

POSITIVE SPONTANEOUS THOUGHTS REFLECT INCENTIVE SALIENCE

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ABSTRACT

Elise L. Rice: Positive spontaneous thoughts reflect incentive salience
(Under the direction of Barbara L. Fredrickson)

Despite the abundance of research on unwanted intrusive thoughts, positive spontaneous thoughts have been the subject of very little prior research. The present work aimed to evaluate the role of positive spontaneous thoughts in motivation by exploring their relationship with incentive salience – a property that energizes wanting and approach motivation by rendering cues that are associated with reward more likely to stand out to the individual when encountered in the environment (Berridge, 2007). I reasoned that positive spontaneous thoughts may be concomitants of incentive salience, and as such, they may mediate the effect of liking on wanting. The three studies discussed in Chapter 2 tested that hypothesis using a variety of measures and methods and revealed that positive spontaneous thoughts do indeed mediate the relationship between liking something and wanting it. Given that positive spontaneous thoughts were related to wanting as predicted, I explored whether they may play an active role in energizing wanting rather than merely co-occurring with incentive salience. The experiment discussed in Chapter 3 provided a preliminary answer to that question; participants who believed that their spontaneous thoughts about a target activity were especially positive planned to engage in that activity more often over the coming week than participants who had no such perception about their spontaneous thoughts. Collectively, these studies demonstrate an important role of positive spontaneous thoughts in shaping approach motivation. Broader implications and future directions in the study of positive spontaneous thoughts are discussed.

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CHAPTER 1: A DIFFERENT KIND OF POSITIVE THINKING

Introduction

Human life is characterized by rich and complex mental experiences. A variegated web of thoughts permeates daily life as memories, ideas, and observations weave in and out of conscious awareness. However, recurring patterns in the way psychologists have approached research on different forms of thought fail to capture this variability, instead painting an undeservedly bleak picture of the experience and consequences of many forms of thoughts. This is not to say that demonstrations of the ways in which thoughts can be toxic have been exaggerated, just that the conversation lacks adequate balance by virtue of a longstanding focus on identifying potential detriments rather than benefits arising from various kinds of thoughts.

Much of this imbalance comes from the abundance of research in clinical psychology, which historically has been dominated by a disease model of mental illness. Important work spanning decades in this field has thoroughly documented how cognitive phenomena such as unwanted intrusive thoughts and rumination are prominent features of multiple psychopathologies, including depression, anxiety disorders, obsessive-compulsive disorder, and post-traumatic stress disorder. As a result, the scientific community has amassed an extensive record of the numerous ways in which the mere act of thinking can go wrong. For example, studies using a variety of methods have linked rumination with higher levels of depressive symptoms (Nolen-Hoeksema & Harrell, 2002), onset of new depressive episodes (Nolen-Hoeksema, 2000), and prolonged duration of depressive episodes, (Nolen-Hoeksema, 1991). Further, a common theme of obsessive-compulsion disorder seems to be the attribution of

exaggerated significance to recurrent, obsessive thoughts (Freeston et al., 1997; Purdon & Clark, 1993; Rachman, 1997). And in a sample of cancer patients who were not diagnosed with any particular mental illness (although other work has noted the presence of PTSD among cancer survivors; Cordova et al., 1995), intrusive thoughts about cancer were strongly related to psychological distress (Baider & De-Nour, 1997).

Given that “negative thinking” is at the core of so much mental illness, it would seem obvious that “positive thinking” could be an important ingredient for well-being. While lay theories persist in support of this idea, empirical research on the efficacy of positive thinking (which admittedly is a very broad term that has been operationalized in many different ways) has not been particularly encouraging. Instead, there are many instances in which positive thinking seems to backfire if it does anything at all. In such cases, mood repair becomes an extra burden on top of the original source of distress, and the effect of realizing how far one is from the goal state (i.e., disappointment) is directly contrary to the goal state itself (i.e., happiness). For example, participants with low self-esteem felt worse after repeating positive statements about themselves than participants who did no such task (Wood, Perunovic, & Lee, 2009). And excessively valuing happiness, which might be cause for positive thinking, has been linked with less positive affect (Mauss, Tamir, Anderson, & Savino, 2011) and greater loneliness (Mauss et al., 2012).

Beyond the context of mood repair, positive thinking has also been considered a possible tool for motivation, although again, empirical research has not supported this perspective. Whereas fantasizing about the future is associated with fewer depressive symptoms when measured at the same time point, fantasizing actually predicts more depressive symptoms over time (Oettingen, Mayer, & Portnow, 2016). Likewise, fantasizing (sometimes simply referred to

as positive thinking, though detachment from reality seems to be the key ingredient) has also been found to derail goal pursuit unless followed by contemplation of the present reality (Oettingen, 2012). In one especially provocative demonstration, archival analyses revealed that positive and future-oriented content in newspaper articles and presidential inaugural addresses predicted declines in the strength of the economy (Sevincer, Wagner, Kalvelage, & Oettingen, 2014).

Even thoughts as seemingly mundane and inconsequential as those that occur during mind-wandering have been cast as predictors of discontent. In an impressive experience-sampling study of over 2000 people, participants reported that they were less happy during episodes of mind-wandering than when focused on the task at hand, regardless of what that task was (Killingsworth & Gilbert, 2010). Importantly, time-lagged analyses revealed that mind-wandering generally preceded unhappiness. These findings led the authors to boldly conclude that “a human mind is a wandering mind, and a wandering mind is an unhappy mind” (p. 932). Other research also suggests that perhaps the typical entertainment value of thoughts is not very high: in one study, a quarter of female participants and two thirds of male participants chose to receive a mild electrical shock rather than sit uninterrupted with their thoughts for 15 minutes (Wilson et al., 2014).

Positive Spontaneous Thoughts

But surely there is more to the story. It seems to be the case that questions about how thoughts can contribute to positive well-being are simply underexplored. Certainly some work – such as research on optimism – implies that positive cognitions can be beneficial, although the bulk of that evidence comes from research on optimism as an individual difference rather than the actual thoughts that may be characteristic of it (Scheier & Carver, 1993). To begin filling that

gap by focusing on the thoughts themselves, I have developed a program of research on positive spontaneous thoughts, which may be conceptualized as the pleasant counterparts to intrusive thoughts. By definition, positive spontaneous thoughts are positively valenced cognitions that arise without the conscious experience of effort or intention. Importantly, this framework places no restrictions on content; positive spontaneous thoughts may take the form of memories, daydreams, or observations. A positive spontaneous thought may be completely irrelevant to whatever task a person is engaged in at the moment it arises (the defining feature of mind-wandering), or it may directly pertain to that task. Regardless of topic, these thoughts are experienced as positively valenced and simply seem to pop into one's mind.

There are at least two broad reasons why positive spontaneous thoughts may be less susceptible to the pitfalls that often derail their deliberate counterparts, and both of them relate to the automaticity by which positive spontaneous thoughts arise. On the one hand, the absence of conscious control in producing positive spontaneous thoughts should leave them relatively unfettered by misguided goals and lay theories, such as excessively valuing happiness. It would seem that a large part of the issue with deliberate positive thoughts intended to improve mood is that in their desire to feel better, people may go about thinking the wrong way. While I am not aware of existing data to speak to differences in spontaneous thoughts as a function of valuing happiness, I expect that most spontaneous thoughts in daily life arise primarily as a result of heightened mental accessibility and would be largely incidental to matters of valuing happiness. If anything, one might predict that valuing happiness would facilitate maladaptive techniques for pursuing happiness (such as positive deliberate thinking), which may get in the way or more organic process that normally unfold without effort, such as positive spontaneous thoughts.

Further, the fact that by definition, positive spontaneous thoughts arise without effort may mean that they hold extra promise for mood repair. Given that these thoughts should arise rather efficiently, their production should not depend on the availability of psychological resources – such as executive functioning or self-esteem – and as such, positive spontaneous thoughts may be a powerful tool for people when they need them most. Again, it may be the case that allowing positive spontaneous thoughts to operate is as simple as not getting in their way with misguided processes that are guided by explicit goals.

However, despite the potential promise of positive spontaneous thoughts, one might also be skeptical of just how much impact they can have. After all, negativity bias – the valence asymmetry by which negative emotions exert greater psychological impact than positive emotions – has been documented across a wide variety of contexts (e.g., reactions to life events, close relationships, learning, memory, etc.; Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001), and it almost certainly applies in the case of spontaneous thoughts. In fact, negativity bias may be at least partly responsible for the imbalance of scientific attention granted to intrusive thoughts rather than their pleasant counterparts over decades of psychological research.

Although positive spontaneous thoughts are likely not felt as intensely as their negative counterparts, they may have substantial import in other ways. In particular, positivity offset is another widely documented valence asymmetry, which refers to the tendency for most mentally healthy people to experience more positive emotions than negative emotions in their daily lives (Catalino & Fredrickson, 2011; Diener, Kanazawa, Suh, & Oishi, 2015; Fredrickson, 2013). Indeed, whereas negative emotions are generally felt acutely in the moment and narrow attention to focus on responding to a problem, positive emotions operate in a different way entirely. Positive emotions are typically felt less intensely in the moment and broaden attention and

cognitive processing, so that as they accumulate over time, they enable people to build biological, psychological, and social resources (Fredrickson, 1998, 2001, 2013). It seems reasonable to expect the thoughts that are colored by positive and negative emotions to adhere to roughly the same patterns. Whereas negative intrusive thoughts are felt intensely and may narrow the perceiver's attention to problems and other negative material, positive spontaneous thoughts may emerge into conscious awareness more quietly but also more frequently, so that their accumulation over time gradually supports beneficial outcomes.

Other questions about the potential impact of positive spontaneous thoughts may relate to their automaticity. Given that spontaneous thoughts are less tethered to conscious awareness than relatively deliberate thoughts, particularly in the ways in which they are produced, they may not seem well situated to exert much influence. It is conceivable that many positive spontaneous thoughts may arise without receiving much attention if they are even noticed at all. However, there is extensive evidence that conscious awareness is not necessary for psychological process to alter emotions (Berridge & Winkielman, 2003; Winkielman & Berridge, 2004; Winkielman, Berridge, & Wilbarger, 2005) or behavior (Bargh, Chen, & Burrows, 1996; Chartrand & Bargh, 1999). And in fact, several studies revealed that people actually infer more meaning from their spontaneous thoughts than relatively deliberate ones (Morewedge, Giblin, & Norton, 2014).

Indeed, recent research on positive spontaneous thoughts suggests that they are consequential phenomena that deserve further empirical attention (Rice & Fredrickson, 2015, 2016a, 2016b). Some of the first work to shed light on positive spontaneous thoughts explored how they related to people's favorite activities, or their *passions*. Passions are a ripe area for research on positive spontaneous thoughts because given their significance in people's lives, the mental concepts of passions are likely to possess chronically heightened accessibility, which

should render them more likely to pop into conscious awareness at any given time. Likewise, because passions are activities that people generally enjoy by definition, thoughts about them should tend to be largely positive.

According to the prevailing theoretical framework in research on passions, people's passions generally possess two types of qualities to varying degrees: more harmonious passions are pursued more freely and generally do not conflict with other life domains (e.g., work, relationships, etc.; Vallerand et al., 2003). By contrast, more obsessive passions are pursued with less autonomy and tend to create conflict with other life domains. Although all passions provide enjoyment, more harmonious passions are associated with more intense experiences of positive affect while engaged in the activity and after completing the activity, whereas levels of obsessive passion tend to be unrelated to positive affect (Vallerand et al., 2003). As such, I hypothesized that people would have frequent spontaneous thoughts about their passions, and that harmonious passion would predict the positivity of spontaneous thoughts people experienced about the passion. Several studies bore out these predictions. First, I found that people did recall experiencing an abundance of spontaneous thoughts about their favorite activities, and those thoughts tended to be overwhelmingly positive (Rice & Fredrickson, 2016a, 2016b). However, there were also measurable differences in the positivity of spontaneous thoughts about passions that seemed to correspond to qualities of the passion. That is, more harmonious passions were associated with spontaneous thoughts about the activity that were more positive, whereas obsessive passion was unrelated to positivity of spontaneous thoughts. Importantly, these effects emerged when examined both cross-sectionally and over time.

Additional work on passions suggests that positive spontaneous thoughts relate not only to the experience of passions but also to several indicators of well-being associated with

passions. In a cross-sectional sample, positivity of spontaneous thoughts about physical activity was associated with greater satisfaction with life, meaning in life, and flourishing, and it was negatively correlated with depressive symptoms (Rice & Fredrickson, 2016b). Further, path analysis revealed that positivity of spontaneous thoughts mediated the effects of harmonious passion on well-being (a latent construct with flourishing, meaning in life, and satisfaction with life) and depressive symptoms.

