Published in final edited form as:

Psychol Health. 2017 May 12; : 1–21. doi:10.1080/08870446.2017.1320798.

Positive Affective Processes Underlie Positive Health Behavior Change

Patty Van Cappellen[1], **Elise L. Rice**[2], **Lahnna I. Catalino**[3], and **Barbara L. Fredrickson**[4]

[1]Duke University

[2]National Cancer Institute

[3]Scripps College

[4]University of North Carolina at Chapel Hill

Abstract

Positive health behaviors such as physical activity can prevent or reverse many chronic conditions, yet a majority of people fall short of leading a healthy lifestyle. Recent discoveries in affective science point to promising approaches to circumvent barriers to lifestyle change. Here we present a new theoretical framework that integrates scientific knowledge about positive affect with that on implicit processes. The *upward spiral theory of lifestyle change* explains how positive affect can facilitate long-term adherence to positive health behaviors. The inner loop of this spiral model identifies nonconscious motives as a central mechanism of behavioral maintenance. Positive affect experienced during health behaviors increases incentive salience for cues associated with those behaviors, which in turn, implicitly guides attention and the everyday decisions to repeat those behaviors. The outer loop represents the evidence-backed claim, based on Fredrickson's broaden-and-build theory, that positive affect builds a suite of endogenous resources, which in turn amplify the positive affect experienced during positive health behaviors and strengthen the nonconscious motives. We offer published and preliminary evidence in favor of the theory, contrast it to other dominant theories of health behavior change, and highlight attendant implications for interventions that merit testing.

Keywords

positive affect; nonconscious; health behavior change; broaden-and-build

By 2020, the World Health Organization expects that chronic diseases (e.g., cardiovascular disease, diabetes, asthma, arthritis, and cancer) will account for almost three-quarters of all deaths worldwide (World Health Organization, 2002). In the U.S. alone, by the time adults reach age 50, 70% have been diagnosed with one or more chronic health conditions that can reduce their quality of life, workforce participation, and lifespan (CDC & AARP, 2013; CDC, AARP, & AMA, 2009). Chronic diseases are also responsible for runaway healthcare costs that burden households, businesses, and governments, and this impact is rapidly

Correspondence concerning this article should be addressed to Barbara L. Fredrickson, University of North Carolina, Chapel Hill, Department of Psychology and Neuroscience, CB 3270, Chapel Hill, NC 27599. blf@unc.edu.

increasing worldwide, no longer limited to the developed regions of the world. Positive health behaviors such as physical activity or healthy eating can prevent or reverse risk for many chronic conditions (Haskell et al., 2007; World Health Organization, 2003, 2006). However, regarding physical activity, a striking number of people fall short of the overall minimum guidelines for physical activity worlsdwide. For example, in the U.S., 80% of adults (Harris et al., 2013) are insufficiently active and in Europe, six in every 10 people above age 15 years never or seldom exercise or play a sport, and more than half never or seldom engage in other kinds of physical activity, such as cycling, dancing or gardening (European Commission, 2014). Regarding obesity, its worldwide prevalence has also nearly doubled between 1980 and 2008. For example, 36% of adults are obese in the U.S. (Ogden, Carroll, Fryar, & Flegal, 2015), and roughly 21% in Europe (World Health Organization, 2008). Although intentions to become and stay healthy are ubiquitous (as evident in perennial New Year's resolutions), lifestyle change is difficult to achieve because people's intentions to be active and healthy yield only trivial changes in actual behavior (Rhodes & Dickau, 2012; Sheeran, 2002).

In this paper we focus primarily on two of the most extensively studied positive health behaviors, physical activity and healthy eating, each of which promotes health and prevents diseases (Macera, 2003). We also include work on meditation, which our team has studied and considers a positive health behavior for its effects on reducing depressive symptoms (Fredrickson, Cohn, Coffey, Pek, & Finkel, 2008), chronic stress and anxiety (e.g., Gotink et al., 2015; Spijkerman, Pots, & Bohlmeijer, 2016), and high blood pressure (Bai et al., 2015), and increasing psychosocial well-being with corresponding changes in markers of immune activity (Fang et al., 2010).

Significance of Positive Affect during Health Behaviors

Discoveries in affective science point to promising approaches to circumvent barriers to lifestyle change. Generally speaking, when people associate enjoyment with the thought of engaging in a health behavior, they are more likely both to intend to engage in that health behavior, and to actually engage in it (Kiviniemi & Duangdao, 2009; Kiviniemi, Voss-Humke, & Seifert, 2007; Lawton, Conner, & McEachan, 2009). Across a range of health behaviors (including physical activity and eating fruits and vegetables), this effect of positive affective attitudes (i.e., that a behavior is seen as enjoyable) has been found to be even stronger than the effects of positive cognitive attitudes (i.e., that a behavior is seen as beneficial; Lawton et al., 2009). The strongest support for this idea comes from research on physical activity: A recent meta-analysis of 82 studies reported a medium to large effect size between people's positive affective judgments about the experience of physical activity and their overall physical activity, which exceeds effect sizes for other predictors of physical activity that receive greater empirical attention (i.e., self-efficacy, the social and built environment; Rhodes, Fiala, & Conner, 2009). Importantly, positive affective judgments about physical activity are unmoved by interventions that deploy persuasive information or target self-regulation skills; personally experienced pleasant affect appears to be key (Rhodes et al., 2009; Williams, 2008). Moreover, *when* that pleasant affect is experienced is critical to forecasting subsequent behavioral engagement. Affective boosts experienced *during* physical activity appear to be especially important in this regard: A recent systematic

analysis of 24 studies concluded that pleasant affect experienced during physical activity forecasts people's future physical activity, whereas pleasant affect experienced after physical activity does not (Rhodes & Kates, 2015). The predictive effects of positive affect felt during activity engagement hold even among initially sedentary adults at 6-and 12-month follow-up (Williams et al., 2008; Williams, Dunsiger, Jennings, & Marcus, 2012).

Similar patterns have emerged within the domain of another health behavior, namely, meditation. Specifically, novice meditators who were one standard deviation above the mean in their positive affective responses to meditation were over 4 times more likely to maintain that behavior 15 months later, compared to those one standard deviation below the mean (Cohn & Fredrickson, 2010). The extent of people's early positive affective reactivity to meditation was the sole psychological predictor of whether, more than 1 year later, they voluntarily chose to continue meditating as a regular habit.

Evidence from multiple domains, then, suggests that positive affect[1], particularly when experienced during positive health behaviors, is consequential for long-term behavioral maintenance. Lacking, however, is a comprehensive theoretical framework that unpacks the mechanisms through which positive affect alters future health-related decision making. To better understand positive health behavioral maintenance, here we present a new theoretical framework that integrates scientific knowledge about positive affect with that on implicit processes. We also highlight attendant implications for interventions that merit testing.

Upward Spiral Theory of Lifestyle Change

Existing theoretical accounts for the role of positive affect in future health behavior engagement rest largely on learned associations, whereby actions that are rewarding or satisfying are more likely to be maintained (Lawton et al., 2009; Rhodes et al., 2009; Rhodes & Kates, 2015; Williams, 2008). Pushing for a deeper understanding of underlying mechanisms, *the upward spiral theory of lifestyle change* draws on discoveries in behavioral neuroscience that unpack complex reward systems into separate “liking,” “wanting,” and “learning” systems. Specifically, the *incentive salience theory of addiction* (Berridge, 2007; Smith, Berridge, & Aldridge, 2011) holds that dopaminergic activity does not account for reward in a general sense, but rather only the subcomponent of wanting (Berridge, 2007). The subcomponent of liking, by contrast, is underpinned by the brain's release of other neurochemicals such as enkephalin (Kringelbach & Berridge, 2012). Over time, associations between pleasantness (liking) and cues predictive of it endow those cues with *incentive salience*, making them more likely to capture attention in the future. When those cues are subsequently encountered, their heightened salience triggers dopaminergic wanting and seeking behaviors. Although much of the foundational support for incentive-salience theory comes from rodent models (Cagniard, Balsam, Brunner, & Zhuang, 2005; Peciña, Cagniard, Berridge, Aldridge, & Zhuang, 2003), a clever paradigm has recently illustrated how

[1]Given the demonstrated independence of positive and negative affect (Watson, Clark, & Tellegen, 1988), studies cited here and the proposed theory focus on positive affect. The functions of positive affect in health behaviors are largely independent of negative affect. Of course, negative affect may well be experienced alongside positive affect, for example during exercise among sedentary individuals. We expect that when the balance between positive and negative affect tip to the positive, the processes described below in the upward spiral theory of lifestyle change will occur.

incentive salience operates in humans (Ode, Winters, & Robinson, 2012). In that research, participants viewed sequential word stimuli that were affectively positive, negative, or neutral, and estimated the font size of the text in which each of the stimulus words were presented. Consistent with incentive salience theory, participants' responses indicated that positively valenced words were perceived as larger than neutral or negative words. Incentive salience thus illuminates the automatic, often nonconscious processes positioned between "liking" a given activity and subsequent and persistent behavioral urges to reenact it ("wanting").

