# POSITIVE
# COMPUTING

## Technology for Wellbeing and Human Potential

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# Acknowledgments

## Sidebars

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**Jeremy Bailenson**, Stanford University. "Virtual Altruism"—chapter 11

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**Jane Burns**, Young and Well Cooperative Research Centre. "When Worlds Collide: The Power of Cooperation in Wellbeing Science"—chapter 3

**David R. Caruso**, Yale University and EI Skills Group. "How Emotional Intelligence Can Inform Positive Computing"—chapter 8

**Mihaly Csikszentmihalyi**, Claremont Graduate University. "Computers and the Condition of Human Plurality"—chapter 10

**Felicia Huppert**, University of Cambridge. "Measuring Subjective Wellbeing"—chapter 2

**Mary-Helen Immordino-Yang**, University of Southern California. "Developing Computer Interfaces That Inspire: Insights from Affective Neuroscience"—chapter 11

**Adele Krusche and J. Mark G. Williams**, University of Oxford. "Mindfulness Online"—chapter 9

**Jane McGonigal**, Institute for the Future. "Let the Positive Games Begin"—chapter 6

**Jonathan Nicholas**, Inspire Foundation. "Inspiring Projects—Opportunities for Mental Health and Technology"—chapter 2

**Don Norman**, Nielsen Norman Group. "Fun and Pleasure in Computing Systems"—chapter 6

**Yvonne Rogers**, University College London. "Is a Diet of Data Healthy?"—chapter 4

# 1 An Introduction to Positive Computing

"Don't be evil," wrote Larry Page and Sergey Brin on the eve of Google's IPO in 2004. Almost a decade later, Apple CEO Tim Cook opened the annual developer's conference with a tribute to emotional experience as part of a campaign in which Apple claimed to ask of their technologies: "Will it make life better? Does it deserve to exist?"

These messages, however aspirational, resonate as overarching goals for a growing number of technologists who want to ensure the work they love to do is actively improving people's lives. If a technology doesn't improve the wellbeing of individuals, society, or the planet, should it exist?

The desire to "do good with technology" has emerged from a shared experience that technology has a major impact on how we live, that it has the capacity not only to increase stress and suffering, but also to improve lives individually and en masse. Indeed, the potential influence of digital and ubiquitous technologies is unprecedented. As you read this book, there are more *mobile* devices than people on the planet,[1] and over the past decade we have watched them play a starring role in the politics of nations, in the politics of human relationships, and in the day-to-day social and emotional dynamics of our lives.

As a result, a growing number of technology professionals are seeking a realignment of business goals away from profit and toward social good—a sentiment manifest in the advent of social enterprise that places profit making secondary to a social purpose.[2] Within the technology industry, we have seen the emergence of initiatives such as Games for Change, UX for Good, Wisdom 2.0, and Design for Good, while human–computer interaction (HCI) conferences provide ongoing testament to the growth in HCI for wellbeing, social impact, and peace.

This growing interest in social good among technology professionals is part of a larger emerging public concern for how our digital experience is

impacting our emotions, our quality of life, and our happiness. We are gradually leaving behind the stark mechanical push for productivity and efficiency that characterized the early age of computing and maturing into a new era in which people demand that technology contribute to their wellbeing as well as to some kind of net social gain.

This sentiment reflects a broader renaissance of focus on humanistic values such as happiness and human potential that has begun to flourish across many different disciplines. A shift in priorities is now loud and clear among economists, politicians, and policymakers as they turn to statistical measures of wellbeing and "gross national happiness" as new indicators of success (Helliwell, Layard, & Sachs, 2012).[3]

Similarly, in the past decade psychologists and psychiatrists have achieved hard-won disciplinary support for research that goes beyond illness into aspects of healthy functioning such as resilience, happiness, and altruism.[4] In concert, neuroscientists have been exploring the physiology of exceptionally healthy minds and studying constructs such as empathy, mindfulness, and meditation empirically. Their findings are fueling action by educators and business leaders who are applying work on emotional intelligence and positive psychology to improve wellbeing among their students and workers (Joinson, McKenna, Postmes, & Reips, 2007; Ong & van Dulmen, 2006). It's inevitable that technology should begin to play a more sophisticated part in these multidisciplinary efforts toward supporting wellbeing.

In this book, we refer to this area of work—the design and development of technology to support psychological wellbeing and human potential—as "positive computing."[5] We believe we are seeing the beginning of an important shift in the focus of modern technologies in which multidisciplinary efforts to support human flourishing are helping to shape thinking around how we design for digital experience.

In the same way that economists are measuring wellbeing at the national level and psychologists have been measuring it at an individual level for decades, it's time to consciously and systematically consider wellbeing measures in the design and evaluation of technology.

That isn't to say it will be easy. Understanding the impact of technology on individuals and on society is fraught with the challenges common to understanding any highly complex system. Cultural, social, ethical, and psychological variables will inevitably conspire to create a complex, nuanced, and challenging space for investigation. This suggests that partnering with social scientists (old hands at dealing empirically with multifaceted human systems) will be absolutely vital to success.

Although we believe this is changing, we have found that our industry's traditional view of humans, useful as it has been to invention historically, creates barriers to progress as we get to a point where devices—far from being the mammoth expert-handled machines they once were—have become embedded into the daily experiences that *shape* all of us.

Nevertheless, some technologists remain reluctant to go beyond the apparent safety of a machine view of users. They are understandably wary of the empirical challenges that this change presents and skeptical of the feasibility of delving into psychological and subjective issues such as wellbeing within their field—and rightfully so, as it is entirely true that the technology field alone is not equipped for such a task. It has neither sufficient experience nor appropriate methodologies for dealing with the complexities of human psychological wellbeing, which is why *multidisciplinary partnership is crucial*. Partnerships with psychologists, anthropologists, sociologists, and educational researchers are already common within branches of HCI, so following in these footsteps should not require too drastic a leap.

Overall, in discussions with field leaders about positive computing, we find our colleagues are most likely to feel uncertain about the feasibility of *measuring* a concept as apparently nebulous and personal as wellbeing. Fortunately, on that point social science has spent decades refining instruments for precisely this purpose.

## Measuring What Matters

Indeed, positive computing may appear out of reach at first glance, in the way that "user experience" felt fuzzy and impractical at the turn of the millennium. Although in technology fields we have little experience with measuring psychological impact, fields such as psychology and psychiatry proffer a wealth of empirically validated methodologies and best practice prerequisite to taking on this challenge.