The Present Research

Following early findings that positive spontaneous thoughts are measurable, track with experienced affect, and can even predict behavior (Rice & Fredrickson, 2016b), the research discussed in the following chapters aims to explore the role of positive spontaneous thoughts in motivation. To that end, this project draws heavily from research on the fundamental psychological mechanisms that govern reward processing and approach motivation. A diverse body of research in that domain suggests that liking and wanting are separately guided by distinct neurological substrates, and that the two are mediated by a property called incentive salience that typically makes objects associated with reward pop out at the perceiver when encountered in the environment. The foundation of research on incentive salience comes from compelling studies of animal models, but to date, far fewer experiments have evaluated how incentive salience operates within the psychology of humans. The research discussed herein aims to integrate positive spontaneous thoughts within the framework of incentive salience and test their role in energizing wanting and approach motivation.

Beyond the conceptual framework of incentive-salience theory, the research discussed in Chapters 2 and 3 also draws heavily from the upward spiral model of lifestyle change (Fredrickson, 2013). The upward spiral model describes how positive emotions may facilitate

sustainable behavior change without relying on the limitations of effortful self-control. In particular, the upward spiral model posits that experiencing positive emotions during an activity (i.e., “liking” an activity) should create incentive salience, rendering cues related to the activity more likely to stand out when encountered in the future. Incentive salience should then amplify wanting, so the individual is more likely to repeat the activity. All the while, the positive emotions one experiences during the activity should accumulate over time to build biological, psychological, and social resources that enable the individual to extract even more positive emotions from future instances of engaging in the activity. This project constitutes a test of a key subset of the upward spiral model from positive emotions to incentive salience (operationalized herein as positive spontaneous thoughts) to behavioral wanting.

Chapter 2 describes three studies that were designed to evaluate positive spontaneous thoughts within the framework of incentive salience. Those studies use correlational and experimental methods to determine whether positive spontaneous thoughts occupy the same psychological space between liking and wanting as incentive salience. The research described in Chapter 3 goes a step further in exploring the relationship between incentive salience and positive spontaneous thoughts. Merely establishing a pattern of mediation does not clarify whether positive spontaneous thoughts are epiphenomenal to incentive salience, or they play an active role in amplifying wanting. The single study described in Chapter 3 uses an experimental manipulation to test whether perceptions of positive spontaneous thoughts about an activity alter wanting to engage in that activity. Collectively, these four novel studies represent a substantial step forward in understanding the role of positive spontaneous thoughts in motivation.

CHAPTER 2: POSITIVE SPONTANEOUS THOUGHTS MEDIATE THE EFFECT OF LIKING ON WANTING

Introduction

Humans are in many ways not unlike Looney Tunes. Though most people's eyes do not literally jump out of their faces when they perceive a delicious meal or other highly desirable stimulus, the ways in which they do process rewards are comparable in some respects (although bounded by the constraints of facial anatomy). One influential perspective on reward processing suggests that liking a stimulus is separable from wanting it, and that the two are mediated by a third psychological construct called incentive salience (Berridge, 2007). In more concrete terms, experiencing positive emotions during some activity or behavior (i.e., "liking" the activity) may imbue that concept and closely associated concepts (e.g., physical objects, people) with incentive salience, enhancing the ability of these cues to capture attention in subsequent encounters. That heightened salience in turn generates wanting and motivates approach behavior, increasing the likelihood that the individual will repeat the behavior in question. The primary purpose of the research reported herein is to evaluate positive spontaneous thoughts (i.e., pleasant thoughts that arise without the subjective experience of intent) as a specific mechanism by which incentive salience operates within this theoretical framework. That is, I predict that enjoying an activity will facilitate more positive spontaneous thoughts about that activity (i.e., thoughts popping into one's head instead of eyes popping out of one's head), and in turn, positive spontaneous thoughts will promote approach behavior.

Incentive Saliency

The incentive-saliency framework was developed to address the role of dopamine in approach motivation (Berridge, 2007). Whereas prior theories struggled to account for findings that dopamine manipulations seemed to increase appetitive behavior toward a target stimulus with no effect on how well the stimulus was liked, this model separates reward processing into three components: liking, wanting, and learning. In particular, incentive-saliency theory suggests that dopamine facilitates only the wanting component of reward, which is separately guided by liking and learning (Berridge, 2007; Smith, Berridge, & Aldridge, 2011). That is, when an individual repeatedly encounters a stimulus that is experienced as pleasant (i.e., “liking”), the learned associations between that pleasantness and the cues that are predictive of it endow those cues with incentive saliency, making the object more likely to capture attention in the future. That heightened saliency in turn prompts dopaminergic wanting and reward-seeking behaviors when the individual subsequently encounters the salient cues. Indeed, this framework has received strong support in animal models (Cagniard, Balsam, Brunner, & Zhuang, 2005; Peciña, Cagniard, Berridge, Aldridge, & Zhuang, 2003; Smith et al., 2011). And in addition, several studies have documented compelling evidence for how incentive saliency operates in humans.

First, a rather simple manipulation of effort allowed researchers to disentangle the relationship between liking and wanting in humans (Waugh & Gotlib, 2008). In that study, individual differences in the degree to which participants enjoyed cartoons were predictive of wanting when low levels of effort were required to earn the opportunity to view more cartoons. However, it was also clear that the two constructs do not always correspond one to one: when participants had to work harder to view more cartoons, the tie between liking and wanting was severed.

Other research has helped to clarify the salience component of incentive salience by showing that positively valenced words are perceived in ways suggestive of heightened approach motivation. That is, study participants overestimated the size of the text in which positive words were presented as well as the duration of time for which they were displayed, implying that positive cues possessed a perceptual emphasis (Ode, Winters, & Robinson, 2012).

More extreme demonstrations of the incentive salience system at work in humans can be found in some cases of drug addiction. In particular, the notable dissociation between liking and wanting that occurs as addiction progresses (i.e., liking decreases as wanting increases) is consistent with the notion that the neural systems altered in certain addictions mediate incentive salience but not pleasure (Robinson & Berridge, 2008).

Based on this broad pattern of findings, incentive salience may play an important role as people try out new behaviors. For example, when a person tries a new exercise class, the extent to which he or she experiences positive affect during the class, may engender the concept of that class as well as related concepts, such as workout clothes, water bottle, exercise mat, etc., with heightened salience. As such, upon encountering any of those cues in the future, they will be more likely to capture attention and evoke some urge, however subtle, to attend that class again.

In light of this framework, there may be multiple ways in which positive spontaneous thoughts relate to incentive salience. First, spontaneous thoughts may be indicators of the incentive salience attributed to reward cues. If positive emotions endow the mental concept of a stimulus with heightened salience, that concept and cues related to it should be more likely to emerge into conscious awareness at any given time, and as such, positive spontaneous thoughts may be an epiphenomenon of incentive salience: a mere marker without downstream effects.

A second possibility, however, is that positive spontaneous thoughts may be active ingredients through which incentive salience motivates subsequent reward-seeking behavior. If incentive salience promotes positive spontaneous thoughts through heightened accessibility and related processes, those thoughts may in turn compound the sense of wanting or lead an individual to develop plans for how she will further pursue the object or activity. I favor this second possibility, which is consistent with prior research suggesting that mental accessibility and positive affect complement one another to motivate goal pursuit (Aarts, Custers, & Marien, 2008; Custers & Aarts, 2005, 2007). Indeed, a central hypothesis in the current work is that positive spontaneous thoughts occupy a key motivational role situated between liking and wanting and thereby energize the effect of incentive salience.

Positive Spontaneous Thoughts

Several relatively distinct lines of research support the hypothesis that positive spontaneous thoughts are a key mechanism through which incentive salience generates appetitive behavior. First, recent research on people's perceptions of their own spontaneous thoughts indicates that such thoughts are felt to be more meaningful than their more deliberate counterparts (Morewedge et al., 2014). Positive spontaneous thoughts may thus be particularly potent drivers of approach behavior. For instance, it seems plausible that repeatedly noticing the prominence of a given activity (or person, object, etc.) in one's mind could spur an individual to make specific plans to pursue that activity. In this way, positive spontaneous thoughts may operate as small nudges that collectively facilitate behavior. More generally, this view is consistent with the basis of self-perception theory, which suggests that people infer their own attitudes and other information about themselves by observing their own behavior and in this extension, their own thoughts (Bem, 1967, 1972).

Second, research on the Zeigarnik effect is also relevant. The Zeigarnik effect refers to the heightened presence of unfinished tasks in memory and thoughts (Zeigarnik, 1938) and is thought to result when the mind rehearses information that may facilitate the completion of ongoing tasks and goals. Strikingly, research on recurrent thoughts has almost exclusively fixated on negative variants, such as rumination and intrusive thoughts. Harkening back to Zeigarnik, one prominent model of rumination posits that concepts and cues associated with unfulfilled goals are granted extra salience, which should result in repeated, unintended thoughts related to the goal (Martin & Tesser, 1996). To bridge this domain with the perspective of incentive salience, one may consider how in some respect, enjoyed activities that bear the promise of future reward may be held in the mind as perpetually unfinished business. In the present research, I predicted that the heightened accessibility of concepts bearing incentive salience should increase the likelihood that at any given time, these concepts will spontaneously seep into conscious awareness.

Finally, work on the basic mental constructs that support goal pursuit is congruent with the current research. Building on prior research on nonconscious goal activation, recent work demonstrates that mental concepts that possess a combination of heightened mental accessibility and association with positive affect are wanted and pursued most strongly relative to those associated with neutral or negative affect (Aarts et al., 2008; Custers & Aarts, 2005, 2007). Positive spontaneous thoughts by definition entail both mental accessibility and positive valence, and as such, they are well suited to energize wanting and approach behavior.

Although the processes described above may well apply to thoughts of any affective valence, theory and past evidence suggest that pleasant and unpleasant spontaneous thoughts may diverge in at least one key domain. To the extent that positive emotions broaden attention

(Fredrickson, 1998, 2001, 2013) and promote cognitive processing that is particularly flexible and divergent (Estrada, Isen, & Young, 1994; Isen, Daubman, & Nowicki, 1987), it may be that positive emotions experienced during an activity – relative to negative emotions – cast a wider net of salience onto co-occurring cues. Indeed, this conceptualization offers a new interpretation of the robust findings of “less marked cuing effects for negative than for positive affect” (Isen, 1993, p. 262). Data indicating that positive mood improves people’s ability to detect semantic association among groups of words suggest even more directly that this may be the case (Bolte, Goschke, & Kuhl, 2003). Though one might expect the avoidance-oriented salience created by negative emotions to be especially intense (Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001), its cue-driven repellant effect appears to have a narrower foothold.

The Present Research

Although very little prior research has directly addressed the motivational functions of positive spontaneous thoughts, several existing findings directly relate to the present research. For example, one investigation of the spontaneous thoughts people have about their favorite activities (i.e., their passions) found that the qualities of passions that are most associated with positive emotions predicted positivity of spontaneous thoughts about the passion (Rice & Fredrickson, 2016b). This effect is consistent with the hypothesis that liking an activity should cultivate positive spontaneous thoughts about it.

Further, one prior investigation has explored the motivational functions of positive spontaneous thoughts (Rice & Fredrickson, 2015). Although it yielded results consistent with the current predictions, limitations of the study design preclude inferences about causality. In that cross-sectional study of 232 mid-life adults sampled at baseline of the larger study reported herein as Study 3, reports of more intense positive emotions during physical activity were

associated with the positivity of spontaneous thoughts about physical activity, and the positivity of those spontaneous thoughts was in turn related to more frequent physical activity.

Bootstrapping analyses revealed a significant indirect effect of positive emotions on activity frequency through positivity of spontaneous thoughts. Importantly, no similar effects emerged for the mere frequency of spontaneous thoughts, regardless of affective valence.

The present research was designed to extend these findings into a variety of contexts and evaluate the larger theoretical model with the added rigor of experimental control. Specifically, Study 1 tests the predicted mediation model across a diverse array of behavioral contexts that extend beyond physical activity. Study 2 incorporates a manipulation of liking to test the causal effect of positive emotions on subsequent spontaneous thoughts as well as the hypothesized downstream impact on behavioral indicators of wanting. Finally, Study 3 tests the full mediation model from liking to wanting through spontaneous thoughts using time-lagged measures over the span of 10 weeks and allows for another manipulation of positive emotions, this time delivered through meditation training.

Study 1

The primary purpose of Study 1 was to test whether people tend to have more positive spontaneous thoughts about activities they enjoy, and whether those thoughts in turn predict differences in wanting across a variety of contexts. To those ends, I asked participants to rate multiple activities in terms of how much they enjoyed them during the previous week and how positive their typical spontaneous thoughts about those activities were in the previous 24 hours. Participants also reported on how much they wanted to engage in each activity in the following 24 hours. Further, participants reported on how much control they felt they typically had over whether and when to enact the activity (to further disentangle obligation from more autonomous

wanting) as well as how frequently they actually did engage in the behavior. Based on my overarching hypothesis that positive spontaneous thoughts mediate the relationship between liking an activity and wanting to do that activity, I predicted that participants would report more positive spontaneous thoughts about activities that were more well-liked, and in turn, positivity of spontaneous thoughts would predict wanting, above and beyond obligation and frequency of actual behavior.