Further, the *broaden-and-build theory of positive emotions* (Fredrickson, 1998, 2001, 2013) provides a theoretical framework to explain how positive affect creates sustained and increasing motives for positive health behaviors. In brief, the broaden-and-build theory posits that experiences of positive emotions (e.g., joy, gratitude, interest, pride, serenity) momentarily broaden people's mindsets in ways that, over time, accumulate and compound to build biological resources (e.g., cardiac vagal tone) as well as cognitive (e.g., mindfulness), psychological (e.g., purpose in life), and social (e.g., positive relations with others) resources (See for a summary of evidence supporting the theory, Fredrickson, 2013).

Weaving together insights from the incentive salience theory with the broaden-and-build theory, Fredrickson (2013) has outlined the *upward spiral theory of lifestyle change* to explain how positive affect can facilitate long-term adherence to positive health behaviors. This theory holds that, to the extent that positive affect is experienced during a new health behavior, it creates nonconscious motives for that activity, which grow stronger over time as they are increasingly supported by certain personal resources – biological, cognitive, psychological, and social – that positive affect serves to build. As such, the theory is well positioned to illuminate the sustained behavioral maintenance that comprises successful lifestyle change. The Figure below depicts the recursive dynamic processes articulated by the upward spiral theory.

The inner loop of this spiral model identifies nonconscious motives as a central mechanism that accounts for behavioral maintenance. It suggests that positive affect experienced during health behaviors incrementally increases incentive salience for cues associated with those behaviors. In turn, heightened incentive salience implicitly guides attention and the quotidian decisions that incrementally set people on trajectories toward healthy lifestyles. The outer loop represents the evidence-backed claim, based on the broaden-and-build theory, that positive affect builds a suite of endogenous resources (Fredrickson, 2013; Fredrickson et al., 2008; Kok et al., 2013). Following Pluess and Belsky (2013), we identify these resources as *vantage resources* to the extent that they render people more sensitive to subsequent positive experiences. As such, just as certain malleable risk factors (e.g., obesity, pessimism, loneliness) deter health, certain malleable vantage resources (e.g., cardiac vagal tone, broad-minded coping, social integration) support health. Vantage resources, we argue, support people's efforts to maintain a healthy lifestyle by amplifying (moderating) the positive affect experienced during positive health behaviors. This greater positive affect, in turn, further strengthens nonconscious motives via the inner loop. We offer, in the sections that follow, an extension of the brief description in Fredrickson (2013) of the upward spiral theory of the of lifestyle change. We first unpack the theory into its two interrelated loops,

and provide new evidence supporting key theorized processes. Second, we discuss the theory in relation to other existing theories in health behavior change. Finally, we provide specific recommendations for future theory-driven research and intervention development.

Evidence for the Upward Spiral's Inner Loop: Positive Affect and Nonconscious Motives

The inner loop of the model (see Figure, gray loop) describes an implicit psychological mechanism hypothesized to explain *how* positive affect can support the maintenance of positive health behaviors. It suggests that positive affect experienced during a positive health behavior creates nonconscious motives for cues associated with that health behavior, motives that in turn support subsequent and repeated decisions to engage in that behavior.

Existing research on health behavior change places undue emphasis on conscious deliberations (Ekkekakis, Parfitt, & Petruzzello, 2011; Rhodes & Kates, 2015). Research has shown, however, that many behavioral decisions are directly influenced by nonconscious motives (Iso-Ahola, 2013; Marteau, Hollands, & Fletcher, 2012; Sheeran, Gollwitzer, & Bargh, 2013). Specifically, evidence suggests that priming concepts related to a behavior or goal can motivate individuals to pursue those behaviors and goals even without conscious awareness of this motivation or its origin (Payne, Brown-Iannuzzi, & Loersch, 2016). Strategies such as implementation intentions (or if-then planning) for example, leverage this mechanism to boost health behavior initation by creating an implicit relation between an anticipated critical situation (opportunity or obstable) and a goal relevant response (Gollwitzer, 1999).

Critically, laboratory experiments have also pinpointed positive affect as particularly influential in the operation of nonconscious motives. In one experiment (Aarts, Custers, & Marien, 2008), nonconscious primes for exertion were paired with positive affect, or not, and also benchmarked against a control condition in which nonconscious primes were absent, but positive affect was present. Comparing handgrip force across these three conditions revealed that when exertion and positive affect were linked, participants used the greatest force to execute their responses – consistent with the idea that positive affect energizes action. Across six other experiments (Custers & Aarts, 2005), priming goal behaviors together with positive affect increased participants' wanting to pursue these behavioral goals and motivated participants to work harder on tasks that were instrumental in attaining them. Such effects emerge even without conscious awareness of the source of the increased motivation. These and other studies suggest that, to the extent that nonconscious goal priming is paired with positive affect, additional motivation is unleashed: people become more likely to want, initiate, and sustain actions for the attainment of nonconsciously primed goals (Custers & Aarts, 2007).

Related experimental work suggests that merely inducing positive affect can non-consciously activate physical activity goals. Participants randomly assigned to experience positive affect showed heightened responses to physical activity words, relative to control participants, on a lexical decision task (Cameron, Bertenshaw, & Sheeran, in press). Induced positive affect also caused participants to broaden their physical activity repertoires,

evidenced by their expressed intentions to undertake more distinct physical activities and being open to trying more new physical activities (Cameron et al., in press).

Recent work by our team indexes nonconscious motives as the relative pleasantness of activity-related thoughts that spontaneously come to mind (Rice & Fredrickson, 2016). To the extent that incentive salience entails heightened activation of mental concepts associated with previously enjoyed stimuli, such concepts may more readily emerge into conscious awareness in the form of positive spontaneous thoughts. Data obtained from a thought-listing task revealed that, as hypothesized, positive spontaneous thoughts were modestly correlated with a previously validated index of incentive salience: estimated font size of a target word (Rice & Fredrickson, 2017, Study 2). Whereas prior work demonstrated that incentive salience makes cues associated with reward visually loom larger in the eyes of perceivers (Ode et al., 2012; Veltkamp, Aarts, & Custers, 2008), these preliminary results suggest that those cues loom larger in their minds as well.

Using this new index of nonconscious motives, our team has found that experienced positive affect shapes positive spontaneous thoughts. Building on preliminary correlational evidence (Rice & Fredrickson, 2017, Study 1), we conducted a laboratory experiment to determine whether the manipulation of pleasantness would alter subsequent patterns of positive spontaneous thoughts about an associated target. Thought-listing data revealed that participants randomly assigned to view a set of relatively more enjoyable cartoons subsequently reported spontaneous thoughts about those cartoons that were more positively valenced than the spontaneous thoughts reported by participants who viewed less amusing cartoons (Rice & Fredrickson, 2017, Study 2). Moreover, a 12-week diary study revealed that the positive affect people experienced during physical activity predicted subsequent increases in the positivity of their spontaneous thoughts about physical activity, and critically that those spontaneous thoughts in turn predicted increases in the frequency and duration of physical activity (Rice, 2016, Study 3). These results provide initial evidence, in the domain of physical activity, that positive affect during a positive health behavior creates nonconscious motives for that health behavior, which in turn predict engagement in that behavior.

Interestingly, although positive affective experiences spark consequential nonconscious motives, the conscious perception that one's spontaneous thoughts are positive may also increase behavioral intentions. We conducted an additional laboratory experiment that used false feedback to test whether perceiving one's own spontaneous thoughts about a physical activity as notably positive is sufficient to alter subsequent behavioral intentions for that activity. Results revealed that participants randomly assigned to receive false feedback that described their spontaneous thoughts about a target physical activity as especially positive planned to devote more time to that activity in the coming week, relative to participants who received no such message (Rice & Fredrickson, 2017, Study 3).

In sum, past research has shown that health behaviors experienced as pleasant are more likely to be maintained (Cohn & Fredrickson, 2010; Rhodes & Kates, 2015; Woolley & Fishbach, 2016a, 2016b). The mechanisms underlying this important effect have remained underdeveloped. The inner loop of the upward spiral theory provides a model to illuminate

the psychological mechanisms that determine how pleasant behaviors are more likely to be maintained, even outside of conscious awareness. Converging evidence from distinct lines of research suggests that positive affective experiences initiate a cascade of nonconscious or spontaneous cognitive processes that may orient the individual to repeat the previously enjoyed behaviors.