For example, researchers have been measuring and assessing attributes such as happiness, quality of life, and subjective wellbeing since at least the 1970s (Fordyce, 1977). There are now more than 1,400 wellbeing and quality-of-life instruments for various specific subgroups (customized to age, culture, religion, context, etc.) and thousands of studies validating these instruments.[8]

Two of the most widely used measures of wellbeing are the Center for Epidemiological Studies–Depression (CES-D) Scale, which has been used in more than 23,000 studies, and the Global Assessment of Functioning Scale

used by psychiatrists and psychologists in clinical and research settings. Doctors, insurance companies, and government agencies rely on these measures to make decisions about treatment, benefits, and spending.

Recent technological advances in areas such as affective computing, computer vision, and data mining are also making inroads. Technology can now help us to better understand people's emotional experience through the analysis of text, facial expression, physiology, interaction, and behavioral analytics. We can also learn from research in cyber-therapies and educational technologies, both of which seek to combine information about user behavior, cognition, and affect to inform their work.

Research and practice in medicine and the social sciences have shown us that measuring wellbeing and related factors not only is entirely feasible but has been well established for a number of decades. But is there any evidence that the technologies we build might actually be recruited to have a positive impact on wellbeing? Again, the work of psychologists has paved the way.

Studies in psychology have already combined the use of wellbeing measures with digital technologies for the delivery of Internet-based "interventions" (interventions are therapeutic or promotional efforts to improve mental or physical health). The *Journal of Medical Internet Research* and the *Journal of Cyberpsychology, Behavior, and Social Networking* are two of the most highly ranked journals publishing in this area. *IEEE Transactions on Affective Computing* also publishes research on the emotional impact of computers, but from an engineering perspective. Psychology research continues to uncover strategies empirically shown to lead to increases in long-term wellbeing, many of which are detailed later in this book.

Although psychologists have developed many proven ways to strengthen our mental resources, we spend much more time with digital technologies than we do with psychologists; digital technologies have unparalleled demographic reach. As psychology researchers Stephen Schueller and Acacia Parks (2012) have said, "The science of internet [*sic*] interventions can be advanced through expanding options and strategies to promote worldwide wellbeing."

As an example of sheer numbers, in 2012 researchers at Facebook published a study in *Nature* that measured the impact of three interface-design variations on social participation behavior (Bond et al., 2012). This randomized control trial had a whopping 61 million participants and succeeded in showing how a small design change can have impressive consequences on user thinking and behavior.

We currently go about designing new technologies without any sense of how our design decisions will impact our users' psychological health and flourishing. Imagine the effects of taking that aspect into account, even just a little bit. Wellbeing-driven improvements to digital experiences have the unique potential to effect population-wide positive change.

Developments in the field of positive computing will have the side effect of giving us a way to critically measure aspirational missions and grandiose claims. Promises such as "do no evil" and "make the world a better place" are currently little more than marketing vagaries. We ought to be better equipped to bring rigor to these kinds of aspirations, to challenge them effectively, and to encourage integrity. For example, when a company such as Google makes the claim that its technology will make a better world,[9] we should be able to assess this claim in a meaningful way from multiple perspectives, including wellbeing, sustainability and social impact. Positive computing will get us part of the way by allowing us to do so from the perspective of human psychological wellbeing. This approach will provide one piece to the puzzle of proof with regard to whether a technology does indeed deserve to exist.

## The Walk-Through

In this book, we hope to support the work of current trailblazers and to facilitate future research and practice by synthesizing multidisciplinary theory, knowledge, and methodologies into a consolidated foundation for a rigorous and prosperous field. In part I, we look at fields outside of computing, such as psychology, economics, and education, as well as at pioneering work within computing that can support or already has begun to address the improvement of wellbeing.

We are privileged to be able to include perspectives from various experts from disciplines such as psychology, neuroscience, and HCI as sidebars throughout the book. Jeremy Bailenson, Timothy Bickmore, danah boyd, Jane Burns, David Caruso, Mihaly Csikszentmihalyi, Felicia Huppert, Mary-Helen Immordino-Yang, Adele Krusche, Jane McGonigal, Jonathan Nicholas, Don Norman, Yvonne Rogers, and J. Mark G. Williams have generously shared aspects of their vision for how future technology might take part in supporting wellbeing.

After a review of the foundational literature, in chapter 5 we propose a theoretical framework and consider appropriate methods for the research and evaluation of positive-computing technologies. We also make efforts to sketch out a scope for the field, looking not only at technologies

specially built to support wellbeing, but also at the potential for wellbeing research to enhance the experience of *all* technology.

In part II, we zoom in on a number of specific wellbeing factors as identified in the literature, specifically positive emotions, motivation, engagement, self-awareness, mindfulness, empathy, compassion, and altruism. We look at the literature that correlates these factors to wellbeing, what kinds of strategies exist for fostering them, how technology has already been used to support their development, and possibilities for future work.

Before coming to a close, we take a critical look at issues such as privacy, paternalism, psychological complexity, and autonomy—all of which need to be judiciously explored as part of future work.

Finally, we envision a way forward, including a pragmatic exploration of how current and future work in positive computing might be funded and sustained.

One of the goals of this book is to make a convincing case that considering wellbeing in the design of technology is not only entirely achievable, but also valuable, if not imperative, to building a digital environment that can make a happier and healthier (not just more productive) world. We also hope to show that to enter an age of ubiquitous computing while turning a blind eye to the influence of technology on wellbeing is to accept a kind of convenient ignorance of the real impact of our work and thus to limit our success as designers and developers.

The potential for technology to become a vehicle for worldwide flourishing is huge, and the intentions of enthusiastic professionals are genuine, but in order for our efforts to be effective they must be grounded in evidence and open to evaluation, and, in the end, they must prove themselves. This book attempts to take a first step in what we hope will be an ongoing rigorous and dynamic interdisciplinary journey toward digital experience that is very deeply human centered.

## Notes

1. See globalenvision.org/2013/12/18/infographic-there-are-more-mobile-devices-people-world.

2. New ways of structuring a profitable organization around a social benefit come in various forms, including "for-benefit organizations" (e.g., Mozilla), low-profit, limited liability corporations (L3Cs), and "social businesses," proposed by Nobel Peace Prize winner Muhammad Yunus (see yunussb.com or his book *Building Social*

*Business*). These new organizational models are sometimes described as being part of an emerging "fourth sector" (see fourthsector.net).

3. In 2011, the United Nations officially put happiness on the global agenda, guided by the king of Bhutan's suggestion that "gross national happiness" complement gross national product as an indicator of social progress (see Ryback 2012). Although the current leader of Bhutan has since set aside the idea of gross national happiness, other measures of happiness and life satisfaction have been adopted by policymakers in the United Kingdom, where the National Wellbeing Programme (which carries the slogan "Measuring what matters") was created as part of the Office for National Statistics. The *World Happiness Report* (Helliwell, Layard, & Sachs, 2012) provides a summary of national and international policy initiatives, which we discuss in more detail in chapter 3.