Methods

Participants

The study sample included 103 adult MTurk workers living in the United States. The sample was fairly balanced in terms of gender (52.4% male), and participants predominantly identified as White or Caucasian, although other ethnicities were represented (1.9% American Indian or Alaska Native, 6.8% Asian, 4.9% Black or African American, 83.5% White or Caucasian, 2.9% Other). Participants ranged in age from 19 to 65, and the mean age was 35.73 ($SD = 11.60$). Participants were compensated \$0.25 for completing the brief online questionnaire.

Procedure

Participants who provided informed consent completed the study by reporting on different aspects of target activities. Ten activities were randomly drawn from a list of common daily activities gathered from multiple sources including the American Time Use Survey and the Day Reconstruction Method (Kahneman, Krueger, Schkade, Schwarz, & Stone, 2004). The final list of target activities included exercising or being physically active, eating a nutritious meal, commuting, learning something new, socializing, running errands, relaxing, doing chores, purchasing consumer goods, and caring for household members.

First, participants read a description of spontaneous thoughts (below) and then estimated how many times they noticed having a spontaneous thought about each activity in the past 24 hours. Then, for activities that had been the subject of at least one spontaneous thought, they rated how positive and negative those thoughts were on separate 10-point scales that ranged from “Not at all” to “Extremely.” In answering the valence items, participants were asked to consider how positive and negative their recent thoughts about each activity had been on average.

“Take a moment to reflect on the spontaneous thoughts you have about each activity listed below. Sometimes, you might deliberately think about a given activity - maybe cooking, if you are trying to remember a recipe - but other times, you might find yourself thinking about that activity without meaning to - perhaps because excited thoughts about an upcoming meal just keep coming to mind. Here, we are especially interested in that second kind of thought - the kind that you have without trying. Sometimes spontaneous thoughts might seem to just pop into your head, or other times you might catch yourself thinking about something without remembering why you started. Sometimes these thoughts are pleasant, and other times they are unpleasant.”

Next, participants reported on the positive and negative emotions they experienced during each activity in the week before the previous day. Specifically, participants responded to items asking to what extent they experienced positive and negative emotions during the target activities, using separate 7-point scales that ranged from “Not at all” to “Extremely.” Participants were also able to select a “Not applicable” option if they had not engaged in a given activity in the specified time period.

In the next section, participants reported how much they wanted to do each activity. The instructions specifically asked respondents to consider wanting strictly in terms of what they felt, regardless of practical issues like scheduling constraints.

Last, participants reported in the same manner on several other factors including how much autonomy versus obligation they generally felt in deciding whether and when to engage in each activity, how recently they last engaged in each activity, how soon they planned to engage

in each activity next, and how often they generally engaged in each activity. After completing these items, they provided demographic information and read a debriefing statement that explained the purpose of the study and the primary hypotheses.

Analytic Strategy

All analyses were conducted using SAS 9.3. Given the nested structure of the data (i.e., multiple activities rated by each participant), I used multilevel modeling to test the predicted associations among liking, positive spontaneous thoughts, and wanting. More specifically, I first tested whether liking predicted positivity of spontaneous thoughts and parsed between- and within-person effects by including both the person-mean centered values and the mean-centered person means as predictors. I then tested whether positivity of spontaneous thoughts predicted wanting using an analogous model. Both models included a random intercept and a random slope for the key predictor variable. To test my prediction that positive spontaneous thoughts mediate the relationship between liking an activity and wanting to engage in it, I analyzed a lower-level (1-1-1) mediation model using the selection-variable approach (Bauer, Preacher, & Gil, 2006) to estimate the entire model simultaneously. In follow-up analyses, I tested the specificity of the predicted effects to positive affect by evaluating analogous processes both in the context of negative affect and in terms of spontaneous thought frequency, regardless of valence.

Results

Descriptive Statistics

Although participants were allowed to opt out of responding to items that were not applicable (e.g., if they never did a particular activity), missing data accounted for less than 6% of cases on most variables. If participants reported not having any spontaneous thoughts about a given activity in the past 24 hours, they were not asked follow-up questions about thought

valence, so these variables have higher rates of missingness (positivity = 14.76%; negativity = 18.35%). See Tables 1 and 2 for more detailed information on missing data and descriptive statistics.

Primary Results

First, I tested whether positive emotions experienced during an activity predicted positivity of spontaneous thoughts about that activity by analyzing a multilevel model with a random intercept and random slope. As predicted, there was a significant within-person effect of liking on the positivity of spontaneous thoughts; see Table 3 for all parameter estimates. This effect indicates that activities associated with more positive emotions were the subject of more positive spontaneous thoughts relative to other activities reported on by the same individual. Further, the analogous between-person effect was also significant, indicating that participants who experienced more positive emotions across activities reported spontaneous thoughts that were more positive than participants who experienced lower levels of positive emotions.

Next, I tested whether positivity of spontaneous thoughts predicted subsequent levels of wanting by testing a multilevel model, also with a random intercept and slope. As predicted, there was a significant within-person effect of positive spontaneous thoughts on wanting, even when autonomy and frequency of behavior were included in the model as covariates. This effect indicates that activities that were the topic of more positive spontaneous thoughts were wanted more in the coming 24 hours than other activities reported on by the same participant. Further, the analogous between-person effect was also significant, which indicates that participants who experienced more positive spontaneous thoughts across activities reported greater levels of wanting than participants who experienced spontaneous thoughts that were less positive.

Positivity of spontaneous thoughts also predicted how soon participants planned to do a given activity next, although in this model, only the within-person effect was significant.

To test my hypothesis that positivity of spontaneous thoughts would mediate the relationship between liking and wanting, I used Bauer et al.'s (2006) method for simultaneously estimating the paths of a 1-1-1 multilevel model. The total effects¹ of liking on positivity of spontaneous thoughts and of positivity of spontaneous thoughts on wanting were both significant, which is consistent with the significant within- and between-person effects from earlier analyses. Further, the direct effect of liking on wanting was significant as well ($\beta = 0.553$, $SE = 0.052$, $t(85.7) = 10.60$, $p < .001$, 95% CI = [0.449, 0.656]). Subsequent bootstrapping analysis with 10,000 draws revealed that the average indirect effect of liking on wanting through spontaneous thoughts was indeed significant (estimate of = 0.260, $SE = 0.046$, $p < .001$, 95% CI = [0.169, 0.351]).

Specificity Analyses

Given that the planned analyses were consistent with my hypotheses, I pursued follow-up analyses to determine whether the observed effects were specific to positive spontaneous thoughts or whether they reflected more general phenomena that applied regardless of valence. As such, I first removed positivity from the model and tested whether the mere frequency of spontaneous thoughts about an activity – positive or negative – predicted subsequent levels of wanting to engage in that activity above and beyond obligation and the frequency with which the activity is typically completed. This analysis revealed a significant within-person effect, such that participants reported greater levels of wanting to do activities about which they had more frequent spontaneous thoughts, regardless of the valence of those thoughts. However, the

¹ Because the within- and between-person effects were all significant in preliminary models, I did not test those effects separately in the mediation model.

between-person effect was not significant. To further explore processes related to spontaneous-thought frequency, I tested a model in which positive emotions and negative emotions during an activity both predicted thought frequency. Interestingly, only the within-person effect of positive emotions was significant, which means that participants had more frequent spontaneous thoughts about activities they enjoyed more intensely.

Next, I tested whether negativity of spontaneous thoughts was related to wanting, controlling for obligation and frequency of behavior. This analysis revealed a significant within-person effect, such that activities that were the topic of more negative spontaneous thoughts were wanted less than other activities reported on by the same participant. The corresponding between-person effect was not significant. To further explore the relationship between valenced spontaneous thoughts about an activity and wanting, I created a new model with positivity of spontaneous thoughts and negativity of spontaneous thoughts as simultaneous predictors and autonomy and frequency of behavior included as additional covariates. This analysis revealed robust effects of positive spontaneous thoughts on wanting both within and between participants. By contrast, only the within-person (and not the between-person) effect of negative spontaneous thoughts on wanting was significant, and it was of a relatively lower magnitude than the analogous within-person effect for positive spontaneous thoughts.

Discussion

The results of Study 1 are consistent with the predicted model wherein positive spontaneous thoughts mediate the relationship between liking an activity in the past and subsequently wanting to engage in it. That is, consistent with my hypothesis that liking generates positive spontaneous thoughts about a target, I found that activities that were enjoyed to a greater degree were associated with spontaneous thoughts that were more positive. Likewise, I found

that activities that were the topic of more positive spontaneous thoughts were wanted in the coming 24 hours to a greater degree, which is consistent with my hypothesis that positive spontaneous thoughts energize wanting. Finally, the overarching indirect effect of liking on wanting through positive spontaneous thoughts was also significant.

Follow-up analyses suggested that while these processes are not entirely specific to positive affect (which would have been an unusual outcome – surely negativity has some bearing on reducing approach motivation), the relationship between positive spontaneous thoughts and wanting may be stronger than that of their negative counterparts. Interestingly, whereas positive emotions during an activity predicted subsequent spontaneous-thought frequency, there was no relationship between negative emotions and spontaneous-thought frequency. This finding is consistent with the prediction that enjoyment may cast a wider net of salience onto related cues than displeasure, which may narrow attention.

Ultimately, these data support the hypothesis that positive spontaneous thoughts mediate the relationship between liking and wanting across a wide array of behavioral contexts. Of course, these data are self-reported, largely retrospective, and correlational, thus allowing no inferences about causality. Study 2 was designed to test the same hypotheses by measuring actual spontaneous thoughts in real time in an experimental design that permits causal inference.

Study 2

The primary purpose of Study 2 was to test whether liking an activity causes increases in the positivity of subsequent spontaneous thoughts about that activity. To these ends, I manipulated the degree of positive affect participants experienced while viewing a series of cartoons by systematically altering the captions of some cartoons to be intentionally humorless. Then, I measured the positivity of subsequent spontaneous thoughts about the cartoons as well as

how much effort participants were willing to expend to view more cartoons of a similar type. Following the hypothesis that liking an activity generates positive spontaneous thoughts about that activity and related cues, I predicted that participants who viewed the funnier cartoons would subsequently report spontaneous thoughts about those cartoons that were more positive than participants who viewed the less amusing cartoons. Further, participants who viewed the funnier cartoons should demonstrate greater willingness to expend effort for the opportunity to view more cartoons of a similar type. Overall, I also predicted that positivity of spontaneous thoughts about the activity would mediate the relationship between liking (i.e., experimental condition) and wanting (i.e., effortful behavior). This study also presents an opportunity to compare positive spontaneous thoughts with a previously validated measure of incentive salience (Ode et al., 2012). As such, I predicted that positivity of spontaneous thoughts about cartoons would be correlated with participants' judgments about the size of the text in which the word "cartoon" was displayed.

Methods

Participants

The study sample included 99 undergraduates enrolled in Introductory Psychology at the University of North Carolina at Chapel Hill. The sample was predominantly female (71.43%), and the majority of participants identified as White or Caucasian, although other ethnicities were represented (i.e., 15.31% Asian, 8.16% Black or African American, 74.49% White or Caucasian, 2.04% Other). Participants ranged in age from 17 to 24, and the mean age was 18.71 ($SD = 1.04$). Participants earned partial course credit by completing the lab-based experiment.

Procedure

Participants who provided informed consent were randomly assigned to one of two conditions before beginning the study procedure, which was largely adapted from earlier research (Sherdell, Waugh, & Gotlib, 2012; Waugh & Gotlib, 2008). In the first section of the study, participants completed 10 trials that involved simultaneously viewing one cartoon from each of two decks (labeled “LUM” or “GUP”; labels were counterbalanced) and indicating how much they preferred one cartoon or the other using a 7-point response scale that ranged from “Strongly prefer the left cartoon” to “Strongly prefer the right cartoon.” In the “funny” condition, all of the cartoons in one deck were funny, and all of the cartoons in the other were not funny; that is, their original humorous captions had been replaced by dry statements that merely described the action portrayed. In the “mixed” condition, the makeup of the humorless deck remained the same, but half of the cartoons in the other deck were altered (by removing the captions or replacing them with dry, descriptive captions) so that they were comparable to those in the humorless deck. To summarize, all participants viewed one deck that was entirely humorless, and the other deck was composed of either only amusing cartoons (“funny” condition) or a mix of amusing and humorless cartoons (“mixed condition”). The primary purpose of this comparison task was to allow participants to learn that one deck was full of humorless cartoons, whereas the cartoons in the other tended to be more amusing, but to varying degrees across the two experimental conditions.

In the next section, participants viewed the same 20 cartoons that had appeared in the preference task one by one and rated how much they enjoyed each when it first appeared. These ratings provided an index of liking and were thus used as a manipulation check to ensure that

participants in the funny condition found the cartoons in the targeted deck to be more amusing than participants in the mixed condition.

Next, participants completed a thought-listing task that lasted three minutes. In this task, participants were asked to clear their minds and let them wander and to write down a keyword or brief phrase that described every distinct thought they had during the allotted time. Immediately after reporting a thought, participants were asked to indicate how spontaneous it felt using a 5-point response scale ranging from “Not at all” to “Completely.” After rating the thought, participants were instructed to clear their minds again and continue the thought-listing task as before. After the three minutes elapsed, participants were asked to respond to two follow-up questions about each thought they reported. Specifically, they were asked to indicate how positive each thought felt (5-point scale, “Not at all” to “Completely”) and to complete a binary measure indicating whether each thought pertained to the cartoons from earlier in the study.