Evidence for the Upward Spiral Theory's Outer Loop: Modifiable Vantage Resources for Health Decision-Making

People vary – from one another and over time – in the extent to which they derive pleasant affect from positive health behaviors (e.g., Ekkekakis, Hargreaves, & Parfitt, 2013). For example, the research literature on health behavior change has uncovered limiting factors, which *reduce* the extent to which one can derive pleasant affect from health behaviors. For example, the lack of social resources (e.g., poor social support), physical resources (e.g., physical limitations, unaccommodating built environment, restricted time), psychological resources (e.g., being tired, depressed, chronically stressed), and socio-economic status (e.g., financial challenges), are important factors to consider in studies of pleasant affect derived from health behaviors (e.g., Giles-Corti & Donovan, 2002; Lappalainen et al., 1997; Olano et al., 2015; Pate et al., 1995). The upward spiral theory of lifestyle change adds to this research literature by spotlighting *vantage* resources, whether biological, cognitive, psychological, or social. The outer loop (see Figure, black loop) draws on the broaden-and-build theory of positive emotions (e.g., Fredrickson, 2013) to explain how variation in certain vantage resources amplifies (moderates) the positive affect gained from positive health behaviors *and* how these vantage resources are in turn further augmented by the experience of positive affect. These reciprocal effects also foster the dynamics of upward spirals. Below, we focus on a subset of biological and psychological variables that have been shown to function as vantage resources.

One biological vantage resource that our team has studied is cardiac vagal tone, which refers to the function of the vagus nerve, a key component of the parasympathetic nervous system. The vagus nerve regulates many internal organs, including the heart, lungs, and digestive system by sending the message to support the body to rest, digest, and connect (Porges, 2007). Cardiac vagal tone is an index of both autonomic flexibility, emotional flexibility, and physical health. Low vagal tone, for instance, has been linked to high fasting glucose, overnight urinary cortisol, and inflammation (Thayer & Sternberg, 2006). Critical to the present theory, cardiac vagal tone is improved by health behaviors and experiences of positive emotions, and in turn appears to modulate the emotional reactions to health behaviors. Supportive initial evidence comes from a longitudinal field experiment in which mid-aged adults were randomly assigned to attend a six-week workshop that taught the positive health behavior of meditation (focused on loving-kindness) or to serve in a monitoring, waitlist control group (Kok et al., 2013). All participants reported their levels of ten distinct positive emotions daily. Participants' high-frequency heart rate variability (HF-HRV), an index of cardiac vagal tone, was measured at baseline and nine weeks later, at the end of the study. Results indicated that baseline HF-HRV amplified (moderated) the positive affect that stemmed from meditation. In turn, HF-HRV showed improvements over time to

the extent that participants' meditation practice evoked positive affect and positive social connections. In addition, to the extent that HF-HRV is a correlate of cardiorespiratory fitness (Buchheit & Gindre, 2006), it also stands both to enhance positive affect during physical activity, and to be augmented further by repeated decisions to be physically active. Cardiac vagal tone thus appears to be one biological vantage resource that may leverage upward spiral dynamics.

Recent evidence from our team suggests that the oxytocin system may also serve as a vantage resource that fuels upward spiral dynamics. Using a similar longitudinal experimental design (i.e., 6-week meditation workshops, daily reports of positive emotions) we found that a common genetic variant associated with oxytocin signaling predict the degree to which mid-aged participants reported positive affect in response to loving-kindness meditation (Isgett, Algoe, Boulton, Way, & Fredrickson, 2016). In another study (Van Cappellen, Way, Isgett, & Fredrickson, 2016), we found that dual-blind administration of exogenous oxytocin vs. a placebo increased mid-aged men's positive affective responses – assessed with both implicit and explicit measures – to an initial 20-minute introduction to meditation, with effects especially evident for meaningful and self-transcendent affective experiences, such as gratitude and awe (Van Cappellen, in press). Future work is needed to investigate whether the oxytocin system influences positive affective responses to health behaviors other than meditation.

Among psychological vantage resources, flourishing mental health, characterized by the lack of mental illness as well as the presence of positive functioning (e.g., self-acceptance; Keyes, 2005), was found to increase (moderate) positive affect during a range of behaviors that contribute to well-being (e.g. interacting with others, helping, spiritual activity). These heightened positive affective reactions, in turn forecasted future increases in flourishing, months later (Catalino & Fredrickson, 2011). Other research shows that positive affect and individual differences in emotion regulation strategies (i.e, positive reappraisal and mindfulness, Garland, Gaylord, & Fredrickson, 2011), positive coping (Burns et al., 2008), and broad-minded coping (Fredrickson & Joiner, 2002) reciprocally and prospectively enhance one another and are therefore potential good candidates to be vantage resources in the specific context of positive health behaviors.

Another psychological resource that both amplifies the positive affect people extract from positive health behaviors, and appears to be built through recurrent experiences of positive affect, is the individual difference of prioritizing positivity. Prioritizing positivity is the tendency to structure daily life to include pleasant experiences (example item, “I structure my day to maximize my happiness,” Catalino, Algoe, & Fredrickson, 2014). In a field study, our team has uncovered preliminary evidence that people scoring higher on a self-report measure of prioritizing positivity report greater positive affect in response to positive health behaviors. Mid-aged adults learned one of two types of meditation over a 6-week workshop and reported daily on the emotions they felt while meditating. We discovered that prioritizing positivity appeared to amplify the positive affect people experienced when engaging in meditation, even after adjusting for participants' typical levels of positivity (Catalino, Van Cappellen, Boulton, Firestine, & Fredrickson, 2017). In this same longitudinal study, participants also provided daily reports of physical activity engagement,

and, if active, the positive affect they experienced in their chosen activity. Results showed that those scoring higher on prioritizing positivity reported greater positive affect during bouts of physical activity, an effect that also remained significant after controlling for participants' typical levels of positivity (Catalino et al., 2017). In addition, Datu and King (2016), in a longitudinal study, found reciprocal relations between prioritizing positivity and positive affect in daily life.

In sum, the outer loop of the model addresses variation over time and across people in the extraction of pleasant affect during positive health behaviors. In addition, the outer loop modulates the inner loop, and in doing so illuminates when and for whom vantage resources predict *increasing* enjoyment of positive health behaviors. Two important implications follow from the outer loop of the model. First, ample past research has documented natural declines in the enjoyment of recurrent experiences due to adaptation, termed the hedonic treadmill (Brickman & Campbell, 1971; Diener, Lucas, & Scollon, 2006). The endogenous vantage resources built via the outer loop of the model may function to counteract such adaptation (Fredrickson et al., 2008). For example, interventions that have taught people how to self-generate positive affect have shown *increased* effectiveness over time (Fredrickson et al., 2008; Moskowitz et al., 2017). Second, the broaden-and-build theory featured in the outer loop asserts that positive emotions create *flexible* patterns of thoughts and behavioral actions. This flexibility may protect against a potentially rigid or obsessive pursuit of positive health behaviors by building harmonious passion for those behaviors (for relevant research on obsessive passion, see Vallerand, 2010; see also Rice & Fredrickson, 2016 for the relation between harmonious passion, incentive salience, and physical activity). Positive emotions may also also render people more flexible and creative in finding solutions when their behavioral goals get derailed or when a particular health behavior no longer evokes positive affect.

Upward Spiral Theory Compared to Other Theories of Health Behavior Change

The upward spiral theory does not replace but rather complements other theories of health behavior change by shedding light on understudied affective, nonconscious and growth-related processes, namely, (1) positive affect experienced during positive health behaviors, (2) nonconscious motives related to incentive salience, and (3) modifiable vantage resources that support increasing and nonconscious motives for positive health behavior change. In addition, whereas other theories of health behavior change largely center on behavioral initiations, the upward spiral theory centers on the long-term behavioral maintenance that defines lifestyle change. Here, we first briefly describe the points of overlap and difference between the upward spiral theory and five dominant theories for health behavior change: the transtheoretical model (Prochaska & Velicer, 1997), goal setting theory (Locke & Latham, 1990), social cognitive theory (Bandura, 1991), and the theory of planned behavior (Ajzen, 1991; Godin & Kok, 1996). We then discuss the upward spiral theory in comparison to related theories, or iterations thereof, that have more explicitely addressed affective mechanisms (e.g., theory concerning fear appeals and protection motivation, Rogers, 1983).

