(1,58)=6.8, p=.01$; for low-value horizontal targets, $F(1,58)=6.17, p=.02$.

For high-value horizontal pairs, participants in both conditions found significantly more targets than average ($F(1,58)=18.0, p<.001$), but there was no difference between

conditions ($F(1,58)=.3, p=.58$). For high-value vertical pairs, participants in both conditions found *fewer* targets than average ($F(1,58)=10.2, p=.002$), with no difference between conditions ($F(1,58)=.2, p=.64$).

These results suggest that participants who searched for horizontal and vertical pairs in the same grid performed better, but not entirely because of an enhanced ability to find vertical pairs. There were also no between-group differences regarding the subjective perception of the task as pleasant, unpleasant, understandable, stressful, or boring.

Figure 2-2: Mean-adjusted performance by condition and target value



Task strategy

We assumed that participants in the same-grid condition would shift some of their attention away from horizontal pairs and towards vertical pairs, especially when the value of vertical pairs was high (the total value of horizontal and vertical pairs was held constant, so rounds with high-value vertical pairs always included low-value horizontal pairs and vice versa).

Overall, horizontal and vertical pairs identified were positively correlated throughout the sample ($r(60)=.54, p<.001$), and the inclusion of an interaction variable between

vertical score and replacement condition did not change this relationship ($\beta_{\text{horizontal}}=-.46$, $p=.02$; $\beta_{\text{interaction}}=-.12$, $p=.53$). However, the correlation differed according to the values of the pairs: when their values were equal, the correlation was large ($r(60)=.63$, $p<.001$); when horizontal pairs were worth more, it was medium ($r(60)=.39$, $p=.002$), and when vertical pairs were worth more, it was near zero ($r(59)=.09$, $p=.52$). A comparison of the magnitude of residuals indicated a nonsignificant omnibus test ($F(2,116)=1.89$, $p=.16$) but a significant linear trend ($F(1,58)=4.34$, $p=.04$). The difference between equal-values and horizontal-high correlations was significant ($F(1,58)=4.35$, $p=.04$). This suggests that during rounds with a large difference between the value of horizontal and vertical pairs, the positive correlation between horizontal and vertical performance was attenuated by a concurrent negative relationship, in which participants who found more pairs of one type were doing so by reducing attention to the other.

Unexpectedly, none of these relationships was qualified by an interaction with replacement condition ($\beta_{\text{interaction}}<.14$, $p>.48$), indicating that participants performed the same tradeoffs even when the information was useless (because they would not be using the same grid for horizontal and vertical pairs).

Main Hypotheses:

H1) Positive emotions will not reduce task performance.

We examined total scores and raw number of pairs found in the positive and neutral emotion groups, separately testing vertical and horizontal pairs as well as both together. No differences were found ($F<1.06$, $p>.31$). The positive emotion induction did not reduce performance. Although a null finding is a poor indicator of a lack of effect, the estimated effect sizes were also small ($\eta^2<.017$).

Self-reports of affect also did not correlate with performance. Affective valence reported immediately after the video and before the task did not correlate with either total points ($r(58)=-.17$, $p=.19$) or total pairs found ($r(58)=-.21$, $p=.11$). The degree of correlation that was found was driven by negative correlations between affect and horizontal pairs found, which did approach significance (score: $r=-.21$, $p=.11$; pairs: $r=-.24$, $p=.06$). Controlling for valence on the pre-video affect grid produced a slightly weaker version of the same pattern. The retrospective report of positive emotions while

watching the video did not approach significance with any measure of performance ($r(60) < -.17, p > .19$).

H2) Positive emotion will increase performance in the same-grid condition.

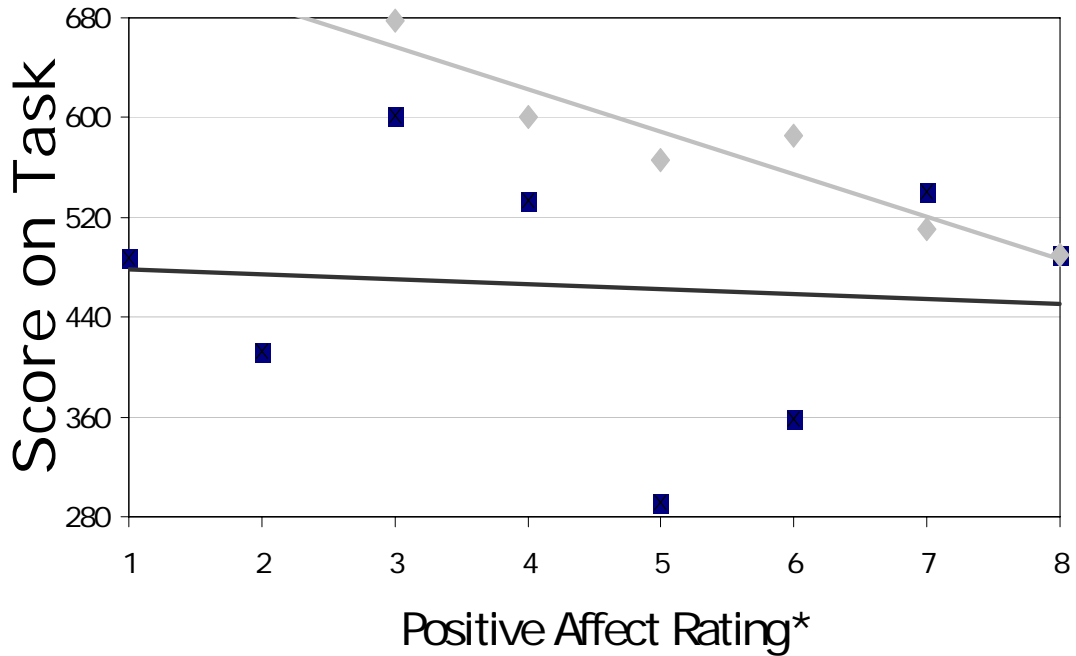
Being in the positive emotion condition did not confer a benefit on participants in the same-grid condition, either to their scores ($F_{\text{task} \times \text{video}} = .45, p = .51$) or to the number of pairs found ($F_{\text{task} \times \text{video}} = .01, p = .91$). The same is true when examining scores and pairs for vertical-search rounds only (score: $F_{\text{task} \times \text{video}} = .56, p = .46$; pairs: $F_{\text{grid} \times \text{video}} = .45, p = .51$).

However, a regression analysis revealed that self-reported positive affect immediately before the task did interact with the task condition. When same-grid was dummy coded as 0 and new-grid as 1, the β coefficients were $-.49$ for positive affect ($p = .02$), and $.40$ for the affect-replacement interaction ($p = .04$). This indicates that positive affect had a medium to large *negative* influence on performance in the same-grid condition, and little or no influence in the new-grid condition. The result is that at high levels of positive affect, the benefits of the same-grid condition disappear and participants perform no better than if they were seeing a new grid each time (see Fig. 3).

The same pattern appeared when looking only at scores on horizontal pairs (positive affect: $\beta = -.48, p = .02$; interaction: $\beta = .37, p = .07$), but was not significant for scores on vertical pairs (positive affect: $\beta = -.32, p = .13$; interaction: $\beta = .27, p = .20$).³ This pattern also appeared when analyzing number of pairs clicked, without regard to point value.

We examined the difference in performance between rounds in which vertical pairs were worth much more than horizontal ones and ones in which they were worth much less. The critical test was a three-way interaction between point value, positive emotion, and grid replacement condition, for which there was no significant difference ($F = .59, p = .45$). No matter what the values of the different types of pairs, positive affect removed the benefits of the same-grid condition and appeared inert in the new-grid condition.

Figure 2-3: Positive affect reduces performance in same-grid condition only



- new-grid
- ◆ same-grid
- Linear (new-grid)
- Linear (same-grid)

* No participant reported a pleasantness rating of zero, so the scale is shown beginning at one.

** In this condition the lowest affect rating reported was three, so data points and trend line are not shown for scores of one or two.

The evidence fails to support the hypothesis that positive emotions increase performance in the same-grid condition, and appears to indicate that they reduce or eliminate the benefits of that condition. Results were generally the same for score and pair counts, indicating that participants higher on positive affect found fewer pairs and not just less valuable ones.

H3) Positive emotions will improve switching between rule sets.

We operationalized set-switching by examining performance when the rules changed unexpectedly.

During the first round of the task, participants switched without warning or foreknowledge from searching for horizontal to vertical pairs. There were no differences between scores on the second round based on either induction condition ($F(1,58)=1.03$, $p=.31$) or self-reported affect ($r(60)=.02$, $p=.87$). The relationships remained nonsignificant when controlling for performance on other rounds.

For the final round, participants switched task conditions: Participants in the same-grid condition saw different grids for horizontal and vertical searches, and those in the new-grid condition saw the same grid twice. They were informed of this before the horizontal round, so the change may have affected either the horizontal or the vertical search. Participants who had been in the same-grid condition and were now doing the new-grid task continued to show higher scores ($F(1,60)=6.38$, $p=.01$). Positive affect continued to reduce performance, but only in this condition, according to a marginal interaction: (positive affect: $\beta=-.40$, $p=.05$; interaction: $\beta=.37$, $p=.06$). Positive affect appeared to have no influence on set-switching.

H4) Positive emotion will cause involuntary attention to peripheral information, in the absence of any knowledge about its potential value.

We tested this hypothesis by examining the first phase, in which participants did not know that they would be shifting from horizontal to vertical search. Any improved performance on the part of the positive emotion / same-grid group would have to rely on unintentional attention to non-focal information about the grid. Relative to performance on the first horizontal round, performance on the first vertical round was unaffected by the interaction between emotion condition and grid replacement ($F(1,56)=.26$, $p=.73$). There was also no relationship between score and self-reported positive affect ($\beta=-.09$, $p=.64$) or affect X task interaction ($\beta=.19$, $p=.33$)

H5) Positive emotion will lead to a wider and more parallel search pattern.

We used the pairs participants clicked on to indicate approximate boundaries for the portion of the grid searched, and computed the area within each boundary.⁴ Searching larger areas was associated with higher scores ($r(60)=.39, p=.002$). Average area explored was not related to emotion condition ($F(1,56)=.81, p=.37$) or emotion X task interaction ($F(1,56)=.45, p=.50$).⁵ There was a marginal negative influence of positive affect on search area ($\beta=-.22, p=.08$), but this was fully mediated by the relationship between affect and score ($\beta_{\text{score}}=.36, p=.005$; $\beta_{\text{affect}}=-.153, p=.22$).

Visual inspection of clicking patterns made it clear that some participants used a serial search strategy, reading across rows or down columns in order, and others used a parallel search strategy, clicking on pairs throughout the board as they popped out visually. Additionally, participants often described using one or the other of these strategies in debriefing questions. We tested for predictors of search strategy, using distance moved between clicks as a proxy for parallel search.⁶ Interclick distance was negatively associated with score ($r(60)=-.36, p=.005$). Although there were substantial individual differences in interclick distance, there was no relationship between distance and emotion condition ($F(1,56)=.03, p=.87$) or emotion X replacement interaction ($F(1,56)=.61, p=.44$), nor was there a relationship with self-reported positive affect ($\beta=.09, p=.49$) or with an affect X task interaction ($\beta=.04, p=.85$).

Discussion

Positive affect and performance

We found that positive affect had no effect on overall task performance. This can be considered a replication and strengthening of Isen's (2007) findings, using a similar but not identical paradigm. However, ratings of affective valence predicted a lack of benefits from the same-grid version of the task. In this version, participants had the opportunity to balance attention to current targets (horizontal pairs) with attention to future targets (vertical pairs). Ratings of affect from "extremely unpleasant" to slightly above "neutral" predicted improved performance relative to the new-grid condition; at higher levels of pleasantness the conditions performed equally. We did not find a relationship between

positive affect and any specific performance metric that would describe how high positive affect participants performed more specifically.

Because the pleasantness ratings were negatively skewed and may have had a ceiling, it is unclear what point on the scale should be considered truly neutral for distinguishing between a benefit of negative affect and a liability of positive affect. We will later discuss methodological changes that will be able to clarify the issue in the future.

In the same-grid condition, it was theoretically possible to ignore the additional information offered by the ability to see vertical pairs during the horizontal phase. This would have led to performance equivalent to that in the new-grid condition, which is what we observed for high positive affect.⁷ In theory this explanation could be tested using our markers for task strategy, but difficulty interpreting those arose as well.

Task strategy

We assumed that any improvement in scores in the same-grid condition relative to the new-grid condition would be due to same-grid participants 1) ignoring low-value horizontal pairs during the horizontal phase and using that time to learn the locations of high-value vertical pairs or 2) inhibiting attention to low-value vertical pairs during the horizontal phase and focusing full effort on finding horizontal pairs. Same-grid participants did show more of a drop in performance on low-value horizontal pairs, but their advantage on high-value horizontal pairs was not significant. They also showed the expected drop in performance on low-value vertical pairs. Unexpectedly, on high-value vertical pairs, both conditions showed lower than average performance, with no difference between groups.

It is unclear why performance dropped for high-value vertical pairs. Because the poor performance was seen in both groups, it cannot be due to any strategy that relies on seeing the same grid for the horizontal and vertical searches. Because high-value vertical pairs always co-occurred with low-value horizontal pairs, there is no reason to believe that horizontal pairs would be more distracting during the rounds in question than during other rounds. One possibility is that some vertical-search grids differed in difficulty: If one condition saw more difficult high-value vertical grids than the other, it could obscure or exaggerate between-group differences in performance. If the high-value vertical grids were more difficult than the low- and medium-value ones, then the generally lower

performance on high-value vertical targets could be an artifact as well. All grids were constructed in a similar fashion and no differences in difficulty were intended, but random differences are always possible.

We also assessed whether participants were trading off attention between the two types of target by comparing correlations between horizontal and vertical pairs found, based on point value. The correlation was large when the values of the two target types were equal, and participants would be expected to devote equal attention to each. Correlations were significantly lower when the values were unequal, suggesting that some participants were increasing their success at one type of target by reducing attention or effort devoted to the other.⁸ However, this finding had no interaction with condition. Participants in the new-grid condition knew from explicit instruction and repeated experience that any vertical pairs they found would be erased before they had a chance to claim them, yet they still devoted attention to finding them during the horizontal phase. This suggests that the changes in attention were largely nonconscious, occurring due to changes in motivation related to the pair types rather than deliberate allocation of effort.

Affect and task strategy

Participants appeared to use the same strategy in the same-grid and new-grid conditions, and we did not find a relationship between strategy and affect in either condition. Thus, the benefit to same-grid performance experienced by participants low in positive affect does not appear to have been caused by a change in strategy, either deliberate or unconscious. Affect was also unassociated with the other components of task performance we measured, including area searched, parallel vs. serial search, and ability to switch rulesets.

We feel it is most likely that either strategy or some aspect of task performance did change, but that the size and structure of our dataset do not provide enough power to detect this. The skew in the positive affect scores means that we have relatively few high performers in the same-grid condition, and the specifics of the task may not have permitted differences in performance dimensions to fully emerge.

Future Studies

Despite our inconclusive results, this paradigm still has potential as a measure of relationships between affect and attentional allocation or strategy choice. Potential

improvements to our methods include 1) inducing a wider and better-controlled range of affect, 2) using psychometrically superior measures of affect, 3) gathering more closely comparable data on scores for individual grids, 4) developing clearer explicit and observational measures of task strategy, and 5) providing more opportunities for differences in performance to emerge. These opportunities for improved empirical strategy are described below.

Emotion inductions

Our improvements to the emotion inductions will involve the use of a neutral induction that is slightly less pleasant, and that does not lower arousal. A negative emotion induction, which is often not required to discern effects of positive emotion, may be required to counteract the high baseline positive affect with which participants began the study (possibly induced by the discussion of prizes for good performance). A longer or more involving neutral induction may also help high positive affect dissipate before the task begins.

It is unclear how far into the study the effects of the positive emotion induction persisted. Positive-induction participants reported a strong immediate response to the induction and a trend towards more positive emotions after the task was complete. However, they did not report more positive affect than neutral-induction participants on the affect grids presented between rounds of the task. For future versions of the task we are considering an ambient induction, in which emotion-inducing musical selections are played during the task itself (e.g., Rowe, Hirsch, & Anderson, 2006). This must be approached with caution, however, because the attentional broadening associated with positive affect may make background music more distracting. Another option may be to retain the mid-task "booster" images used in this task, but to make them longer or more intense.

Affect measures

We plan to move to an implicit assessment of affect, using either an affect misattribution paradigm (Payne, Cheng, Govorun, & Stewart 2005) or a lexical decision task (Olafson & Ferraro, 2001) pre-induction, post-induction, and mid-task. An implicit measure can tap subtle moods that often escape self-report, and can avoid the problem of weakening or complicating emotional reactions when participants are asked to focus on

them. A lexical decision task also taps the cognitive and attentional aspects of emotion, which are closer to the constructs of interest in this study than are subjective feelings. Either task could be constructed to assess accessibility of positively-valenced responses independently of negative ones, which may help determine whether increased positive or reduced negative affect is primarily responsible for effects on performance.

Psychometrically, reaction-time scores should avoid the ceiling effect seen on our affect grid, and are continuous enough to permit transformation to remove skew. Removing the ceiling effect will help clarify another critical question about our findings: Does high positive affect lead to equivalence performance between the same-grid and new-grid conditions, as suggested by task scores at the highest valence ratings? Or will the negative trend continue, leading to even lower scores in the same-grid condition as positive affect rises?

Score comparisons

As described above, there was a confound caused by having each grid associated with only one point value, and with having certain grids appear only in the new-grid condition. Although all grids had similar properties, there may have been between-group differences in the relative difficulties of the horizontal vs. the vertical grids, or of the high-value vs. the low-value vertical grids. This puts both within- and between-group comparisons into question. This could be handled by counterbalancing presentation so that each grid is seen by some participants in each condition, or by gathering normative score data on each grid from a separate experimental sample.

Strategy assessments

We are improving our assessments of strategy, including strategies participants actually use, strategies they intend to use, and whether they succeed in using them. More specific questions about intention to trade off attention between target types will be added to the debriefing. We can also construct grids in which targets are "planted" in areas that are either rich or poor in conspicuous targets of the other type – this will distinguish between individuals who are remembering the locations of future targets, and those who are performing a fresh search each time (in which case the likelihood of clicking on a target would be unrelated to its proximity to targets of the other type).

In our replication, we will also have the vertical search occur first, followed by the horizontal one. Because horizontal pairs pop out more easily during a parallel search, and because participants consistently scored more highly on these than on vertical pairs, we expect that attempts to find them during the vertical search will be more successful (and thus more detectable) than attempts to find vertical pairs during the horizontal search. Because horizontal pairs will be more likely to be noticed involuntarily, even in rounds in which searching for them is undesirable, they will also make it easier to distinguish strategic from involuntary attentional tradeoffs. (this is not expected to introduce ceiling effect on scores, as no participant approached a perfect score on any grid).

Divergence in scores

Each horizontal or vertical grid search lasted 30 seconds, which provided enough time for participants to find some but not all of the targets. We plan to introduce searches that last 1 minute, which will still prevent perfect scores but will also allow more time for differences between different search strategies or search skills to emerge. This will lead to increased variance in scores between groups, or between individuals at different levels of positive affect, without necessarily increasing random variance between or within individuals. Increased statistical power will result. Longer rounds will also provide more data points per round, improving the reliability of our indices of search speed, pattern, and area.

Positive Affect and Divided Attention

This study suggests that performing tasks while in a positive mood can undermine performance, but only for complex tasks with competing demands on attention. However, it would be premature to conclude that this is a fundamental effect of positive affect, especially in light of other studies that have found increases in the ability to handle extensive information (Bless et al., 1996; Estrada et al., 1994, 1997; Isen, 2007; Waugh, 2006). It may also be that positive mood encouraged participants to put more effort into a complex trade-off strategy, which they were unable to carry out successfully, or that it made it easier for them to notice future targets but harder to remember and find them later (perhaps consistent with Dreisbach & Goschke, 2004; Dreisbach, 2006). The effects of positive mood would become beneficial, then, if the tradeoff strategy were made easier to implement, or if the value of future targets was were increased even further relative to

current targets. The improvements planned for future studies will help us contextualize the current findings and understand their practical applications.

The tasks used here also did not give participants the opportunity to compare scores to those of other participants, or to those they earned on different rounds. Another line of inquiry could explore whether individuals in positive moods are more responsive to unfavorable feedback (Raghunathan & Trope, 2002; Aspinwall & Brunhart, 1996) or to switching strategies (Estrada, Isen, & Young, 1997), which would counteract any tendency to use suboptimal strategies.