Next, participants completed a click-count task previously used as a behavioral measure of wanting (Sherdell et al., 2012; Waugh & Gotlib, 2008). In each of the 36 trials in this task, participants were given the choice to view a cartoon from the LUM or GUP deck, but each deck was associated with a variable cost, such that they had to click on a moving black square a certain number of times to earn the opportunity to view a cartoon from each deck. The values associated with each deck were determined by an algorithm that adjusted the click costs across trials (both in terms of absolute values for each deck and relative differences between them) to determine two indifference points. One indifference point corresponded to how many times participants were willing to click for the funnier deck when the unfunny deck was anchored at 0 (i.e., no effort). A second indifference point corresponded to the analogous value when the unfunny deck was anchored at 15 clicks (i.e., some effort). For example, when the unfunny deck

was anchored at 0, perhaps a participant would consistently opt for the funny deck when it cost 5, 10, or 15 clicks, but when it cost 20 clicks or above, his choices would become more random. In this way, the algorithm scored how much extra effort participants were willing to exert to earn a cartoon from the funnier deck over a cartoon from the unfunny deck. In several cases where participants' responses were too random, the algorithm was not able to determine an indifference point within the 36 trials included in the study. See Table 4 for sample sizes across conditions.

In the next phase of the study, participants completed a font-size estimation task that has previously been used to measure incentive salience (Ode et al., 2012). In this task, participants completed multiple trials that involved comparing target words to a vertical array of the letter "Z" presented along the far left side of the screen in increasing font sizes. Their task was to quickly estimate the size of the font in which the stimulus word was presented, using the array of letters as a reference. Stimuli included words normed as somewhat positive (e.g., melody) or neutral (e.g., paper) as well as the target word, "cartoon."

Last, participants provided demographic information and read a debriefing statement that described the hypotheses and the purpose of the study.

Analytic Strategy

All analyses were conducted using SAS 9.3. First, to validate positive spontaneous thoughts against a previously validated measure of incentive salience, I compared patterns of spontaneous thoughts about the cartoons to responses on the font-estimation task. Specifically, I computed bivariate correlations to test the association between the font-size estimate of the target word (i.e., "cartoon") and frequency of spontaneous thoughts about the cartoons (i.e., a ratio of spontaneous thoughts about the cartoons to total thoughts) as well as the average positivity of spontaneous thoughts about the cartoons.

To evaluate my primary hypotheses, I first used simple linear regression analyses to test whether participants assigned to the funny condition experienced spontaneous thoughts about the cartoons that were more positive than those reported by participants in the mixed condition. Then, I used a similar approach to test whether positivity of spontaneous thoughts predicted indifference points in the click-count task – the behavioral index of wanting. To the extent that those effects emerged as hypothesized, I planned to use a bootstrapping procedure in Mplus 7.11 (Muthén & Muthén, 2004) to test the indirect effect of condition on wanting (i.e., click counts coded as in Waugh & Gotlib, 2008) through positivity of spontaneous thoughts.

Results

Descriptive Statistics

See Table 4 for descriptive statistics for key variables.

Manipulation Check

To determine whether participants in the funny condition liked the cards in the amusing deck more than participants in the mixed condition, I aggregated the individual liking ratings (in pixels) for those cards into an average liking score for each participant. I then submitted these scores to a simple linear regression analysis in which condition was a dummy-coded predictor variable, which revealed a significant difference in liking across conditions ($\beta = 155.164$, $SE = 36.038$, $t(1) = 4.31$, $p < .001$, 95% CI = [83.638, 226.689]). As expected, participants in the funny condition reported that they liked the cartoons in the amusing deck more than participants in the mixed condition.

Validation Analyses

First, I sought to determine whether positive spontaneous thoughts about cartoons corresponded to a previously validated measure of incentive salience. Before testing the

predicted association, I analyzed participants' estimates of positive and neutral words, to determine whether the effect found in previous research replicated in the current sample. A paired-sample *t*-test revealed that participants estimated positively valenced words ($M = 4.585$, $SD = 3.819$) to be larger than neutral words ($M = 3.462$, $SD = 3.186$), $t(105) = 3.63$, $p < .001$, 95% CI = [0.509, 1.737]. Given that the task appeared to operate as intended, I computed the bivariate correlation between participants' font-size estimates for the word "cartoon" and the positivity of their spontaneous thoughts about the cartoons. The correlation was positive, although it escaped statistical significance ($r = 0.239$, $p = .052$). It is worth noting that when all thoughts about the cartoons (regardless of spontaneity) were included, thought positivity was unrelated to size estimates ($r = 0.152$, $p = .179$). Likewise, frequency of spontaneous thoughts was also unrelated to size estimates ($r = -0.010$, $p = .925$). Finally, font-size estimates did not differ by experimental condition ($\beta = 0.165$, $SE = 0.264$, $t = 0.63$, $p = .533$, 95% CI = [-0.358, 0.688]).

Primary Analyses

To determine whether the click-cost task operated as expected, I tested whether indifference points differed as a function of condition. Consistent with prior research (Waugh & Gotlib, 2008), participants in the funny condition were willing to work harder than participants in the mixed condition when the unfunny deck was anchored at 15 ($\beta = 6.571$, $SE = 2.370$, $t = 2.77$, $p = .007$, 95% CI = [1.855, 11.287]). The analogous effect when the unfunny deck was anchored at 0 merely approached significance ($\beta = 5.209$, $SE = 2.873$, $t = 1.81$, $p = .074$, 95% CI = [-0.511, 10.931]). However, the means were in the predicted direction: participants in the funny condition exerted more effort than participants in the mixed condition.

To test whether the manipulation altered the positivity of participants' spontaneous thoughts about the cartoons, I submitted those scores to a simple linear regression analysis with condition predicting positivity of spontaneous thoughts. Consistent with my hypothesis, there was a significant effect of condition ($\beta = 0.932$, $SE = 0.243$, $t = 3.83$, $p < .001$), 95% CI = [0.447, 1.418]), such that participants in the funny condition reported spontaneous thoughts about the cartoons that were more positive than those reported by participants in the mixed condition.

Likewise, I tested whether the manipulation altered the frequency of participants' spontaneous thoughts about the cartoons to examine the specificity of the effect to positive spontaneous thoughts. After excluding thoughts that were not rated as at least moderately spontaneous, I computed a ratio for each participant corresponding to the number of thoughts about the cartoons relative to total number of thoughts reported. Then, I submitted these ratios to a simple linear regression analysis with experimental condition as a binary predictor. This analysis revealed that there was no effect of condition on frequency of spontaneous thoughts about the cartoons ($\beta = 0.030$, $SE = 0.052$, $t = 0.58$, $p = .566$, 95% CI = [-0.073, 0.133]).

Last, I tested whether the positivity of participants' spontaneous thoughts about the cartoons predicted their behavior in the click-cost task. To that end, I first submitted the indifference points when the unfunny deck was anchored at 0 clicks to a simple linear regression analysis with positivity of spontaneous thoughts about the cartoons as the predictor variable. The results of this analysis suggest that there was no association between the positivity of participants' spontaneous thoughts about the cartoons and subsequent effort they exerted to earn funny cartoons ($\beta = -0.046$, $SE = 1.485$, $t = -0.03$, $p = .976$, 95% CI = [-3.025, 2.934]). I repeated the same kind of analysis using the indifference points when the unfunny deck was anchored at 15 clicks, and this model also yielded null results ($\beta = 1.066$, $SE = 1.132$, $t = 0.94$, $p = .350$, 95%

CI = [-1.201, 3.333]). Frequency of spontaneous thoughts about the cartoons was also unrelated to effort when the unfunny deck was anchored at 0 clicks ($\beta = -4.768$, $SE = 5.781$ $t = -0.82$, $p = .412$, 95% CI = [-16.284, 6.748]) and 15 clicks ($\beta = -2.232$, $SE = 4.922$ $t = -0.45$, $p = .652$, 95% CI = [-12.032, 7.567]). Because there was no relationship between positivity of spontaneous thoughts and indifference points, I did not pursue the planned mediation analysis.

Discussion

Study 2 extended the findings of Study 1 by testing the causal links between liking and positive spontaneous thoughts in an experimental context. Consistent with my hypothesis that liking generates positive spontaneous thoughts about a target, participants assigned to the funny condition reported spontaneous thoughts about the cartoons they viewed that were more positive than participants assigned to the mixed condition. This effect enables greater confidence in the causal relationship between liking and positive spontaneous thoughts. Further, it is notable that this result is based on actual thought data reported in real time as opposed to global estimates made retrospectively by participants. There was no such effect of condition on frequency of spontaneous thoughts about the cartoons.

Study 2 also provided an opportunity to compare patterns of positive spontaneous thoughts to a previously validated indicator of incentive salience based on estimating the size of a target word. Consistent with my overarching hypothesis that positive spontaneous thoughts reflect incentive salience, average positivity of spontaneous thoughts about the cartoons showed a modest association with font-size estimations in the predicted direction. That is, participants who had more positive spontaneous thoughts about the cartoons they had viewed tended to overestimate the size of the word “cartoon” to a greater degree. Granted, the estimate scores

were based on a single trial and may not be as reliable as aggregate scores that have been used in prior research.

Although I predicted that positivity of spontaneous thoughts would be associated with greater willingness to work to view funny cartoons (i.e., higher indifference points in the click-count task), this effect did not emerge. One explanation for the null effect of thoughts on effort might have been that the click-count task simply did not operate in this sample as expected. However, that does not seem to have been the case given that participants in the funny condition were generally willing to work more to view the cartoons – which they reported enjoying more – than participants in the mixed condition.

An alternative explanation may be that the effect of positive spontaneous thoughts on wanting for a particular stimulus is forged over a longer time period than the three minutes allotted in the procedure. For example, it may be necessary for participants to detect sustained patterns within their spontaneous thoughts, and if that is the case, such mental computations (or merely impressions) may require more mental “data” than can be acquired in a few minutes. Or if spontaneous thoughts can exert direct influence on wanting in the absence of conscious perception, perhaps they simply need more time to accumulate. Explanations concerning time might seem more plausible if it were not for the effect of condition on behavior, which suggests that the path from liking to wanting did indeed unfold within the timeframe of the study procedure. In this brief evaluation at least, the data can’t rule out that positive spontaneous thoughts are epiphenomenal to incentive salience, rather than active ingredients by which it produces wanting. Still, it may be that positive spontaneous thoughts operate over a longer term to supplement basic connections among liking, incentive salience, and wanting. Study 3 provides an opportunity to explore that possibility.

Study 3

Study 3 builds on the previous studies by testing the full mediation model of liking to wanting through positive spontaneous thoughts in a longitudinal, experimental design. In particular, this study will test three questions. Does liking an activity increase the positivity of spontaneous thoughts about that activity over time? And does spontaneous-thought positivity promote more frequent instances of behavior? Ultimately, do positive spontaneous thoughts mediate the relationship between liking and wanting?

In Study 3, I explored these questions within the framework of the upward spiral model of lifestyle change (Fredrickson, 2013), which outlines how positive emotions may promote the integration of wellness behaviors in people's daily lives. That is, to the extent that positive emotions endow activities and associated cues with incentive salience (which should spark positive spontaneous thoughts), people should subsequently want to engage in those behaviors more. In turn, the more they engage in those behaviors, the more likely they are to continue experiencing positive emotions during them in a self-reinforcing cycle. Concurrently, as positive emotions broaden mindsets, they may also build resources over the long term, some of which may increase the positive-emotion yield of wellness behaviors down the road, such that the aforementioned cycle becomes amplified. In Study 3, meditation training was selected to deliver the positive-emotion intervention, given that prior research has documented an increase in daily positive emotions among individuals who practice loving-kindness meditation relative to individuals who practice mindfulness meditation (Fredrickson et al., unpublished data). Measures of positive emotions, spontaneous thoughts, and various behaviors related to physical health and well-being (e.g., meditation, physical activity, eating fruits and vegetables) were collected before, during, and after meditation training. I predicted that participants randomly

assigned to the loving-kindness condition would show increases in positive emotions during meditation (and throughout their day, more generally) that should predict increases in the positivity of subsequent spontaneous thoughts about meditation. Those thoughts should in turn predict increases in how frequently participants practiced meditation.

Methods

Participants

The study sample includes 226 adults from the Chapel Hill community enrolled in a study on wellness behaviors. The majority of participants identified as female (61.06%) and White or Caucasian, although other ethnicities were represented (i.e., 0.44% American Indian or Native Alaskan, 4.87% Asian, 17.26% Black or African American, 77.43% White or Caucasian). Ages ranged from 34 to 65 ($M = 48.513$, $SD = 8.887$). Participants received monetary compensation for completing the study.