The construct of “stage of change” is a key element of the transtheoretical model (TTM) of health behavior change (Prochaska & Velicer, 1997). The TTM proposes that people can be at different stages of readiness to adopt healthful behaviors: precontemplation, contemplation, preparation, action, maintenance, and termination. In relation to the TTM, the upward spiral theory concerns the later stages of change, i.e., action, maintenance, and termination. We suggest that once a new health behavior is enacted with concurrent experiences of positive affect, then the implicit processes identified by the upward spiral theory of lifestyle change ensue.

Goal-setting theory is another widely used theory, which holds that individuals who set hard and specific goals for health behavior change perform better than those who set easy or abstract goals (as long as the person has the necessary ability to reach the goal and does not have conflicting goals). In relation to goal-setting theory, the upward spiral theory specifies an additional condition necessary to render goals for behavioral change more likely to be sustained in the long-term. Specifically, the upward spiral theory suggests that individuals who work toward hard and specific goals for positive health behaviors that evoke positive emotions (e.g., pride, joy) during behavioral enactment will be more likely to sustain behavioral maintenance.

A limitation to the theories of health behavior change cited above is the common focus on change in behavioral *intentions* (i.e., earlier stages in the TTM). The assumption is that people with the right intentions will be able to summon the willpower to enact their intended behavioral changes. People's conscious behavioral intentions, however, often do not align with their actual behavioral engagement, a mismatch termed the intention-behavior gap (Sheeran, 2002). That is, many people, despite having the support, the means, and the beliefs that they can initiate positive health behaviors, fail to adopt or sustain healthy habits.

Moreover, each of these dominant theories rests, to some extent, on *conscious* behavioral intentions. Social cognitive theory (Bandura, 1991), in particular, frames behavior change as relying on conscious self-monitoring and the deliberate exercise of self-influence. The concept of self-efficacy, the belief that one has the ability to perform a specific behavior that will bring about desired outcomes, is a key component of social cognitive theory, one that is also relevant to the upward spiral theory (Strecher, McEvoy DeVellis, Becker, & Rosenstock, 1986). Self-efficacy, for instance, may be central to individuals' ability to identify and enact positive health behaviors that are anticipated to spark positive affect. Concepts related to agency and self-efficacy have also been co-opted into other dominant theories of health behavior change. The theory of planned behavior (Ajzen, 1991; Godin & Kok, 1996), for instance, unpacks the formation of conscious behavioral intentions as a function of attitudes toward a behavior (general evaluation of the behavior as positive or negative), subjective norms (how much peers support one's engagement in a behavior), and perceived behavioral control (how much one has control over the realisation of the behavior). However, research shows that people's day-to-day health behaviors often defy conscious willpower and are instead shaped by implicit emotions and nonconscious motives (Iso-Ahola, 2013; Marteau et al., 2012; Sheeran et al., 2013). Moreover, the processes that guide people's day-to-day health decisions change as they move beyond initiating a new health behavior into the habitual maintenance of it (Rothman, 2000; Rothman, Baldwin,

Hertel, & Fuglestad, 2011), with the impact of nonconscious (versus conscious) processes becoming stronger over time (Papies & Aarts, 2011).

Whereas the theory of planned behavior and other dominant theories of health behavior change are silent on the influence of nonconscious processes, the upward spiral theory pinpoints positive affect experienced during positive health behaviors as the source of (1) nonconscious motives to repeat positive health behaviors, (2) increasingly positive attitudes toward positive health behaviors, and (3) the accrual of vantage resources, such as resilience, harmonious passion, and flexibility, that may impact perceived behavioral control.

Whereas most classic theories of health behavior change rest on rationally made decisions that weigh the costs and benefits of adopting a new behavior, other, often newer theories spotlight affective processes. Perhaps the earliest to do so pertains to fear appeals and protection motivations. According to this approach, one strategy to modify a person's intention to initiate a given health behavior is to induce fear by increasing perceptions of the probability that a health threat will occur. When such fear appeals are connected to a recommended preventive health behavior, then the intention to adopt this health behavior is said to increase. One limit of this theory is that it only applies to situations involving threat and it makes fear a condition for behavior change. This is problematic for multiple reasons. First, healthy lifestyles are valuable even if there is no direct or imminent threat to a person's health. Second, individuals do not always recognize objective threat when present. Finally, fear appeals and protection motivations do not capture the full range of motivations for health behavior change, many of which are promotion-focused rather than prevention-focused (Higgins, 1998). As such, additional theories are needed to account for promotion-focused health behavior change in non-threatening contexts. The upward spiral is one such theory.

Later iterations of Ajzen's theory of planned behavior have also spotlighted affective processes (Ajzen & Driver, 1991). In studying the role of attitudes (overall evaluation of the behavior) in predicting people's intentions to engage in a behavior, two types of attitudes have been differentiated: cognitive (whether one evaluates the behavior as beneficial) and affective (whether one associates the behavior with a particular affective state) attitudes. As mentioned previously, when affective attitudes toward health behaviors are positive, those attitudes predict behavior engagement, over and above cognitive attitudes (e.g., Lawton et al., 2009). In a distinct body of research, another conceptualization of affective attitudes has emerged, namely, anticipated affective reactions (Ajzen & Sheikh, 2013). These capture the feelings expected to *follow* the act of doing (e.g., relief, pride) or not doing (e.g., guilt) a behavior. Most research has been concentrated on negative anticipated affect associated with not doing a behavior, which predicts intention and behavior. By contrast, positive anticipated affect associated with doing the behavior has received far less attention (Conner, Godin, Sheeran, & Germain, 2013; Sandberg & Conner, 2008).

Providing further proof of principle that affective attitudes predict people's intention to engage in a behavior, other research has tested whether it is possible to change, at least in the short term, people's affective attitudes toward the representation of a behavior. The

technique of evaluative conditioning is deployed here: pairing pictures of health behaviors with valenced stimuli, to investigate whether doing so modifies people's health behavior decisions in a subsequent task. For example, Walsh and Kiviniemi (2014) primed participants with positive, neutral, or negative affective pictures before showing pictures of fruits. They found that participants who saw fruit images paired with positive images (vs. neutral or negative) were more likely to select a fruit snack vs. a granola bar at the end of the lab study. Similar results using similar procedures for evaluative conditioning were also found in the domain of physical activity. Despite small sample size, participants who had preexisting negative affective attitudes toward exercising but acquired more positive attitudes through an evaluative conditioning task were found to subsequently choose to ride a bycicle ergometer at a higher intensity, compared to participants in a control group (with varying levels of preexisting affective attitudes and for whom exercise-related images were paired with neutral instead of positive images, Antoniewicz & Brand, 2016).

The upward spiral theory of lifestyle change advances beyond affective attitudes and evaluative conditioning to deepen scientific understanding of the mechanisms (nonconscious processes and increasing vantage resources) through which these affective constructs operate. In addition, the upward spiral theory focuses on the affect associated with the actual enactment of a health behavior and not with the idea or the representation of the health behavior (e.g., affective attitudes are typically measured by asking someone how they feel when thinking about eating fruits). This difference is critical for two reasons. One is that positive affect experienced *during* a positive health behavior appears to be particularly predictive of behavioral maintenance (Rhodes & Kates, 2015). Another is that personally experienced positive affect during behavioral enactment may be required to build resources that will in turn amplify the positive emotion yield of health behaviors and support their maintenance. Moreover, vantage resources are posited to increase over time, built through repeated experiences of positive emotions, which explains how affective effects can defy adaptation and instead grow in impact (Fredrickson et al., 2008; Moskowitz et al., 2017). As such, in contrast with the application of evaluative conditioning to health behavior change, the upward spiral theory provides a rationale to understand not only behavioral initiation or short term changes, but also long-term maintenance.

Despite the differences between the upward spiral theory and research on affective attitudes and evaluative conditioning, points of connection emerge as well. For instance, the upward spiral theory can be said to describe evaluative conditioning as it unfolds in natural, day-to-day circumstances, rather than in a one-time, artificial laboratory settings. The upward spiral theory also describes how recurrent experiences of positive affect during a given category of health behaviors (e.g, jogging, or eating dark, leafy greens), little by little shape people's more general affective attitudes about that category of behaviors (e.g., I enjoy jogging; I like eating greens). Within the upward spiral model, these more general positive attitudes – built through the repeated experiences of positive affect in situ – may function as vantage resources that ultimately enhance (moderate) the positive affect felt within subsequent enactments of that behavior.

Future Directions: Increasing Positive Affect During Positive Health Behaviors

As articulated in the upward spiral theory of lifestyle change, positive affect during positive health behaviors is hypothesized to spark *nonconscious* (cf. inner loop) and *increasing* (cf. outer loop) motives to pursue that behavior in the future. As such, increasing positive affect felt while engaging in positive health behaviors stands to trigger the hypothesized upward spiral dynamics. Interventions that boost such affective experiences merit investigation.