Even if our main finding proves to generalize, and we determine that positive affect simply reduces performance on tasks that require complex divided attention, we would still be making progress towards an important goal: moving the study of mood and performance beyond simple effects seen in isolation, and beginning to making theoretically-grounded predictions about the effects of mood in specific tasks, jobs, and contexts. Moreover, it would allow psychologists to begin recommending specific and theoretically grounded changes to specific tasks, to bring them into line with the performance style evoked by positive mood. This would allow individuals to bring the proven benefits of positive affect to their work (Harter et al., 2003; Lyubomirsky et al., 2005), and to aim for negative affect only when it is clearly and specifically helpful. More than that, these advances could help bring about better-functioning and more humane schools and workplaces, in which individuals can enjoy the long-term health and well-being benefits of frequent positive emotions, while regulating those emotions in specific ways that benefit the tasks at hand.

Chapter 3

Happiness Unpacked: Positive Emotions Increase Life Satisfaction by Building Resilience

Abstract

Happiness – a composite of life satisfaction, coping resources, and positive emotions – predicts desirable life outcomes in many domains. The broaden-and-build theory suggests that day-to-day positive emotions help people build lasting resources, which contribute to better life outcomes. To test this hypothesis we measured emotions daily for one month in a sample of students (n=86) and assessed life satisfaction and trait resilience at the beginning and end of the month. Positive emotions predicted growth in both resilience and life satisfaction. Negative emotions had null or substantially weaker effects, and did not interfere with the benefits of positive emotions. Positive emotions also mediated the relation between baseline and final resilience, but life satisfaction (a broader, more cognitive positive evaluation) did not. Finally, the relation between positive emotions and growth in life satisfaction was mediated by growth in resilience. These results suggest that day-to-day positive emotions are responsible for the beneficial effects of happiness – not simply by making people feel good, but by helping them develop better resources for living well.

Introduction

A large empirical literature shows that people who are happier achieve better life outcomes, including financial success, supportive relationships, mental health, effective coping, and even physical health and longevity. Moreover, prospective and longitudinal studies show that happiness often *precedes* and *predicts* these positive outcomes, rather than simply resulting from them (for a review of 225 studies, see Lyubomirsky, King, & Diener, 2005).

Little is known about how or why happiness can lead to such a wide range of beneficial outcomes. Fredrickson's *broaden-and-build theory of positive emotions* (1998, 2001) offers an overarching theoretical explanation, by linking the experience of positive emotions to the development of resources for long-term success and well-being. We present a study that links day-to-day positive emotions to improvements in life outcomes, through the ability of positive emotions to build resilience.

The Broaden-and-Build Theory

The broaden-and-build theory of positive emotions (Fredrickson, 1998; Fredrickson & Cohn, in press) proposes that positive emotions are evolved adaptations that function to build lasting resources. Unlike negative emotions, which narrow attention, cognition, and physiology toward coping with an immediate threat or problem (Cosmides & Tooby, 2000; Carver, 2003), positive emotions produce novel and broad-ranging thoughts and actions that are usually not critical to one's immediate safety, well-being, or survival. Over time, however, these novel experiences aggregate together, building up consequential resources that can change people's lives. For example, idle curiosity can become expert knowledge, or affection and shared amusement can become a lifelong supportive relationship. Positive emotions forecast valued outcomes like health, wealth, and longevity because they help build the resources to get there.

Evidence confirms that positive emotions broaden thought-action repertoires: Induced positive emotions produce wider visual search patterns, novel and creative thoughts and actions, more inclusive social groups, and more flexible goals and mindsets (for reviews see Ashby, Isen, & Turken, 1999; Fredrickson & Cohn, in press). Indirect evidence suggests that positive emotions build resources (Fredrickson, 1998; Fredrickson & Cohn, in press), but so far few prospective studies exist (but see Conway, 2005; Waugh &

Fredrickson, 2006; Fredrickson, Tugade, Waugh & Larkin, 2003).

Positive Emotions and Ego-Resilience

Ego-resilience (Block & Block, 1980; Block & Kremen, 1996) is a fairly stable personality trait that reflects an individual's ability to adapt to changing environments – identifying opportunities, adapting to constraints, and bouncing back from misfortune. It is related to a variety of consequential life outcomes: fewer behavioral problems in early childhood (Conway & McDonough, 2006), better interpersonal and intrapersonal adjustment across the lifespan (Klohn, 1996), faster cardiovascular recovery following a laboratory stressor (Tugade & Fredrickson, 2004), and less depression and more thriving following a real-world tragedy (the 9/11 terrorist attacks; Fredrickson et al., 2003).

Positive emotions may help build ego-resilience, yet ego-resilience also functions partly by generating positive emotions. When faced with a stressor, people high on ego-resilience experience more positive emotions than their less resilient peers, even though they experience negative emotions at comparable levels. The difference in positive emotions accounts for their better ability to rebound from adversity and stress, ward off depression, and continue to grow (Fredrickson et al., 2003; Ong, Bergeman, Bisconti & Wallace, 2006; Tugade & Fredrickson, 2004).

Despite this close relationship with positive emotions, ego-resilience is associated with coping and recovery as well as positive development. Thus, it is a good candidate for testing the hypothesis that over time, positive emotions reach beyond temporary hedonic experience to build lasting resources for survival and flourishing.

Happiness Unpacked

Happiness is conceptualized as having multiple empirically separable facets, including global life satisfaction, domain-specific satisfaction, positive beliefs about life, and frequent positive emotions relative to negative ones (Diener, Lucas, & Scollon, 2006; Lucas, Diener, & Suh, 1996). Happiness researchers frequently combine these facets to obtain a thorough assessment of overall well-being. In contrast, the broaden-and-build theory explores distinct antecedents and functions for different elements: Momentary experiences of positive emotions fuel growth and change over time, helping build positive beliefs and coping skills, which function as resources. When a person is

experiencing positive emotions and using their resources to meet life's challenges and opportunities, global life satisfaction rises. We test this model by separately assessing the three constructs, and hypothesizing that positive emotions predict ego-resilience, which in turn predicts life satisfaction,

Specifics of the Broaden-and-Build Theory

In addition to assessing beneficial life outcomes, we target analyses at finer-grained implications of the broaden-and-build theory: The effectiveness of moderate and stable levels of positive emotions, the independence of positive and negative emotions, and the unique role of emotions as opposed to more general evaluations.

The broaden-and-build theory views positive emotions as functional: Experiencing a positive emotion shifts cognition, attention, and motivation towards states that help an individual gradually build resources. Thus, a stable level of positive emotions should fuel continuing growth in resources; benefits should not be confined to individuals who are extraordinarily happy or growing constantly happier. Nor should continued growth require an absence of negative emotions. It is true that negative emotions generally oppose the effects of positive emotions and frequently overcome them subjectively (Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001; Derryberry, 1993). However, within any given day many positive and negative emotional episodes can occur, and unless a negative feeling follows very quickly on the heels of a positive one, there is no reason to expect that they will cancel each other out. A vivid example occurs during bereavement: Many people who are grieving still report some episodes of positive emotions, and doing so predicts better psychological outcomes despite the high level of negative emotions bracketing those episodes (e.g., Bonanno & Keltner, 1997).

Finally, the broaden-and-build theory attributes the beneficial effects of happiness specifically to the in-the-moment effects of positive emotions, and not to the general evaluation that one is satisfied or doing well in life. Thus, life satisfaction should not predict the same outcomes as day-to-day positive emotions.

Hypotheses

In the current study we use computer-validated diary data to examine the relationships among day-to-day positive emotions, ego-resilience, and global life satisfaction. After examining correlations, we test the broaden-and-build theory with two mediational

models. The first examines positive emotions as both a result of ego-resilience and a path to its further growth, and the second tests whether positive emotions enhance life satisfaction specifically because they help build ego-resilience. Finally, we look more closely at the role played by levels of negative emotions over the same period, and at whether stable levels of positive emotions are as effective at producing change as are increasing levels.

1. Daily positive emotions measured throughout the month predict growth in both ego-resilience and life satisfaction over the month. Daily negative emotions have no effect.
2. The relation between baseline ego-resilience and ego-resilience one month later is partially mediated by daily positive emotions. Although life satisfaction is similarly valenced, it is global rather than momentary, and so it will not similarly mediate.
3. The relation between positive emotions and growth in life satisfaction is mediated by growth in resilience.
4. Levels of negative emotions will not affect the associations among positive emotions, ego-resilience, and life satisfaction.
5. The models tested in Hypotheses 1-3 will not be improved by the addition of a variable reflecting change in positive emotions across the month.

Methods

Participants

University students were recruited via newspaper ads and posters offering up to \$100 for participation in a month-long study of psychological adjustment. Volunteers responded to background questionnaires and a measure of depression (CESD; Radloff, 1977). We accepted volunteers who were ≥ 18 years old, in their first or second year of college, native English speakers, and who scored below 24 on the CESD. This cutoff included a wide range of levels of well-being, but excluded individuals with a high likelihood of clinical depression.

We randomly selected 120 eligible respondents (out of 214 eligible, 559 total), split equally between males and females. One hundred nine began the study, 98 completed the study, and 86 provided adequate daily responses (21 days out of 28). The final sample

was 80.5% White and 59.8% female, mean age = 18.7 years (SD=0.65).

Measures

Daily emotions: Participants used our website to submit daily emotion reports (the modified Differential Emotions Scale: mDES; Fredrickson et al., 2003). Responses were automatically uploaded and timestamped, which enhances compliance and eliminates the common problem of backdated entries (Stone, Schiffman, Schwartz, Broderick, & Hufford, 2002). Participants rated their strongest experiences of 18 emotions in the past day on a 5-point scale (0 = not at all, 4 = extremely).⁹ The Positive Emotions subscale consists of amusement, awe, compassion, contentment, gratitude, hope, interest, joy, love, and pride (average of 28 daily alphas = .86). The Negative Emotions subscale consists of anger, contempt, disgust, embarrassment, fear, guilt, sadness, and shame (average α = .82).

Ego-Resilience: Ego-resilience was measured using the ER89, which taps the ability to flexibly respond to challenging and shifting circumstances (Block & Kremen, 1996). Participants responded on a four-point Likert scale to 14 items, including “I quickly get over and recover from being startled,” and “I enjoy dealing with new and unusual situations” ($\alpha_{T1}=.69$, $\alpha_{T2}=.74$).

Life satisfaction: Life satisfaction was measured using the Satisfaction with Life Scale (SWLS; Diener, Emmons, Larsen, & Griffin, 1985), a widely used index that is associated with many positive life outcomes (Lyubomirsky et al., 2005). Participants responded to 5 items including “So far I have gotten the important things I want in life” using a seven-point Likert scale ($\alpha_{T1}=.82$, $\alpha_{T2}=.85$).

Only two individuals had scores >3 SD from the mean on any measure. All results remain the same when these scores are recoded to 3 SD.

Procedure

Participants visited our lab, where an experimenter explained the significance of the project and the importance of consistent participation. They then completed T₁ questionnaires, including ego-resilience and life satisfaction. Participants were instructed to visit our website every evening for 28 days. They logged in and completed the mDES for “the past 24 hours,” followed by other measures not reported here.¹⁰ After the final

daily entry, participants returned to the website to complete T₂ ego-resilience and life satisfaction measures. Participants were paid up to \$100 depending on the completeness of their data.

Results

H1: Do positive (but not negative) emotions predict growth in ego-resilience and life satisfaction?

Positive and negative emotion scores were calculated for each day and averaged across the month (positive: $M = 1.95$, $SD = 0.51$; negative: $M = 0.63$, $SD = 0.38$). The two scores were not correlated on any day (median $r = -.05$, median $p = .51$), nor were the averages ($r = .17$, $p = .12$).

Correlations between composite emotion scores and the outcome variables are displayed in Table 1. Positive emotions predict increases in ego-resilience and life satisfaction over the course of the month, over and above any change predicted by T₁ values. Effect sizes are in the medium-to-large range.

Table 3-1: Correlations: Emotions, Resilience, and Life Satisfaction

	Resilience			Life Satisfaction		
	Baseline	One-month	Residual	Baseline	One-month	Residual
Positive Emotions	.320**	.454***	.217***	.273**	.357***	.146*
Negative Emotions	-.165 <i>ns</i>	-.217*	-.085 <i>ns</i>	.164 <i>ns</i>	.083 <i>ns</i>	-.052 <i>ns</i>

* $p < .05$ ** $p \leq .01$ *** $p \leq .001$

note: Residual correlations are standardized regression coefficients when one-month score is regressed on emotions and baseline score simultaneously

Negative emotions predict T₂ resilience only ($r = -.22$, $p = .05$), and do not predict any life satisfaction scores ($ps > .13$). Estimated effect sizes are small.

Ego-resilience and life satisfaction were not correlated at either timepoint ($r_{T1} = .14$, $p = .21$; $r_{T2} = .07$, $p = .54$), but change in ego-resilience predicted change¹¹ in life satisfaction ($\beta = .32$, $p = .003$).

H2: Are positive emotions (but not life satisfaction) partially responsible for the relation between Initial and Final ego-resilience scores?

We constructed a mediation model in which T₁ ego-resilience predicted T₂ ego-resilience, with daily positive emotions as a mediator. We used the Sobel test for mediation with bootstrap estimation for coefficients (Preacher & Hayes, 2004). Positive emotions continued to predict T₂ ego-resilience ($\beta=.22, p=.001$), as did T₁ ego-resilience ($\beta = .74, p < .001$). The indirect pathway – T₁ influences T₂ through positive emotions – was significant ($\beta = .09, p < .01$), indicating that positive emotions partially mediate the relationship between T₁ and T₂.¹²

We assessed life satisfaction as an alternate mediator, testing models using T₁, T₂, and their average. In each case the indirect path was nonsignificant and near zero ($|\beta| < .01, p > .15$; change in direct path $\leq .01$).

H3: Is growth in ego-resilience responsible for the relation between positive emotions and growth in life satisfaction?

Positive emotions predicted change in life satisfaction ($\beta=.15, p=.03$). To determine whether positive emotions contribute to life satisfaction specifically by building resources, we tested change in ego-resilience as a mediator. T₂ life satisfaction was treated as the outcome, with T₁ life satisfaction as a predictor. Thus, partial correlations of other variables with T₂ life satisfaction predict change in one's relative level of life satisfaction, above and beyond that predicted by T₁ levels. Positive emotions were an additional predictor, and change in resilience was a mediator.

When the paths through all predictors are taken into account, change in resilience remains significant ($\beta=.15, p=.02$). The direct path from positive emotions to change in life satisfaction becomes nonsignificant ($\beta=.08, p=.22$), but the indirect path through change in resilience is significant ($\beta=.05, p<.01$). This pattern indicates that the relationship of positive emotions to change in life satisfaction is fully mediated by change in resilience.

The relations described here can be illustrated by viewing change in ego-resilience across positive emotions quartiles (Fig. 1a) and change in life satisfaction across ego-resilience change quartiles (Fig. 1b).

Figure 3-1: Resilience and Life satisfaction change scores
a) Raw Change in Ego-Resilience Scores by Positive Emotion Quartiles.

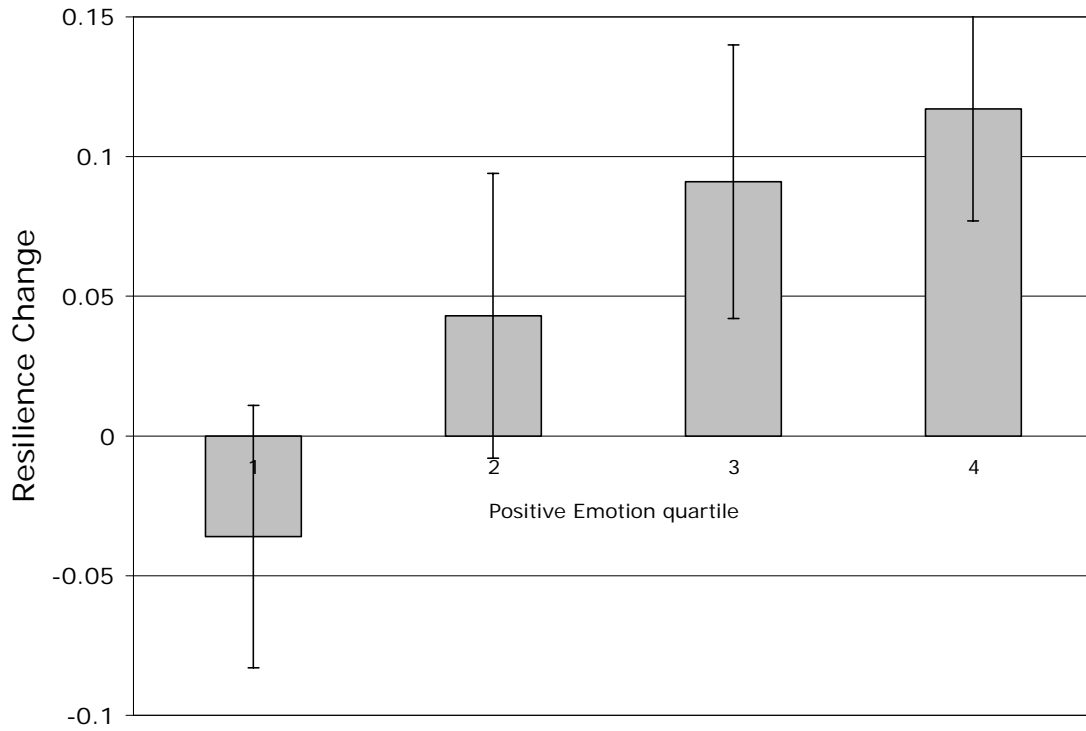
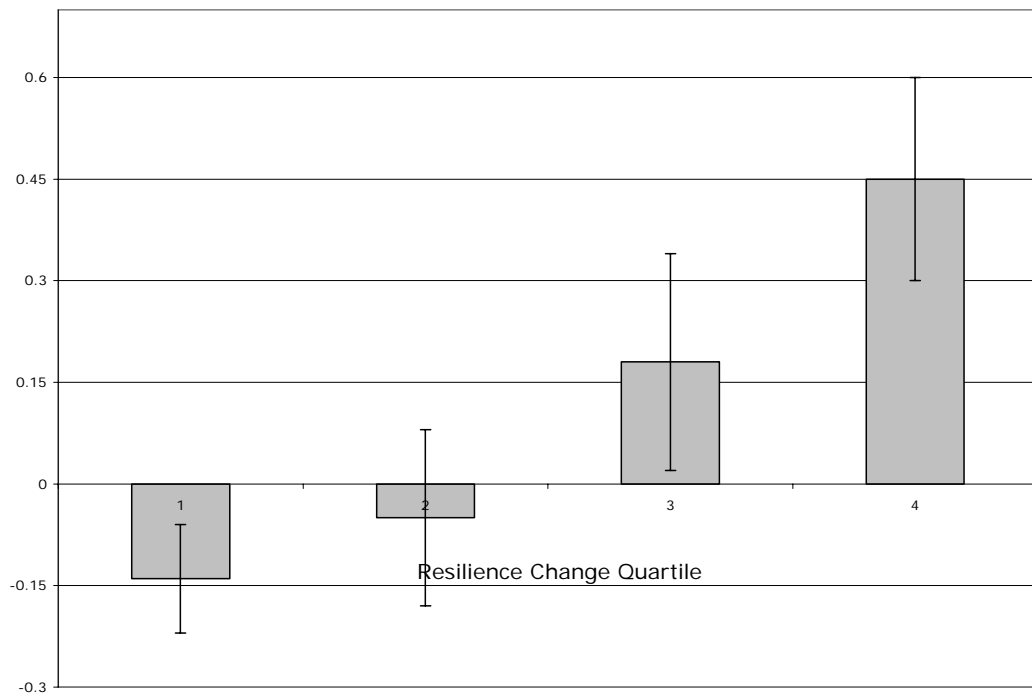


Figure 1b: Raw Change in Life Satisfaction by Ego-Resilience Change Quartiles.



H4: Do negative emotions reduce the effect of positive emotions?