Procedure

In the first week of the study, participants completed a baseline lab visit, which involved providing biological samples and completing a variety of measures unrelated to the main themes of this project. During the next two weeks, participants completed daily, weekly, and biweekly questionnaires. Daily questionnaires included a dichotomous item asking whether participants had meditated in the past 24 hours.² If participants indicated having meditated, follow-up items prompted them to report on how positive they felt while meditating. One set of questionnaires administered every other week included an event-reconstruction task that guided participants through recalling the last time they meditated. In the course of this task, participants reported on their emotions during the activity, intentions to change their behavior, and the frequency and

² Analogous data were also collected for other key health-related behaviors (i.e., physical activity, eating fruits and vegetables, smoking, and alcohol use).

positivity of spontaneous thoughts they generally had about the activity. All questionnaires also contained other measures not directly related to the present research.

In weeks four through nine, participants attended a weekly meditation class (loving-kindness or mindfulness meditation, depending on the condition to which they were randomly assigned at the beginning of the experiment), which was led by an expert instructor and lasted about an hour. Classes in both conditions broadly aimed to cultivate open and nonjudgmental attitudes, though instructions for directing one's attention varied notably between groups. The loving-kindness training directed practitioners to focus their attention on various social targets (i.e., a loved one, oneself, an acquaintance, a difficult person, and all beings) and on physical sensations in the chest. The mindfulness training directed practitioners to focus their attention toward different elements of conscious experience (i.e., breathing and hearing, the body, emotions, thoughts, and choiceless awareness). Daily and biweekly questionnaires continued during this phase of the procedure.

For the three weeks after the meditation classes (i.e., weeks ten through twelve), participants continued to complete the usual series of daily and biweekly questionnaires. Last, participants returned to the lab during the thirteenth week of the procedure.

Analytic Strategy

All analyses were conducted using SAS 9.3 and primary hypotheses were tested using multilevel modeling, given the nested nature of the data (i.e., repeated observations within individuals). As a first step, I analyzed three separate models to test the effect of condition on all three key variables: positive emotions during meditation³, positive spontaneous thoughts about

³ Note that no previous research has demonstrated differences in positive emotions during loving-kindness meditation versus mindfulness meditation. This predicted effect is based on the possibility that increases in daily positive emotions associated with lovingkindness meditation practice (which have been noted in previous research)

meditation, and frequency of meditation behavior. Then, I planned to test a 2-1-1 mediation model to evaluate the indirect effect of condition on change in behavior through change in positive spontaneous thoughts. To these ends, I aggregated the daily measures of behavior and positive emotions into two-week blocks, so that they corresponded to the biweekly time scale on which spontaneous thoughts were measured. My primary analyses were designed to test whether condition predicted positivity of spontaneous thoughts about meditation in a given time block above and beyond positivity of spontaneous thoughts measured in the preceding time block and whether positivity of spontaneous thoughts predicted increases in meditation behavior above and beyond behavior measured in the preceding time block.

Results

To lay the groundwork for my primary analyses, I tested the effects of condition on positive emotions during meditation, positivity of spontaneous thoughts about meditation, and frequency of meditation behavior. First, I created a multilevel model with condition and average positive emotions during meditation at time T (e.g., Block 1) predicting average positive emotions during meditation at time T+1 (e.g., Block 2). This analysis revealed that condition did not predict changes in positive emotions during meditation over time; see Table 5 for parameter estimates. Likewise, there was no effect of condition on changes in positivity of spontaneous thoughts about meditation, nor was there an effect of condition on changes in meditation behavior when those variables were evaluated in analogous time-lagged models. Simpler multilevel models with condition predicting mean levels of each variable without regard for time also revealed no differences.

will be manifest during meditation behavior as well as throughout the day, so that there may be differences in positive emotions during meditation across the two conditions.

After the planned analyses based on condition did not turn out as predicted, I created models that tested the effects of measured positive emotions during meditation (rather than condition) on positive spontaneous thoughts about meditation and in turn, on meditation behavior. First, I found that average positive emotions during meditation predicted increases in positivity of spontaneous thoughts about meditation over the next two-week block; see Table 5 for parameter estimates. Likewise, average positive emotions during meditation also predicted increases in frequency of spontaneous thoughts about meditation. Although spontaneous-thought frequency actually approach significance in predicting less frequent meditation behavior, there was no effect of positivity of spontaneous thoughts on change in behavior.

Next, I explored the same analyses in the context of physical activity; whereas meditation was a new activity for all participants, physical activity in some form was probably quite familiar to most of them. As with the meditation data, condition did not predict changes in positive emotions during physical activity, positivity of spontaneous thoughts about physical activity, or frequency of physical activity, nor were there differences in the mean levels of any of those variables based on condition. See Table 6 for parameter estimates.

However, treating positive emotions during physical activity as a measured rather than manipulated variable was again more fruitful. Positive emotions during physical activity predicted increases in positivity of spontaneous thoughts – but not frequency of spontaneous thoughts in general – about physical activity; see Table 6 for parameter estimates. Further, positivity of spontaneous thoughts about physical activity predicted increases in frequency of physical activity and average duration of cardiovascular activity. Finally, frequency of spontaneous thoughts (regardless of valence) also predicted changes in both measures of behavior.

Discussion

Study 3 provided a controlled test of how the predicted pathway from liking to behavior through positive spontaneous thoughts proceeds over several weeks. Although the manipulation of positive emotions does not appear to have altered positive emotions during the target activities based on the present analyses, the richness of the densely repeated measures within this longitudinal dataset afforded a compelling evaluation of several key hypotheses nonetheless. Interestingly, the pattern of results depended somewhat on the activity in question. While analyses of the meditation data revealed that experiencing positive emotions during meditation predicted subsequent increases in the frequency and positivity of spontaneous thoughts about meditation, positivity of spontaneous thoughts was unrelated to subsequent changes in frequency of meditation behavior. This pattern is similar to the findings from Study 2, in which the manipulation of liking produced changes in the positivity of spontaneous thoughts about the cartoons, but positivity of spontaneous thoughts did not predict wanting behavior. However, both pieces of the path emerged as significant in the case of physical activity. Experiencing positive emotions during physical activity predicted subsequent increases in the frequency and positivity of spontaneous thoughts about physical activity, and the positivity of those thoughts predicted increases in frequency and duration of behavior.

Although it is unclear why the effect of positive spontaneous thoughts on wanting held for physical activity but not meditation, one explanation may pertain to the nature of the larger study. In this experiment, meditation training was chosen as the means for delivering the manipulation of daily positive emotions, and as such, participants' decisions to meditate may have been complicated by a sense of adherence to the study procedures rather than merely driven by wanting. However, the results of Study 1 suggested that positive spontaneous thoughts may

relate to wanting above and beyond obligation. Alternatively, the null effect of positive spontaneous thoughts on wanting to meditate could also be related to the novelty of meditation for participants in the sample.

General Discussion

The primary aim of the present research was to evaluate a possible role of positive spontaneous thoughts in motivation. Study 1 extended prior correlational work by testing the associations among liking, wanting, and spontaneous thoughts in a variety of contexts. Study 2 provided evidence for the causal effect of liking on positive spontaneous thoughts, and Study 3 provided additional evidence for the model by which liking predicts positive spontaneous thoughts and in turn wanting in a more extensive longitudinal framework. Collectively, these studies largely support my overarching hypothesis that positive spontaneous thoughts represent a key mechanism through which incentive salience facilitates wanting and approach behavior.

However, important questions remain. Although the main purpose of Study 2 was to test the effect of positive emotions on positive spontaneous thoughts in an experimental context, it also provided an opportunity to explore the effect of positive spontaneous thoughts on a behavioral index of wanting. This test produced null results, so the greater pattern of findings does not rule out the possibility that positive spontaneous thoughts are mere indicators of incentive salience. Further, although the results Study 3 were consistent with the hypothesized model in the context of physical activity, there was no effect of positive spontaneous thoughts about meditation on changes in the frequency with which participants practiced meditation. Future research should explore boundary conditions – such as novelty of the activity in question – to explain this pattern of effects.

Perhaps the most substantial limitation of the present research is the absence of a direct manipulation of positive spontaneous thoughts. Given the very nature of spontaneous thoughts, developing manipulations to increase their prevalence is difficult, sometimes necessitating designs that evaluate indirect effects involving some preceding variable (in the case of the present studies, positive emotions). Direct manipulations of positive spontaneous thoughts may not be impossible, however. One workaround may involve preventing rather than generating thoughts, akin to how manipulations of facial feedback have used props to prevent the activation of muscles involved in smiling (Strack, Martin, & Stepper, 1988) or have taken advantage of facial paralysis in individuals who had received Botox injections (Neal & Chartrand, 2011). Future research might involve asking some participants to focus on a distractor topic, which may impede the occurrence of spontaneous thoughts (Wegner, Schneider, Carter, & White, 1987), and asking other participants to mind wander or engage in some other relatively unbounded thought task that should allow for positive spontaneous thoughts. Though the measures of spontaneous thoughts described herein have been used successfully in prior research (Rice & Fredrickson, 2016), it will be extremely valuable to continue to develop novel methods and improve existing ones.

One major theoretical implication of this work lies in its potential for extending the incentive-salience framework. Though some recent research has documented experiential elements of incentive salience in humans (Ode et al., 2012), the vast majority of prior research in this area has focused on neurobiological mechanisms in animal models. In contrast, the research described herein is designed to identify a distinct psychological mechanism by which incentive salience creates wanting: the generation of positive spontaneous thoughts. Relatedly, to the extent that positive spontaneous thoughts may be taken as indicators of incentive salience, the

current work may also suggest new methodological possibilities for measuring a construct that is otherwise rather challenging to operationalize.

The present research is all the more important given the shortage of existing work on positive spontaneous thoughts. Indeed, a common trend in earlier literature seems to have been acknowledging that positive spontaneous thoughts do exist but focusing rationale and methodology on their negative counterparts (e.g., Horowitz, 1986; Klinger, 1975; Martin & Tesser, 1989, 1996; Rachman, 1981). On the contrary, the primary focus of this work involves identifying an important function of these everyday phenomena. Still, much additional work needs to be done before positive spontaneous thoughts are on equal footing with related phenomena like intrusive thoughts.

Beyond contributions to basic understanding of motivational processes, this research may also inform more applied research on goal pursuit and behavior change. Many of the measures and paradigms selected for this project relate to health and wellness contexts, and it is not difficult to see the utility of better understanding how to promote desired behavior in these domains. In short, this research may suggest an alternative to the long-standing Nike slogan “just do it.” Instead, a data-driven alternative may be something more along the lines of “just *like* it.” According to the data presented herein, infusing positive emotions in daily life and especially during activities one wishes to up-regulate should generate more of the positive thoughts that pop into one’s head and inspire appetitive behavior.

CHAPTER 3: PERCEPTIONS OF POSITIVE SPONTANEOUS THOUGHTS SHAPE PLANS TO ENGAGE IN PHYSICAL ACTIVITY

Introduction

Recent research on positive spontaneous thoughts (Chapter 2) suggests that they are related to incentive salience – a motivational property that energizes wanting and approach orientation. However, the nature of that relationship remains unclear. Are positive spontaneous thoughts merely indicators of incentive salience, or do they play an active role in altering wanting? Incentive salience arises when an activity or object becomes associated with a positive experience, and that association with reward lends heightened accessibility to the mental representation of the activity or object (Berridge, 2007; Smith et al., 2011). As such, that concept (as well as closely related concepts) should be more likely to emerge into conscious awareness, either when encountered in the environment or at any given time in the form of spontaneous thoughts. However, it remains to be seen whether those thoughts are merely an epiphenomenon of incentive salience, or they are an active ingredient in the process by which incentive salience amplifies wanting.

The present study was designed to follow up on the results of prior research by testing whether perceptions of positive spontaneous thoughts are sufficient to cause increases in wanting, above and beyond actual thought patterns. One reason that positive spontaneous thoughts may be potent primers of appetitive behavior is that people seem to infer more meaning from spontaneous thoughts than from their more deliberate or controlled counterparts (Morewedge et al., 2014). If people perceive their spontaneous thoughts as nonconscious

indicators that they should do something, it may be the case that providing people with feedback to suggest that their spontaneous thoughts about a given activity are especially positive may be sufficient to make them want to engage in that activity.

The Present Research

To test the effect of perceived positive spontaneous thoughts on wanting, this experiment adopted a framework inspired by prior research on post-decision spreading of alternatives (e.g., Brehm, 1956). The classic paradigm in that research involves asking participants to rank a series of items (such as household products) in order of decreasing desirability and then choose between two of the items (often the two rated as fifth or sixth most desirable) to receive as a gift. Later, participants are asked to re-rank the items, and the two sets of rankings are analyzed. Typically, the chosen item rises in the rankings, whereas the rejected item falls in a subtle mental calculus that justifies the prior decision.