People pursue positivity in various ways, some more effective than others. Research shows, for instance, that when people deliberately try to maximize their current positive affect, with excessively high standards in mind, it ironically makes them feel worse (Catalino et al., 2014; Mauss, Tamir, Anderson, & Savino, 2011). Willfully up-regulating momentary pleasant affect during the enactment of health behaviors may thus backfire. This precaution is important to keep in mind when developing interventions to increase positive affect during positive health behaviors.

Our team's initial evidence suggests that a more effective approach to experiencing more positive affect during positive health behaviors is to “prioritize positivity” at various stages of goal setting. A first stage would be activity selection, which involves strategically choosing more enjoyable health behaviors. This approach capitalizes on the evidence that situation selection is one of the most successful strategies for affect regulation (Gross & Thompson, 2007). Our research has shown that scheduling regular pleasant events in daily life is an effective way to deliberately experience more positive affect (Catalino et. al, 2014). For example, for some people, going for a run is experienced as a chore, whereas for others it is a joy. When choosing a health-enhancing activity, people can explicitly base their selection on the positive affect they anticipate during the activity. Research shows, for instance, that women who select types of exercise that they genuinely enjoy end up being more active than those who prioritize health or weight loss (Segar, Eccles, & Richardson, 2008, 2011). Importantly, preliminary evidence from our laboratory suggests that people can be taught to prioritize positivity when engaging in their positive health behaviors (Catalino et al., 2017; Van Cappellen, Catalino, Boulton, Firestine, & Fredrickson, 2017). In one study, for instance, we randomized participants to read one of two brief “news articles” that presented scientific facts about positive emotions. Those in the experimental condition read about the benefits of positive emotions and prioritizing pleasant experiences rather than forcing them. Those in the control condition read about the neuroscience of positive emotions, which presented no implications for daily life choices. Participants were subsequently asked to list all the activities they had “on deck” for the coming Sunday, and later rated the pleasantness of each. Relative to the control condition, the top five activities reported by those induced to prioritize positivity were more pleasant (Catalino, Van Cappellen, & Fredrickson, 2016). Future interventions could be tailored to motivate individuals to prioritize positivity specifically when choosing physical activities or healthy foods.

A second stage at which prioritizing positivity may operate is during activity engagement. While engaging in their selected activity, people high on prioritizing positivity may be more

likely to look for and nurture (not force) their positive affective experiences as they naturally occur, an approach that deploys the related yet distinct skills of mindfulness and savoring (Kiken, Lundberg, & Fredrickson, in press). Studies described in the earlier section on the outer loop provide preliminary evidence that people who score higher on a self-report measure of prioritizing positivity derive more positive emotions from physical activity and from meditation. Additional preliminary evidence again suggests that it is possible to teach people these skills. Specifically, using the same experimental manipulation based on news articles (described above), participants who learned about the benefits of positive emotions and prioritizing (and not forcing) pleasant experiences reported greater savoring and experiences of love and compassion during a 20-minute introduction to loving-kindness meditation (Van Cappellen et al., 2017).

A third stage at which prioritizing positivity may operate is at post-activity evaluation: After having engaged in their selected activity, people high on prioritizing positivity may be more likely to monitor whether they actually experienced pleasant feelings during activity engagement. We speculate that people who score higher on prioritizing positivity may be more motivated to change the selected activity if it fails to yield positive affect. For example, if intial attempts to go for a run are unenjoyable, people who score higher on prioritizing positivity may next time choose another activity, such as gardening. These first and third stages, activity selection and post-activity evaluation, may be particularly critical in overcoming common barriers to health behaviors such as not being in the mood, bad weather, or seeing a healthy lifestyle as another chore. The upward spiral theory implies that such barriers are not best fought by willpower, but rather ought to be acknowledged and dealt with creatively. The goal shifts from rigidly adopting a healthy lifestyle regardless of how it feels to do so, to judiciously pursuing enjoyable health behaviors to support the long-term maintenance of the desired healthy lifestyle.

It thus appears possible to teach people to prioritize those positive health behaviors that, in their enactment, boost experiences of pleasant affect, and to derive more enjoyment from the health behaviors in which they already engage. Fully-powered randomized controlled trials that meet these objectives would answer the call for intervention studies that modify the affective experience of physical activity (Rhodes & Kates, 2015).

Current Limits

One boundary condition of the upward spiral theory of lifestyle change may be that it applies to increasing positive health behaviors (e.g., physical activity, healthy eating, meditation) more than reducing negative health behaviors (e.g., smoking, excessive alcohol consumption). One reason is that to reduce negative health behaviors, positive affect would need to be associated with *not* drinking alcohol excessively or *not* smoking. Although these eliciting situations are likely to occur (e.g., not being out of breath anymore after having stopped smoking or sleeping better when not drinking), absences of unpleasant experiences are less circumscribed and perhaps harder for people to recognize. A related reason is that the positive affect that may arise when refraining from negative health behaviors necessarily competes with the physical pleasures that arise when enacting negative health behaviors. For example, someone who “feels good” when drinking excessive amounts of alcohol may

already have undergone addiction-related neural sensitization (Berridge, 2007), or otherwise use those good feelings to justify maintaining that unhealthy behavior. Elsewhere we distinguish between two forms of positive affect, i.e., positive emotions and physical pleasures (Fredrickson, 2001), and hypothesize here that only the former creates the dual-loop reciprocal processes articulated within the upward spiral of lifestyle change. Whereas physical pleasures may activate the inner loop, they may not broaden awareness in ways that build endogenous vantage resources, as indicated by the model's outer loop (see Figure). Preliminary evidence indirectly suggests that pleasures may not trigger the same psychological processes as positive emotions. For example, positive emotions have been shown to broaden attention, which is not the case for pleasurable stimuli such as pictures of delicious desserts (Fredrickson, 2013; Gable & Harmon-Jones, 2008).

Another limit of the upward spiral theory is the current paucity of direct tests of it within the domain of healthy lifestyle choices. Some of the evidence cited here, for instance, draws from research within domains not specifically tied to health behaviors (e.g., Rice & Fredrickson, 2017, Study 2). Rigorous experimental and longitudinal research within the domain of positive health behaviors is needed to directly tests the many hypotheses about positive health behavior change that are articulated by the theory.

Finally, the upward spiral theory would benefit from articulating and testing its relations to socioeconomic disparities and other barriers to lifestyle change that may reduce the extent to which positive emotions may be derived from positive health behaviors. Evidence suggests, for instance, that severe and chronic stress experienced in early childhood can produce a biological residue that alters affective and behavioral proclivities decades later (Miller, Chen, & Parker, 2011; Shonkoff, Boyce, & McEwen, 2009). Less known is whether and how such changes are reversible later in life. However, animal research suggest that if early adversity increases the risk for vulnerability in later life, positive experiences (e.g., maternal warmth) can decrease such risk (See Shonkoff et al., 2009). Intervening early in life appears to be especially important to prevent entranched health disparities and bad health behavior habits later in life. The present model could be applied for children growing in low SES household. In addition, its focus on positive affect may be particularly relevant given the known relation between positive emotions and coping with stress (e.g., Folkman & Moskowitz, 2000). Additionally, resources such as finances, access to conducive built environments (e.g., parks, recreation centers) and natural environments (e.g., oceans, forests) are less mutable than the vantage resources identified in the upward spiral theory. Even so, the upward spiral theory suggests that people who can find ways – within their current contexts – to be creative and flexible in their efforts to maximize positivity during positive health behaviors may fare better than others in those same contexts. Still, we acknowledge that such entrenched limiting factors may reduce the likelihood of experiencing positivity during health behaviors or overwhelm the influence of more subtle nonconscious processes.

Conclusion

Recent studies, primarily regarding physical activity and meditation, suggest that the positive affect experienced during these positive health behaviors may forecast people's

continued engagement in them. Illuminating possible mechanisms for this effect, the upward spiral theory of lifestyle change holds that positive affect experienced during positive health behaviors predicts subsequent increases in *nonconscious motives* for those health behaviors, which in turn predict future engagement in them (Rice & Fredrickson, 2017, Study 3). In addition, over time these positive affective boosts function to build endogenous vantage resources. Whether biological (e.g., cardiac vagal tone), cognitive (e.g., mindfulness), psychological (e.g., prioritizing positivity), or social (e.g., social integration), these vantage resources *increase* the coupling between positive health behaviors and positive affect. Accordingly, interventions that boost the positive affect experienced during positive health behaviors stand to facilitate repeated decisions to engage in those health behaviors by cultivating *nonconscious* and *increasing* motives for those behaviors. Future research should focus on developing effective strategies to modify the affective experience of positive health behaviors. We suggest that people who prioritize positivity in their day-to-day choices of whether and how to lead their desired healthy lifestyle may be more likely to show long-term sustained adherence to that lifestyle.