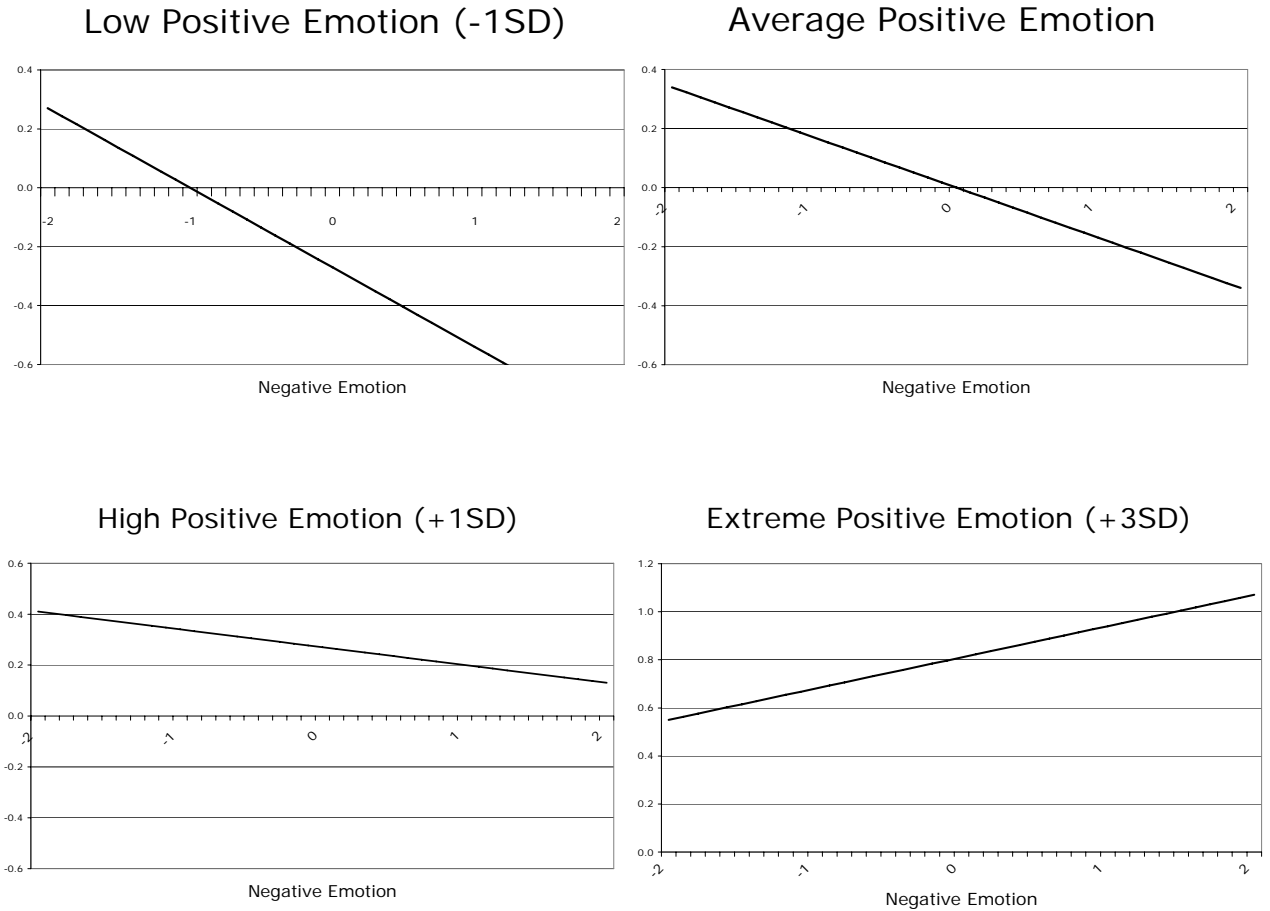
Although negative emotions were not a significant predictor of change in ego-resilience or life satisfaction, they may interact with positive emotions. We tested a model in which the relationship between T₁ and T₂ ego resilience was simultaneously mediated by positive emotions, negative emotions, and their interaction. Positive emotions remained a significant predictor of change in resilience ($\beta=.27, p<.001$). Negative emotions became a significant negative predictor ($\beta=-.17, p=.01$), but there was no significant interaction ($\beta=.10, p=.10$). The indirect path through positive emotions accounted for a significant portion of the relationship between T₁ and T₂ ego-resilience ($\beta=.09, p<.01$), but the paths through negative emotions ($\beta=.03$) and through the interaction ($\beta=-.03$) did not ($p\geq.15$). This model was a significant improvement over the model with positive emotions as the sole predictor ($\Delta R^2=.03; \Delta F=4.1, p=.02$).

When an interaction variable is estimated, the individual predictor coefficients only represent the case where other predictors are zero. By adding constants to the two emotions variables, we determined that negative emotions cease to independently predict growth in ego-resilience when positive emotions are $\geq.45$ SD above the mean (see Figure 2). In contrast, positive emotions become a stronger predictor as negative emotions increase, and become nonsignificant when negative emotions are >1 SD *below* the mean.

This model implies that when positive emotions are high ($\sim >1.5SD$), negative emotions are predicted to become beneficial (illustrated by the fourth image in Figure 2). This may reflect post-traumatic growth or response to challenge, but it may also be an artifact of the regression procedure. It will be necessary to study populations with more extreme levels of positive and negative emotions to determine the range in which the model holds.

We also tested positive emotions, negative emotions, and their interaction as predictors of growth in life satisfaction. Positive emotions remained significant ($\beta=.17, p=.01$), negative emotions remained nonsignificant ($\beta=-.10, p=.15$), and the interaction was nonsignificant ($\beta=.09, p=.19$). This model did not improve over using positive emotions alone ($\Delta R^2=.01; \Delta F=1.5, p=.23$).

Figure 3-2: Positive emotion neutralizes the damaging effects of negative emotion on resilience



Predicted correlations between negative emotions (horizontal axis) and increase or decrease in resilience (vertical axis), at four different levels of positive emotions. As positive emotions increase, negative emotions become less able to reduce resilience.

The fourth graph shows an edge case, in the top percentile of positive emotions. Understanding whether extreme positive emotions can actually make negative emotions become beneficial will require further study.

H5: Are increasing levels of positive emotions necessary?

We tested whether growth in ego-resilience and life satisfaction required not just the presence of positive emotions, but an increase in positive emotions over baseline. We created a change variable from the Week 4 positive emotions score with Week 1 positive emotions partialled out, and repeated the tests described above with the change variable in place of the aggregate positive emotions variable. Positive emotions change did not significantly predict baseline, one-month, or change scores for ego-resilience or life satisfaction ($r < .19$, $p \geq .09$). It also did not have a significant indirect effect in the relationship between T₁ and T₂ ego-resilience ($\beta = .10$, $p = .12$). We replicated these tests again with aggregate positive emotions and positive emotions change entered simultaneously (despite overlap in predictors, all tolerance scores were $> .78$). The regression coefficients for positive emotions change declined, while aggregate positive emotions remained significant.

Discussion

Why do happier people do better in life? This prospective study strengthens the evidence that positive emotions do not just reflect desirable outcomes but actively help create them (Lyubomirsky et al., 2005). It also supports the specific predictions of the broaden-and-build theory: People who experience frequent positive emotions become more satisfied not simply because they are enjoying themselves, but because they are becoming better at meeting a wide range of life's challenges. We found that daily positive emotions predicted growth in ego-resilience, a psychological resource that has proved useful in dealing with both mild and severe stressors (Fredrickson et al., 2003; Ong et al., 2006; Tugade & Fredrickson, 2004). Growth in ego-resilience then accounted for the relation between daily positive emotions and increases in global life satisfaction.

The broaden-and-build theory is further supported by our finding that life satisfaction could not replace positive emotions as a predictor of growth in ego-resilience. It is the momentary experience of positive emotions that is critical to building resources, not an overall positive view of life. These findings also suggest that life satisfaction is more than just the summation of good and bad feelings over time (Kahneman, 1999). Life

satisfaction in our sample was correlated with positive emotions but ultimately depended on growth in ego-resilience, a multifaceted skill involving emotion regulation, problem-solving, and the ability to change perspective – one that goes well beyond the pleasurable emotions that gave rise to it.

Positive emotions also emerged as functionally distinct from an absence of negative emotions. Growth in life satisfaction was predicted specifically by feeling good, not by avoidance of feeling bad. Growth in ego-resilience was predicted by both independently, but negative emotions became nonsignificant at moderately high levels of positive emotions (+.45 SD). Positive emotions, consistent their role in grief and stress recovery (Bonanno & Keltner, 1997; Fredrickson et al., 2003), remained a positive predictor no matter how strong negative emotions became. At timescales as short as one month, the typical finding that negative emotions overwhelm positive ones appears to reverse: Positive emotions were the better predictor of whether people built important resources and became more satisfied with their lives, and these benefits persisted even in the midst of negative emotions.

These results help assuage concerns that happiness research may end up endorsing a Pollyannaish refusal to engage with challenging or upsetting aspects of life. Participants with average and stable levels of positive emotions still showed growth in resources (see Fig. 1a), even amid concurrent negative emotions. Perpetually-increasing levels of mania are not required (see also Fredrickson & Losada, 2005). This is consistent with the broaden-and-build theory, which views the relationship between positive emotions and long-term growth as part of everyday human functioning, rather than a rare and extraordinary event.

This study was able to go further than past research in determining what aspects of happiness lead to positive life outcomes. Using a computer-validated diary method, we gathered data on day-to-day positive emotions, which is far more accurate than using broad retrospective ratings or paper diaries. We also elaborated on the functional distinction between experiencing positive emotions and making a general positive evaluation of one's life: Only in-the-moment positive emotions helped build resources.

The study's weakness is its reliance on observational data. The repeated-measures data helped support our claims of causality, but the next step will be to induce positive

emotions consistently, over time. Long-term follow-up assessments will be vital for understanding how durable these resources are, especially if positive emotions later decrease or negative emotions rise. Sampling a population with very high baseline negative emotions would help determine if there is a point at which negative emotions can begin to interfere with the benefits of positive emotions. Finally, future research will benefit from daily measures of mechanisms that may link positive emotions and increased resources, which include broadened thought-action repertoires and improved regulation of stress responses (see Fredrickson & Cohn, in press).

Our results support the view that positive emotions are a powerful source of growth and change, predicting both individuals' judgments about life and their skills for living well. The relation between ego-resilience scores across one month depends partly on the fact that ego-resilience generates positive emotions, suggesting an upward spiral in which ego-resilience and positive emotions contribute to each other's maintenance and growth. This is another way that the effects of positive emotions emerge over time: Even if any single experience of enjoyment, pride, or love is brief or easily disrupted, it presents an opportunity to build lasting resources. Those resources can later improve one's life, offering up new opportunities for pleasurable experiences and growth. We look forward to further exploring this potential for daily positive emotions to feed a cycle of lifelong growth.

Chapter 4

Open Hearts Build Lives: Positive Emotions, Induced through Loving-Kindness Meditation, Build Consequential Personal Resources

Abstract

Fredrickson's (1998; 2001) broaden-and-build theory of positive emotions asserts that people's daily experiences of positive emotions compound over time to build a variety of consequential personal resources. We tested this *build hypothesis* in a field experiment with working adults ($n = 139$), half of whom were randomly-assigned to begin a practice of loving-kindness meditation. Results showed that this meditation practice produced increases over time in daily experiences of positive emotions, which in turn produced increases in a wide range of personal resources (e.g., increased mindfulness, purpose in life, social support, decreased illness symptoms). In turn, these increments in personal resources predicted increased life satisfaction and reduced depressive symptoms. Discussion centers on how positive emotions are the mechanism of change for the type of mind-training practice studied here, and how loving-kindness meditation is one intervention strategy that produces positive emotions in a way that outpaces the *hedonic treadmill* effect.

Introduction

A paradox surrounds positive emotions. On one hand, they are fleeting: Like any emotional state, feelings of joy, gratitude, interest, and contentment typically last only a matter of minutes. Moreover, positive emotions are less intense and less attention-grabbing than the negative emotions (Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001) and more diffuse (Ellsworth & Smith, 1988). Yet on the other hand, research indicates that positive emotions contribute to important downstream life outcomes, including friendship development (Waugh & Fredrickson, 2006), marital satisfaction (Harker & Keltner, 2001), higher incomes (Diener, Nickerson, Lucas, & Sandvik, 2002) and better physical health (Doyle, Gentile, & Cohen, 2006; Richman, Kubzansky, Maselko, Kawachi, Choo, & Bauer, 2005). People who experience frequent positive emotions have even been shown to live longer (Danner, Snowden, & Friesen, 2001; Moskowitz, 2003; Ostir, Markides, Black, & Goodwin, 2000). Indeed, a recent meta-analysis of nearly 300 findings concluded that positive emotions produce success and health as much as they reflect these good outcomes (Lyubomirsky, King, & Diener, 2005).

How do they do this? How do people's fleeting and subtle pleasant states pave the way to their later success, health, and longevity? Fredrickson's (1998) broaden-and-build theory of positive emotions outlines a possible pathway: Because positive emotions arise in response to diffuse opportunities rather than narrowly-focused threats, positive emotions momentarily broaden people's attention and thinking, enabling them to draw on higher-level connections and a wider-than-usual range of stimuli and ideas. In turn, these broadened outlooks often help people to discover and build consequential personal resources. These resources can be *cognitive*, like the ability to mindfully attend to the present moment; *psychological*, like the ability to maintain a sense of mastery over environmental challenges; *social*, like the ability to give and receive emotional support; or *physical*, like the ability to ward off the common cold. People with these resources are more likely to effectively meet life's challenges and take advantage of its opportunities, becoming successful, healthy, and happy in the months and years to come. Thus, the personal resources accrued, often unintentionally, through frequent experiences of

positive emotions are posited to be keys to later increases in well-being. Put simply, the broaden-and-build theory states that positive emotions widen people's outlooks in ways that, little by little, reshape who they are.

The key hypotheses of the broaden-and-build theory have received empirical support from multiple laboratories. First, the *broaden hypothesis* holds that positive emotions broaden people's attention and thinking. Experiments have shown that, relative to neutral and negative states, induced positive emotions widen the scope of people's visual attention (Fredrickson & Branigan, 2005, Rowe, Hirsh, & Anderson, 2007; Wadlinger & Isaacowitz, 2006), broaden their repertoires of desired actions (Fredrickson & Branigan, 2005), and increase their openness to new experiences (Kahn & Isen, 1993) and critical feedback (Raghunathan & Trope, 2002). At the interpersonal level, induced positive emotions increase people's sense of "oneness" with close others (Hejmadi, Waugh, Otake, & Fredrickson, 2008), their trust in acquaintances (Dunn & Schweitzer, 2005), and their ability to accurately recognize faces of individuals of another race (Johnson & Fredrickson, 2005). The empirical evidence is mounting, then, that positive emotions broaden people's attention and thinking in both personal and interpersonal domains.

The second part of the theory, the *build hypothesis*, holds that positive emotions set people on trajectories of growth that, over time, build consequential personal resources. To date, the empirical evidence for the build hypothesis has been largely indirect. Prospective correlational studies have shown that people who, for whatever reasons, experience or express positive emotions more than others show increases over time in optimism and tranquility (Fredrickson, Tugade, Waugh, & Larkin, 2003), ego-resilience (Cohn, Fredrickson, Brown, Mikels, & Conway, 2008), mental health (Stein, Folkman, Trabasso, & Richards, 1997), and the quality of their close relationships (Gable, Gonzaga & Strachman, 2006; Waugh & Fredrickson, 2006).

Here we present the first experimental evidence that directly tests the *build hypothesis*. To our knowledge it is preceded by only two other studies on longitudinal effects of enhanced positive emotions (Emmons & McCullough, 2003; King, 2001), both of which involved specific positive emotions and associated outcomes; this study tests the effects of a wide range of positive emotions on many varying life outcomes.

This type of research is challenging because participants are expected to show enhanced resources only after many experiences of positive emotion over separate occasions. This necessitates not only a longitudinal study design, but also a reliable, repeatable method for evoking positive emotions. The well-documented *hedonic treadmill* effect (Brickman & Campbell, 1971; Diener, Lucas, & Scollon, 2006) implies that emotion elicitation techniques used with success in the laboratory (e.g., film clips, gifts of candy) would likely become tedious and ineffective if repeated daily. As the novelty of an experience subsides, people's emotions tend to revert to a trait-like baseline. In this study, we sought to overcome this challenge by using an induction based on meditation.

We suspected that meditation would outpace the hedonic treadmill for several reasons. First, it incorporates mindful attention, which has been shown to undo hedonic adaptation (Schwarz, Kahneman, & Xu, in press). Second, unlike watching a film or receiving a gift, meditation practice is active and personalized. Participants can lengthen the meditation, alter their focus, or otherwise try to get more out of their practice, keeping it within a range that is feasible but not boring. Most importantly, participants can use the insights and psychological skills developed during meditation practice in many situations and life domains. Meditation, then, offers opportunities for enhanced emotions throughout the day, not simply during meditations per se.

Meditation and mindfulness, which are perhaps best known as elements of Buddhist spiritual practice, have also proven to be fruitful topics within empirical research on well-being (Baer, 2003; Kabat-Zinn, 2003; Segal, Williams, & Teasdale, 2002; Wallace & Shapiro, 2006). For instance, for more than two decades, Kabat-Zinn and colleagues have reported evidence that meditation helps people to self-regulate stress, anxiety, chronic pain and various illnesses (for a review, see Kabat-Zinn, 2003). Building on the observation that formerly-depressed individuals who are able to take a critical distance from their emotions are more resistant to relapse, Teasdale and colleagues have developed a successful therapy that combines mindfulness meditation with cognitive therapy (Teasdale, Segal, Williams, Ridgeway, Soulsby, & Lau, 2000).

More recently, Kabat-Zinn collaborated with Richard Davidson and colleagues to examine the affective, brain, and immunological effects of beginning a meditation

practice (Davidson et al., 2003). Volunteers were randomly assigned either to a waitlist control group (n = 16), or to an 8-week mindfulness-based stress reduction workshop (n = 25), which required a daily practice of guided meditation lasting about an hour. As in past studies, trait anxiety was significantly reduced in the meditation group. Both immediately after the training period and 4 months later, EEG monitoring revealed that meditators showed increases in left-sided anterior brain activation, which has been repeatedly linked to greater positive, approach-related emotions (for a review, see Davidson, 2000). Meditators also showed a more robust and effective immune response to an influenza vaccine administered at the end of the training period, and the strength of this response was correlated with the magnitude of left-sided anterior brain activation. The suggestion that meditation practice increases positive affect is also supported by at least one experience sampling study (Easterlin & Cardena, 1998).

Most empirical work on meditation has centered on mindfulness meditation (e.g., Davidson et al., 2003; Teasdale et al., 2000). Because we were particularly interested in evoking positive emotions, we employed a related mind-training practice, loving-kindness meditation (hereafter LKM). LKM is a technique used to increase feelings of warmth and caring for self and others (Salzberg, 1995). Like mindfulness and other meditation practices, LKM involves quiet contemplation in a seated posture, often with eyes closed and an initial focus on the breath. However, mindfulness meditation involves open attention to the present moment, rather than to one's thoughts and feelings. LKM involves deliberately directing one's thoughts and feelings towards widely inclusive warmth and compassion. Thus, we expected that the effects of LKM would resemble those of mindfulness to the extent that they are caused by relaxation or mental training, but also that it might lack benefits due to cultivating mindful attention. Most importantly, we expected that LKM would uniquely show wide-ranging benefits for a variety of resources, as it generated positive emotions and fed into the build effect.

In LKM, individuals are first asked to focus on their heart region and contemplate a person for whom they already feel warm and tender feelings (e.g., their child, a close loved one). They are then asked to extend these warm feelings first to themselves and then to an ever-widening circle of others. Thus, LKM may well cultivate broadened

attention in addition to positive emotions. According to the broaden-and-build theory, these two experiential consequences go hand-in-hand.

LKM involves cultivating the intention to experience positive emotions during the meditation itself, as well as in the user's life more generally. Moreover, mind-training practices like LKM are thought to not only shift people's fleeting emotional states, but also reshape their enduring personality traits (Davidson et al., 2003), a coupling of momentary with long-term gains fully compatible with the broaden-and-build theory. We acknowledge that mind-training practices, including LKM, are not simply vehicles for improving emotion experiences. The primary goal within contemplative traditions is instead to learn about the nature of one's mind and dispel false assumptions about the sources of one's happiness (Dalai Lama & Cutler, 1998). These insights can in turn shift people's basic outlooks on themselves in relation to others, increasing empathy and compassion. Approaching daily life with the new insights and outlooks developed through mind-training practice is what is thought to enhance people's emotion experiences. That said, the goal of the present study is to test the build hypothesis, which requires a means of reliably eliciting positive emotions over the span of months. We saw LKM as a suitable vehicle to meet this goal. Future empirical work will be needed to test whether the cognitive shifts outlined by scholars of contemplative practices are indeed responsible for any success LKM has in enhancing positive emotions.