In the present study, participants rated a series of activities in terms of how much they wanted to do them, then engaged in thought-listing tasks while facial EMG and cardiovascular data were recorded. Findings from the psychophysiological data will be reported elsewhere; for the purposes of the present study, the psychophysiological equipment simply served to bolster the credibility of the bogus thought profile presented in the feedback condition. In that condition, the computer delivered a prefabricated message suggesting that patterns of subtle facial and physiological activity during the thought task indicated that the participant likely experienced especially positive spontaneous thoughts about one of the activities. Participants in the control condition received no such message. Next, participants rated the activities once again, and to the extent that perceptions of positive thoughts alter wanting, whichever activity was the subject of

the feedback should rise in the ratings, whereas there should be no changes for participants in the control group.

Methods

Participants

The study sample included 74 undergraduates enrolled in Introductory Psychology at the University of North Carolina.⁴ The average age of participants was 19.19 ($SD = 2.63$), and the majority of participants identified as female (71.62%). Although most participants identified as White or Caucasian, other ethnicities were represented in the sample (12.33% Asian, 16.44% Black or African American, 64.38% White or Caucasian, 6.85% Other). Participants earned partial course credit by completing the lab-based experiment.

Procedure

Participants who enrolled in the study via the Psychology Participant Pool Website were contacted by email 12-24 hours before the beginning of their lab session. The message included a reminder about the scheduled session and asked the participant to complete a brief pre-lab questionnaire. After providing electronic consent, participants rated how much they wanted to do 10 physical activities in the next 24 hours, using a response scale from 0 (Not at all) to 10 (Extremely). The instructions specifically asked participants to consider their responses strictly in terms of how much they wanted to do each activity, regardless of practical constraints like other obligations or the availability of necessary equipment. The 10 activities included running, hiking, walking, swimming, dancing, playing basketball, cycling, playing soccer, doing yoga, and lifting weights. These activities were pre-tested to ensure that they are the kinds of activities undergraduates actually do.

⁴ Because study recruitment proceeded much more slowly than anticipated, data collection was not completed by the dissertation reporting deadline. However, any final publication will include the planned sample of 80 participants.

Shortly before the beginning of each lab session, the experimenter accessed the prospective participants' wanting ratings and determined which activity was given the fourth-highest rating. This selection process was also pre-tested to ensure that the target activity would not be consistently given ratings at the very top of the scale (in an attempt to avoid a ceiling effect) but would still be something the participant wanted to do at least a little. The experimenter then set up the lab-session questionnaire by specifying which of the ten physical activities would be the target activity for that participant.⁵

When participants arrived for the scheduled lab session, they were provided with a paper copy of the same consent form and asked to review it before beginning. If participants failed to complete the pre-lab questionnaire, they completed the pre-test wanting ratings at the beginning of the lab session, and the experimenter surreptitiously used those ratings to determine which activity would be the target activity and set up the electronic questionnaire accordingly. Then, the experimenter explained to the participant how she would affix the physiological sensors (i.e., two ECG sensors on opposite sides of the lower torso, a ground sensor on the back of the left hand, a respiration band around the upper torso, a finger-pulse sensor on the middle finger of the left hand, two sensors placed above the left eyebrow to measure activity of the corrugator supercili, two sensors placed below the outer corner of the left eye to measure activity of the orbicularis oculi, and two sensors placed in the middle of the left cheek to measure activity of the zygomaticus major). Once all the sensors were in place, they were connected to the recording equipment (James Long Company, Caroga Lake, NY), and the experimenter visually examined sensor output using Snap-Master data acquisition software (HEM Data Corporation, Southfield, MI) to ensure that the signals were calibrated and recording properly.

⁵ Each of the ten activities were selected as the target activity for at least one participant. Running, walking, and dancing were selected as the target activity most often, each for 11 participants.

Next, participants began the computerized section of the experiment. In the first step, they completed a three-minute task that involved viewing neutral pictures of plants to allow for baseline physiology recording. Then, they completed a one-minute task that involved vividly imagining doing the target activity (i.e., the one that had been given the fourth highest rating on the pre-test wanting questionnaire).

Next, participants completed a three-minute thought-listing task. During that time, they were instructed to clear their minds and let them wander, pausing only when they had a thought to type a keyword or phrase about that thought in a text box on the screen. Immediately after listing a thought in that way, participants were asked to rate how spontaneous versus deliberate the thought felt (using a 5-point response scale ranging from “Not at all spontaneous” to “Completely spontaneous”) and then return to letting their minds wander. After the thought-listing phase was completed, participants were asked follow-up questions about each of the thoughts they reported when prompted with the text they provided. Specifically, participants were asked to rate how positive and negative each thought felt as well as whether it pertained to the target activity they imagined doing earlier in the study.

Next, participants who had been randomly assigned to the feedback condition viewed a “thought profile” (see Appendix A) that included the false feedback. The message explained that the participant’s physiological responses and thought data collectively suggested that their spontaneous thoughts about the target activity were likely to be especially positive and was accompanied by a simple graph designed to support the text. Participants assigned to the no-feedback condition moved to the next section without receiving any feedback.

In the next section, all participants completed a second thought-listing task (this one only one minute long) and then rated the second set of thoughts they reported. Then, they once again

rated how much they wanted to do each of the ten activities and reported their plans to engage in each by indicating whether they intended to do each activity in the morning, afternoon, or evening of each of the following seven days. They then used those planned schedules to estimate how many total hours they would devote to each activity in the coming week. Finally, all participants completed several scales unrelated to the primary themes of the present study.

After participants completed the computerized tasks, the experimenter removed all physiological sensors and recorded the participants' height and weight. Then, the experimenter asked the participant several questions as part of a funneled debriefing procedure designed to detect suspicion of the false feedback or whether the participant had guessed the hypotheses or the purpose of the study. Finally, the experimenter read a debriefing statement to the participant that explained the purpose and hypotheses of the study.

Analytic Strategy

All analyses were conducted using SAS 9.3. To test the hypothesis that the bogus feedback altered wanting to pursue the target activity, I submitted the wanting scores for the target activities to a repeated-measures ANOVA with condition (feedback, no feedback) as a between-subjects factor and ranking (pre-test, post-test) as a within-subjects factor. Similarly, I conducted another test of the hypothesis that perceptions of positive spontaneous thoughts amplify wanting by analyzing the data on participants' behavioral intentions. As such, I submitted total number of times each participant intended to engage in the target activity over the following week and the total duration of those planned instances to separate simple linear regression analyses with condition as a dummy-coded predictor variable.

Results

Descriptive Statistics

See Table 7 for descriptive statistics pertaining to key variables.

Suspicion Check

None of the participants in the feedback condition suspected that the message was prefabricated, although five questioned its accuracy. Excluding those participants from the analyses does not alter the pattern of results.

Primary Analyses

To test whether participants' wanting ratings were influenced by their perceptions of positive spontaneous thoughts, I submitted pre- and post-test wanting ratings to a repeated-measures ANOVA with condition as a between-subjects factor. This analysis revealed that the interaction of time and condition was not significant, $F(1, 70) = 0.184, p = 0.813$, nor was the main effect of condition significant, $F(1, 70) = 0.09, p = 0.768$. However, there was a significant main effect of time, $F(1, 70) = 5.70, p = 0.020$, such that participants wanted to do the target activity less when completing the post-test measure than when completing the pre-lab questionnaire.

To test whether perceptions of positive spontaneous thoughts altered participants' intentions to engage in the target activity, I first created a variable corresponding to the number of times participants intended to engage in the target activity in the following week based on the schedules they completed. Then, I submitted those scores to a simple linear regression analysis following a Poisson distribution (given the count nature of the outcome variable) with condition as a dummy-coded predictor variable. This analysis revealed a significant effect of condition on behavioral intentions ($\beta = 0.322, SE = 0.123, p = .009, 95\% CI = [0.082, 0.563]$), such that

participants who received the bogus feedback intended to engage in the target activity more frequently in the coming week than participants in the control condition. As another index of intentions, I submitted participants' log-transformed estimates⁶ of how long they planned to engage in the target activity over the following week to a simple linear regression analysis with condition as a dummy coded predictor. This analysis revealed no significant effect of condition on behavioral intentions ($\beta = 0.130$, $SE = 0.097$, $t = 1.34$, $p = .189$, 95% CI = [-0.067, 0.327]).

Discussion

In the present study, I explored the process by which positive spontaneous thoughts may drive appetitive behavior, specifically testing whether mere perceptions of thoughts may energize wanting regardless of actual thought patterns. Although self-reported wanting was not affected by the manipulation, the data suggest that merely believing that one's spontaneous thoughts about a particular activity are especially positive is sufficient to alter the number of times one plans to engage in that activity in the coming week.

The theoretical model at the heart of this endeavor suggests that positive spontaneous thoughts should amplify wanting and motivate appetitive behavior, but it was not clear whether this step proceeds nonconsciously or whether some conscious awareness and possibly even active contemplation of one's own thoughts contribute to the effects on behavior. My primary prediction was that participants who believed their thoughts about a target activity were especially positive would demonstrate increases in wanting and plan to engage in that activity more than participants who held no such belief regardless of what their actual thoughts are like, suggesting that meta-cognitive evaluations may play some role in driving behavior. Though there was no change in subjective wanting, participants who received the false feedback reported that

⁶ Raw data exhibited substantial positive skewness (1.736), but the log-transformed data exhibited very little skewness (-0.160).

they intended to engage in the target activity more often in the coming week than participants in the control condition. Future research may seek to identify similar mechanisms by which this process may occur in more ecologically valid contexts. For example, if perceptions (accurate or not) of one's thoughts about an activity can alter behavior, could contemplating positive spontaneous thoughts as they arise in daily life have a similar effect?

This study also begins to address the question of *how* positive spontaneous thoughts are related to incentive salience. It may be that positive spontaneous thoughts are simply epiphenomenal to incentive salience; they are amusing or interesting at most, but they are little more than side effects with no actual effect on behavior. On the other hand, positive spontaneous thoughts may be an active mechanism through which incentive salience facilitates appetitive behavior. Whereas prior research had not convincingly demonstrated a causal effect of positive spontaneous thoughts on behavior (Chapter 2), the results of the present study suggest that they may indeed cultivate approach motivation, at least at the level of behavioral intentions.

Although this study represents a promising step toward understanding how positive spontaneous thoughts may facilitate appetitive behavior, important questions linger. First, the current research only goes as far as intentions, and it is not clear whether the differences apparent at that stage correspond to changes in actual behavior. Second, this experiment explores how *perceptions* of positive spontaneous thoughts – rather than positive spontaneous thoughts themselves – may influence approach motivation. On the one hand, this design may offer some insight about how conscious awareness and perception may be involved in the effect of positive spontaneous thoughts on wanting. However, it also sidesteps the direct question of how positive spontaneous thoughts themselves may influence wanting, which remains to be tested in an experimental paradigm.

Although prior research provided correlational evidence that positive spontaneous thoughts may promote approach behavior (Chapter 2), the current study is the first to test the effect of such thoughts on wanting in an experimental context. The present data indicate that believing that one's spontaneous thoughts about a given activity are especially positive shapes intentions to engage in that activity such that people actually plan to do the activity more often in the coming week. This research suggests that rather than merely arising as incidental features of incentive salience, positive spontaneous thoughts may play an active role in energizing wanting.

CHAPTER 4: MORE FOOD FOR THOUGHT(S)

The research discussed in the preceding chapters represents the first steps toward understanding how positive spontaneous thoughts are involved in the psychological processes that govern motivation. The studies described in Chapter 2 collectively support the hypothesis that positive spontaneous thoughts mediate the relationship between liking and wanting. The results of those studies provide compelling evidence that positive spontaneous thoughts could at least be considered indicators of incentive salience, but it remained to be seen whether they exerted a causal effect on approach motivation. The experiment described in Chapter 3 provided an answer to that open question. In that simple study, participants who were led to believe that their spontaneous thoughts about a given activity were especially positive intended to engage in that activity more often over the following week than participants who did not consider the positivity of their spontaneous thoughts. This finding suggests that perceptions of positive spontaneous thoughts influence approach motivation and potentially behavior, which is just one pathway by which positive spontaneous thoughts themselves may energize wanting. Ultimately, this project merges new theorizing about positive spontaneous thoughts with prior research on incentive salience. Although some forms of positive thinking can be detrimental to goal pursuit (Oettingen, 2012), positive spontaneous thoughts may play an important role in cultivating sustainable behavior change.

Looking forward, additional research should address the shortcomings of the research discussed herein. In particular, Studies 2 and 3 from Chapter 2 present several important opportunities for follow-up work. Although both of those studies provided at least some support

for the hypotheses they were designed to test, the evidence they produced was not overwhelmingly convincing. In Study 2, positivity of spontaneous thoughts did not predict performance on the click-cost task, which served as a behavioral index of wanting. In Study 3, data concerning physical activity supported the primary hypotheses, but there was no effect of positive spontaneous thoughts about meditation on change in meditation behavior. Novelty may be a common factor across these two null findings. By design, meditation was a novel activity for participants enrolled in Study 3 (at least at the start of the study), and although participants in Study 2 had almost certainly all seen cartoons before, it may be the case that they don't often pass their time by viewing series of cartoons. Future studies may explore whether novelty represents a boundary condition to the mediating effect of liking on wanting.