Acknowledgments

Support for the authors' time came from four research grants awarded by the U.S. National Institutes of Health (NIH) to Principal Investigator Barbara L. Fredrickson. These were a National Institute for Nursing Research Grant (R01NR012899), an award supported by the NIH Common Fund, which is managed by the NIH Office of the Director/Office of Strategic Coordination; a National Cancer Institute Research Grant (R01CA170128); a National Center for Complementary and Integrative Health Research Grant (R01AT007884) and a National Institute on Aging Research Grant (R01AG048811). These funding agencies played no role in study design, data collection, data analysis, decision to publish, or preparation of the manuscript.

References

Aarts H, Custers R, Marien H. Preparing and motivating behavior outside of awareness. Science. 2008; 319(5870):1639.doi: 10.1126/science.1150432 [PubMed: 18356517]

Ajzen I. The theory of planned behavior. Organizational Behavior and Human Decision Processes. 1991; 50(2):179–211.

Ajzen I, Driver BL. Prediction of leisure participation from behavioral, normative, and control beliefs: An application of the theory of planned behavior. Leisure Sciences. 1991; 13(3):185–204.

Ajzen I, Sheikh S. Action versus inaction: Anticipated affect in the theory of planned behavior. Journal of Applied Social Psychology. 2013; 43(1):155–162.

Antoniewicz F, Brand R. Learning to like exercising: Evaluative conditioning changes automatic evaluations of exercising and influences subsequent exercising behavior. Journal of Sport and Exercise Psychology. 2016; 38(2):138–148. DOI: 10.1123/jsep.2015-0125 [PubMed: 27385674]

Bai, Z., Chang, J., Chen, C., Li, P., Yang, K., Chi, I. Investigating the effect of transcendental meditation on blood pressure: a systematic review and meta-analysis; Journal of Human Hypertension. 2015. p. 653-662.doi:http://dx.doi.org/10.1038/jhh.2015.6

Bandura A. Social cognitive theory of self-regulation. Organizational Behavior and Human Decision Processes. 1991; 50(2):248–287.

Berridge KC. The debate over dopamine's role in reward: The case for incentive salience. Psychopharmacology. 2007; 191(3):391–431. DOI: 10.1007/s00213-006-0578-x [PubMed: 17072591]

Brickman, P., Campbell, DT. Hedonic relativism and planning the good society. In: Appley, MH., editor. Adaptation level theory: A symposium. New York, NY: Academic Press; 1971. p. 287-302.

Buchheit M, Gindre C. Cardiac parasympathetic regulation: Respective associations with cardiorespiratory fitness and training load. American Journal of Physiology Heart and Circulatory Physiology. 2006; 291(1):H451–458. DOI: 10.1152/ajpheart.00008.2006 [PubMed: 16501030]

Burns AB, Brown JS, Sachs-Ericsson N, Plant EA, Curtis JT, Fredrickson BL, Joiner TE. Upward spirals of positive emotion and coping: Replication, extension, and initial exploration of neurochemical substrates. Personality and Individual Differences. 2008; 44(2):360–370. DOI: 10.1016/j.paid.2007.08.015 [PubMed: 21753863]

Cagniard B, Balsam PD, Brunner D, Zhuang X. Mice with chronically elevated dopamine exhibit enhanced motivation, but not learning, for a food reward. Neuropsychopharmacology. 2005; 31(7):1362–1370. [PubMed: 16319913]

Cameron DS, Bertenshaw EJ, Sheeran P. Positive affect and physical activity: Impacts on goal setting, activation, prioritization, and attainment. Psychology & Health (Special Issue on "Emotion, Health Decision Making, and Health Behavior"). in press.

Catalino LI, Algoe SB, Fredrickson BL. Prioritizing positivity: An effective approach to pursuing happiness? Emotion. 2014; 14:1155–1161. [PubMed: 25401290]

Catalino LI, Fredrickson BL. A Tuesday in the life of a flourisher: the role of positive emotional reactivity in optimal mental health. Emotion. 2011; 11(4):938–950. [PubMed: 21859208]

Catalino LI, Van Cappellen P, Boulton A, Firestine A, Fredrickson BL. Prioritizing positivity predicts engagement in new wellness behaviors that evoke positive emotions. Manuscript in preparation. 2017

Catalino LI, Van Cappellen P, Fredrickson BL. Manipulating prioritizing positivity causes changes in the scheduling of future pleasant events. Unpublished raw data. 2016

CDC, & AARP. Use of Clinical Preventive Services and Prevalence of Health Risk Factors Among Adults Aged 50-64. 2013.

CDC, AARP & AMA. Promoting Preventive Services for Adults 50-64: Community and Clinical Partnerships. Atlanta, GA: National Association of Chronic Disease Directors; 2009.

Cohn MA, Fredrickson BL. In search of durable positive psychology interventions: Predictors and consequences of long-term positive behavior change. The Journal of Positive Psychology. 2010; 5(5):355–366. [PubMed: 21709728]

Conner M, Godin G, Sheeran P, Germain M. Some feelings are more important: Cognitive attitudes, affective attitudes, anticipated affect, and blood donation. Health Psychology. 2013; 32(3):264–272. DOI: 10.1037/a0028500 [PubMed: 22612559]

Custers R, Aarts H. Positive affect as implicit motivator: On the nonconscious operation of behavioral goals. Journal of Personality and Social Psychology. 2005; 89(2):129–142. DOI: 10.1037/0022-3514.89.2.129 [PubMed: 16162049]

Custers R, Aarts H. In search of the nonconscious sources of goal pursuit: Accessibility and positive affective valence of the goal state. Journal of Experimental Social Psychology. 2007; 43(2):312–318. DOI: 10.1016/j.jesp.2006.02.005

Datu, JAD., King, RB. Prioritizing positivity optimizes positive emotions and life satisfaction: A three-wave longitudinal study; Personality and Individual Differences. 2016. p. 111-114.doi:http://dx.doi.org/10.1016/j.paid.2016.02.069

Diener E, Lucas RE, Scollon CN. Beyond the hedonic treadmill: Revising the adaptation theory of well-being. American Psychologist. 2006; 61(4):305–314. [PubMed: 16719675]

Ekkekakis P, Hargreaves EA, Parfitt G. Invited Guest Editorial: Envisioning the next fifty years of research on the exercise–affect relationship. Psychology of Sport and Exercise. 2013; 14(5):751–758.

Ekkekakis P, Parfitt G, Petruzzello SJ. The pleasure and displeasure people feel when they exercise at different intensities: Decennial update and progress towards a tripartite rationale for exercise intensity prescription. Sports Medicine. 2011; 41(8):641–671. [PubMed: 21780850]

European Commission. Special Eurobarometer. Vol. 412. 2014. Sport and physical activity report.

Fang CY, Reibel DK, Longacre ML, Rosenzweig S, Campbell DE, Douglas SD. Enhanced psychosocial well-being following participation in a mindfulness-based stress reduction program is associated with increased natural killer cell activity. Journal of Alternative Complementary Medicine. 2010; 16(5):531–538. DOI: 10.1089/acm.2009.0018 [PubMed: 20455784]

Folkman S, Moskowitz JT. Stress, positive emotion, and coping. Current Directions in Psychological Science. 2000; 9(4):115–118.

Fredrickson BL. What good are positive emotions? Review of General Psychology. 1998; 2:300–319. [PubMed: 21850154]

Fredrickson BL. The role of positive emotions in positive psychology: the Broaden-and-Build Theory of positive emotions. American Psychologist. 2001; 56:218–226. [PubMed: 11315248]

Fredrickson BL. Positive emotions broaden and build. Advances in Experimental Social Psychology. 2013; 47:1–53.

Fredrickson BL, Cohn MA, Coffey KA, Pek J, Finkel SM. Open hearts build lives: Positive emotions, induced through loving-kindness meditation, build consequential personal resources. Journal of Personality and Social Psychology. 2008; 95:1045–1062. [PubMed: 18954193]

Fredrickson BL, Joiner T. Positive emotions trigger upward spirals toward emotional well-being. Psychological Science. 2002; 13(2):172–175. [PubMed: 11934003]

Gable PA, Harmon-Jones E. Approach-motivated positive affect reduces breadth of attention. Psychological Science. 2008; 19(5):476–482. [PubMed: 18466409]

Garland EL, Gaylord SA, Fredrickson BL. Positive reappraisal mediates the stress-reductive effects of mindfulness: An upward spiral process. Mindfulness. 2011; 2(1):59–67. DOI: 10.1007/s12671-011-0043-8

Giles-Corti B, Donovan RJ. Socioeconomic status differences in recreational physical activity levels and real and perceived access to a supportive physical environment. Preventive Medicine. 2002; 35(6):601–611. [PubMed: 12460528]

Godin G, Kok G. The theory of planned behavior: A review of its applications to health-related behaviors. American Journal of Health Promotion. 1996; 11(2):87–98. [PubMed: 10163601]

Gollwitzer PM. Implementation intentions: Strong effects of simple plans. American Psychologist. 1999; 54(7):493–503.