LKM involves a range of thoughts and visualizations, plus it directly evokes only select positive emotions (i.e., love, contentment, and compassion) and carries some potential to evoke negative emotions. Moreover, given the possibility of both state and trait shifts, we expected the positive emotions generated by LKM to increase over time. Our study involved daily assessment of time spent meditating and of a wide range of discrete positive and negative emotions. This strategy allowed us to determine whether (a) positive emotions, measured directly, are responsible for any changes produced by LKM, (b) different classes of positive emotions (e.g., low- vs. high-arousal, or self- vs. other-focused) are differentially induced by this practice, and (c) the effects of LKM on positive emotions increase (due to practice) or decrease (due to adaptation) over time.

We are aware of only one other field experiment that has tested the effects of LKM. Carson and colleagues compared a group of chronic pain patients who were taught LKM

(n = 18) to a group receiving standard care (n = 25). Results from this pilot trial indicated that LKM reduced pain, anger, and psychological distress (Carson et al., 2005). The present study tests LKM in a larger sample, with a wider variety of outcome measures. Most critically, it gathers detailed data on positive emotions as a potential mediator of the benefits of this form of meditation.

Overview of Empirical Strategy

We conducted a randomized, longitudinal field experiment to test whether positive emotions, induced through LKM, build consequential personal resources. In designing our experiment we grappled with selecting the most appropriate comparison condition. In laboratory research, we have used sham meditation (i.e., sitting with eyes closed) to achieve precise experimental control. For a 7-week intervention that asked participants for a substantial investment of time and effort, both ethical and face validity concerns led us away from this sort of placebo meditation.

Another approach is to choose a comparison condition that best addresses the current state of knowledge in a given area. Our review of the scientific literature had uncovered no published evidence that LKM could produce sustained increases in positive emotions and only limited and indirect evidence that positive emotions could build personal resources. Given this embryonic state of evidence, an appropriate initial comparison group would reflect treatment-as-usual, which outside the clinical literature is perhaps better phrased as life-as-usual. Thus, we opted for a waitlist control design, which can assess treatment efficacy while controlling for self-selection, history, maturation, regression to the mean, and the effects of repeated testing (Chambless & Hollon, 1998; Kazdin, 2003). Although the groups differ in terms of experimenter demand, delivery format, and expectation of improvement, we address these limitations procedurally and analytically to the extent possible (see Discussion).

In the context of a workplace wellness program, we offered a 7-week meditation workshop to employees interested in stress reduction and willing to respond to questionnaires and provide daily, web-based reports of their emotions. All volunteers completed an initial survey that assessed their life satisfaction, depressive symptoms, and their status on a range of personal resources, including cognitive, psychological, social, and physical resources. Volunteers were then randomly assigned to either our meditation

workshop or a waitlist control group (which received the same workshop after the study ended). Over the next 9 weeks (including one week before and after the workshop) participants in 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 re-assessed their life satisfaction, depressive symptoms, and their status on the same personal resources measured previously.

In addition to daily reports of emotion experiences, which may well underestimate the frequency of emotion experiences, at the time of the final survey participants also completed a detailed account of the emotions they experienced that particular day using the Day Reconstruction Method (DRM; Kahneman, Krueger, Schkade, Schwarz, & Stone, 2003). The DRM is a survey method that builds on the strengths of two older methods: time-budget measurement and momentary data capture (i.e., experience sampling). Like each of these earlier methods, the DRM minimizes recall biases and provides a comprehensive picture of daily experience. Participants first reconstruct a detailed diary of “this morning” by dividing it into sequences of episodes. Next, they complete a series of questions, including emotion reports, for each episode of their morning.

We predicted that participation in the 7-week LKM workshop would increase individuals’ daily experiences of positive emotions, over time across the 9 weeks of daily reporting and within the specific morning targeted by the DRM. Drawing from the broaden-and-build theory, we further predicted that increases in positive emotions, produced by LKM or otherwise, would in turn build participants’ personal resources. To test the generality of the build effect of positive emotions, we targeted a wide range of personal resources, including cognitive resources (e.g., mindfulness, the ability to savor positive experiences), psychological resources (e.g., trait resilience, environmental mastery), social resources (e.g., positive relations with others, social support given and received), and physical resources (e.g., illness symptoms, duration of sleep). Finally, we investigated whether these resources actually made a difference in participants’ lives. To do so, we tested whether any increments in resources in turn contributed to changes in overall life satisfaction, a judgment of fulfillment and well-being that differs from positive affectivity in its global focus and cognitive emphasis (Lucas, Diener, & Suh,

1996). As a secondary way to assess whether newly-built resources were consequential, we tested whether they led to decreases in depressive symptoms. We distill this series of predictions into the following overarching mediational hypothesis:

Main Hypothesis:

Becoming skilled in loving-kindness meditation will, over time, increase people’s daily experiences of positive emotions, which in turn build a variety of personal resources that hold positive consequences for their mental health and overall life satisfaction.

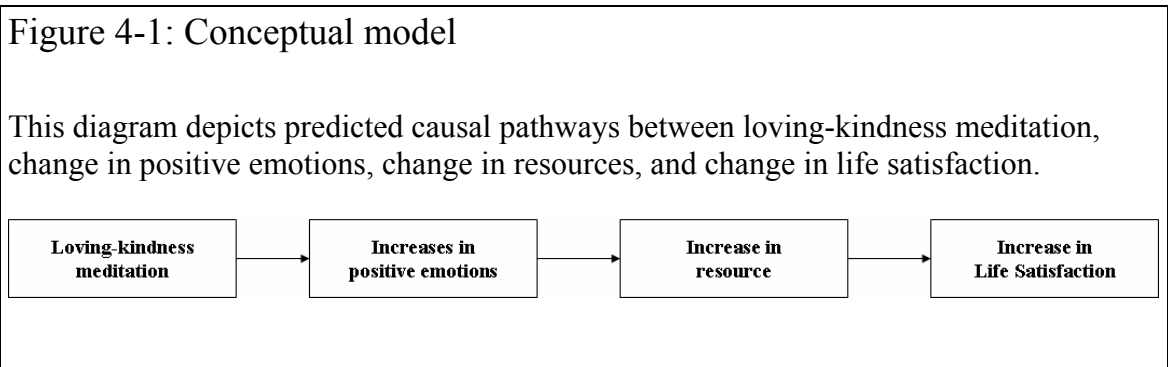


Figure 1 portrays the conceptual model that underlies the build hypothesis as we tested it here. Note that this study does not directly assess momentary changes in broadened cognition, due to the lack of valid measures that could be used repeatedly and in the field. Nor does it directly assess the cognitive shifts produced by LKM that trigger positive emotions. The primary target of this study is positive emotions and their potential large-scale benefits, rather than the momentary mechanisms by which they function or LKM produces them. As such, this study evaluates positive emotions as a mechanism for the effects of LKM, but does not further decompose the mechanisms by which LKM and positive emotions exert their influence.

Method

Participants

The study was conducted at the Compuware Corporation, a large business software and IT services company in Detroit, Michigan. All full-time employees working at

Compuware's Detroit headquarters (approximately 1800 individuals, 38% female, 34% ethnic minorities) received an e-mail message from Compuware executives inviting them to participate in the study.¹³ The study was described as a scientific investigation of "the benefits of meditation ... [to] reduce stress." The e-mail included a link to a website where employees could learn more about the project. The information made clear that the study was being conducted by university researchers, that the results would be confidential, and that the choice of whether to participate would not affect their standing with their employer.

Two hundred and two Compuware employees attended the study orientation, gave their consent and completed the initial survey. Of these, 102 were assigned to the LKM group and 100 were assigned to the waitlist control group. Participants were excluded from analyses for the following reasons: (a) they violated random assignment ($n = 7$), (b) they failed to complete Time 2 measures ($n = 27$), (c) they were assigned to the meditation condition but attended fewer than three of the six weekly classes ($n = 5$), or (d) they completed fewer than 30 of the 61 daily reports ($n = 24$). In total, 63 participants were excluded, 34 from the LKM group and 29 from the waitlist group. Attrition and disqualification affected the LKM and waitlist groups equally ($\chi^2(1,202) = 0.4, p = 0.51$) and was comparable to other studies on meditation (Carson et al., 2005; Davidson et al., 2003; Teasdale et al., 2000). The final sample, then, consisted of 139 participants, 67 of whom were in the LKM group and 72 of whom were in the waitlist control group.

Demographic information is presented in Appendix 2, Table 1. The compositions of the initial and completer samples were similar: Most participants were female, most had bachelor's or master's degrees, and the average age was 41 years ($SD = 9.6$). The completer sample was 65.5% female, 73.7% White, 9.5% Black, 8.8% South Asian, 6.6% East Asian, 0.7% Hawaiian/Pacific Islander, and 0.7% Hispanic. Male participants were disproportionately lost to attrition and disqualification ($\chi^2(1, N = 180) = 10.9, p = 0.001$). There was also a trend towards loss of married participants ($\chi^2(1, N = 178) = 3.2, p = 0.07$). These groups, however, were lost equally between conditions (waitlist = 64% female, meditators = 67% female; $\chi^2(1, N = 139) = .17, p = 0.69$; waitlist = 56% married, meditators = 60% married; $\chi^2(1, N = 137) = .22, p = 0.67$), implying that married and male participant attrition related to the study in general, and not to group differences in

reactions to LKM. Otherwise, the initial and completer samples did not differ on demographic characteristics, condition assignment, or depression and life satisfaction scores ($p > .24$). Nineteen participants had a meditation practice at the start of the study, but they did not differ from others on positive emotions or resource measures, and removing their data did not appreciably alter the pattern of findings reported here.

In addition to providing access to the participant pool, Compuware supported this study in multiple ways. All study orientation meetings and meditation workshop sessions were held during business hours at Compuware's Detroit office. The meditation workshops were offered free of charge to all interested employees. Compuware also provided employee release-time so that participants could attend a study orientation meeting, six meditation workshop sessions, and complete all web-surveys during work-time, without loss of compensation.

Participants received monetary compensation for time spent on study measures. They received \$10 for completing the initial survey, \$20 for completing the final survey, and \$1 for each daily report. Additionally, participants who completed daily reports for at least 40 of the 61 days received a \$10 bonus and a copy of a popular book on meditation by Jon Kabat-Zinn (valued at \$24.95). The total possible payment for the study was \$101, plus the book.

Procedure

All study orientation sessions were held during employees' lunch hour, in a large auditorium on Compuware premises. At orientation, one of the authors (BLF or MAC) introduced interested employees to the rationale for investigating the effects of meditation on health and well-being. We sought to enhance prospective participants' investment in the study by describing benefits of meditation already featured in the popular press and regularly used to draw attendees to comparable workplace wellness courses, specifically, the potential to reduce stress and improve health and well-being. We also described the timeline of the study and the details of compensation and explained the value of gathering data from a waitlist control group. We did not describe LKM, the broaden-and-build theory, our hypotheses regarding mediation by daily positive emotions, or other information that might have created detailed expectancy or

demand effects. Those who could not attend an orientation session received information by phone.

Within the week following orientation, interested employees logged on to a secure website, gave consent to participate in the study, and responded to the initial (T1) survey (described below). Participants learned their group assignment (meditation workshop or wait-list control) only after completing the T1 survey.

The daily reporting phase of the study began one week following orientation and continued for approximately nine weeks. Each day, participants visited our secure website to complete a short report on their emotions over the past 24 hours and time spent in “meditation, prayer, or solo spiritual activity” since their last report (including any days they had missed reporting). After approximately one week of baseline reporting, workshop classes and daily practice began for the meditation group (described below). Daily reporting continued for approximately one week after the meditation workshop ended.

After the daily reporting phase ended, the final (T2) survey became available on-line. Participants visited our website a final time and completed the same measures as at T1 followed by a Day Reconstruction (described below) and a demographics questionnaire. After data collection was completed, participants received debriefing information explaining more about the details of the study.¹⁴ Approximately two months later, meditation classes began for the waitlist control group. No further data were collected at that time.

The websites for the initial questionnaires and the daily reports were available around the clock. The final survey was available only between noon and 2:00 AM, due to the specifics of the Day Reconstruction Method. Although participants were encouraged to complete the surveys at work, they were asked to practice meditation at home. Participants who missed more than three consecutive weekday report forms, or who did not fill out the final survey, received an automated e-mail reminder asking them to visit our website. The study team did not otherwise initiate contact with participants.

Loving-Kindness Meditation Workshops

The meditation training involved six 60-minute group sessions (held over 7 weeks due to religious holidays) with 20-30 participants per group. All sessions were led by a stress

management specialist (SF) with extensive experience practicing and teaching LKM. The median number of sessions attended was 5 ($M = 4.3$, $SD = 1.8$). At the first session, participants were given a CD that included three guided meditations of increasing scope, led by the workshop instructor. The Appendix contains selections from the text of the third guided meditation, which contains the core material from the prior two. During Week 1, participants practiced a meditation directing love and compassion toward themselves. During Week 2, the meditation added loved ones. During subsequent weeks, the meditation built from self, to loved ones, to acquaintances, to strangers, and finally, to all living beings. The first meditation lasted 15 minutes, and the final one lasted 22 minutes.

Each workshop session included 15-20 minutes for a group meditation, 20 minutes to check on participants' progress and answer questions, and 20 minutes for a didactic presentation about features of the meditation and how to integrate concepts from the workshop into one's daily life. Participants were assigned to practice LKM at home, at least 5 days per week, with the guided recordings. The text of the guided meditations and week-by-week content outlines are available by request from the fifth author (SF).¹⁵

Measures

Cognitive resources

Mindfulness and Awareness Scale (MAAS; Brown & Ryan, 2003). The MAAS assesses awareness of one's circumstances, as well as tendencies towards automated, "mindless" behavior or acting on "autopilot." Participants indicate the frequency of 15 behaviors on a 6-point scale (1 = *almost always*, 6 = *almost never*). Items include "I snack without being aware of what I am eating" and "I could be experiencing some emotion and not be conscious of it until some time later." All items are reverse-scored. ($\alpha_{T1}=.86$, $\alpha_{T2}=.89$).

Agency Thinking and Pathways Thinking (Snyder et al., 1991; Snyder, Rand, & Sigmon, 2002). We used the Trait Hope Scale to assess these two cognitive components of Snyder's hope theory. Participants use a four-point scale to indicate agreement or disagreement (1 = *definitely false*, 4 = *definitely true*) with ten items divided between two subscales: Agency Thinking (belief that one has been / will be personally able to achieve

one's goals), including "I meet the goals I set for myself" ($\alpha_{T1}=.84$, $\alpha_{T2}=.81$) and Pathways Thinking (belief that there are multiple ways to achieve one's goals), including "There are lots of ways around any problem" ($\alpha_{T1}=.84$, $\alpha_{T2}=.83$).

Savoring Beliefs Inventory (SBI; Bryant, 2003). The SBI assesses one's tendency to enjoy pleasant experiences in the moment (*Savoring the Present*), pleasurable anticipate them beforehand (*Savoring the Future*), and pleasurable recall them afterwards (*Savoring the Past*). Participants indicate agreement on a 7-point scale with 24 items, including "It's easy for me to rekindle the joy from pleasant memories" and "When I think about a pleasant event before it happens, I often start to feel uneasy or uncomfortable" (reverse scored; savoring the past: $\alpha_{T1}=.88$, $\alpha_{T2}=.92$; savoring the present: $\alpha_{T1}=.88$, $\alpha_{T2}=.89$; savoring the future: $\alpha_{T1}=.87$, $\alpha_{T2}=.91$).

Psychological resources

Life Orientation Test (LOT-R; Scheier, Carver, & Bridges, 1994). The LOT-R is a 6-item scale that assesses generalized *Optimism* as the belief that positive things are possible in the future. Participants indicated agreement or disagreement on a five-point scale (1 = *I agree a lot*, 5 = *I disagree a lot*) with ten statements (4 items are fillers), including "In uncertain times, I usually expect the best" and "If something can go wrong for me, it will" (reverse scored; $\alpha_{T1}=.82$, $\alpha_{T2}=.79$).

Ego Resilience (ER89; Block & Kremen, 1996). The ER89 assesses *Trait Resilience* as the ability to bounce back from adversity and flexibly adapt to shifting demands. Participants indicate agreement or disagreement on a four-point scale with 14 items including "I quickly get over and recover from being startled" and "I like to do new and different things." ($\alpha_{T1}=.73$, $\alpha_{T2}=.74$).

Psychological Well-Being (PWB; Ryff, 1989). We measured five additional psychological resources using subscales of Ryff's broader PWB measure. Participants indicate agreement on a 6-point scale (1 = *strongly disagree*, 6 = *strongly agree*) with 7-8 items for each of the following five subscales: *Personal Growth*, with items like "For me, life has been a continuous process of learning, changing, and growth" ($\alpha_{T1}=.76$, $\alpha_{T2}=.80$); *Environmental Mastery*, with items like "I often feel overwhelmed by my responsibilities" (reverse scored; $\alpha_{T1}=.78$, $\alpha_{T2}=.80$); *Autonomy*, with items like "I am not afraid to voice my opinions, even when they are in opposition to the opinions of most

people” ($\alpha_{T1}=.72$, $\alpha_{T2}=.77$); *Self-acceptance*, with items like “I like most parts of my personality” ($\alpha_{T1}=.88$, $\alpha_{T2}=.86$); and *Purpose in life*, with items like “My daily activities often seem trivial and unimportant to me” (reverse scored; $\alpha_{T1}=.80$, $\alpha_{T2}=.80$).

Social resources

Dyadic Adjustment Scale (DAS; Spanier, 1976). The DAS measures social support as the amount of emotional support the participant provides to and receives from close others. Using a 5-point scale (0 = *not at all*, 4 = *an extreme amount*), participants respond to questions including "On the whole, how much do your friends and relatives make you feel loved and cared for?" and “If one of your close friends got sick or were injured in a car accident, how much could they count on you to take care of them?” Items are divided into subscales for *Social Support Given* ($\alpha_{T1}=.81$, $\alpha_{T2}=.81$) and *Social Support Received* ($\alpha_{T1}=.83$, $\alpha_{T2}=.83$).

Positive Relations with Others (Ryff, 1989). Our third index of social resources was drawn from Ryff’s (1989) PWB scale (see above). The 7-item subscale includes items like, “I know that I can trust my friends, and they know they can trust me” and “I often feel lonely because I have few close friends with whom to share my concerns” (reverse scored; $\alpha_{T1}=.81$, $\alpha_{T2}=.81$).

Physical resources

Illness symptoms (Elliot & Sheldon, 1998). This self-report measure assesses 13 common symptoms of illness or poor health, including headaches, chest pain, congestion, and weakness. Participants use a 7-point scale to rate the frequency of each symptom over the past month (1 = *not at all*, 7 = *very frequently*; $\alpha_{T1}=.82$, $\alpha_{T2}=.84$).

Sleep duration (Buysse, Reynolds III, Monk, Berman, & Kupfer, 1989). This single item, extracted from the Pittsburgh Sleep Quality Index, asked participants to respond to the question “During the past month, how many hours of actual sleep did you get at night?”

Outcome measures

Satisfaction with Life Scale (SWLS; Diener, Emmons, Larsen, & Griffin, 1985). We assessed cognitive evaluations of *Life Satisfaction* with this 5-item scale. It assesses participants' global satisfaction with their lives and circumstances. Participants indicate

agreement on a 7-point scale with each item, including "So far I have gotten the important things I want in life" ($\alpha_{T1}=88$, $\alpha_{T2}=90$).

Center for Epidemiological Studies-Depression Measure (CES-D; Radloff, 1977). We assessed *Depressive Symptoms* with the CES-D. We excluded the 4 positively-worded items to minimize conceptual overlap with positive emotions (see Moskowitz, 2003; Ostir et al., 2000). On a 5-point scale, participants indicated how often they had felt symptoms of depression in the past week (0 = never, 4 = most of the time), including "I felt that I could not shake off the blues even with help from my family or friends" ($\alpha_{T1}=0.86$, $\alpha_{T2}= 0.88$).

Daily Questionnaire: Emotions and Meditation Practice

During daily reports, participants completed the Modified Differential Emotions Scale (mDES; Fredrickson, Tugade, Waugh, & Larkin, 2003). The mDES asks participants to recall the past 24 hours and rate their strongest experience of each of 19 specific emotions on a 4-point scale (0 = *not at all*, 4 = *extremely*). The emotions listed were: amusement, anger, awe, compassion, contempt, contentment, disgust, embarrassment, gratitude, hope, joy, interest, love, pride, guilt, sadness, shame, fear, and surprise. Participants also reported whether they had engaged in "meditation, prayer, or solo spiritual activity" since the last time they filled out the survey (not necessarily the same 24-hour timespan as mDES responses). Both meditation and wait-list participants responded to these questions.