4. In the past decade, psychologists such as Ed Diener, Barbara Fredrickson, Martin Seligman, Sonja Lyubomirsky, and Mihaly Csikszentmihalyi have been part of an effort to extend the focus of psychology and psychiatry beyond a disease model to study the factors of wellbeing and optimal functioning. We discuss positive psychology in chapter 2.

5. Various terms such as *positive technologies*, *positive computing*, and *interaction design for emotional wellbeing* have been used to refer to the potential for technology to support positive psychology and related themes. To our knowledge, it was Tomas Sander who first proposed the term *positive computing* in an article for the edited book *Positive Psychology as Social Change* in 2011. Guiseppe Riva and colleagues use the term *positive technology* in the cyberpsychology context (we look at this work in greater detail in chapter 2).

6. We would include here *The Shallows* by N. Carr, *Alone Together* by S. Turkle, *Nudge* by R. Thaler and C. Sunstein, and also *Flourish* and *Authentic Happiness* by M. Seligman among others.

7. Longitudinal studies by economists show that although wealth has tripled in the United States over the past 30 years, increases in life satisfaction have been marginal. This increase in wealth has likewise come with a significant increase in digital technology use, yet with no significant increase in life satisfaction. Even if we don't expect wellbeing measures to follow Moore's law, a correlation with wellbeing and technology should show more than marginal increases. See Helliwell, Layard, & Sachs 2012 for details.

8. The Australian Quality of Life Centre maintains a useful directory of research instruments. For example, the Personal Wellbeing Index has separate versions for adults, preschoolers, school children, and those with cognitive disabilities (see deakin.edu.au/research/acqol/instruments/instrument.php). You can figure out how you would score on the CESD-R (R = Revised) scale at cesd-r.com.

## 2  The Psychology of Wellbeing

"How are you?" "How's it hanging?" "¿Como estás?" "你怎么样?" Humanity's most frequently asked question is none other than an inquiry into another's wellbeing. Responses can vary in sincerity and sophistication: "Good, you?" "Wicked," "Been better," "The clouds of sorrow hang heavy." Despite the variation, we are generally able to understand something of the state of someone's wellbeing following a simple greeting, and, more importantly, we solicit this information before we do anything else. It's not just a social norm—this feedback is vital to any decisions we make about what to do or say next.

Despite its quotidian and timeless nature, this question remains a formidable research question for scientists. Some of the difficulty lies in how science should define and empirically measure variations on "being well." The search for an understanding of happiness and how to attain it is arguably a contender for the world's oldest profession. If we are to look to the academic pursuit of happiness as it has unfolded through time, we find ourselves journeying back at least as far as Aristotle and the Buddha, moving on through various schools of philosophy in Europe, Asia, and the Americas, until we land squarely in the modern world. Today the empirical search for wellbeing rests largely in the hands of psychologists and neuroscientists. Before we can involve digital technology more consciously in this pursuit, we'll need to understand the methods, theory, and practice—as they have been refined over hundreds of years—that have formed our complex modern-day understanding of human psychological wellbeing and its correlates.

This chapter looks at key elements of this understanding from the viewpoints of multiple specializations in psychology and the mind sciences. Needless to say, we could never be anything like comprehensive in one chapter about a subject to which libraries might be devoted, but we do aim to highlight core research and practices that may be particularly

helpful to technology researchers and professionals looking to incorporate this knowledge into their practice.

## Paradigms of Wellbeing

Because the term *happiness* is so loaded with diverse interpretations (from fleeting hedonic pleasure to consumer spiritualism), scientists refer with greater precision to "optimal human functioning," "optimal mental health," "psychological flourishing," or "psychological wellbeing." It is to psychological wellbeing that we are dedicated in this book (and which we generally shorten simply to "wellbeing"). We occasionally also use the word *flourishing*, which has been widely adopted within the field of positive psychology as a way of emphasizing the optimal (rather than just average) end of possible human psychological functioning.

First off, we should acknowledge that there is an understanding common to all theories of wellbeing that it is contingent on certain basic material needs essential to survival, such as food, water, and shelter. What enhances wellbeing after basic needs are satisfied is more controversial and depends on how wellbeing is defined. For example, is wellbeing defined as the absence of mental dysfunction, in the way that physical health might be described as the absence of illness? Is wellbeing measured as an aggregate of pleasurable experiences (or what percentage of your life you experience positive emotions)? Perhaps it is best understood as the level to which one finds meaning in life and fulfills one's greatest potential. These three perspectives roughly equate with the medical, hedonic, and eudaimonic approaches, which together form the foundations for modern theories of wellbeing. We look at each of these perspectives here.

It's important to note that none of the theories we include herein is simply hypothetical. Each is supported by ample empirical evidence and is associated with a series of measures and validated methodologies for research. The theories don't so much contradict each other as they do focus on different components of wellbeing. For designers of technology, the underlying philosophical standpoint is perhaps less important than the strategies arising from these theories that have been proven to improve wellbeing in practice. We call on examples of these strategies throughout the book.

We believe it would be foolhardy for us to arbitrarily select a theory and posit it as the "right" choice for use in technology fields. Instead, we provide a review geared toward technology designers and imagine that professionals will select (as some already have) a theoretical perspective

most appropriate to their context, the backgrounds of their teams, their goals, and their opportunities. The important point is that theory and supporting literature are essential. Work in positive computing might sail aimlessly or, worse, head into harmful waters if not anchored in research-based evidence. Therefore, it's necessary to ground work in existing research, even if the specific literature from which we draw and the disciplinary lens through which we view the problem vary among projects.

For this reason, the framework we propose in chapter 5 is designed to support practitioners in grounding their efforts in the available theory and research, but without prescribing the use of a specific theory. For example, a combination of medical and positive-psychology models of wellbeing shape the work we do with the Young and Well Cooperative Research Centre. A research organization that focuses on the mental health of young people, the center is influenced by the psychologists with whom we work. Specifically, we work to build technologies that support certain psychological strengths such as resilience and autonomy by drawing on the literature in psychiatry and positive psychology. Our target audience contributes via participatory design practice. As new partners get involved in the project, we work with sensitivity to their background and understand that our approaches to influencing and measuring wellbeing may have to adapt over time. Later in the book we look more specifically at how various theories shape design and evaluation in different ways.

## The Medical Model—Wellbeing as the Absence of Dysfunction

"How does that make you feel?" asked Sigmund. Despite its wild success as a cliché, if you seek professional assistance for any number of mental health problems, you are more likely to be asked about your appetite, your sleep patterns, and your sense of hopelessness. These questions are just a few in a standard slew that will allow your doctor to determine a diagnosis using a method recognized by the American Psychiatric Association (or the equivalent in your country).