Gotink RA, Chu P, Busschbach JJ, Benson H, Fricchione GL, Hunink MM. Standardised mindfulness-based interventions in healthcare: an overview of systematic reviews and meta-analyses of RCTs. Plos One. 2015; 10(4):e0124344. [PubMed: 25881019]

Gross, JJ., Thompson, RA. Emotion regulation: Conceptual foundations. In: Gross, JJ., editor. Handbook of emotion regulation. New York, NY: Guilford Press; 2007. p. 3-24.

Harris CD, Watson KB, Carlson SA, Fulton JE, Dorn JM, Elam-Evans L. Adult participation in aerobic and muscle-strengthening physical activities - United States, 2011. Morbidity and Mortality Weekly Report, Center for Disease Control. 2013; 62(17):326–330.

Haskell WL, Lee IM, Pate RR, Powell KE, Blair SN, Franklin BA, et al. Bauman A. Physical activity and public health Updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. Circulation. 2007; doi: 10.1161/CIRCULATIONAHA.107.185649 [PubMed: 17671237]

Higgins ET. Promotion and prevention: Regulatory focus as a motivational principle. Advances in Experimental Social Psychology. 1998; 30:1–46.

Isgett SF, Algoe SB, Boulton AJ, Way BM, Fredrickson BL. Common variant in OXTR predicts growth in positive emotions from loving-kindness training. Psychoneuroendocrinology. 2016; 73:244–251. [PubMed: 27543885]

Iso-Ahola, SE. Exercise: Why it is a challenge for both the nonconscious and conscious mind; Review of General Psychology. 2013. p. 93-110.doi:http://dx.doi.org/10.1037/a0030657

Keyes CLM. Mental illness and/or mental health? Investigating axioms of the complete state model of health. Journal of Consulting and Clinical Psychology. 2005; 73(3):539–548. [PubMed: 15982151]

Kiken LG, Lundberg K, Fredrickson BL. Being present and enjoying it: Dispositional mindfulness and savoring the moment are distinct, interactive predictors of positive emotions and psychological health. Mindfulness. in press.

Kiviniemi MT, Duangdao KM. Affective associations mediate the influence of cost–benefit beliefs on fruit and vegetable consumption. Appetite. 2009; 52(3):771–775. [PubMed: 19501779]

Kiviniemi MT, Voss-Humke AM, Seifert AL. How do I feel about the behavior? The interplay of affective associations with behaviors and cognitive beliefs as influences on physical activity behavior. Health Psychology. 2007; 26(2):152. [PubMed: 17385966]

Kok BE, Coffey KA, Cohn MA, Catalino LI, Vacharkulksemsuk T, Algoe SB, et al. Fredrickson BL. How positive emotions build physical health: Perceived positive social connections account for the upward spiral between positive emotions and vagal tone. Psychological Science. 2013; 24(7): 1123–1132. DOI: 10.1177/0956797612470827 [PubMed: 23649562]

Kringelbach ML, Berridge KC. The joyful mind. Scientific American. 2012; 307(2):40–45. [PubMed: 22844850]

Lappalainen R, Saba A, Holm L, Mykkanen H, Gibney M, Moles A. Difficulties in trying to eat healthier: Descriptive analysis of perceived barriers for healthy eating. European Journal of Clinical Nutrition. 1997; 51(2):S36. [PubMed: 9222722]

Lawton R, Conner M, McEachan R. Desire or reason: Predicting health behaviors from affective and cognitive attitudes. Health Psychology. 2009; 28(1):56–65. DOI: 10.1037/a0013424 [PubMed: 19210018]

Locke, EA., Latham, GP. A theory of goal setting & task performance. Englewood Cliffs, NJ: Prentice-Hall; 1990.

Macera, CA. Promoting healthy eating and physical activity for a healthier nation. 2003. Retrieved from Center for Disease Control and Prevention Website: http://www.cdc.gov/healthyyouth/publications/pdf/pp-ch7.pdf

Marteau TM, Hollands GJ, Fletcher PC. Changing human behavior to prevent disease: The importance of targeting automatic processes. Science. 2012; 337(6101):1492–1495. DOI: 10.1126/science.1226918 [PubMed: 22997327]

Mauss IB, Tamir M, Anderson CL, Savino NS. Can seeking happiness make people unhappy? Paradoxical effects of valuing happiness. Emotion. 2011; 11(4):807–815. DOI: 10.1037/a0022010 [PubMed: 21517168]

Miller GE, Chen E, Parker KJ. Psychological stress in childhood and susceptibility to the chronic diseases of aging: Moving toward a model of behavioral and biological mechanisms. Psychological Bulletin. 2011; 137(6):959. [PubMed: 21787044]

Moskowitz J, Carrico A, Duncan L, Cohn M, Cheung E, Batchelder A, et al. Folkman S. Randomized controlled trial of a positive affect intervention for people newly diagnosed with HIV. Journal of Consulting and Clinical Psychology. 2017 [PubMed: 28333512]

Ode S, Winters PL, Robinson MD. Approach motivation as incentive salience: perceptual sources of evidence in relation to positive word primes. Emotion. 2012; 12(1):91–101. DOI: 10.1037/a0025186 [PubMed: 21875189]

Ogden, CL., Carroll, MD., Fryar, CD., Flegal, KM. NCHS data brief, no 219. Hyattsville, MD: National Center for Health Statistics; 2015. Prevalence of obesity among adults and youth: United States, 2011–2014.

Olano HA, Kachan D, Tannenbaum SL, Mehta A, Annane D, Lee DJ. Engagement in mindfulness practices by US adults: Sociodemographic barriers. The Journal of Alternative and Complementary Medicine. 2015; 21(2):100–102. [PubMed: 25685958]

Papies, EK., Aarts, H. Nonconscious self-regulation, or the automatic pilot of human behavior. In: Vohs, KD., Baumeister, RF., editors. Self-Regulation: Research, Theory, and Applications. New York, NY: The Guilford Press; 2011. p. 125-142.

Pate RR, Pratt M, Blair SN, Haskell WL, Macera CA, Bouchard C, et al. King AC. Physical activity and public health: A recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. Jama. 1995; 273(5):402–407. [PubMed: 7823386]

Payne BK, Brown-Iannuzzi JL, Loersch C. Replicable effects of primes on human behavior. Journal of Experimental Psychology: General. 2016; 145(10):1269.

Peciña S, Cagniard B, Berridge KC, Aldridge JW, Zhuang X. Hyperdopaminergic mutant mice have higher “wanting” but not “liking” for sweet rewards. The Journal of Neuroscience. 2003; 23(28): 9395–9402. [PubMed: 14561867]

Pluess M, Belsky J. Vantage sensitivity: Individual differences in response to positive experiences. Psychological Bulletin. 2013; 139(4):901–916. [PubMed: 23025924]

Porges SW. The polyvagal perspective. Biological Psychology. 2007; 74(2):116–143. [PubMed: 17049418]

Prochaska JO, Velicer WF. The transtheoretical model of health behavior change. American Journal of Health Promotion. 1997; 12(1):38–48. [PubMed: 10170434]

Rhodes RE, Dickau L. Experimental evidence for the intention–behavior relationship in the physical activity domain: A meta-analysis. Health Psychology. 2012; 31(6):724–727. [PubMed: 22390739]

Rhodes RE, Fiala B, Conner M. A review and meta-analysis of affective judgments and physical activity in adult populations. Annals of Behavioral Medicine. 2009; 38(3):180–204. DOI: 10.1007/s12160-009-9147-y [PubMed: 20082164]

Rhodes RE, Kates A. Can the affective response to exercise predict future motives and physical activity behavior? A systematic review of published evidence. Annals of Behavioral Medicine. 2015; 49(5):715–731. DOI: 10.1007/s12160-015-9704-5 [PubMed: 25921307]

Rice, EL. Unpublished doctoral dissertation. Psychology and Neuroscience. University of North Carolina; at Chapel Hill: 2016. Positive spontaneous thoughts reflect incentive salience.