Day Reconstruction Method

We used the DRM (Kahneman et al., 2004) to assess participants' time-varying emotion experiences during a specific day. Because of time constraints, we limited our assessment to the morning of the targeted day. We asked participants to divide their morning – from the time they awoke until they completed lunch – into a continuous series of episodes and to provide a descriptive label for each episode. We allowed a maximum of 10 episodes. Thereafter, participants revisited each labeled episode to provide ratings from *not at all* (0) to *extremely* (4) for the emotion adjectives from the mDES, as described above (Fredrickson, et al., 2003). For each episode, participants were also asked "What were you doing?" followed by a checklist of several activities that included "praying/worshipping/meditating." They also responded "yes" or "no" to the

question: "Were you interacting with anyone (including on the phone, in a teleconference, etc)?"

Results

Overview of Data Analytic Strategy

Given the complexity of the data set, we performed a range of analyses, which we forecast here.¹⁶ As a manipulation check, t-tests confirmed that participants in the LKM condition were, in fact, meditating and were meditating more than the control participants. A series of hierarchical linear models with time nested within individual – also known as growth models – investigated the impact of experimental condition, passage of time, and time spent meditating on self-reported emotions. A last series of analyses examined participants' emotions within a single morning, incorporating information about the amount of time that participants had meditated over the course of the study and whether they had meditated on the particular morning in question.

We then tested the *build hypothesis* in a combined latent growth curve and path analysis structural equation model. The growth curve for positive emotions from the hierarchical linear model analyses was re-parameterized as a structural equation modeling-based latent trajectory model. In the path analysis portion of the model, baseline positive emotions and slope of change in positive emotions predicted change in the targeted resource, which then predicted change in life satisfaction or depression. Each of the 18 resources we measured was tested in a separate model.¹⁷

Results were analyzed separately in three samples: 1) individuals who adhered to the study requirements described above (our “complete data” sample, n = 139); 2) an intent-to-treat sample (n=195), comprising all of the participants who were successfully randomly assigned to experimental condition; and 3) a per-protocol sample (n=175), comprising (a) all of the participants successfully randomly assigned to the waitlist control condition (n=98) and (b) those participants assigned to LKM who received a predetermined “minimum effective dose” of LKM training (at least three of the six weekly loving-kindness sessions; n=77). Analyses with the complete data sample are described below. At the end of the section, analyses with the other samples are discussed.

Manipulation Check

Did participants in the meditation condition comply with instructions to meditate?

Time spent in “meditation, prayer, or solo spiritual activity” was assessed each day. As expected, during the baseline period, meditators and control participants did not differ in duration of meditative activity ($t = -0.25$, $df = 135$, $p = .80$, means were 13 and 12 min/week, respectively). Beginning with Week 1 of the study and for each subsequent week, participants in the LKM group engaged in significantly more meditative activity than those in the control group, averaging about 80 min/week, although this dropped to about 60 min/week after the workshop ended.

Effects of Loving-Kindness Meditation on Emotions

Did loving-kindness meditation impact positive emotions over the course of the study?

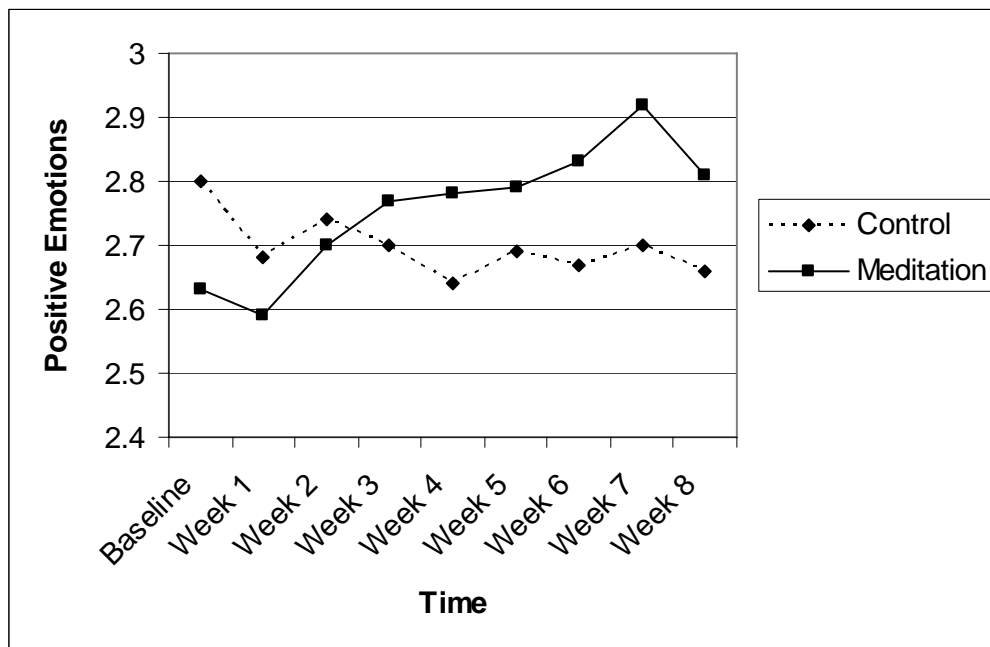
Measurements for nine positive emotions, consisting of amusement, awe, contentment, joy, gratitude, hope, interest, love, and pride, were averaged within each day and then these daily means were averaged over the week to create a composite positive emotions variable for each week of the study. Across weeks, this index score had an average alpha coefficient of 0.94 (range = .94 - .95).

The impact of LKM on positive emotions over time was tested using hierarchical linear modeling, with time nested within individual. Experimental condition, week in the study, and their interaction were included as predictors. The model also included random effects for the intercept, which represented each participant’s level of positive emotions at baseline, and for the impact of week in the study, which represented each participant’s change in positive emotions over time. Both random effects were significant (*intercept variance* = 0.34, $SE = 0.05$, $p < .0001$; *week variance* = 0.002, $SE = 0.0006$, $p = .0002$), indicating that participants varied in their baseline levels of positive emotions and showed differing rates of change over time, after accounting for fixed effects. The fixed effects for experimental condition and week were not significant, but their interaction was ($b = 0.041$, $SE = 0.011$, $p = 0.0004$). Thus, neither time nor condition predicted positive emotions alone, but over time a difference between conditions emerged (see Figure 2). We probed the interaction by treating time as the focal predictor and experimental condition as the moderating variable (as recommended by Preacher, Curran, & Bauer, 2006). These analyses revealed that time did not significantly predict positive

emotions for control participants ($b = -0.008$, $SE = 0.0079$, $p = 0.31$) but did significantly predict positive emotions for participants in the LKM condition ($b = 0.03$, $SE = 0.008$, $p = 0.0001$). Thus, these results confirmed that LKM increased participants' positive emotions over the course of the study.

We then tested similar growth models for each of the nine positive emotions included in the composite. In all cases, the interaction between time and experimental condition was significant, and neither main effect was (the sole exception was that interest also showed an effect of condition; see Appendix 2, Table 2). These results suggest that the findings for the composite positive emotions variable were not determined by any single positive emotion, and that it is appropriate to consider the positive emotions collectively.

Figure 4-2: Positive emotions by experimental condition.



We tested an additional growth model that examined compassion over the duration of the study. Neither the main effects for experimental condition and week, nor their interaction ($b = 0.021$, $SE = 0.016$, $p = .21$), was significant. Visual inspection revealed the same pattern for compassion as for the positive emotions, but the increase over time for meditators was not statistically significant.

What role did individual effort play in the impact of the intervention on positive emotions?

The impact of LKM on positive emotions might be expected to be a function not only of experimental condition, but also of individual effort put into daily practice. We tested a growth model for positive emotions that included the number of hours of meditation practice each week as a fixed effect, time-varying predictor, along with time and experimental condition. To allow us to examine any changes in the impact of meditation practice on positive emotions over the course of the study, meditation practice for each week of the study was entered as a separate variable, dummy-coded to zero for the off-weeks. Experimental condition was deliberately left in the model to test the unique contribution of time spent meditating each week, above and beyond the impact of participation in the workshop or interaction with the meditation instructor. Unexpectedly, time spent in "meditation, prayer, or solo spiritual activity" significantly predicted positive emotions during the baseline week before the workshops began ($p = 0.05$), even when we excluded the participants who reported a pre-existing meditation practice. After the first week of meditation instruction, time spent in meditative activity predicted positive emotions for all time points except Week 4 ($p = .08$), even after controlling for the other predictors in the model. These results are presented in Appendix 2, Table 3.¹⁸

To estimate the impact of LKM instruction and practice on positive emotions, we tested a separate model with the meditators alone. By excluding the control participants, who were not receiving LKM instruction, we avoided diluting the estimate for the impact of LKM on positive emotions. In this model, one hour of meditation practice during Week 2 was associated with a 0.06-unit increase in positive emotions ($SE = 0.03$; $p = 0.06$) on the five-point Likert scale described above. This value increased steadily during Weeks 3-7 of the study. By Weeks 7 and 8, each hour of meditation practice was associated with a 0.17-unit increase in positive emotions ($SE = 0.03$; $p < .0001$). Thus, even though meditation practice dropped after the workshop ended in Week 7, the effect of meditation on positive emotions did not change. These data suggest that the dose-response relationship between the practice of LKM and the experience of positive emotions tripled over the course of the study.

Did loving-kindness meditation influence negative emotions over the course of the study?

We also examined the impact of LKM on negative emotions over the course of the study. Negative emotions were indexed by a composite of daily ratings for anger, shame, contempt, disgust, embarrassment, guilt, sadness, and fear. Across weeks, this index score had an average alpha coefficient of 0.85 (range = 0.81 – 0.90). As described above for positive emotions, the model included experimental condition, week in the study, time X condition interaction, and hours of meditation practice each week. None of the predictors were significant. Thus, neither experimental condition, week in the study, their interaction ($b = -0.011$; $SE = 0.011$; $p = .28$), nor time spent meditating during any weeks of the study (range: $p = 0.11$ to 0.74) significantly influenced the negative emotions sampled in this study.

Did loving-kindness meditation influence emotions within a targeted morning?

The DRM provided data on participants' emotional experiences within the episodes of an ordinary morning. This offered a window into the impact of our intervention on emotional experiences in response to specific daily events, rather than emotions summarized over an entire day. Five participants did not provide DRM data, leaving 134 for analysis. There were 918 episodes recorded in total, with each participant reporting a mean of about 7 episodes ($M = 6.85$, $SD = 2.38$). As with the daily reports, composite scores of positive and negative emotions were computed by taking the mean of positive items and negative items, respectively. Consistent with the daily reports, participants reported higher ratings of positive emotions ($M = 1.16$, $SD = 0.15$) than negative emotions ($M = 0.15$, $SD = 0.28$). Positive and negative emotions were largely uncorrelated ($r = -.06$, $p = 0.09$).

Multilevel random-coefficient regression modeling has been recommended for analyzing DRM data (Stone et al., 2006). We used SAS's PROC MIXED (Littell et al., 1996) to estimate a series of models predicting positive or negative emotions for a given episode from experimental condition, total number of hours engaged in meditative activity over the course of the study, the time of day of the episode, whether the episode included meditation, whether the episode included social interaction, and the interaction between social interaction and total hours of meditative activity. This interaction term was included to explore whether LKM – which focused on kindness and compassion

toward others – had a specific influence on their response to interactions with others. All quantitative predictors were mean-centered.

We established that the best fitting unconditional models for positive and negative emotions had significant random intercepts ($ps < .0001$) and autoregressive covariance structures ($ps < .0001$), indicating that participants began the day with significant variability in their levels of positive and negative emotions and that temporally close measures of emotion were more highly correlated than more distant measures. Time of day positively predicted positive emotions ($b = 0.065$, $SE = 0.009$, $p < .0001$) whereas no time trend emerged for negative emotions ($b = 0.002$, $SE = 0.003$, $p = 0.54$). These findings are consistent with diurnal rhythms of positive emotions, which have been found to peak at noon (Stone et al., 2006). Experimental condition was not significant for either positive or negative emotions ($b = 0.067$, $SE = 0.118$, ns and $b = -0.082$, $SE = 0.048$, ns respectively).

We next tested the total number of hours spent in meditative activity (over the previous 9 weeks) as a predictor of emotional experiences during the episodes of the targeted morning.¹⁹ A positive effect of time spent meditating on positive emotions emerged, above and beyond the effect of time ($b = 0.033$, $SE = 0.010$, $p = .0008$). This was not true for negative emotions ($b = -0.005$, $SE = 0.004$, $p = 0.2064$). Hence, time spent in meditative activity over the previous 9 weeks was associated with more frequent positive emotions and no change in negative emotions across episodes within the targeted morning. We do not consider negative emotions further.

A small number of participants ($n = 9$) indicated in their DRM responses that they had engaged in meditative activity that morning. To assess whether the target day's meditative activity alone could account for the significant effects on positive emotions reported above, we reran the models in two ways. First, we added meditation at episode as a time-varying predictor to test the effects of engaging in meditative activity on positive emotions experienced during that same episode. Second, in place of the episode-level predictor, we added a dummy variable indicating whether participants meditated that day or not to test the effects of engaging in meditative activity on positive emotions experienced that day. Meditating during an episode predicted higher positive emotions during that episode ($b = 0.39$, $SE = 0.17$, $p = .0207$), but did not change the effect of

hours engaged in meditative activity over the previous nine weeks on positive emotions experienced that morning ($b = 0.033$, $SE = 0.010$, $p = .0008$). Meditating anytime that morning also predicted positive emotions experienced that morning ($b = 0.52$, $SE = 0.23$, $p = .0247$), but also did not change the effect of total hours meditated throughout the study ($b = 0.029$, $SE = 0.010$, $p = .0031$). Thus, we can attribute much of the increase in positive emotions on this particular day to the time participants had spent meditating over the last several weeks.

Taken together, these DRM findings indicate that (a) meditation produces positive emotions during meditation practice; (b) these positive emotions persist after the meditation session has ended; and (c) over time, repeated LKM practice produces a cumulative increase in positive emotions that appears on subsequent days, whether or not the individual meditates on that day.

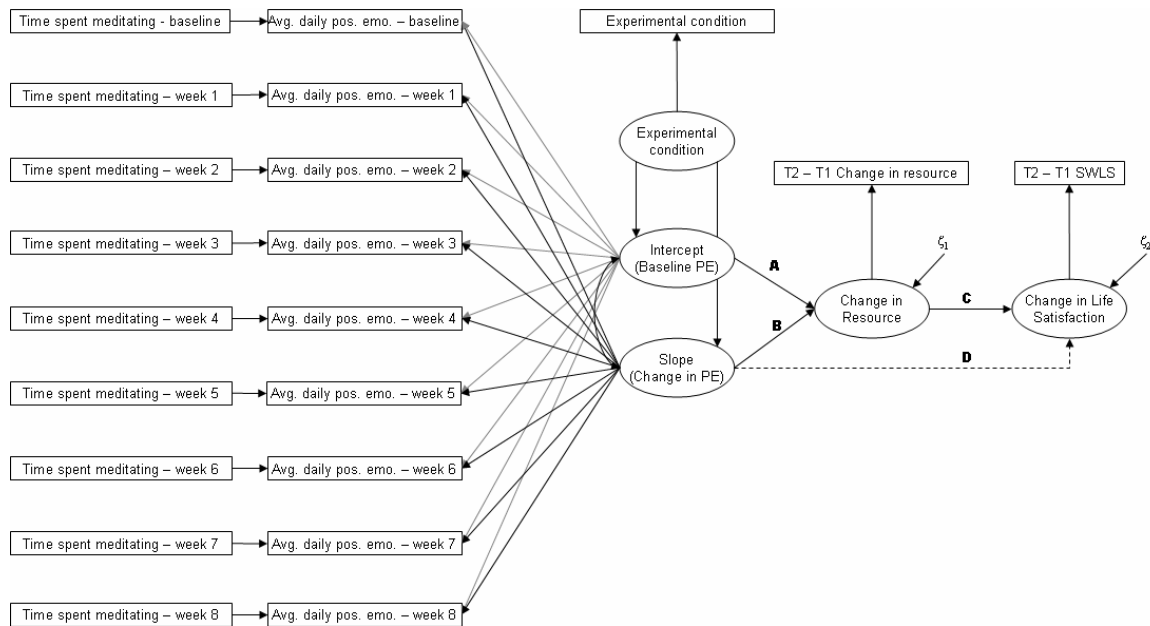
Previous research has shown that, in general, people experience more intense positive emotions when interacting with others than when alone (McIntyre, Watson, Clark, & Cross, 1991). We explored whether time spent meditating over the previous 9 weeks differentially influenced participants' experiences of positive emotions depending on whether they were interacting with others or not. We tested a model with time of day, social interaction, time spent meditating over the previous nine weeks, and the interaction of social interaction and time spent meditating as predictors. The slope for social interaction was allowed to vary ($\text{Var}_{\text{slope}} = 0.052$, $SE = 0.25$, $p = 0.0187$), confirming that interacting with others predicted positive emotions differentially across individuals. Beyond the effects of time and hours spent in meditation, episode-level social interactions ($b = 0.232$, $SE = 0.059$, $p < .0001$) and the interaction between time spent meditating and social interactions ($b = 0.014$, $SE = 0.006$, $p = 0.0363$) predicted positive emotions in that morning. That is, more time spent meditating is associated with higher positive emotions, and this effect is stronger during social interactions.

Testing the Build Hypothesis

We tested the full *build hypothesis* by combining a growth model for positive emotions with a structural equation modeling path analysis. This combined model utilized the strengths of growth modeling, which considers individual trajectories of change over time, and path analyses, which can examine direct and indirect effects in

mediational models. The growth model for positive emotions was re-parameterized as a latent trajectory model in a structural equation modeling framework (Curran and Hussong, 2003). Experimental condition and time spent meditating during the week predicted positive emotions for each week of the study. Time spent meditating was entered as a time-varying predictor. An intercept and slope for positive emotions over the course of the study were created by allowing the indicators for positive emotions, representing positive emotions during each week of the study, to cross-load on both intercept and slope latent variables. The latent variable that reflected the intercept of positive emotions, at baseline, was created by fixing factor loadings for the indicators to 1.0. The latent variable that reflected change in positive emotions over the course of the study was then created by specifying factor loadings that reflected week in the study (0.0 = baseline, 1.0 = week 1, 2.0 = week 2, etc.).

Figure 4-3: Combined latent trajectory and path analysis model



Given our experimental design, only change in positive emotions (i.e., slope) was predicted to build participants' resources. Thus, we predicted that the path from slope of positive emotions to resources would be significant, but the path from baseline positive

emotions to change in resources would not. The resource variable was a difference score that represented change between T1 and T2 in the specific resource featured within each model. We tested the model for each resource assessed, and this was the only variable that changed across models. Lastly, the life satisfaction variable was also a difference score, representing change in life satisfaction between T1 and T2. Thus, the model examined whether initial positive emotions and changes in positive emotions over the course of the study predicted changes in resources over the course of the study, which in turn predicted changes in life satisfaction over the course of the study. Participants with greater increases in positive emotions were hypothesized to exhibit greater increases in resources and, in turn, life satisfaction. A diagram of the model tested is depicted in Figure 3.

The model was tested for each of the 18 resources identified in Appendix 2, Table 4, using LISREL 8.80 (Jöreskog & Sörbom, 1996). A multitude of factors may be associated with individual trajectories of change over time, therefore it is rare for growth models or combined growth and path analysis models to fit well when assessed using standard SEM fit indices, such as RMSEA (Widaman & Thompson, 2003). For this reason, it is noteworthy that each of the models we tested produced an estimated RMSEA less than 0.08 (range = 0.068 – 0.076), indicating an acceptable fit to the data. Given that all of the models tested were acceptable fits to the data, and that overall model fit was influenced by the fit of the latent trajectory portion of the model (which was the same for each resource) we examined the significance of the individual pathways in the models for each resource to test the build hypothesis.