Other work on positive spontaneous thoughts and motivation may further explore the effect of those thoughts on wanting and approach behavior. The experiment described in Chapter 3 represents an important first step in this line of understanding, although in manipulating *perceptions* of positive spontaneous thoughts, it provides only an indirect answer to the question of whether positive spontaneous thoughts themselves actively alter wanting. Subsequent experiments should aim to manipulate actual positive spontaneous thoughts – perhaps by inhibiting versus allowing them – and should include measures of actual behavior rather than mere intentions.

In addition to further work in the domain of motivation, subsequent research should explore other functions of positive spontaneous thoughts, especially those that bear on well-being. For example, future research may explore whether patterns of positive spontaneous thoughts track with individual differences such as flourishing, which represents positive mental health – not simply the mere absence of mental illness – and has been compellingly linked with a

range of desirable outcomes (Keyes, 2002, 2005a, 2005b). Despite the abundance of research documenting the benefits of flourishing, little is known about the cognitive experiences that characterize it. To the extent that unwanted intrusive thoughts perpetuate and intensify mental illness, it may be the case that positive spontaneous thoughts about others, activities, and even one's self are an important ingredient of mental health. Other work has documented how chronically happy people process their experiences differently than people who are less satisfied (Lyubomirsky, 2001), and positive spontaneous thoughts may be yet another cognitive factor that supports well-being.

One particularly fruitful avenue for exploring how positive spontaneous thoughts could promote optimal states like flourishing may involve considering a recently validated construct: prioritizing positivity, which is related to flourishing (Catalino, Algoe, & Fredrickson, 2014). Prioritizing positivity has been conceptualized as an individual difference that refers to the extent to which people organize their daily lives based on the propensity of various activities to yield positive emotions. People who prioritize positivity tend to endorse statements such as “I look for and nurture my positive emotions” and “I structure my day to maximize happiness.” Further, prioritizing positivity is related to greater levels of positive emotions in daily life, greater overall life satisfaction, greater levels of self-compassion, and more positive relations with others, as well as lower levels of negative emotions in daily life and fewer depressive symptoms.

While it seems clear that prioritizing positivity is a largely adaptive construct, much less is known about the specific mechanisms by which it operates. Although the items included in the prioritizing positivity scale largely seem to imply deliberate processes (e.g., “What I decide to do with my time outside of work is influenced by how much I might experience positive emotions”), there are almost certainly more automatic processes at play that support the same

behaviors. On the one hand, to the extent that this is indeed a reasonably stable trait variable, people likely engage in the same positivity-seeking activities repeatedly, and so they may develop into habits over time. Given the evidence reported in Chapters 2 and 3 that positive spontaneous thoughts support the repetition of previously enjoyed activities, it may be worthwhile to explore differences in positive spontaneous thoughts – or perhaps responses to them – as a function of prioritizing positivity.

Other work may explore the role of positive spontaneous thoughts in regulating emotions through means beyond situation selection. Though early research in the domain of emotion regulation was dominated by a focus on consciously controlled strategies for altering mood (especially dampening negative mood), more recent work has considered how many of the same processes may – and likely do – unfold automatically (Mauss, Bunge, & Gross, 2007). Positive spontaneous thoughts may represent one such example of automatic emotion regulation. In fact, positive spontaneous thoughts theoretically entail automatic attentional deployment, given that by definition they involve spontaneously tuning one's attention to pleasant topics, which is the ultimate goal of attentional deployment. Future work may seek to evaluate the effectiveness of positive spontaneous thoughts in the context of mood repair and identify individual differences that predict propensity to experience positive spontaneous thoughts during challenging circumstances.

To the extent that positive spontaneous thoughts can serve as agents of emotion regulation, it would be valuable to understand how they may be deployed strategically, perhaps using implementation intentions. Implementation intentions are if-then statements that operate by creating an association between an opportunity to enact a desired behavior and the behavior itself (Gollwitzer, 1993, 1999). Research on implementation intentions has documented their

impressive effectiveness across a wide variety of domains (Gollwitzer & Sheeran, 2006), and given that they operate by harnessing automaticity, they may provide a uniquely direct answer to the question of how to promote positive spontaneous thoughts.

The research described in Chapter 2 (especially Study 2) suggests that one way to cultivate positive spontaneous thoughts is to alter processes upstream, such as experiences of positive emotions. However, it may be possible to prepare positive spontaneous thoughts by strategically creating implementation intentions. For example, one might create an implementation intention to think about a recent experience of gratitude if they are feeling sad. This kind of plan could potentially be particularly useful for individuals who tend to respond to such episodes in less adaptive ways, such as engaging in rumination. Indeed this may be an answer to prior research showing that although positive distractors are effective in combatting rumination, depressed samples often encounter difficulty in identifying such distractors in the moment (Wenzlaff, Wegner, & Roper, 1988).

Other research may explore the ways in which positive spontaneous thoughts diverge from their more intentional counterparts. Part of the problem with positive thinking may be that the process is actually too cognitive. When people engage in positive thinking as a strategy for improving mood, they may fixate too much on the mood itself and too quickly make comparisons between their current state (e.g., still unhappy) and the goal state (e.g., happy) and upon realizing the discrepancy, add disappointment at their failure to whatever undesirable affect they were originally trying to remedy (Carver & Scheier, 1982; Schooler, Ariely, & Loewenstein, 2003). These are simply not the conditions under which most emotions – positive or negative – typically unfold. Rather, emotions generally involve a complex cascade of psychological and biological changes that may be stifled in these cases by the heavy-handed

evaluation that characterizes ineffective positive thinking. In contrast, positive spontaneous thoughts should arise in ways that are incidental to these kinds of issues (i.e., as a function of the heightened accessibility of some concept), and as such, the sparks of positive emotions they create may have a greater propensity to permeate the mind and body as affect normally does without being choked off by explicit goals pertaining to emotion regulation or ideal affect.

Studies of psychophysiological processes at play in positive spontaneous thoughts may yield helpful insights into whether and why they help regulate mood when deliberate positive thinking falls short. For example, there may be simple differences in the extent to which spontaneous and deliberate positive thoughts are associated with the physiological concomitants of positive affect, such as quickened recovery from the cardiovascular effects of negative emotions (Fredrickson & Levenson, 1998; Fredrickson, Mancuso, Branigan, & Tugade, 2000) or more simply, smiling. The experiment described in Chapter 3 actually presents one opportunity to explore this question. Although the primary purpose of the psychophysiological equipment used in that study was to lend credibility to the false feedback presented to participants in the experimental condition, experimenters did record cardiovascular and facial EMG data before and during the thought-listing task. As such, it will be possible to evaluate for example whether expressed smiles relate to patterns of positive spontaneous thoughts. Future research should continue to explore how the pleasant thoughts that pop into people's heads may relate to physiological changes in facial musculature and throughout the body.

More broadly, the research described herein along with preceding work on positive spontaneous thoughts may be seen as occupying a previously desolate space at the intersection of positive psychology and automaticity. My sense is that positive psychology has so far largely underutilized the rich methods developed to study automatic processes in the tradition of social

cognition as well as the vast scientific literature that has accumulated in that area. As one example, though bad habits may be more salient than good ones, crafting desirable habits should be a relatively straightforward way to promote goal-consistent behavior in a way that sidesteps many limitations of effortful self-control and will-power. Research on this broad topic would not only contribute to the fields of self-regulation and positive psychology, but it could also inspire a wide range of applications.

Further, other work on positive automaticity may explore how automatic processes at play in people's everyday lives support prosocial behavior and social connections. Prior work has already documented how nonconscious behavioral mimicry facilitates social affiliation (Lakin & Chartrand, 2003; Lakin, Jefferis, Cheng, & Chartrand, 2003) and prosocial behavior (van Baaren, Holland, Kawakami, & Knippenberg, 2004), but these demonstrations likely only represent the tip of the iceberg. Likewise, other research should evaluate how automatic processes may support broader outcomes like meaning in life, life satisfaction, and other indices of well-being. As an example, existing research already suggests that accessibility of "true-self" traits is positively related to meaning in life (Schlegel, Hicks, Arndt, & King, 2009). While individual differences and behaviors should continue to receive empirical attention as predictors of well-being, future research in the domain of positive psychology should widen its theoretical and methodological repertoire to better address how nonconscious processes may contribute to well-being.

The research described herein is largely informed by prior work on automaticity and social cognition, and it embraces key tenets from those traditions to explore how positive spontaneous thoughts are involved in promoting wanting and approach motivations, especially to enact the kinds of behaviors that support health and wellness. Collectively, these studies suggest

that positive spontaneous thoughts are related to incentive salience at least incidentally – they arise following experiences of positive affect and are positively correlated with a previously validated measure of incentive salience. Much as incentive salience makes stimuli pop out to the individual when encountered in the environment, positive spontaneous thoughts may make concepts associated with reward pop into people’s minds regardless of the environment. Further, this project provides data to suggest that perceptions of positive spontaneous thoughts about a given behavior may even play an active role in shaping intentions to enact that behavior. Although the experience of positive spontaneous thoughts may not seem to possess much impact at face value, the data presented herein suggest that they play an important role in reward processing and may ultimately guide people’s day-to-day behavioral choices.

Table 1

Study 1 Descriptive Statistics

Variable	N	Min	Max	Mean	SD
ST Frequency	1030	0	100	3.296	5.502
ST Positivity	878	0	10	6.058	2.823
ST Negativity	841	0	10	2.002	2.775
Pos. Emotions	970	1	7	4.534	1.729
Neg. Emotions	975	1	7	2.985	1.820
Wanting	992	1	7	4.096	2.105
Autonomy	991	1	7	4.414	1.983
Last Time	1030	1	6	4.675	1.223
Next Time	1030	1	7	2.247	1.594
How Often	1030	1	7	5.545	1.608

Note: Sample sizes differ across variables because in some cases participants were given the option not to report on individual activities if a particular item did not apply. In other cases, as with spontaneous thought frequency, if participants did not have any spontaneous thoughts about a given activity in the specified time period, they would enter “0” rather than “not applicable.”

Table 2

Study 1 Correlation Matrix

Variable	1	2	3	4	5	6	7	8	9	10
1 ST Frequency	-									
2 ST Positivity	.12*	-								
3 ST Negativity	-.03	-.50*	-							
4 Positive Emotion	.17*	.61*	-.35*	-						
5 Negative Emotion	-.01	-.25*	.43*	-.18*	-					
6 Wanting	.20*	.57*	-.35*	.67*	-.16*	-				
7 Autonomy	.08*	.40*	-.27*	.52*	-.11*	.57*	-			
8 Last Time	.22*	.14*	-.05	.27*	.02	.24*	.14*	-		
9 Next Time	-.19*	-.13*	.13*	-.24*	.06	-.26*	-.16*	-.71*	-	
10 How Often	.21*	.11*	-.02	.29*	.07*	.27*	.22*	.76*	-.79*	-

Note: * $p < .05$

Table 3

Study 1 Analyses

Outcome	Effects	Estimate	SE	<i>t</i>	df	<i>p</i>	95% CI
Positivity of STs	Intercept	5.910	0.129	45.73	101	<.001	5.654, 6.167
	Positive Emotion (W)	1.027	0.069	14.97	766	<.001	0.892, 1.162
	Positive Emotion (B)	1.020	0.145	7.04	101	<.001	0.733, 1.307
Wanting	Intercept	1.642	0.260	6.32	101	<.001	1.127, 2.157
	Positivity of STs (W)	0.348	0.032	10.80	757	<.001	0.285, 0.411
	Positivity of STs (B)	0.214	0.051	4.22	101	<.001	0.113, 0.315
	Autonomy of Behavior	0.368	0.030	12.44	747	<.001	0.310, 0.426
Time to Next Activity	Frequency of Activity	0.171	0.039	4.37	747	<.001	0.094, 0.248
	Intercept	5.587	0.172	32.54	101	<.001	5.246, 5.927
	Positivity of STs (W)	-0.043	0.013	-3.39	773	<.001	-0.068, -0.018
	Positivity of STs (B)	0.029	0.044	0.65	101	0.515	-0.058, 0.115
Wanting	Time Since Last Act.	-0.740	0.032	-22.79	773	<.001	-0.803, -0.676
	Intercept	0.656	0.255	2.57	101	0.012	0.150, 1.162
	Frequency of STs (W)	0.133	0.025	5.27	875	<.001	0.084, 0.183
	Frequency of STs (B)	0.030	0.022	1.37	101	0.174	-0.014, 0.074
	Autonomy of Behavior	0.539	0.028	19.55	875	<.001	0.485, 0.593
Frequency of STs	Frequency of Activity	0.186	0.041	4.60	875	<.001	0.107, 0.266
	Intercept	3.475	0.357	9.74	100	<.001	2.767, 4.183
	Positive Emotion (W)	0.592	0.113	5.26	861	<.001	0.371, 0.813
	Positive Emotion (B)	0.503	0.355	1.42	100	0.160	-0.201, 1.207
	Negative Emotion (W)	0.172	0.115	1.50	861	0.134	-0.053, 0.398
Wanting	Negative Emotion (B)	0.185	0.246	0.75	100	0.453	-0.303, 0.673
	Intercept	1.032	0.274	3.76	100	<.001	0.487, 1.576
	Negativity of STs (W)	-0.285	0.037	-7.64	723	<.001	-0.358, -0.212
	Negativity of STs (B)	-0.015	0.047	-0.31	100	0.757	-0.109, 0.079
Wanting	Autonomy of Behavior	0.456	0.030	14.98	723	<.001	0.396, 0.516
	Frequency of Activity	0.201	0.042	4.79	723	<.001	0.118, 0.283

Wanting	Intercept	1.710	0.361	6.55	99	<.001	1.192, 2.228
	Positivity of STs (W)	0.317	0.036	8.78	717	<.001	0.246, 0.387
	Positivity of STs (B)	0.221	0.053	4.15	88	<.001	0.116, 0.327
	Negativity of STs (W)	-0.070	0.035	-1.97	717	0.049	-0.138, -0.001
	Negativity of STs (B)	0.038	0.045	0.83	99	0.407	-0.052, 0.127
	Autonomy of Behavior	0.369	0.030	12.43	717	<.001	0.310, 0.427
	Frequency of Activity	0.156	0.039	3.99	717	<.001	0.079, 0.232

Note: All models include random intercepts and random slopes for the within-person effects (W). However, the random slope for the within-person effect of negative emotion on frequency of spontaneous thoughts was omitted because the model failed to converge when it was included. Between-person effects are denoted (B).