Rice EL, Fredrickson BL. Of passions and positive spontaneous thoughts. Cognitive Therapy and Research. 2016; 40:1–12. DOI: 10.1007/s10608-016-9755-3

Rice EL, Fredrickson BL. Do positive spontaneous thoughts function as incentive salience? Emotion. 2017; doi: 10.1037/emo0000284 [PubMed: 28206793]

Rogers RW. Cognitive and physiological processes in fear appeals and attitude change: A revised theory of protection motivation. Social Psychophysiology. 1983:153–176.

Rothman AJ. Toward a theory-based analysis of behavioral maintenance. Health Psychology. 2000; 19:64–69. [PubMed: 10709949]

Rothman, AJ., Baldwin, AS., Hertel, AW., Fuglestad, PT. Self-regulation and behavior change: Disentangling behavioral initiation and behavioral maintenance. In: Vohs, KD., Baumeister, RF., editors. Self-Regulation: Research, Theory, and Applications. New York, NY: The Guilford Press; 2011. p. 106-122.

Sandberg T, Conner M. Anticipated regret as an additional predictor in the theory of planned behaviour: A meta-analysis. British Journal of Social Psychology. 2008; 47(4):589–606. [PubMed: 18039428]

Segar ML, Eccles JS, Richardson CR. Type of physical activity goal influences participation in healthy midlife women. Womens Health Issues. 2008; 18(4):281–291. DOI: 10.1016/j.whi.2008.02.003 [PubMed: 18468920]

Segar ML, Eccles JS, Richardson CR. Rebranding exercise: Closing the gap between values and behavior. The International Journal of Behavioral Nutrition and Physical Activity. 2011; 8:94.doi: 10.1186/1479-5868-8-94 [PubMed: 21884579]

Sheeran P. Intention—behavior relations: A conceptual and empirical review. European Review of Social Psychology. 2002; 12(1):1–36.

Sheeran, P., Gollwitzer, PM., Bargh, JA. Nonconscious processes and health; Health Psychology. 2013. p. 460-473.doi:http://dx.doi.org/10.1037/a0029203

Shonkoff JP, Boyce W, McEwen BS. Neuroscience, molecular biology, and the childhood roots of health disparities: Building a new framework for health promotion and disease prevention. JAMA. 2009; 301(21):2252–2259. DOI: 10.1001/jama.2009.754 [PubMed: 19491187]

Smith KS, Berridge KC, Aldridge JW. Disentangling pleasure from incentive salience and learning signals in brain reward circuitry. PNAS Proceedings of the National Academy of Sciences of the United States of America. 2011; 108(27):E255–264.

Spijkerman, MPJ., Pots, WTM., Bohlmeijer, ET. Effectiveness of online mindfulness-based interventions in improving mental health: A review and meta-analysis of randomised controlled trials; Clinical Psychology Review. 2016. p. 102-114.doi:http://dx.doi.org/10.1016/j.cpr.2016.03.009

Strecher VJ, McEvoy DeVellis B, Becker MH, Rosenstock IM. The role of self-efficacy in achieving health behavior change. Health Education Quarterly. 1986; 13(1):73–92.

Thayer JF, Sternberg E. Beyond heart rate variability: Vagal regulation of allostatic systems. Annals of the New York Academy of Sciences. 2006; 1088(1):361–372. [PubMed: 17192580]

Vallerand RJ. On passion for life activities: The dualistic model of passion. Advances in Experimental Social Psychology. 2010; 42:97–193.

Van Cappellen P. Rethinking self-transcendent positive emotions: Perspectives from psychological and biblical research. Psychology of Religion and Spirituality. in press.

Van Cappellen P, Catalino LI, Boulton AJ, Firestine AM, Fredrickson BL. Teaching individuals to prioritize positivity predicts warm feeling derived from Loving-kindness meditation. Manuscript in preparation. 2017

Van Cappellen P, Way B, Isgett SF, Fredrickson BL. Effects of oxytocin administration on spirituality and emotional responses to meditation. Social Cognitive and Affective Neuroscience. 2016; 11:1579–1587. DOI: 10.1093/scan/nsw078 [PubMed: 27317929]

Veltkamp M, Aarts H, Custers R. Perception in the service of goal pursuit: Motivation to attain goals enhances the perceived size of goal-instrumental objects. Social Cognition. 2008; 26(6):720–736.

Walsh EM, Kiviniemi MT. Changing how I feel about the food: Experimentally manipulated affective associations with fruits change fruit choice behaviors. Journal of Behavioral Medicine. 2014; 37(2):322–331. DOI: 10.1007/s10865-012-9490-5 [PubMed: 23299831]

Watson D, Clark LA, Tellegen A. Development and validation of brief measures of positive ans negative affect: the PANAS scale. Journal of Personality and Social Psychology. 1988; 54:1063–1070. [PubMed: 3397865]

Williams DM. Exercise, affect, and adherence: An integrated model and a case for self-paced exercise. Journal of Sport Exercise Psychology. 2008; 30:471–496. [PubMed: 18971508]

Williams DM, Dunsiger S, Ciccolo JT, Lewis BA, Albrecht AE, Marcus BH. Acute affective response to a moderate-intensity exercise stimulus predicts physical activity participation 6 and 12 months later. Psychology of Sport and Exercise. 2008; 9(3):231–245. DOI: 10.1016/j.psychsport.2007.04.002 [PubMed: 18496608]

Williams DM, Dunsiger S, Jennings EG, Marcus BH. Does affective valence during and immediately following a 10-min walk predict concurrent and future physical activity? Annals of Behavioral Medicine. 2012; 44(1):43–51. DOI: 10.1007/s12160-012-9362-9 [PubMed: 22532005]

Woolley K, Fishbach A. For the fun of it: Harnessing immediate rewards to increase persistence in long-term goals. Journal of Consumer Research. 2016a; 42(6):952–966.

Woolley K, Fishbach A. Immediate rewards predict adherence to long-term goals. Personality and Social Psychology Bulletin. 2016b; 0146167216676480

World Health Organization. The world health report 2002: reducing risks, promoting healthy life. 2002. Retrieved from http://www.who.int/nutrition/topics/2_background/en/

World Health Organization. Report of the joint WHO/FAO expert consultation on diet, nutrition and the prevention of chronic diseases. 2003. Retrieved from http://apps.who.int/iris/bitstream/10665/42665/1/WHO_TRS_916.pdf

World Health Organization. Physical activity and health in Europe: evidence for action. 2006. Retrieved from http://www.euro.who.int/_data/assets/pdf_file/0011/87545/E89490.pdf

World Health Organization. The challenge of obesity - quick statistics. 2008. Retrieved from http://www.euro.who.int/en/health-topics/noncommunicable-diseases/obesity/data-and-statistics

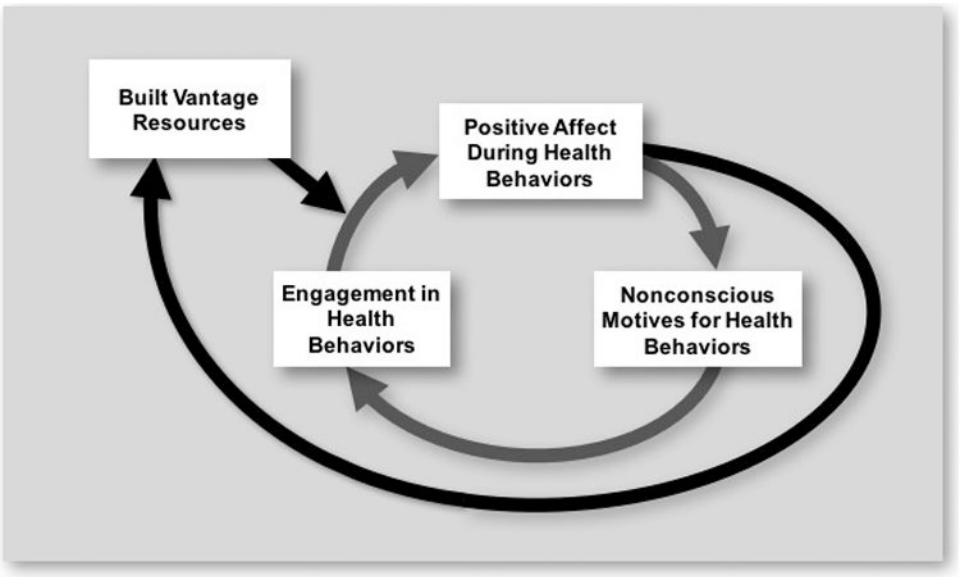

Figure.
Upward Spiral Theory of Lifestyle Change. The inner loop is in gray. The outer loop is in black.