As predicted, the path from baseline positive emotions to change in resources (pathway A) was not significant for any of the resources, indicating that change in resources over the course of the study was not significantly affected by participants' initial levels of positive emotions (see Appendix 2, Table 4). The paths from change in positive emotions (i.e., slope, which carries the effect of experimental condition) to change in resources (pathway B) and from change in resources to change in life satisfaction (pathway C) are central to the build hypothesis. These paths were significant for 9 of the 18 resources tested: mindfulness, pathways thinking, savoring the future, environmental mastery, self-acceptance, purpose in life, social support received, positive

relations with others, and illness symptoms. In other words, increases in positive emotions over the course of the study were associated with significant increases in these resources, which were in turn associated with significant increases in life satisfaction. Appendix 2, Table 4 presents the parameter estimates for all pathways tested. The first two columns of Appendix 2, Table 5 present the amount of variance explained in the changes in resource and life satisfaction when the predicted “build” pathways were significant.

Six of the nine remaining resources showed significant paths influencing life satisfaction (path C), but were not significantly influenced by change in positive emotions (path B). These resources were agency thinking, savoring the past, savoring the present, optimism, personal growth, and autonomy. This suggests that these six measures are indeed consequential resources, even though increases in positive emotions did not significantly augment them.

Did changes in positive emotions directly influence life satisfaction, in addition to their indirect influence through built resources?

We examined the possibility that changes in positive emotions could exert a direct effect on increases in life satisfaction (pathway D), in addition to the indirect effects via “built” resources (pathways B and C). To examine this, we tested a series of models that included a direct effect from change in positive emotions to change in life satisfaction. The “pathway D” column in Appendix 2, Table 4 presents the results for this pathway. (In Appendix 2, Table 4, the columns for pathways A, B, and C report values for these pathways when pathway D is *not* in the model.) The direct effect from change in positive emotions to change in life satisfaction was not significant for any of the models tested, nor did model fit significantly improve when this path was included. For the 9 resources that were found in previous analyses to exhibit the predicted pattern of significant “build” pathways, these pathways remained significant when the direct effect of change in positive emotions on change in life satisfaction was included in the model. These results indicate that changes in positive emotions only produced changes in life satisfaction to the extent that they built personal resources. This further underscores the conceptual distinction between transient experiences of positive emotions and global judgments of life quality (Cohn et al., 2007; Diener et al., 2006).

Did experimental condition and time spent meditating directly impact resources and life satisfaction, in addition to the impact they exert via their influence on changes in positive emotion?

We also examined the possibility that experimental condition and amount of time spent meditating directly influenced changes in resources and life satisfaction, in addition to their indirect influence via positive emotions. For purposes of clarity, these pathways are not represented in Figure 3, but they entail direct effects from experimental condition and from each week's variable for time spent meditating to both change in resource and change in life satisfaction. These effects were generally non-significant, with values that varied depending upon the pathway and the resource being tested. There was one exception: The direct effect from time spent meditating in Week 2 to change in life satisfaction was significant for each of the eighteen resources tested (e.g., Mindfulness: $b = 0.49$, $z = 2.47$). Excluding this direct effect, there were other, isolated significant effects, which represented a total of 4% of the 360 pathways estimated, but there was no pattern to these effects and they did not exceed the percentage of pathways that would be expected on the basis of chance alone. These results suggest that experimental condition and time spent meditating primarily exerted their influence on resources and life satisfaction because of their impact on positive emotions.

Do positive emotions influence depressive symptoms through the same mechanism (i.e., built resources) by which they influence life satisfaction?

To explore whether positive emotions might beneficially influence measures of negative psychological adjustment through the same mechanisms by which they influence life satisfaction, we tested a series of models for which depressive symptoms was the ultimate variable in the model, replacing life satisfaction. In these models, change in positive emotions predicted change in the resource, which in turn predicted change in depressive symptoms. Model fit, using RMSEA, remained acceptable. In addition, the predicted “build” pathways were significant for the same 9 resources for which these pathways were significant when life satisfaction was the ultimate variable in the models. These findings suggest that increases in positive emotions decrease depressive symptoms through the same mechanisms by which they increase life satisfaction: built resources.

We also examined the possibility that positive emotion directly influenced depressive symptoms, in addition to its indirect impact via built resources. In the first set of models, we examined the significance of the direct effect from change in positive emotions to change in depressive symptoms (pathway D). Unlike the results for life satisfaction, this pathway was significant for all models tested. In addition, the overall fit of the models significantly improved for all eighteen resources when this pathway was included in the model ($p < .0025$), as assessed by decrements in chi-squared values. Even so, the predicted “build” pathways remained significant for eight of the nine previously-significant resources. This pattern of results suggests that increases in positive emotions influenced the decline in depressive symptoms both via built resources and via a direct impact on depressive symptoms. The one resource for which this was not the case was social support received, for which the mediated “build” pathways were not significant when pathway D was included. Appendix 2, Table 6 presents the parameter estimates for these models. The last two columns of Appendix 2, Table 5 present the amount of variance explained in the changes in the resource and depressive symptoms when the predicted “build” pathways were significant. In a second set of models, we examined the direct effects from experimental condition and time spent meditating each week to the changes in resources and depressive symptoms, for each of the resources tested. Although isolated pathways were significant, these represented only 2.8% of the pathways tested and there was no discernible pattern to which pathways were significant.

Intent-to-Treat Analyses

To test for possible effects of differential participant completion on our results, we repeated the analyses above using our intent-to-treat and per-protocol samples. The impact of experimental condition over time on positive emotions was not significant in either the intent-to-treat ($t=1.37$, $df=1380$, $p=0.17$) or per-protocol samples ($t=1.58$, $df=1380$, $p=0.11$), whereas it was in our completer sample (discussed above). The impact of time spent meditating on positive emotions remained significant in both samples starting with the first week of instruction. The resources for which we found significant *build* pathways (pathways from positive emotion change to resource to life satisfaction; shown as pathways B and C in Figure 3) generally showed the same significant pathways in the intent-to-treat and per-protocol samples. Positive emotions significantly predicted

savoring the future only in the completer sample, and change in resilience significantly predicted change in life satisfaction and depression in the intent-to-treat and per-protocol samples, even though it did not do so in the completer sample. Overall, the hypothesis that positive emotions help people build consequential personal resources was supported in the intent-to-treat analysis. However, this analysis suggests that conclusions about the efficacy of LKM may need to be restricted to individuals who invest adequate effort in training and practice (approximately 70% in this sample).

Discussion

The broaden-and-build theory (Fredrickson, 1998; 2001) states that, over time, recurrent experiences of positive emotions allow people to build consequential personal resources. The data reported here provide the first experimental test of the build hypothesis. The findings are clear-cut: The practice of loving-kindness meditation led to shifts in people's daily experiences of a wide range of positive emotions, including love, joy, gratitude, contentment, hope, pride, interest, amusement, and awe. These increases in positive emotions were evident both within the trajectories of change in daily emotions over the span of 9 weeks, and within a detailed analysis of a given morning two weeks after formal training ended. These shifts in positive emotions took time to appear and were not large in magnitude, but over the course of nine weeks they were linked to increases in a variety of personal resources, including mindful attention, self-acceptance, positive relations with others, and good physical health. Moreover, these gains in personal resources had consequences: They enabled people to become more satisfied with their lives and to experience fewer symptoms of depression. By elevating daily experiences of positive emotions, the practice of LKM led to long-term gains that made genuine differences in people's lives.

The conceptual model – drawn from the broaden-and-build theory and depicted in Figure 1 – is unambiguously supported by the evidence reported here. Most importantly, positive emotions emerge as the clear centerpiece of the model. LKM was beneficial because it helped people experience positive emotions; it had few effects beyond this. Positive emotions emerge as the mechanism that enables people to build the resources that make their lives more fulfilling and ward off depression.

These data also echo a message from our recent work unpacking the relationship between positive emotions and life satisfaction (Cohn et al., 2007). Although both can be considered facets of happiness or subjective well-being (Lucas, Diener, & Suh, 1996), we found that it is positive emotions, and not life satisfaction, that predict change in resources. Furthermore, the association between increased positive emotions and increased life satisfaction is fully mediated by resource building. This suggests that people judge their lives to be more satisfying and fulfilling not because they feel more positive emotions per se, but because their greater positive emotions helped them build resources for living happily and successfully.

Nine of the eighteen resources were tested in this study fit the hypothesized build pathways. Of the remaining nine, six showed changes in the expected direction on the build pathways. It may simply be that these resources are affected by positive emotions less strongly or more slowly than others, and not that the build hypothesis is categorically inapplicable to them. Future work will help answer the more practical question of whether any association with positive emotions is strong or robust enough that a positive emotion intervention is an appropriate way to influence them.

The resources that did show a significant build effect might be loosely related to two broad dimensions. The first involves having a loving attitude towards oneself and others, and includes self-acceptance, social support received, and positive relations with others. The second involves a feeling of competence about one's life, and includes pathways thinking, environmental mastery, purpose in life, and resilience (which was influenced by positive emotion, although it did not significantly influence life satisfaction). We speculate that increases in positive emotions may impact these broad dimensions more rapidly and to a greater extent than other aspects of participants' lives.

This study confirms yet again that positive emotions are more than momentary good feelings. Laboratory experiments have documented that positive emotions broaden cognition (for a review, see Fredrickson & Cohn, in press). Now we have evidence from a field experiment to document that positive emotions also place people on trajectories of growth, leaving them better able to ward off depressive symptoms and become ever more satisfied with life. This experiment also carries the inspiring implication that people can

take deliberate action to cultivate experiences of positive emotion, and reap these benefits as a result.

This field experiment also further documents the benefits of meditation. When people initiated a practice of LKM they both achieved the immediate goal – self-generated positive emotions – and enjoyed valuable outcomes over time, including becoming more mindful, more purposeful, and more socially integrated. Those who meditated also experienced fewer health complaints, fewer depressive symptoms, and more satisfaction with their lives. Finally, meditators experienced enhanced positive emotions not just while meditating but in ordinary life situations, especially those involving other people. This substantiates the claim that this type of meditation helps people change the way they approach life, rather than simply generating emotions while meditating. These findings join the amassing empirical literature on the benefits of meditation, including the work of Carson and colleagues (2005) that first tested the benefits of LKM in particular.

We found that the effects of LKM were specific to positive emotions, without a comparable decrease in negative emotions. This resembles the work of Teasdale and colleagues (2000), who anecdotally report that their mindfulness-based protocol does not reduce negative emotions, but instead alters responses to negative emotions that can lead to depression (Segal, Williams, & Teasdale, 2002). In contrast, Carson and colleagues (2005) uncovered a marginal decrease in trait anger in their pilot study of LKM. They also observed reductions in anxiety and distress, but these may have been due to the study's central outcome of pain amelioration. Davidson and colleagues (2003) also found a decrease in trait anxiety with mindfulness-based stress reduction, but only weak support for changes in negative emotion. Future work might resolve these inconsistencies. Another curious finding was the null effect of LKM on self-ratings of compassion. In hindsight, we speculate that our sole daily item for compassion (“In the past 24 hours, what is the most sympathy, concern or compassion you have felt?”) may have oriented respondents toward compassion felt in response to the suffering of others, and less towards the everyday kindness and equanimity we also intended the item to measure. Another possibility is that the meditation's frequent references to open-hearted, all-inclusive compassion set a very high standard and caused participants to downgrade their

own daily experiences of compassion. Future work will be able to explore this issue directly by specifically assessing different facets of compassion.

Because we set out to develop a durable method of inducing positive emotions, the dose-response results we documented are particularly inspiring. We found that the amount of positive emotions participants gained per hour spent meditating increased over the course of the study, tripling from the first week to the last. Rather than becoming bored with or jaded to the effects of meditation, our participants seemed to be building a dependable skill for self-generating positive emotions again and again. These findings are especially noteworthy given that most of our participants were novice meditators and our meditation workshop lasted only 7 weeks.

Future Directions, Alternate Explanations, and Open Questions

This study breaks new ground in several ways, which leaves ample room for future research to probe or refine its findings. First, the sample was predominantly White, wealthy, and educated, and also motivated for self-change. Mindfulness-based programs have shown widespread emotional and medical beneficial in diverse populations and in individuals without prior interest in meditation (Kabat-Zinn, 1990), but it will be important to determine whether the same holds true for LKM. Second, the duration of the experiment was just over 10 weeks. In the future it will be important to investigate the extent to which the resources endure beyond the end of the intervention or into periods of heightened stress or negative emotions. We found that after the formal workshop ended time spent meditating and positive emotions decreased in tandem, even though meditation remained effective at evoking positive emotions. Lyubomirsky and colleagues have argued that intentional activity is required to sustain gains in happiness (Lyubomirsky, Sheldon, & Schkade, 2005). Future research will benefit from assessing duration of gains or determinants of continued, independent practice. Finally, the current experiment did not include daily measures of broadened cognition, which would have allowed a more precise test of the proposed links between positive emotion, broadening, and resources. Currently there are no measures of broadening that are valid, repeatable, and administerable outside the lab, but once one has been developed and validated it will be an important contribution to this research.

Another methodological improvement will be moving beyond self-report data. Briefly, three classes of evidence that could enhance the depth and validity of these findings are implicit measures, biological indices, and peer informant reports. Implicit measures reduce opportunities to fake good, often by measuring performance rather than self-perception. Relevant examples include the remote associates test (Isen, Daubman, & Nowicki, 1987), which taps breadth and acuity of cognitive associations and the lexical decision task, which can be used to assess mood (Olafson & Ferraro, 2001). Biological indices can reflect trait and state affect as well as forecasting long-term health and functioning, and are similarly difficult to fake. Previous research has associated positive emotions with improved immune function (Markland, Pressman, & Cohen, 2006) and improved regulation of stress response (Tugade & Fredrickson, 2004). It would be worthwhile to see whether meditators show these features of positive emotions on an ongoing basis, or whether they are better at recruiting positive emotions to produce them when necessary (as do resilient individuals; Tugade & Fredrickson, 2004). Finally, peer-report measures would produce a less biased view of participants' emotions and their social functioning. In LKM-based studies, peer reports would also clarify whether participants merely enjoy their feelings of warmth and compassion, or whether they extend into their visible behavior and treatment of others.

The comparison condition within this experiment was a wait-list control group. Although typical for initial tests of psychological interventions (e.g., Davidson et al., 2003; Teasdale et al., 2000), this experimental design can inadvertently create experimenter demand, expectation of improvement, or nonspecific effects related to delivery format. We address each possibility in turn: First, the explicit focus on love and kindness may have created demand to elevate self-reports of these emotions. However, our data indicated that (a) LKM was associated with changes in many positive emotions, not just the ones explicitly discussed; (b) guided meditations featured the terms “love” and “compassion” beginning in Week 1, yet the profile of changes in self-reported positive emotions (Figure 2) shows that positive emotions did not significantly increase until Week 3; and (c) self-reported positive emotions fit into a full set of mediational pathways (see Figure 3), which participants were unlikely to intuit and use to shape their responses.²⁰ Second, simply participating in a meditation workshop might create the

expectation of improvement. These expectations might give rise to positive emotions such as hope and confidence, in which case they are a legitimate, though nonspecific, effect of the intervention. However, we note that the increase in positive emotions evident in the current study did not appear until Week 3 (see Figure 2), whereas placebo responses typically emerge rapidly (Scott et al., 2007). Third, nonspecific effects of delivery format, including contact with a caring instructor, group interaction, and weekly work-release time might also have contributed to increases in positive emotions. However, we found that when controlling for group assignment, time spent meditating still predicted increases in positive emotions. Even among participants who received the nonspecific benefits, meditation – the proposed core of the intervention – predicted positive change. We also examined whether participants reported a boost in positive emotions on the day of workshop sessions or the day after, comparing waitlist participants, LKM participants who did not attend that week's workshop, and LKM participants who did. The results did not differ from chance, suggesting that the higher positive emotions reported by LKM participants reflected a continuous upward trend, rather than a temporary response to the one day each week that involved time off of work, social support, and contact with the instructor. Overall, patterns in our data argue against spurious results arising from our use of a waitlist control group. Now that LKM has shown efficacy in increasing positive emotions and building personal resources, future work will be able to directly control for nonspecific effects and expectancies by comparing it to other meditative or self-change techniques.

Another alternative explanation for our findings is that whatever positive emotions our participants were feeling at T2 cast a rosy glow over all their self-reports and artificially produced the appearance of growth in resources. The reports from the Day Reconstruction Method provided an estimate of positive emotions for the day the T2 measures were completed. We regressed that day's positive emotions on aggregate positive emotions over the 9 weeks of daily reports ($R=.69$) and created a residual term, representing positive emotions that were present at T2 and could have cast a rosy glow over responses, but that were not present during the time resources were being built. We tested the residual variable in our mediational models, in place of change in positive emotions over time. It did not predict change in any of the resources. This suggests that

positive emotions experienced over time exerted a gradual, cumulative effect, rather than simply biasing responding at the moment participants were responding to T2 questionnaires.

A final puzzling finding is the initially lower levels of positive emotions in the meditation group. We speculate that this difference reflects the difficulties of initiating any self-change effort, even if those changes are self-chosen. Consider the parallel to the perennial New Year's resolution to lose weight to be healthier. At the peak of a person's motivation to shed pounds, he might join a local gym. Then, days later, he realizes that now he actually has to go and exercise. Starting a meditation practice may similarly involve a period of doing something unfamiliar, difficult, and draining without immediate rewards. Contemplative traditions have articulated five obstacles facing novice meditators, including craving, anger, boredom, restlessness, and doubt (Kabat-Zinn, 2005). These obstacles are thought to result from increased awareness of challenging inner states that may be commonly present, yet not noticed during one's typical busy and outward-directed focus. Indeed, nearly all attrition occurred during the initial weeks, when participants may not have been sufficiently "in shape" to feel competent at meditation or derive benefits from it. Yet if people can endure these first difficult weeks, meditation becomes more effective and positive emotions begin to accumulate and compound, changing people for the better.

Conclusion

One of the most deflating concepts facing positive psychology is the hedonic treadmill (Brickman, Coates, & Janoff-Bulman, 1978): Even though positive and negative events (e.g., winning the lottery, becoming paraplegic) temporarily alter levels of happiness, people quickly adapt to them and return to a fixed emotional set-point. The hedonic treadmill, as classically stated, implies that all efforts to improve happiness are doomed to failure. However, more detailed research (Diener et al., 2006) indicates that adaptation is not necessarily inevitable, and that it may be strongest for negative affect and weaker for positive affect and life satisfaction. The evidence reported here reveals that one way to outpace the hedonic treadmill is to begin a practice of loving-kindness meditation. Participants who invested several hours each week practicing this form of meditation

enhanced a wide range of positive emotions in a wide range of everyday life situations, especially when interacting with others. This mind-training practice produced positive emotions during practice, later that day, and even into subsequent days. We find these data especially promising. LKM appears to be one positive emotion induction that keeps on giving, long after the identifiable “event” of meditation practice.

Certainly, all positive emotions feel good, and feelings like love, joy, and contentment can be valuable in and of themselves. Yet the broaden-and-build theory posits that natural selection sculpted our ancestors’ positive emotions to be useful in more far-reaching ways as well. When our ancestors experienced positive emotions in safe and opportune situations, they would have accrued personal resources that subsequently gave them an edge in circumstances that impinged on their probability to survive and reproduce. Such gains in consequential personal resources were presumably accounted for by the broadened attention and thinking that positive emotions momentarily produced. Whereas a now ample set of laboratory experiments has tested and confirmed that positive emotions broaden people’s attention and thinking (e.g., Bolte, Goschkey, & Kuhl, 2003; Fredrickson & Branigan, 2005; Isen & Daubman, 1984; Rowe et al., 2007; Wadlinger & Isaacowitz, 2006), to our knowledge, this is the first experiment undertaken to test whether positive emotions build a range of consequential personal resources. The evidence provides clear support for the build hypothesis. By random assignment, one group of individuals began a meditation practice that increased their daily experiences of positive emotions. The more their positive emotions increased, the more gains in personal resources they evidenced. In turn, the more gains in personal resources they showed, the more they enjoyed increases in life satisfaction and decreases in depressive symptoms. We speculate that mindful attention to one’s current circumstances, self-acceptance, positive relations with others, and fewer illness symptoms (among other resources) would have been as valuable to our hunter-gatherer ancestors as they are to modern-day humans. Just as the broaden-and-build theory predicts, then, when people open their hearts to positive emotions they seed their own growth in ways that transform them for the better. As such, investing time and effort to cultivate more day-to-day experiences of positive emotions not only makes modern-day humans feel better, but it also sculpts their future

selves, as they become more resourceful, with better odds of success, survival, and overall well-being.