These questions are not random. They have been carefully evaluated in hundreds of studies as accurate indicators of mental illness. Health-care workers, psychiatrists, and insurance companies rely on these methods to determine treatment, write prescriptions, initiate therapy, recommend hospitalization or calculate insurance coverage. The questions included in these standardized questionnaires have been refined over time and after

considerable debate have been included in what is known as the *Diagnostic and Statistical Manual* (DSM), recognized by an organization of more than 36,000 American psychiatrists. Similarly, the *International Classification of Diseases* (ICD) is a statistical classification of diseases and related health problems (including mental health) published by the World Health Organization.

Psychiatrists, like other doctors, treat illness, dysfunction, and disease. You can't get much out of a doctor's appointment if there's nothing identifiably wrong with you. You can't, for example, drop in to see your general practitioner because you feel you're not thriving emotionally, you'd like to make wiser decisions, or you want to experience happiness more frequently. The initial evaluation made in the medical field is generally a binary one: you're either sick (and need treatment), or you're not (have a sticker). If you're not ill, your needs will generally fall outside of your doctor's area of professional responsibility.

But the focus of this book is on designing technologies to support and *promote* psychological wellbeing, not specifically for those who are ill and who seek help, but for the population at large, situated as we all are along a continuum from languishing to thriving. Only then can we promote improved life experience and optimum functioning for everyone. Promotion is differentiated from prevention and treatment in the health professions. For example, Mary Ellen O'Connell, Thomas Boat, and Kenneth Warner (2009) describe prevention as the avoidance of risk factors, whereas promotion strives to advance supportive conditions and protective factors. In this context, a medical or psychiatric model may seem inadequate. Nevertheless, even in the context of promotion, a medical model can contribute to our work in many ways.

First, psychiatric methods for diagnosis and intervention have a long history of empirical study and have been extremely successful at evolving diagnosis and treatment for many disorders. Moreover, when we work with teams of mental health professionals, they generally expect to use established medical instruments for assessing the impact of an intervention (even a promotional one). Take, for example, a prototypical randomized control trial evaluating the impact of a preventative intervention on young people at risk of depression (Clarke et al., 2001). In the study, research psychiatrists used cognitive restructuring therapy to prevent the symptoms of depression in young people who were mentally healthy but were nevertheless at risk because their parents were clinically depressed. The study evaluated a preventative intervention using two scales: the CES-D and the DSM-IV Global Assessment of Functioning, which are generally used both

2001), and companies such as Apple have built and strengthened a reputation on the idea of product as positive emotional experience.

In his book *The Architecture of Happiness*, philosopher Alain De Botton (2006), describes how art and architecture "talk" to those who experience them and change the way they feel and behave. One could argue that digital technology has the incredibly unique ability to turn the architectural monologue into an interactive dialogue. Digital technologies have the ability also to listen and adapt to what they hear. Imagine an empathic Siri or an emotionally attuned mobile phone. We discuss positive emotions more thoroughly as a factor for increasing wellbeing in chapter 7.

### Subjective Wellbeing—If You're Happy and You Know It, Let Us Know

Modern hedonic psychology has come a long way since Aristippus, but there are still problems with relegating evaluations of wellbeing to measures of fleeting emotions, which neglects the long-term overall stability that generally differentiates the concept of wellbeing from definitions of happiness. Kahneman, among others, has approached the need for a measure of longer-lasting characteristics by developing measures of wellbeing based on an individual's self-reported assessment of his or her own life satisfaction. "Subjective wellbeing" (SWB) (Kahneman, Diener, and Schwarz, 1999) consists of the cognitive and affective evaluations of one's life, including life events, life satisfaction, and fulfillment. These measures have been used, for example, for the development of national happiness indices (Diener, 2000; Diener & Suh, 2003), which are increasingly used to inform policymaking in multiple countries (examples are discussed in more detail in chapter 3 from within the multidisciplinary context of economics).

Subjective measures of wellbeing generally consist of three components: *life satisfaction*, the presence of *positive mood*, and the absence of *negative mood*. Life satisfaction is based on more reflective judgment, whereas the latter two refer to hedonic, affective components and can be either retrospective (as in "Over the last week I felt happy") or present focused (as in "I feel happy").

Most of the academic research in hedonic psychology has employed SWB measures that have shown substantial validity, as reflected by their agreement with other types of measures, such as third-party reports and biological measures of wellbeing (e.g., functional magnetic resonance imaging). A review by Ed Diener (2000), for example, highlights what was already known about subjective wellbeing and its different measures at the

end of the twentieth century. Progress since then has come on several fronts, including new brain-imaging and genomic techniques (Fredrickson et al., 2013) and digitally facilitated methods for data collection and self-report.

Some research studies employ experience-sampling methods, in which emotions are repeatedly reported at random times during the day (Kahneman, 1999), and others have used diary methods (Bolger, Davis, & Rafaeli, 2003), also common in HCI research, to record memories of good and bad events or satisfaction about different aspects of life. According to these self-reports, people (those not living in extreme poverty or dire circumstances) tend to report being slightly happy. It is uncommon to find people reporting very high or very low levels of wellbeing.

On a time scale, an individual's self-reports can be classified as either "online" (as they occur in real time) or "recalled" (as reported in a diary) or as life evaluations that span long periods of time. These three time scales influence behavior in different ways. For example, Diener has shown that recalled feelings predict future behavior better than moment-to-moment feelings, a finding that relates to how we remember and judge our previous experiences. Because our personal values change very slowly, when we reflect on life satisfaction over a number of weeks or months, our judgments tend to be quite stable. However, reports of satisfaction with life will change over extended periods of time because both personal values and circumstances change more dramatically as we age and as time goes by.

One interesting thing about the effects of external circumstance on wellbeing is our ability to adapt to it. According to the "hedonic treadmill" concept, people adapt to or "get used to" all changes, be they good or bad, by returning to a personal neutral baseline. In other words, that new TV that fills you with happiness the day you buy it will have little to no effect on your happiness level in a month or so. More dramatic is the research showing smaller than expected changes to life satisfaction for both lottery winners and recent paraplegics after their life-changing events (Boyce & Wood, 2011; Brickman, Coates, & Janoff-Bulman, 1978). The hedonic treadmill concept could render efforts to increase happiness pointless if we simply return to a previous set point every time. However, the Boyce and Wood study (2011) shows the importance of personality and attitudes in predicting positive adaptation, and Diener and others have revised the hedonic treadmill model (Diener, Lucas, & Scollon, 2006), arguing that the set point is not neutral, but instead generally positive, and, more importantly, that it can be changed.