Table 4

Study 2 Descriptive Statistics

Variable	Funny Condition			Mixed Condition		
	<i>N</i>	Mean	SD	<i>N</i>	Mean	SD
Cartoon Ratings	50	1318.59	198.20	49	1163.42	157.63
ST Frequency	50	0.270	0.256	46	0.240	0.250
ST Positivity	36	3.644	0.844	31	2.712	1.141
Indifference (0)	38	14.868	13.177	41	9.659	12.360
Indifference (15)	40	28.000	12.341	42	21.429	8.923
Font Estimate	50	0.920	1.291	49	0.755	1.331

Note: Cartoon ratings were measured in pixels because a visual analog scale spanning the width of the computer screen was used to record responses. ST Frequency corresponds to ratios of number of spontaneous thoughts about cartoons relative to total number of spontaneous thoughts reported during the thought-listing task; ST Positivity refers to the mean positivity scores of spontaneous thoughts about the cartoons. Indifference (0) and Indifference (15) refer to the indifference points when the unfunny deck was anchored at the value in parentheses. Font Estimate is computed as the difference between participants' estimates of the size of the font in which the word "cartoon" was displayed and the actual size of the font, so a score of zero would indicate perfect accuracy, and positive values indicate a tendency to overestimate the size of the word cartoon.

Table 5

Study 3 Analyses Concerning Meditation

Outcome	Effects	Estimate	SE	<i>t</i>	df	<i>p</i>	95% CI
Positive Emotions (T+1)	Intercept	0.477	0.054	8.82	210	<.001	0.370, 0.583
	Positive Emotions (T)	0.824	0.020	42.16	545	<.001	0.786, 0.862
	Condition	-0.025	0.034	-0.74	210	0.461	-0.091, 0.041
Positive Emotions	Intercept	2.449	0.082	29.96	212	<.001	2.288, 2.611
	Condition	-0.091	0.108	-0.84	212	0.400	-0.304, 0.122
Positivity of STs (T+1)	Intercept	5.790	0.344	16.81	184	<.001	5.110, 6.469
	Positivity of STs (T)	0.279	0.038	7.31	347	<.001	0.204, 0.354
	Condition	0.065	0.202	0.32	184	0.748	-0.333, 0.463
Positivity of STs	Intercept	7.977	0.181	44.02	204	<.001	7.620, 8.335
	Condition	-0.196	0.250	-0.78	204	0.434	-0.689, 0.297
Frequency of Meditation (T+1)	Intercept	0.532	0.027	19.88	215	<.001	0.480, 0.585
	Frequency of Med. (T)	0.184	0.030	6.19	632	<.001	0.126, 0.243
	Condition	0.042	0.030	1.43	215	0.154	-0.016, 0.101
Frequency of Meditation	Intercept	0.559	0.020	27.89	215	<.001	0.520, 0.599
	Condition	0.033	0.029	1.13	215	0.261	-0.025, 0.091
Frequency of STs (T+1)	Intercept	2.441	0.186	13.14	185	<.001	2.075, 2.807
	Frequency of STs (T)	0.098	0.034	2.84	342	0.005	0.030, 0.165
	Positive Emotions (T)	0.241	0.069	3.48	342	<.001	0.105, 0.377
Positivity of STs (T+1)	Intercept	5.002	0.386	12.97	180	<.001	4.241, 5.763
	Positivity of STs (T)	0.214	0.039	5.44	314	<.001	0.136, 0.291
	Positive Emotions (T)	0.579	0.102	5.70	314	<.001	0.379, 0.779
Frequency of Meditation (T+1)	Intercept	0.564	0.065	8.67	204	<.001	0.436, 0.692
	Frequency of Med. (T)	0.161	0.033	4.83	454	<.001	0.095, 0.226
	Positivity of STs (T)	0.002	0.008	0.30	454	0.764	-0.013, 0.017
Frequency of Meditation (T+1)	Intercept	0.625	0.040	15.44	206	<.001	0.520, 0.640
	Frequency of Med. (T)	0.192	0.036	5.33	479	<.001	0.271, 0.391
	Frequency of STs (T)	-0.021	0.013	-1.65	479	0.100	-0.046, 0.004

Table 6

Study 3 Analyses Concerning Physical Activity

Outcome	Effects	Estimate	SE	<i>t</i>	df	p	95% CI
Positive Emotions (T+1)	Intercept	0.190	0.042	4.57	202	<.001	0.108, 0.272
	Positive Emotions (T)	0.937	0.013	72.19	533	<.001	0.911, 0.962
	Condition	-0.008	0.026	-0.31	202	0.759	-0.059, 0.043
Positive Emotions	Intercept	2.666	0.089	30.07	210	<.001	2.491, 2.841
	Condition	-0.234	0.122	-1.91	210	0.057	-0.475, 0.007
Positivity of STs (T+1)	Intercept	2.694	0.227	11.89	186	<.001	2.247, 3.141
	Positivity of STs (T)	0.685	0.027	25.50	364	<.001	0.632, 0.738
	Condition	-0.079	0.120	-0.65	186	0.514	-0.316, 0.158
Positivity of STs	Intercept	7.609	0.217	35.01	204	<.001	7.180, 8.037
	Condition	-0.088	0.298	-0.30	204	0.767	-0.675, 0.499
Frequency of PA (T+1)	Intercept	0.523	0.054	9.62	215	<.001	0.416, 0.630
	Frequency of PA (T)	0.391	0.038	10.18	609	<.001	0.316, 0.467
	Condition	0.068	0.066	1.04	215	0.300	-0.062, 0.198
Frequency of Physical Activity	Intercept	0.889	0.056	15.86	215	<.001	0.779, 1.000
	Condition	0.025	0.084	0.30	215	0.762	-0.140, 0.191
Frequency of STs (T+1)	Intercept	0.527	0.124	4.25	188	<.001	0.282, 0.771
	Frequency of STs (T)	0.801	0.025	31.53	347	<.001	0.751, 0.851
	Positive Emotions (T)	0.046	0.039	1.17	347	0.242	-0.031, 0.122
Positivity of STs (T+1)	Intercept	2.753	0.276	9.97	184	<.001	2.208, 3.298
	Positivity of STs (T)	0.600	0.032	16.52	339	<.001	0.536, 0.664
	Positive Emotions (T)	0.218	0.080	2.71	339	0.007	0.060, 0.377
Frequency of PA (T+1)	Intercept	0.331	0.128	2.59	204	0.010	0.079, 0.582
	Frequency of PA (T)	0.408	0.043	9.57	472	<.001	0.324, 0.492
	Positivity of STs (T)	0.031	0.016	1.99	472	0.047	0.001, 0.062
Frequency of PA (T+1)	Intercept	0.090	0.082	1.11	205	0.269	-0.070, 0.251
	Frequency of PA (T)	0.389	0.029	10.07	478	<.001	0.313, 0.465
	Frequency of STs (T)	0.151	0.030	5.00	478	<.001	0.092, 0.210

Duration of Cardio (T+1)	Intercept	4.404	2.521	1.75	204	0.082	-0.568, 9.375
	Duration of Cardio (T)	0.715	0.026	27.38	472	<.001	0.664, 0.766
	Positivity of STs (T)	0.721	0.331	2.18	472	0.030	0.070, 1.372
Duration of Cardio (T+1)	Intercept	7.408	2.391	3.10	204	0.002	2.694, 12.121
	Duration of Cardio (T)	0.633	0.029	21.56	478	<.001	0.576, 0.691
	Frequency of STs (T)	1.538	0.739	2.08	478	0.038	0.086, 2.989

Table 7

Chapter 3 Descriptive Statistics

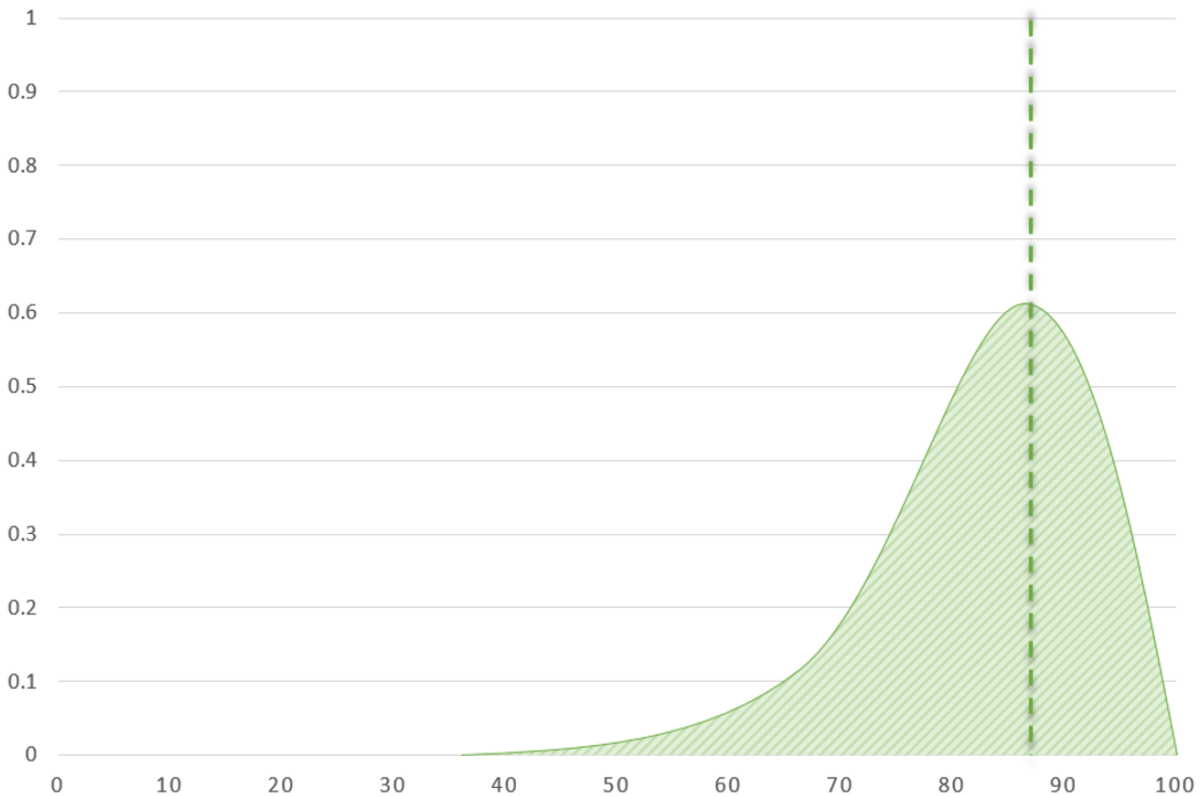
Variable	<u>Control</u>		<u>Feedback</u>	
	Mean	SD	Mean	SD
Wanting (pre-test)	5.541	2.129	5.314	2.246
Wanting (post-test)	4.553	2.787	4.583	2.989
Intended Events	3.079	3.395	4.250	5.940
Intended Hours	1.568	2.270	2.389	2.834

Note: Responses on the wanting measure ranged from 0 to 10, with higher scores indicating greater wanting.

APPENDIX: THOUGHT PROFILE FROM CHAPTER 3

Our computer program has now processed the data we recorded earlier regarding your physiological activity and has integrated these data with the information you provided about your thoughts. Together with your survey responses, your patterns of facial and cardiovascular activation allow us to determine (with 95% confidence) how positive or negative your spontaneous thoughts about [activity] generally are.

Your data suggest that your spontaneous thoughts are generally quite positive, averaging approximately 88% positive.



Note that this estimation pertains only to your spontaneous thoughts, that is, those thoughts that seem to pop into your head, even if you don't notice them very often. The state-of-the-science does not yet allow us to determine this kind of information about your deliberate thoughts.

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