Appendices

Appendix 1: Tables

Table 4-1: Participant Demographics

Participant characteristics	Intent-to-Treat	Per-Protocol	Completers*
N	195	175	139
% Providing demographic information**	88.2%	93.9%	100.0%
% In meditation group	49.2%	43.4%	48.2%
% Female	59.8%	60.8%	65.5%
Age***	41	41	41
Education level***	Bachelor's degree	Bachelor's degree	Bachelor's degree
% Married	60.5%	59.8%	57.7%
Income***	>\$85,000	>\$85,000	>\$85,000
Depression**** (CES-D, full scale)	Baseline: 16.1 Post-Test 12.7	Baseline: 15.4 Post-Test 12.4	Baseline: 15.9 Post-Test 12.8
Life Satisfaction (SWLS)	Baseline: 4.12 Post-Test: 4.42	Baseline: 4.17 Post-Test: 4.46	Baseline: 4.10 Post-Test: 4.50
% White non-Hispanic	73.7%	73.3%	72.6%

* For exclusion criteria, see Methods section.

**Twenty-three participants declined to provide demographic information. Median and percentage calculations use only participants who provided data. Group assignment data was available for all participants.

*** Value reported is median.

**** To facilitate comparison to previously published work, values reported here represent scores based on the full CES-D scale, including both positively- and negatively-worded items. In subsequent analyses we omit the positively-worded items to minimize conceptual overlap with positive emotions.

Table 4-2: Loving-kindness Meditation and Specific Positive Emotions

Emotion	Experimental Condition			Week			Exp. Cond * Week		
	Estimate	SE	<i>p</i> -value	Estimate	SE	<i>p</i> -value	Estimate	SE	<i>p</i> -value
Amusement	-0.112	0.125	0.37	-0.012	0.009	0.20	0.040	0.014	0.003
Awe	-0.163	0.123	0.19	-0.0003	0.010	0.97	0.046	0.014	0.001
Contentment	0.036	0.120	0.76	-0.002	0.011	0.83	0.043	0.016	0.006
Gratitude	-0.010	0.141	0.94	0.0006	0.010	0.96	0.035	0.014	0.01
Hope	-0.139	0.127	0.28	-0.006	0.010	0.55	0.044	0.015	0.003
Interest	-0.421	0.136	0.002	-0.022	0.011	0.05	0.060	0.016	0.0002
Joy	0.0005	0.124	0.997	-0.013	0.010	0.21	0.037	0.014	0.01
Love	0.060	0.134	0.66	-0.009	0.010	0.33	0.036	0.014	0.009
Pride	-0.249	0.1369	0.07	-0.016	0.010	0.15	0.048	0.014	0.0008

Table 4-3: Positive Emotions, Meditation, and Time

Predictor	Estimate	SE	<i>p</i> -value
Intercept	2.717	0.075	<0.0001
Experimental condition	-0.124	0.110	0.26
Week	-0.010	0.008	0.20
Experimental condition * week	0.026	0.013	0.04
Time spent meditating – baseline	0.167	0.086	0.05
Time spent meditating – week 1	0.006	0.039	0.88
Time spent meditating – week 2	0.083	0.032	0.01
Time spent meditating – week 3	0.068	0.031	0.03
Time spent meditating – week 4	0.045	0.026	0.08
Time spent meditating – week 5	0.093	0.029	0.002
Time spent meditating – week 6	0.107	0.028	0.0001
Time spent meditating – week 7	0.144	0.029	<0.0001
Time spent meditating – week 8	0.130	0.048	0.007

Table 4-4: Resource Models with Life Satisfaction as Outcome

Resource tested	RMSEA (90% CI) <i>df</i> = 137	Chi- square	Pathway A	Pathway B	Pathway C	Pathway D
Cognitive Resources						
Mindfulness*	0.068 (0.051 – 0.083)	224.58 (P = 0.00)	-0.10 (z = -1.17)	0.20 (z = 2.04)	0.25 (z = 3.04)	0.12 (z = 1.24)
Agency thinking	0.074 (0.058 – 0.089)	241.15 (P = 0.00)	-0.03 (z = -0.38)	0.17 (z = 1.74)	0.36 (z = 4.46)	0.11 (z = 1.15)
Pathways thinking*	0.071 (0.056 – 0.087)	234.24 (P = 0.00)	-0.03 (z = -0.32)	0.22 (z = 2.25)	0.24 (z = 2.94)	0.12 (z = 1.19)
Savoring the Past	0.070 (0.053 – 0.085)	228.99 (P = 0.00)	0.05 (z = 0.51)	0.15 (z = 1.52)	0.18 (z = 2.17)	0.15 (z = 1.49)
Savoring the Present	0.071 (0.055 - 0.086)	232.88 (P = 0.00)	-0.13 (z = -1.45)	0.18 (z = 1.87)	0.30 (z = 3.72)	0.12 (z = 1.19)
Savoring the Future*	0.072 (.056 - 0.087)	235.94 (P = 0.00)	-0.06 (z = -0.74)	0.20 (z = 2.08)	0.28 (z = 3.38)	0.12 (z = 1.22)
Psychological Resources						
Optimism	0.075 (0.059 - 0.090)	243.70 (P = 0.00)	-0.06 (z = -0.70)	0.04 (z = 0.38)	0.26 (z = 3.10)	0.16 (z = 1.64)
Resilience	0.075 (0.059 - 0.090)	243.13 (P = 0.00)	-0.07 (z = -0.83)	0.25 (z = 2.53)	0.14 (z = 1.65)	0.14 (z = 1.42)
Personal Growth	0.073 (0.057 - 0.088)	237.88 (P = 0.00)	0.00 (z = --0.05)	0.14 (z = 1.42)	0.30 (z = 3.75)	0.13 (z = 1.37)
Environmental Mastery*	0.070 (0.054 - 0.086)	231.02 (P = 0.00)	0.06 (z = 0.66)	0.33 (z = 3.37)	0.38 (z = 4.86)	0.06 (z = 0.64)
Autonomy	0.075 (0.059 - 0.090)	243.87 (P = 0.00)	-0.08 (z = -0.94)	-0.01 (z = -0.07)	0.18 (z = 2.15)	0.17 (z = 1.72)
Self- Acceptance*	0.072 (0.056 - 0.088)	236.21 (P = 0.00)	-0.08 (z = -0.92)	0.27 (z = 2.77)	0.42 (z = 5.45)	0.05 (z = 0.58)

Resource tested	RMSEA (90% CI) <i>df</i> = 137	Chi- square	Pathway A	Pathway B	Pathway C	Pathway D
Purpose in Life*	0.076 (0.060 - 0.091)	245.55 (P = 0.00)	0.11 (<i>z</i> = 1.30)	0.29 (<i>z</i> = 2.95)	0.40 (<i>z</i> = 5.09)	0.07 (<i>z</i> = 0.71)
Social Resources						
Social Support Given	0.071 (0.055 - 0.087)	233.63 (P = 0.00)	0.16 (<i>z</i> = 1.82)	0.15 (<i>z</i> = 1.49)	0.15 (<i>z</i> = 1.77)	0.15 (<i>z</i> = 1.57)
Social Support Received*	0.072 (0.056 - 0.087)	235.84 (P = 0.00)	-0.09 (<i>z</i> = -0.98)	0.25 (<i>z</i> = 2.54)	0.21 (<i>z</i> = 2.54)	0.13 (<i>z</i> = 1.28)
Positive Relations with Others*	0.071 (0.055 - 0.086)	232.06 (P = 0.00)	-0.01 (<i>z</i> = -0.10)	0.29 (<i>z</i> = 2.97)	0.36 (<i>z</i> = 4.54)	0.08 (<i>z</i> = 0.79)
Physical Resources						
Illness Symptoms*	0.071 (0.055 - 0.086)	232.82 (P = 0.00)	-0.09 (<i>z</i> = -1.01)	-0.24 (<i>z</i> = -2.47)	-0.20 (<i>z</i> = -2.37)	0.13 (<i>z</i> = 1.27)
Duration of sleep	0.072 (0.057 - 0.088)	236.80 (P = 0.00)	-0.11 (<i>z</i> = -1.22)	-0.14 (<i>z</i> = -1.35)	0.01 (<i>z</i> = 0.14)	0.18 (<i>z</i> = 1.78)

Note. Asterices indicate that the model was a good fit for the data, and that the predicted build hypothesis pathways (pathways B and C) were significant. Parameter estimates are reported in standardized units. Pathway D was tested in a separate set of models, for which the RMSEA values and parameter estimates for pathways A, B, and C were slightly different than those listed above. For purposes of brevity, we have not presented these slightly different values when pathway D was incorporated in the model.

Table 4-5: Variance each resource explains for life satisfaction and depression

Resource	Life Satisfaction Models		Depression Models (Negative Symptoms Only)	
	Change in Resource R ²	Change in Life satisfaction R ²	Change in Resource R ²	Change in Depression R ²
Cognitive Resources				
Mindfulness	0.06	0.06	0.06	0.22
Pathways thinking	0.05	0.06	0.05	0.15
Savoring the Future	0.05	0.08	0.05	0.16
Psychological Resources				
Environmental Mastery	0.10	0.15	0.10	0.25
Self-Acceptance	0.09	0.18	0.09	0.24
Purpose in Life	0.08	0.16	0.08	0.29
Social Resources				
Social Support Received	0.08	0.04	0.08	0.15
Positive Relations with Others	0.08	0.13	0.09	0.24
Physical Resources				
Illness Symptoms	0.06	0.04	0.05	0.18

Note. The variance estimates reported above for the life satisfaction models is for models that include pathways A, B, and C, but not D, because this pathway was not significant for any of the life satisfaction models tested. The variance reported above for the depression models is for models that include pathways A, B, C, and D, because pathway D was significant for each of the depression models tested. Direct effects from experimental condition and time spent meditating to resource and life satisfaction/depression were not included in any of the models.

Table 4-6: Resource Models with Depressive Symptoms as Outcome

Resource tested	RMSEA (90% CI) <i>df</i> = 136	Chi- square	Pathway A	Pathway B	Pathway C	Pathway D
Cognitive Resources						
Mindfulness*	0.070 (0.053 - 0.085)	227.53 (P = 0.00)	-0.10 (z = -1.18)	0.20 (z = 2.06)	-0.28 (z = -3.88)	-0.31 (z = -3.06)
Agency thinking	0.074 (0.059 - 0.090)	240.88 (P = 0.00)	-0.03 (z = -0.39)	0.18 (z = 1.77)	-0.27 (z = -3.41)	-0.30 (z = -3.25)
Paths thinking*	0.072 (0.056 - 0.087)	233.37 (P = 0.00)	-0.03 (z = -0.31)	0.22 (z = 2.23)	-0.17 (z = -2.02)	-0.31 (z = -3.22)
Savoring the Past	0.069 (0.053 - 0.085)	226.33 (P = 0.00)	0.05 (z = 0.52)	0.16 (z = 1.59)	-0.23 (z = -2.81)	-0.32 (z = -3.39)
Savoring the Present	0.073 (0.057 - 0.088)	237.09 (P = 0.00)	-0.13 (z = -1.46)	0.19 (z = 1.89)	-0.42 (z = -5.62)	-0.27 (z = -3.04)
Savoring the Future*	0.072 (0.056 - 0.087)	233.93 (P = 0.00)	-0.07 (z = -0.75)	0.21 (z = 2.15)	-0.19 (z = -2.37)	-0.31 (z = -3.24)
Psychological Resources						
Optimism	0.075 (0.059 - 0.090)	241.11 (P = 0.00)	-0.06 (z = -0.70)	0.04 (z = 0.40)	-0.10 (z = -1.27)	-0.35 (z = -3.63)
Resilience	0.075 (0.059 - 0.090)	242.45 (P = 0.00)	-0.07 (z = -0.83)	0.25 (z = 2.53)	-0.02 (z = -0.25)	-0.35 (z = -3.45)
Personal Growth	0.075 (0.059 - 0.090)	241.56 (P = 0.00)	0.00 (z = - 0.04)	0.14 (z = 1.45)	-0.35 (z = -4.58)	-0.30 (z = -3.35)
Environmental Mastery*	0.071 (0.056 - 0.087)	232.54 (P = 0.00)	0.06 (z = 0.69)	0.33 (z = 3.39)	-0.37 (z = -4.61)	-0.24 (z = -2.57)
Autonomy	0.072 (0.057 - 0.087)	243.07 (P = 0.00)	-0.08 (z = -0.94)	-0.01 (z = 0.07)	-0.08 (z = -0.98)	-0.35 (z = -3.66)
Self-Acceptance*	0.073 (0.058 - 0.089)	237.81 (P = 0.00)	-0.08 (z = -0.93)	0.27 (z = 2.78)	-0.35 (z = -4.36)	-0.25 (z = -2.71)

Resource tested	RMSEA (90% CI) <i>df</i> = 136	Chi- square	Pathway A	Pathway B	Pathway C	Pathway D
Purpose in Life*	0.076 (0.061 - 0.091)	246.05 (P = 0.00)	0.12 (<i>z</i> = 1.33)	0.29 (<i>z</i> = 2.97)	-0.43 (<i>z</i> = -5.65)	-0.24 (<i>z</i> = -2.66)
Social Resources						
Social Support Given	0.071 (0.055 - 0.087)	231.87 (P = 0.00)	0.16 (<i>z</i> = 1.81)	0.16 (<i>z</i> = 1.59)	-0.06 (<i>z</i> = -0.69)	-0.35 (<i>z</i> = -3.58)
Social Support Received	0.072 (0.056 - 0.088)	234.70 (P = 0.00)	-0.08 (<i>z</i> = -0.98)	0.25 (<i>z</i> = 2.60)	-0.15 (<i>z</i> = -1.80)	-0.32 (<i>z</i> = -3.21)
Positive Relations with Others*	0.071 (0.055 - 0.086)	230.43 (P = 0.00)	-0.01 (<i>z</i> = -0.08)	0.30 (<i>z</i> = 3.02)	-0.35 (<i>z</i> = -4.33)	-0.25 (<i>z</i> = -2.71)
Physical Resources						
Illness Symptoms*	0.072 (0.056 - 0.088)	234.74 (P = 0.00)	-0.09 (<i>z</i> = -1.02)	-0.24 (<i>z</i> = -2.40)	0.26 (<i>z</i> = 3.17)	-0.29 (<i>z</i> = -3.09)
Duration of sleep	0.073 (0.057 - 0.088)	235.69 (P = 0.00)	-0.10 (<i>z</i> = -1.11)	-0.15 (<i>z</i> = -1.48)	-0.13 (<i>z</i> = -1.50)	-0.37 (<i>z</i> = -3.87)

Note. Asterices indicate that the model was a good fit for the data, and that all predicted build hypothesis pathways (pathways B and C) were significant. Parameter estimates are reported in standardized units.

Appendix 2: Samples from Guided Meditation

These excerpts from the third guided meditation demonstrate the physical, attentional, and relational content of LKM practice. Ellipses indicate omitted text.

"We will now do a loving-kindness meditation, a guided meditation intended to help us stretch open our heart a bit more, to be more accepting of ourselves and others, to feel more love and compassion.

Let your eyes close gently. Bring your attention to the breath, gently breathing in and gently breathing out. Let your body be soft and your mind be soft. Now bring your attention to the area of your heart. See if you can feel your breath and your heart together as if you could breathe into the heart and out...

May you receive all the experiences of the body, all feeling, all moods and thoughts with the spirit of loving-kindness. May you meet any challenges in life with wisdom, courage and compassion. May the burden of difficulties and challenges disappear and you feel light and free, peaceful and happy. May you be joyful. May you be healthy and prosperous. May you have all good conditions in your life.

Now, think of someone you love very much. Bring them into your heart. Share the feeling... Feel compassion for their sorrow and struggles. How much you love them and would help them. May this one meet all challenges with wisdom, courage and compassion. May they be filled with loving-kindness and peace.

Let another person or two into your heart. Let it grow bigger... Let in all your friends and family, the people you love. May they all come into your heart. May they all be happy. May they be filled with loving-kindness. See them meeting all challenges with wisdom, compassion and courage...

And as you sit here, filled with wishes for your own happiness and freedom from difficulties and those of others, know that you can generate this wish for yourself or others at any time. The feelings of caring are available to you throughout your day."

Chapter 5

Conclusion: The Future of Broaden-and-Build

The past ten years of work have strengthened the broaden-and-build theory, in many ways culminating in the papers presented here. We now have precision laboratory research, theory-based predictions with high specificity, and practical support from a real-life intervention. Our work on positive emotions and growth is now poised for a period of adaptive radiation, moving into new niches all over the psychological world. I will describe the next steps for progress on the broaden-and-build theory, followed by contributions that the theory can make to other areas of research.

Improving the Core Theory

In this dissertation, I have tried to emphasize our basic approach to research. Each study has sought not only to test a single hypothesis or extend a finding into a new area, but also to provide feedback into our core theory about the broaden effect, the build effect, and the relationship between the two. In chapter 2 I tested a hypothesis about how emotions would affect specific types of tasks, but also tried to establish a new framework for looking at the broaden effect – seeing it as a widely variable set of responses contingent on the environment, rather than a domain-general and relatively consistent set of responses. In chapter 3 I was able to observe the build effect in context and strengthen the link between positive emotions and resources, but I also examined specific predictions about the interplay between positive emotions, negative emotions, and changes in emotions over time. In chapter 4, we found experimental evidence for the build effect, but also demonstrated a clear progression from daily positive emotions to resources for living well, and finally to important and well-established life outcomes. We were also able to answer important questions about how our intervention exerted its effects, finding that it increased a wide range of positive emotions throughout participants' lives and not just at a single point in each day, and that these effects were especially strong in social situations.

In this section I describe potential next steps for these lines of work, again focusing both on new effects to be demonstrated and new refinements to be made to the underlying theory.

Longitudinal and intervention research

I have brought up numerous unanswered questions about what precisely occurs in broadened states and how positive emotions can be used to build resources. However, I have also described a successful intervention based on the principles we understand right now! The meditation study gives us license to be audacious in seeking applications for our work. Whatever changes the basic theory may undergo in the future, we are already able to get clear real-world results. The most pressing improvements to our intervention work will be more objective outcome assessments, stronger comparison conditions (either a convincing placebo, or a similar but non-emotive form of meditation), and discovering new ways to induce lasting positive emotion. These do not need to wait on further theoretical support for the basic build hypothesis.

The two longitudinal studies also demonstrate that work on the build hypothesis need not be constrained by a strict basic / applied dichotomy. By measuring multiple discrete emotions and emotion-like positive states and gathering fine-grained data on emotions and behavior over time, we were able to maintain precision and test multi-step causal logic at the same time as we observed meaningful, situated effects of positive emotions outside the laboratory. Given the gradual, cumulative nature of the build effect, this strategy may prove necessary for studying many aspects of positive emotions. Both longitudinal studies demonstrated important exceptions to the "bad is stronger than good" truism, but these exceptions only appeared because we were able to look at long-term distal outcomes of everyday emotions, instead of immediate cognitive or physiological effects. Many proposed mechanisms for the benefits of positive emotions, such as improved stress regulation (Fredrickson & Levenson, 1998; Fredrickson, Mancuso, Branigan, & Tugade, 2000; Tugade & Fredrickson, 2004) and imaginative thinking (Isen & Daubman, 1984; Isen, Johnson, Mertz, & Robinson, 1985; Fredrickson & Branigan, 2005), also may not be of high importance within a given moment, and longitudinal monitoring will be required to demonstrate either that they mediate the beneficial effects of positive emotions, or that they are actually beneficial to begin with. Even studies of more reductive processes, such as learning on a given task or relationship formation with a single individual, may require more than one assessment occasion to capture the process of gradual change.

The trend towards merging process measurement and concrete outcomes will only become stronger as we enhance our methodological scope. Our initial intervention study, as an early test of both the build hypothesis and of the potential of loving-kindness meditation as an emotion induction, was limited to self-report measures. We have already performed a one-year followup that added informant reports of participants' relationship quality and expressed emotions, and a second intervention study that added measures of physiological and hormonal response to meditation.

A final challenge will be to demonstrate definitively that positive emotions are contributing to long-term resources, and not affecting outcomes in some other way. As an example, consider the improvements to positive relationships with others that were seen among those who meditated and those who experienced increased positive emotions. It would be plausible to suggest that these improved relationships were caused by greater social inclusiveness, enhanced self-other overlap, or increased generosity (Vaugh & Fredrickson, 2006; Johnson, 2005; Otake, Shimai, Tanaka-Matsumi, Otsui, & Fredrickson). However, as with much of the research on positive emotions and cognitive performance, the demonstration of improved relationships while in positive emotional states does not speak directly to whether positive emotions affect long-term relationship strength. In this sense, the extraordinarily broad and multi-contextual effects of the meditation induction pose a problem: Because participants appeared to be happier *during* social interactions, it is difficult to make a case that they were building resources that would persist for any length of time when they were not happy.