Genetic predispositions and environmental influences play out at the cultural level as well. Large-scale longitudinal databases of self-reports allow researchers to compare SWB across cultures and time, noting differences in various dimensions. For example, France is consistently associated with surprisingly low levels of subjective wellbeing, but Scandinavian countries with unusually high levels. Digging deeper, Huppert and So (2013) point out that although France has the highest ranking of all countries on engagement, it has the lowest ranking on self-esteem and is in the bottom for optimism and positive relationships. They highlight this as evidence for why multidimensional measures for wellbeing are critical to understanding differences between people and nations. National measures of wellbeing together with regional and cultural differences represent an ongoing area of study (Diener & Suh, 2003; Huppert et al., 2009). Measures such as the Happy Planet Index, World Happiness Report, and Eurobarometer provide a looking glass into the differences across countries and cultures as well as into the impact of national events and policy interventions. Some of this research is discussed in the next chapter.

Measures of life satisfaction, SWB, and quality of life are all widely used within various economic, social, and research contexts. But positive emotions are only part of the picture. For the rest of it, we turn to Aristotle's notion of eudaimonia.

## Eudaimonic Psychology—Wellbeing as Engagement with Meaning and the Fulfillment of Potentials

Few among us eschew pleasure or positive emotion. In fact, most of us spend much of the day seeking pleasures out in small ways, from that nip to the cookie jar or that session of online games to the sitcom after dinner or cuddles before bed. Positive emotions are part of a happy life, but we're nevertheless stuck with the reality that you can get too much of a good thing, and positive emotions alone may not be a complete answer to lasting wellbeing. Here enters the much celebrated notion of the "middle path" or "golden mean," along with theories of wellbeing that go beyond the experience of positive emotion into the realms of engagement, meaning, relationships, and human potential.

## Self-Determination Theory—Wellbeing as Determined by Autonomy, Competence, and Relatedness

Don't ask how we can motivate people. That's the wrong question. Ask how we can provide the conditions within which people can motivate themselves.

—Edward Deci, TEDxFlourCity

Richard Ryan and Edward Deci's self-determination theory (SDT),[1] which posits that *autonomy*, *competence*, and *relatedness* are the key components of both motivation and wellbeing, is one of the theories of wellbeing most readily applied to a technology context, in part because it is relatively straightforward to operationalize.

In order to be self-determined, we must feel autonomous—that is, be able to attribute the outcomes of our activity to our own intentions (what researchers call the "internal locus of causality"). We must feel competence or confident in our ability to meet challenges (e.g., experience optimal challenges and freedom from threats or demeaning evaluations). And finally, we must feel secure and connected to others.

SDT has many implications for design, perhaps the most conspicuous of which is its attention to intrinsic motivation and autonomy. In chapter 7, we look later at how these implications can influence the design of technologies, in particular those that seek to change or support behavior.

Another implication for design stems from the way in which SDT deals with interpersonal, social, and cultural factors. SDT does not suggest that autonomy, competence, and relatedness would be equally *valued* by people from different socioeconomic backgrounds, families, or cultures. It does maintain, however, that environmental conditions that hinder these factors will have negative psychological consequences in *all* social or cultural contexts. According to this line of thought, socio-cultural (and, we argue, digital) environments that support these needs can influence wellbeing at both between-person and within-person levels of analysis.

Whereas hedonic theories of wellbeing rely on SWB research, eudaimonic theories often use measures of how well an individual does on a set of factors that support wellbeing (such as autonomy or positive relationships). Those with a eudaimonic perspective have challenged SWB models for being too narrow and a flawed indicator of healthy living. Those with a hedonic perspective, in turn, have argued that eudaimonic criteria are generally defined by experts, whereas the focus on "subjective" in SWB research respects people's individual ideas on what makes a good life. We believe both measures can be valuable to work in technology design, sometimes in combination, and we look more deeply at how wellbeing can be measured from each of these viewpoints in chapter 5.

## Combining Hedonic and Eudaimonic Approaches

Many current theories include both hedonic and eudaimonic aspects as factors of wellbeing, such as the model by Huppert and So mentioned previously. Corey Keyes combines emotional wellbeing (hedonic aspects) with aspects of psychological and social wellbeing (eudaimonic) to describe a mental health continuum. Martin Seligman, originator and ongoing champion of the positive-psychology movement, has developed the PERMA model, which stands for Positive Emotions, Engagement, Relationships, Meaning, and Achievement. Seligman and Keyes are among a number of researchers making inroads to our understanding of wellbeing from within the field of positive psychology.

## Positive Psychology—Wellbeing as Flourishing

The field of positive psychology at the subjective level is about valued subjective experiences: well-being, contentment, and satisfaction (in the past), hope and optimism (in the future); and flow and happiness (in the present).
—Martin Seligman and Mihaly Csikszentmihalyi, "Positive Psychology"

Thanks to life-saving progress in psychology and psychiatry, many mental disorders can now be diagnosed, treated, and sometimes cured. Psychologists, however, have come to question the nearly exclusive disease focus of their discipline. In 2000, Martin Seligman, then president of the American Psychological Association, and Mihaly Csikszentmihalyi (Seligman & Csikszentmihalyi, 2000) argued for placing greater emphasis on promoting healthy functioning rather than exclusively on dysfunction. The idea of "positive psychology," as they called it, resonated with a great number of researchers and has come to represent an active field of work with ever-increasing influence.

Positive psychology has matured to an extent that it now influences education, policy, management, and mental health. Journals such as the *Journal of Happiness Studies* and the *Journal of Positive Psychology* as well as conferences, symposia, and handbooks of academic literature have developed from this approach. It has been argued that a special term is no longer needed and that a study of healthy and optimal functioning should simply be understood as an essential part of psychology as a whole.

Many researchers in the area of positive psychology have translated their research findings into self-help books for public benefit. These books often have enough detail that they can go some way to informing design

as the ones we feel when receiving compliments, tend to increase proso-
cial behavior. In contrast, empirical evidence has shown that punitive
practices can increase antisocial behavior (Mayer, 1995). This research
has been used to promote positive interventions rather than punitive
ones in schools and prisons. For example, the Los Angeles Unified
School District (2007) recently adopted a policy that requires the imple-
mentation of systems of positive reinforcement in schools as an alterna-
tive to punishment. Interventions like these for social and emotional
learning (Payton et al., 2000) are often grounded in EI theory. We discuss
EI in greater detail in part II. (For more detail on EI capacities and the
potential of technology to support them, see David Caruso's sidebar in
chapter 8.)

### Buddhist Psychology—a Science of the Mind

The primary orientation of the Buddhist investigative tradition has been toward
understanding the human mind and its various functions. The assumption here is
that by gaining deeper insight into the human psyche, we might find ways of trans-
forming our thoughts, emotions and their underlying propensities so that a more
wholesome and fulfilling way of being can be found. It is in this context that the
Buddhist tradition has devised a rich classification of mental states, as well as con-
templative techniques for refining specific mental qualities.
—His Holiness the Dalai Lama, "Science at the Crossroads"

To focus only on Western theory would be strangely remiss for a topic such
as wellbeing, which has been studied systematically by Eastern philoso-
phers for thousands of years. An interest in Buddhism for its practices such
as mindfulness and meditation and for the culture of peace and compas-
sion it represents has led to a growing integration of Buddhist philosophy
into Western notions of wellbeing.

   This has been possible in part because Buddhist philosophy and practice
can be investigated separate from the religious aspects of cultural rituals
and belief systems in which it is nested. It is probably the relatively bare-
bones, nonreligious style of Zen that has made it one of the most widely
accessed sources of Buddhist thought in Western culture. In fact, the term
zen has become a clichéd colloquial synonym for simplicity and tranquility
of mind (visit any home furnishings store for evidence). But the other
essential element that makes Buddhist philosophy amenable to a partner-
ship with Western science is its commitment to empiricism.

   The Dalai Lama is adamant that Buddhist doctrine is subject to scien-
tific evaluation and should change in light of new evidence. He explains

that "in the Buddhist investigative tradition, between the three recognized sources of knowledge—experience, reason and testimony—it is the evidence of the experience that takes precedence, with reason coming second and testimony last. This means that, in the Buddhist investigation of reality, at least in principle, empirical evidence should triumph over scriptural authority, no matter how deeply venerated a scripture may be" (2005).

Psychologist Paul Gilbert (2011) puts it this way:

*For thousands of years Buddhist scholars and devotees studied and developed practices of introspective and reflective psychology and an ethic based on compassionate insights—these are ways by which individuals can become very familiar with their minds, learn to stabilise and organise them for their wellbeing, and cultivate key qualities that are associated with personal and social health. … While the focus of science has been on understanding and alleviating the physical nature and causes of pain, spiritual traditions like Buddhism have tended to focus more on alleviating suffering, that is, working with how the mind reacts to pain.*

It is perhaps owing to this empirical stance that technologists interested in Buddhist philosophy are now significant enough in number to have motivated the creation of the annual "Buddhist Geeks" conference. Interest lies in how Buddhist practitioners investigate the interrelationships between emotion, cognition, and behavior as well as in Buddhist practices such as mindfulness and various forms of meditation, taught for centuries as paths to wellbeing. These practices have also of late been increasingly evaluated by Western psychology and neuroscience. Work in multiple fields using multiple measures has consistently shown Buddhist meditative and mind-training practices to be highly effective for treating mental illness and increasing wellbeing. So compelling is the evidence of their effectiveness that mental health professionals at institutions such as Oxford, Harvard, Stanford, Yale, the University of California at Berkeley, and the University of Wisconsin at Madison, among many other institutions around the world, have incorporated them into clinical and research work.

Jon Kabat-Zinn (2003), the originator of the Mindfulness-Based Stress Reduction program, one of the most successful integrations of Buddhist and Western psychology to date (which we discuss in greater detail in chapter 9), adeptly describes Buddhist practices in untraditional and elucidating terms: "Of course, the Buddha himself was not a Buddhist. One might think of dharma as a sort of universal generative grammar, an innate set of empirically testable rules that govern and describe the generation of the inward, first-person experiences of suffering and happiness in human

beings. … It is neither a belief, an ideology, nor a philosophy. Rather, it is a coherent phenomenological description of the nature of mind, emotion, and suffering and its potential release, based on highly refined practices aimed at systematically training and cultivating various aspects of mind and heart via the faculty of mindful attention." In the following chapters of this book, we look more closely at how these practices are used in various contexts.

## Biology and Neuroscience—Wellbeing as Physiologically Identifiable

Researchers in biology and neuroscience have used physiological and brain signals to detect and understand individual emotions. Others study biological factors that influence wellbeing (such as genes or physical health), while some investigate how those biological systems interact with environmental conditions.

This work intersects with HCI most clearly in affective computing. Rafael's research group has been among those to use physiological signals to detect emotions during HCI, particularly for applications within education and mental health. For example, physiological signals can be used to measure the impact of feedback when students receive it during online activities (Pour, Hussain, AlZoubi, D'Mello, & Calvo, 2010). Moreover, signals from multiple physiological systems can be combined, including electroencephalography (EEG), electromyography, skin conductivity, and respiration (AlZoubi, Hussain, D'Mello, & Calvo, 2011). We come back to this work with respect to affective computing in chapter 4.

Neuroscience researchers seek to identify patterns of electrical and chemical activity in the brain that correlate with the emotion, cognition, and behavior we experience. In the past two decades, their research has come to include positive emotions as well as characteristics associated with increases in wellbeing, such as resilience and meditative practice.

Using brain-imaging techniques, scientists can learn more about the brain's structures and the processes behind emotions. For example, researchers may have found the neural network responsible for answering our opening question: "How are you?" The anterior insula cortex seems to contain the interoceptive representation of our embodied feelings and emotions (Craig, 2009b). Together with the anterior cingulate cortex, it is activated in subjects experiencing emotional feelings such as love, anger, fear, sadness, happiness, indignation, social exclusion, and empathy.

These neural correlates have been used to propose a model of awareness that includes homeostatic, environmental, hedonic, motivational, social,

and cognitive activity to describe both a "global emotional moment" and the fact that a series of such moments produces a representation of sentiments over time. Eight prosocial positive emotions (love, hope, joy, forgiveness, compassion, faith, awe, and gratitude) are often identified as the components of wellbeing in this model. Notably, almost all involve human connection rather than just the self. These models do not require that all our emotions be positive and acknowledge that negative emotions are necessary for survival (Craig, 2009a, 2009b).

Affective and social neuroscience recognize that our brain is also shaped by what we experience. For example, studies using functional magnetic resonance imaging (fMRI) show that early stressful and nurturing environments have a strong effect on how the brain develops. Richard Davidson and others (e.g., Davidson & McEwen, 2012) have been gathering evidence that certain interventions can be intentionally designed to promote prosocial behavior and wellbeing. According to Davidson's research, structural changes in the brain can be triggered by regular exercise, cognitive therapy, and meditation practices, suggesting that we can develop training practices for this purpose. This work poses tantalizing questions for the potential impacts of technologies in these same areas.

In a recent article, Davidson and colleagues (2012) discuss how such results can inform education. They posit that it should be possible to support prosocial behaviors and academic success in young people by developing the underlying elements of wellbeing through systematic contemplative practices that have been shown to be effective and to trigger neuroplastic change. They have also pointed to the potential for technologies such as videogames to be used to develop positive characteristics, including mindfulness and empathy.