One potential solution is to conduct lengthy follow-ups that will track individuals through both periods of both increasing and decreasing positive emotion. A follow-up to the meditation study attempted to do this, but was stymied because participants who showed gains in resources and positive emotions tended to maintain both in tandem (Cohn, 2007). This is not unexpected, given that resources are hypothesized to be a source as well as a consequence of positive emotions (Cohn & Fredrickson, in press; Fredrickson & Joiner, 2002; Tugade & Fredrickson, 2004), but it means that a larger sample would be needed to analyze the experience of individuals who continue meditating without clear benefits, or vice versa. Another option is to search for discrete episodes of dissociation, assessing whether individuals who are higher on positive

emotion show good outcomes even in specific situations in which they are no longer unusually positive. A small amount of work using this method has supported the durable-resource hypothesis (e.g., Tugade & Fredrickson, 2004; Losada & Heaphy, 2004), showing both improved objective outcomes and more rapid returns to high positive emotion. However, future work would do well to examine closely the precise way in which individuals recover from negative circumstances, to ensure that the proposed resource really is at work, and that use of the resource precedes the return of positive emotion (or that improved outcomes can occur even if they don't make the individual feel better). Work proposed by Cohn and Lyubomirsky (2007) may shed light on these questions, both through behavioral challenges and through observing the effects of a relatively brief positive emotion intervention in individuals at risk for relapse into depression – the question would be whether, within a given degree of low positive and high negative emotion, having received the intervention in the past predicts a reduced risk of a new depressive episode.

A more methodological option is to determine whether our measures of resources actually do measure lasting resources, as intended, or whether they may also measure temporary changes in behavior and outcomes, as proposed above. I am currently conducting research that measures self-reports of resources following a simple, one-time emotion induction, as well as examining lay theories about relationships between emotions and a variety of resources and outcomes. If an emotion induction can cause participants to rate themselves as happier, but not more resilient, healthy, or free of depression, and so forth, then we would have better reason to trust our measures. There was evidence of this from an analysis in chapter 4, in which we established that positive emotions over the eight weeks of the study predicted outcomes far better than positive emotions on the day of the post-intervention assessment, but more data with clearer manipulations of emotion are needed. This kind of research is also an inexpensive way to develop methods that can help participants disregard input from transient emotions while reporting on resources and outcomes (e.g., describing the measures as important, following Aspinwall, 1998, or alerting participants to their emotions, as in Schwarz & Clore, 1983).

Research on basic processes

At the same time as work on the build hypothesis is prepared to become more ambitious and applied, work on the broaden hypothesis is prepared to become more precise and predictive. Initial work on broadening demonstrated that it is linked to positive emotions (reviewed in Cohn & Fredrickson, in press), and that broadening appears to occur synchronously across many domains (Johnson, 2005; Fredrickson & Branigan, 2005; Rowe, Hirsh, & Anderson, 2007). There has also been speculation about mechanisms underlying global broadening processes (Ashby, Isen, & Turken, 1999; Dreisbach & Goschke, 2004; Isen, 2000), but limited hard evidence. The divided-attention study presented here is an example of research that can emerge once the phenomenon of broadening is taken for granted, and new questions emerge about how broadening will look in specific domains and contexts. Because of the disputes that have arisen among researchers using different lab tasks and different conceptualizations of how mood affects cognition, it will be important for studies to move beyond finding a single detrimental or beneficial outcome of positive affect and trying to generalize it to a wide range of tasks and situations. This study used a task complex enough to require multiple modes of cognitive processing, offering the potential to discover not just benefits or risks of positive affect, but also moderators that will allow us to determine what specifically creates these effects, and how they can be manipulated. Although the results reported here were disappointingly nonspecific, future studies will be able to improve on the experimental paradigm and hone the precision of our measures of strategic and involuntary attention. We can then begin to discover very specific aspects of a task that evoke particular forms of broadening and particular outcomes. With many such studies, using different tasks with different cognitive demands, we will be able to piece together a clearer understanding of how broadening functions in the real world.

A second innovation in smaller-scale studies will be to distinguish between broaden phenomena and build phenomena and to capture their potentially separable effects. This is similar to the need for intervention studies that discriminate between beneficial effects of broadened states and durable resources that last beyond a period of enhanced positive emotion. These studies will need to look for changes that develop over time, possibly over multiple lab sessions, and that are maintained even after induced positive emotions have worn off.

Finally, research in the broaden-and-build tradition has done little to look at distinctions between emotions. The studies that have compared the effects of different emotional states (e.g., Fredrickson & Branigan, 2005; Fredrickson et al., 2000) did so in order to demonstrate a *lack* of difference in terms of broadening potential. This has been tenable first because we make the claim that broadening is a state that underlies (and perhaps even defines) all positive emotions, and second because inductions like those used in studies 1 and 3 often increase positive emotions across the board. However, there are important reasons to study specific emotions more closely. Research has demonstrated specific thought-action tendencies associated with gratitude (McCullough, Kirkpatrick, Emmons, & Larson, 2001), interest (Silvia, 2000, 2005), awe (Keltner, 2003), joy or playfulness (Panksepp, 2005), and elevation (moral admiration; Haidt, 2003), among others. Ironically, less can be said about simpler emotions such as amusement and contentment, because they are more often used as "generic" positive emotions rather than distinct objects of study. This heterogeneity may help explain some of the unpredictability associated with positive emotions – if different studies use amusing induction films that are subtly biased towards evoking joy vs. contentment vs. smugness, then the type of broadened behavior evoked may also differ. On the other hand, if techniques that reliably evoke a single emotion in isolation can be developed, then it will become possible to create specific, minimalist interventions. Rather than targeting a wide and scattered range of life outcomes, there could be pride-based interventions targeted specifically at work performance, joy-based interventions targeted at creativity or physical activity, and contentment-based interventions targeted at increasing mindful awareness or relationship satisfaction.

The big picture

A third set of opportunities will grow out of enhanced knowledge of how positive emotions broaden and of what they build, and allow us to link the two. Currently the links between broadening and building are largely speculative, with no studies documenting a step-by-step link between broadened cognition or behavior and the small gains that presumably accumulate to form long-term resources. An example of this kind of meso-process research would be observing enhanced self-other overlap, which is a known correlate of positive emotion, lead to social behaviors like socially-appropriate personal

disclosure, behavioral synchrony, or active-constructive responding, which are known predictors of improved relationships. Ideally this process would then be observed over time, to demonstrate that these behaviors typically do occur when the individual is in a positive mood, and that repeating them over time does produce a more supportive or reliable relationship. This type of research is probably the most demanding and cumbersome: The observations must be both detailed and repeated over time, and the use of diaries, experience-sampling, and other *in situ* measurement methods will require new innovations. To date, all measures of broadening, regardless of domain, either require controlled lab conditions (typically implicit methods like those in Johnson, 2005; Wadlinger & Isaacowitz, in press) or are not amenable to extensive repeated administration (e.g., insight problems like those in Isen, Daubman, & Nowicki, 1987; Rowe et al., .2007). Measures of momentary behavioral repertoires (Fredrickson & Branigan, 2005) and associative breadth (Isen, 2007) present possibilities; as long as participants are unaware that they "should" be coming up with longer lists or more unusual associations, these measures may be slow to show practice effects. The search for linguistic markers of broadening, while so far inconclusive (Cohn et al., 2004), may also show promise.

As this third area of research suggests, the ultimate test of the broaden-and-build theory would be an intensively detailed study that captures the entire pathway from positive emotions, to broadening, to behaviors linked to broadening, to short-term cumulative outcomes, to measurable improvements in resources. The work in papers 2 and 3 has extended the chain even farther, requiring this ultimate study to also connect resources to more general life outcomes such as life satisfaction and reduced symptoms of depression. The ultimate study would also require at lengthy followup, to test the assertion that resources are durable and remain available even if positive emotions drop.

Fortunately, we are not required to wait for the ultimate study, or to make it the goal of all future efforts. Future changes to the broaden-and-build theory will not negate the insights it has produced into the structure and function of positive emotions, or the benefits it has brought to people who have participated in our interventions. The broaden-and-build theory is now strong enough not just to stand on its own, but also to give support to the work of others.

Broadening Scope, Building Connections

Work on positive emotions is flourishing, giving rise to interventions for people with clinical depression, non-clinical low mood, new HIV diagnoses, and lifelong chronic illness; to both formal interventions and popular advice for youths and adults who are healthy, but want to increase their resilience or levels of happiness; and to new interpretations of world economic and social trends, intended to influence national economic and public health policy; as well as to increasingly specific basic emotions research that forges connections with health, naturalistic behavior, cognition, neurology, psychophysiology, and psychoneuroimmunology.²¹ For the most reductive work, the broaden-and-build theory provides a broader interpretive framework that can help reveal the functional significance of findings. For more applied work, the theory offers both a set of underlying mechanisms (the broaden effect), and a long-term justification for the work (the build hypothesis). The following are a few examples of places in which the findings of our lab can be applied to the work of others.

The broaden model provides a functional framework capable of tying together diverse low-level physiological effects of positive emotion, including changes in psychophysiology (Fredrickson & Levenson, 1998; Tugade & Fredrickson, 2004), immune function (Kiecolt-Glaser, McGuire, Robles, & Glaser, 2002; Markland, Pressman, & Cohen, 2006), and patterns of neural activation (Davidson, 2004; Davidson et al., 2003; Waugh, 2006). It allows researchers to think functionally about their findings, seeing them as manifestations of the body and mind releasing its focus on immediate problems and turning towards longer timescales or the larger environment. This outlook can help guide research on the processes linking these low-level effects to higher-level outcomes, such as health behavior (Scheier & Carver, 2003; Shmueli & Moskowitz, 2008; de Ven, Kippax, Knox, Prestage, & Crawford, 1999) and long-term mental and physical health outcomes (e.g., Cohen & Pressman, 2006; Danner, Snowdon, & Friesen, 2001; Fredrickson, Cohn, Coffey, Pek, & Finkel, 2007; Moskowitz, Folkman, & Acree, 2003). Research on the broaden effect can also contribute by proposing psychological processes that may mediate between physiological changes and behavioral outcomes, such as increased openness to new information and reduced defensiveness.

On the other end of the spectrum, Interventions to enhance positive emotions predate

the broaden-and-build theory, but chapter 4 was one of the first studies to examine induced positive emotions as part of a larger process of growth (preceded, to my knowledge, only by Emmons & McCullough, 2003 and King, 2001). Our findings suggest that long-term benefits from positive emotions, such as those sought in interventions for depression (Cohn & Lyubomirsky, 2007; Seligman, Rashid, & Parks, 2006) and chronic disease (Brown, 2006; Emmons & McCullough, 2003; J. Moskowitz, personal communication, February 22, 2008), will arise if and only if participants build lasting resources, and that identifying and assessing these resources is crucial to understanding and improving the intervention.²² Even interventions that seek only to increase levels of positive emotions over time (e.g., Seligman, Steen, Park, & Peterson, 2005; Sheldon & Lyubomirsky, 2006; Tkach & Lyubomirsky, 2005) may rely on participants building skills for creating positive emotions, such as savoring, expressing gratitude, and giving or evoking social support. If these resources can be identified, then there is the potential to teach them explicitly at the same time as participants are undergoing a more general positive emotion intervention. There may even be synergy between the two goals, as participants' increased curiosity and broadened cognitive repertoires make them more open to learning and implementing new ideas.

The skills-and-resources perspective will also help when communicating knowledge about positive emotions to the public. Scientifically-based popular works on increasing happiness (e.g., Csikszentmihalyi, 1998; Lyubomirsky, 2007; Seligman, 2002) already frequently focus on the idea of building personally meaningful methods for creating positive emotions, but future works (such as the forthcoming book by Fredrickson, 2008) will be able to go further by explicitly discussing ways that positive emotions can help build resources of all kinds. Carrying description of positive emotions all the way to the build effect can also aid efforts to legitimize well-being and life satisfaction as social indicators that deserve a place along more "serious" measures like GDP and political ideology (Diener, 2000, 2005; Kahneman, Kruger, Schkade, Schwarz, & Stone, 2005; Gallup Corporation, 2007). There is copious work supporting the idea that positive emotions lead to concrete personal and social benefits (Lyubomirsky et al., 2005), but the broaden-and-build theory is unique in providing a model that specifies all the steps leading up to those benefits.

Concluding thoughts

I see this dissertation as broaden-and-build's coming of age story. The introduction discussed its maturation as a standalone scientific theory, as it has become able to generate predictions of both increasing specificity and increasing practical importance. The conclusion has discussed its maturation as part of the scientific discourse, reviewing ways it can contribute to other areas of work. I look forward to future research that will help sharpen our understanding of broadening phenomena and the ways they help build resources. But I also look forward to the theory's dissolution, as it makes its way into other concepts of emotions and other positive emotions research. Should the work we have done prove replicable and generative, and the theory not be supplanted by an even better one, then I hope to see the term "broaden and build" evolve beyond the intellectual property of a specific research group, and into a fundamental part of the landscape of emotions.

Afterword

I was not terribly happy in grad school. I despaired over my studies on happiness, felt trapped and unproductive while researching creative broadening, and spent lonely, isolated hours worrying about the loving-kindness study. But there were also the months when I devoured the research on cognitive costs and benefits of positive emotions, and played with ideas and models nonstop. I've been in the middle of writing literature reviews and watched, awed, as a mess of recondite findings suddenly fell together into something clear and elegant. I've had hundreds of conversations at conferences with people who are thoughtful and curious and love to share what they've learned, and I've never felt more at home. And so I might be the right person to write a dissertation on positive and negative emotions, and the ways they guide our lives.

The time I spent feeling awful gave me compassion and insight, and showed me that I have the strength to endure. But after a while you learn those lessons, and then unhappiness is just unhappiness. The times I've been happy and confident and curious have taught me things too, and they've kept me going and helped me go on to learn more. That's another form of broadening, I think: Suffering gives us insight into suffering. Joy gives us the whole world. It moves and sustains us as we learn and act and share with others.

My friend Elizabeth boils over when she hears people talk about antidepressant drugs in terms of medicating our cares away, or turning people into smiling zombies. She understands the same thing my research shows -- that feeling good is not the place where we stop after our work is done; it's the firm ground that allows us to pursue our work, rather than putting all our energy into getting through the day. There's plenty of research suggesting that people become happy when they're engaged, whether in an activity, in an idea or story, or in another person. Yes, there is such a thing as mindless hedonism -- but as with our meditation intervention, the most effective ways to become happier are often the most meaningful and valuable ones. They draw attention to a skill or a goal, not to the raw feeling. Making happiness the center of your attention is the equivalent of asking

yourself "are we there yet? are we there yet?", and it's about as effective at getting you to your destination.

Here's what I can say quickly: We should experience more positive emotions, and do more things that create them. Selectivity is important. Situations and constraints are important. But there aren't many people who simply have too much enjoyment, love, or interest in their lives and need to cut down.

That leaves a lot unsaid. We researchers are experts on what happens when people are happy, and we even know a fair bit about what general kinds of activities, pursued in what kinds of ways, can lead to happiness. But we're not the authority on what people need to do to become happier, or share their happiness with others. That's the work of artists, writers, and teachers; of urban planners, software designers, and librarians; of activists, advocates, and unions. It's the work you do when you have an interesting conversation with a friend, or give your partner a backrub at the end of a long day, or do a ridiculous trick that makes your kid giggle. These are basic, human actions, and even if they seem trivial, they're working bit by bit to make the world a better place.

Let's get to it.

Endnotes

¹ It is important to distinguish state positive emotions from an optimistic attitude, which may or may not be activated at any given time. However, an optimistic attitude would be associated with believing that a problem is under control and solutions are feasible and accessible, and these are the same beliefs that many theorists believe are activated by positive emotions (e.g., Carver, 2003, Schwarz, 2001)

² This level of granularity precludes using a transformation to reduce skew.

³ Because the positive induction affected both valence and arousal, we tested whether arousal might account for the effects of positive valence. Instead, arousal had a separate and opposite effect: a nonsignificant positive effect in the same-grid condition ($\beta=.22, p=.15$), and an interaction indicating a significantly stronger negative effect in the new-grid condition ($\beta=-.44, p=.004$).

⁴ Boundaries were drawn using a computerized implementation of Graham's hull-finding algorithm (de Berg, van Kreveld, Overmars, & Schwarzkopf, 2000).

⁵ Degrees of freedom vary between tests in this section because some indices of breadth could not be calculated unless the participant exceeded a minimum number of pairs.

⁶ Distance was the length of a straight line between a given point on a single pair and the same point on the next pair clicked. A correction was introduced for participants who read from left to right across a row, and then returned to the left end of the next row down (or wrapped around the grid in any other direction); this was treated as if the grid wrapped continuously from one row to the next, not as if they had traveled across its entire length.

⁷ Participants in both conditions completed the same number of rounds, meaning that those in the new-grid condition saw some grids that were not seen in the same-grid condition. However, the positive affect – condition interaction remained even when considering only the grids shared between both conditions.

⁸ Regardless of point value, all rounds of the task involved the same basic actions. Thus, although this interpretation of the data is speculative, it seems reasonable to conclude that the rounds with low horizontal-vertical correlations had some process counterbalancing the usual positive correlation between performance on the two target types. The alternative would be to propose that there was a basic performance dimension accounting for a large portion of variance in scores, which functioned in some rounds and not others.

⁹ Research has shown that strongest experiences are recalled accurately, while reports of averages are prone to a variety of biases even over short timescales (e.g., Fredrickson & Kahneman, 1993).

¹⁰ Participants were randomly assigned to one of three groups that did different daily journaling exercises. Group assignment had no effect on the measures in this article and so is not discussed further.

¹¹ Here and elsewhere, "change" refers to deviation from the value expected based on T_1 (i.e., the residual). For discussion of this use of "change," see Campbell & Kenny (1999).

¹² We followed Campbell and Kenny's (1999) recommendation to test the reversed model (T_2 predicting T_1). The indirect path coefficient also reversed ($\beta= -.03, p=.30$), consistent with a genuine effect and not a statistical artifact

¹³ The population was limited to employees with a Compuware e-mail address. This included executives, developers, and administrators, but not maintenance or custodial workers.

¹⁴ Participants who did not complete the T2 survey were contacted to request demographic information and to make the debriefing information available.

¹⁵ Sandra Finkel can be reached by electronic mail to smfinkel@med.umich.edu.

¹⁶ Sex of participants did not significantly predict positive emotions, the impact of experimental condition on positive emotions, or the impact of experimental condition on positive emotions over time. In addition, it was not related to the constructs we examine in subsequent models. For this reason, all reported analyses collapse across male and female participants and we do not consider the impact of participant sex further.

¹⁷ We explored whether we might reduce the number of models tested by considering the 18 different resources assessed as indicators of either one latent "resources" factor, or four latent factors distinguished by type of resource (e.g., cognitive, psychological, social, and physical resources). However, confirmatory and exploratory factor analyses suggested that no such reduction was warranted. The correlation matrix is available on request.

¹⁸ To address concerns about multicollinearity between experimental condition and time spent meditating, we tested a model in which number of hours of meditation practice was group mean-centered. The pattern of significant findings was identical, except that the impact of time spent meditating became nonsignificant for week 3 along with week 4. Table 3 reports the uncentered meditation time values for ease of interpretation.

¹⁹ Not surprisingly, experimental condition and time spent meditating were highly correlated, $r(139) = 0.71, p < .0001$. We thus examined them separately as predictors of emotions within the morning targeted by the DRM.

²⁰ Another way experimenter demand might have produced the results is if meditation participants gradually began to skip responding on days low in positive emotions, thus producing a rising mean. Meditation participants did respond less frequently over time (dropping from 5.2 to 4.6 responses per week) while waitlist participants did not ($F(7,132)=3.75, p=.002$). However, the week-by-week correlations between positive emotions and response frequency were very low in both groups. The sole significant correlation suggested that if anything, the highest positive emotions were reported by participants who responded most frequently (i.e., least selectively). Also recall that emotion measures were analyzed using per-participant means for each week, meaning that frequent responders did not disproportionately influence the data.

²¹ Citations below.

²² Positive emotions can be seen as directly affecting health by reducing chronic stress or otherwise sparing participants from the "demolish effect" that may be associated with extreme or prolonged negative emotions. We deal with this possibility by conceptualizing physical health as a resource: It can be built up, carried forward over time, and used to enable better outcomes in the future. This is especially true of capacities such as endurance, stress hormone regulation, and heart rate variability. Of course, this does not prevent health from also being treated as an outcome, especially in medical interventions.

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