Others who study the biological factors of wellbeing look at the relationship of physical behaviors such as circadian rhythms, diet, and exercise to psychological health. For example, Ian Hickie at the University of Sydney studies the chronobiology system (our physiological clock) and its effect on depression. Even research in this area can inform work in positive computing. For example, together with Hickie we are exploring how information about sleep cycles collected from social networks might be used for detecting people at risk of depression.

Personality traits (Costa & McCrae, 1992) and genetics are other acknowledged determinants of wellbeing. During the 1990s, neuroscientists hoped to be close to identifying the genetic determinants of mental illnesses. Since then we have come to better recognize the complexity and sheer number of genes involved in both mental disorders and in
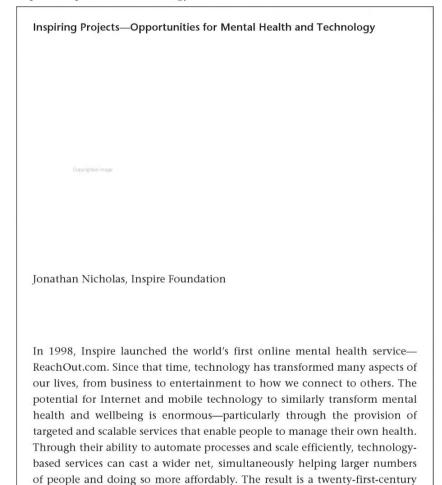
flourishing, yet progress has been made on many fronts. A groundbreaking paper (Caspi et al., 2003), for example, revealed the impact of a certain gene configuration known as the 5-HTT promoter that determines how well our neurons transport serotonin—a neurotransmitter famously linked to depression and wellbeing. They found that those with one or two copies of the short allele of the gene were more vulnerable to depression when faced with life-stressing situations. Another study (Pluess & Belsky, 2013) resulted in four categories of resilience: (1) those that are highly reactive to both negative and positive events, (2) those that are low reactive to both types of events, (3) those that are vulnerable to negative events (low resilience), and (4) those that are more influenced by positive events or "vantage sensitive."

Even the apparently predetermined factors of genetics and personality traits can be influenced and changed. For instance, we now understand that gene expressions are modified by the environment and personal experience, an area of research known as "epigenetics." One extraordinary example is presented in recent work by Barbara Fredrickson and her colleagues that shows how different forms of wellbeing correlate with different gene transcription (as discussed in the next section).

## Hedonic versus Eudaimonic Wellbeing at the Molecular Level

If you're confused about whether to take a hedonic or eudaimonic approach to wellbeing, you might consider letting your cells decide. Fascinating new research (Fredrickson et al., 2013) suggests that the human genome may be more sensitive to the differences between hedonic and eudaimonic wellbeing than either our affective states or our philosophers have been. It turns out that hedonic wellbeing and eudaimonic wellbeing are correlated with different patterns of gene expression. Moreover, the molecular patterns associated with hedonic wellbeing are associated with a stress response that promotes inflammation and decreases antibody production. In contrast, eudaimonic wellbeing is associated with transcription patterns that *increase* antibody production. Fredrickson and her colleagues conclude: "If 'the good life' is a long and healthy life free from the allostatic load of chronic stress, threat, and uncertainty, CTRA gene expression may provide a negative reference point for how not to live. ... If we ask which type of happiness most directly opposes that molecular antipode, a functional genomic perspective favors eudaimonia". According to their findings, hedonic forms of wellbeing (arising from pleasure) are associated with increases in a particular type of stress-related gene expression, whereas eudaimonic wellbeing (arising from connectedness and purpose)

Expert Perspectives—Technology for Mental Health

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**Inspiring Projects—Opportunities for Mental Health and Technology**

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Jonathan Nicholas, Inspire Foundation

In 1998, Inspire launched the world's first online mental health service—ReachOut.com. Since that time, technology has transformed many aspects of our lives, from business to entertainment to how we connect to others. The potential for Internet and mobile technology to similarly transform mental health and wellbeing is enormous—particularly through the provision of targeted and scalable services that enable people to manage their own health. Through their ability to automate processes and scale efficiently, technology-based services can cast a wider net, simultaneously helping larger numbers of people and doing so more affordably. The result is a twenty-first-century model of mental health care that integrates traditional services, such as counseling, with scalable services that allow people to monitor, manage, and improve their own mental health. The goal should be to enable all people to access the right help at the right time in the way they want it.

Our experience of delivering ReachOut.com in Australia, Ireland, and the United States has provided some insight into how this might occur. ReachOut.com reaches 1.6 million unique visitors each year in Australia alone and has the potential to reach many more and for considerably lower cost than traditional commercial and government mental health services.

One of our biggest challenges in reaching this goal of a twenty-first-century mental health system will be to ensure that the user is placed at the
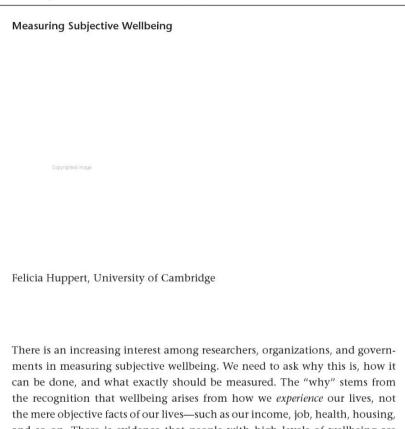
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(continued)

center of that system and to build that system around mental health promotion. We can achieve these things by better integrating technology that enables people to manage and monitor their own wellbeing and assist them with evidence-based advice for personalized mental health care. As one of the pioneers in e–mental health, we are committed to this technology.

We recognize that we can't do it alone, however, and need to form partnerships with researchers and policymakers to build the evidence for these new services and then take them to scale. One of the challenges we continue to face is that "traditional" research processes are often unsuitable in a context where producing innovative and relevant services relies on much quicker timeframes. In this sense, we sincerely welcome positive-computing initiatives that center technology research and practice on mental health and wellbeing support.

Our experience of delivering e–mental health services for more than 15 years is that technology continues to provide exciting opportunities to improve and promote mental health. Taking advantage of these opportunities will require a commitment to research and collaboration between technical and clinical professionals and ultimately a commitment to developing a twenty-first-century mental health system that will enable all people to thrive.

**Measuring Subjective Wellbeing**

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Felicia Huppert, University of Cambridge

There is an increasing interest among researchers, organizations, and governments in measuring subjective wellbeing. We need to ask why this is, how it can be done, and what exactly should be measured. The "why" stems from the recognition that wellbeing arises from how we *experience* our lives, not the mere objective facts of our lives—such as our income, job, health, housing, and so on. There is evidence that people with high levels of wellbeing are healthier, more productive, and more creative and have better relationships with others, so high subjective wellbeing is a desirable goal for individuals and society alike.

How can subjective wellbeing be measured? Skeptics sometimes say that subjective experiences such as happiness cannot in principle be measured. Yet most of us are able to indicate how much we enjoyed a meal or a movie or rate our level of pain on a scale from 0 to 10 when asked by a doctor. Likewise, it is widely accepted that individuals can reliably rate symptoms of distress, such as sadness or anxiety, so there is no reason to suppose they cannot also reliably rate positive experiences. Perhaps more compellingly, many studies show that verbal reports of positive experiences such as happiness or interest are highly correlated with objective measures such as facial expression.

(continued)

The field of subjective wellbeing has also received a great boost from neuroscience because it can be demonstrated that when people report particular experiences, there are patterns of brain activation in regions known to be involved in the neural pathways associated with such experiences.

Since it is important to measure subjective wellbeing, and it is clear that it can be done, we need to consider exactly what should be measured. Studies have traditionally used generic single-item questions about happiness or life satisfaction. But wellbeing is more than a positive feeling or a positive life evaluation. It involves both feeling good and functioning effectively. Feeling and functioning can be measured using questions with different timeframes, including ongoing experiences, recent experiences, and typical experiences.

Importantly, wellbeing is a multidimensional construct that includes feelings, evaluations, and perceptions of how well a person is functioning across different aspects of his or her life. Scholars may differ in what they regard as the central components of wellbeing, but there is consensus about its multidimensional nature. In an empirically derived approach, the components of positive wellbeing (or flourishing) have been conceptualized as the opposite of the symptoms of ill-being—that is, the common mental disorders, namely depression and anxiety. This conceptualization has led to the identification of ten features of flourishing: positive emotion, engagement, meaning, self-esteem, optimism, vitality, resilience, sense of competence, emotional stability, and positive relationships. Measuring multiple features of wellbeing in this way has allowed the discovery of major group and cross-national differences in wellbeing profiles. Future research using this approach can elucidate which features are affected by specific interventions or policies.

As distinguished economist Gus O'Donnell states in relation to wellbeing, "If you treasure it, measure it."

## Note

1. See http://www.selfdeterminationtheory.org/.

## References

AlZoubi, O., Hussain, M. S., D'Mello, S., & Calvo, R. A. (2011). Affective modeling from multichannel physiology: Analysis of day differences. In *Affective computing and intelligent interaction: International conference, ACII 2011, proceedings* (pp. 4–13). Heidelberg: Springer-Verlag Berlin.

Bolger, N., Davis, A., & Rafaeli, E. (2003). Diary methods: Capturing life as it is lived. *Annual Review of Psychology*, *54*(1), 579–616.

Botella, C., & Riva, G. (2012). The present and future of positive technologies. *Cyberpsychology, Behavior, and Social Networking*, *15*(2), 78–84.

Boyce, C. J., & Wood, A. M. (2011). Personality prior to disability determines adaptation: Agreeable individuals recover lost life satisfaction faster and more completely. *Psychological Science*, *22*(11), 1397–1402.

Brickman, P., Coates, D., & Janoff-Bulman, R. (1978). Lottery winners and accident victims: Is happiness relative? *Journal of Personality and Social Psychology*, *36*(8), 917–927.

Calvo, R. A., & Peters, D. (2012). Positive computing: technology for a wiser world. *Interactions (New York, N.Y.)*, *19*(2), 28–31.

Calvo, R. A., & Peters, D. (2013). Promoting psychological wellbeing: loftier goals for new technologies. *IEEE Technology and Society*, *32*(4), 19–21.

Caspi, A., Sugden, K., Moffitt, T. E., Taylor, A., Craig, I. W., Harrington, H., … Poulton, R. (2003). Influence of life stress on depression: Moderation by a polymorphism in the 5-HTT gene. *Science Signaling*, *301*(5631), 386–389.

Clarke, G. N., Hornbrook, M., Lynch, F., Polen, M., Gale, J., Beardslee, W., … Seeley, J. (2001). A randomized trial of a group cognitive intervention for preventing depression in adolescent offspring of depressed parents. *Archives of General Psychiatry*, *58*(12), 1127–1134.

Costa, P., & McCrae, R. (1992). The five-factor model of personality and its relevance to personality disorders. *Journal of Personality Disorders*, *6*, 343–359.

Craig, A. D. B. (2009a). Emotional moments across time: A possible neural basis for time perception in the anterior insula. *Philosophical Transactions B*, *364*(1525), 1933–1942.

• **Reflection** occurs when the user reflects on his or her behavior based on the data, and this reflection can happen in real time as in "How many steps have I just walked?" or after the fact as in "How many hours a day have I been walking this month?"

• **Action** is the phase most closely related to the challenges of positive computing. It is here where Li, Dey, and Forlizzi ask, "What are the effects of personal informatics on daily life?" and list aspects such as "trust in the system, motivation, better decision making, loss of control, etc.," some of which are not directly related to wellbeing.

In part II, we look more deeply at the reflective thinking that personal-informatics technologies can support as well as at how reflection can, in the right circumstances, lead to increased wellbeing.

The quantified-self movement, (a.k.a. "personal Informatics," "self-surveillance," "self-tracking," or "personal analytics") has been wildly successful on many fronts. Thousands participate in the online communities, meeting as part of groups around the world, and the movement has received extensive mainstream press coverage. It is driving a significant amount of innovation, academic research, commercial enterprise, and ideally, positive personal change.

But the full story is only beginning to take shape. The workshop on personal informatics held at the Association of Computing Machinery's Computer–Human Interaction conference has sought to develop the dialogue between those in "design, ubiquitous computing, persuasive technology and information visualization" (Li, Dey, Forlizzi, Höök, & Medynskiy, 2011) who are involved in personal informatics. Psychologists are conspicuously missing from the list, despite the fact that psychological impact and issues such as self-awareness, motivation, self-esteem, balance, frustration, pride, self-criticism, ironic processes, and wellbeing are at the core of these digital experiences. Research such as the study by Li, Dey, and Forlizzi has helped illuminate many of the technical obstacles people face at each stage of self-tracking, but research on psychological barriers and variations to experience will be critical to future work. Yvonne Rogers at University College London discusses this point further (see her sidebar in this chapter).

Deborah Lupton (2012), a sociologist at the University of Sydney, has explored how digital technologies affect the people who use them, including their experiences of embodiment, selfhood, and social relationships. Lupton describes self-tracking using "m-health" devices as a conceptual shift in health promotion. On the one hand, digital self-tracking brings a