Desire Over Time: The Multi-Faceted Nature of Satiation

Joseph P. Redden

University of Minnesota

Chapter for *The Psychology of Desire*, edited by Wilhelm Hofmann and Loran F. Nordgren.

February 2014

Abstract

Desire is dynamic in that enjoyment and wanting typically decline as one repeatedly consumes the same thing. This consequence of satiation arises in many fields, including economics (diminishing marginal utility), psychology (adaptation, habituation), food sciences (nutritional needs), advertising (wearout), and well-being (hedonic treadmill). Although researchers have often viewed satiation as an automatic meter that tracks the quantity consumed and inexorably leads to satiation, growing research indicates that satiation also has a malleable component rooted in perception and self-reflection. This chapter details the multi-faceted nature of satiation, offers a framework to capture its mechanisms, and discusses implications for influencing satiation through interventions and individual differences.

Keywords: satiation, changing desire, hedonic consumption, adaptation, habituation

Desire Over Time: The Multi-Faceted Nature of Satiation

Nearly everyone experiences the phenomenon of satiation every day. For instance, a once loved song now makes us want to change the radio, a special restaurant no longer seems the obvious choice, a large piece of chocolate cake gets eaten a bit less enthusiastically, a new toy is no longer played with, skydiving becomes less exhilarating, and a new acquaintance becomes a little less exciting. These examples all illustrate the effects of satiation, which is defined here as the drop in enjoyment with repeated consumption. Of course, satiation is not an imperative such as when enjoyment increases as one gains familiarity with an unknown stimulus (Zajonc, 1968), or drug addictions alter normal neural processes (Nestler & Malenka, 2004). However, these exceptions aside, it is a stylized fact that nearly everyone satiates on nearly every experience at high levels of repeated consumption. This chapter highlights this ubiquitous phenomenon, provides a framework for understanding its nature, and discusses the implications of its effects.

Because satiation occurs for virtually every experience, it follows that how much one likes something is quite dynamic and constantly changing. It is then somewhat inadequate to characterize one as having a high level of desire as an enduring trait (e.g., a chocoholic); instead, it seems more appropriate to capture only a current state of desire as a sort of snapshot within an ongoing movie. The prevailing desire state will then reflect the current level of satiation that depends on the past quantity consumed, the variety of things previously consumed, and the time since the last consumption. Satiation ensures that current desire incorporates each of these and other factors, and that this overall liking reflects how it changes with ongoing behavior over time. Thus, a full understanding of desire must incorporate the dynamics of and recovery from satiation, which is sketched in Figure 1 and discussed next.

--- Insert Figure 1 about here ---

The Consumption Cycle

Satiation as Decreased Liking

The notion of satiation is a deeply ingrained core concept in a number of disciplines. Introductory psychology courses generally include a unit on habituation (Thompson & Spencer, 1966) whereby an organism responds less to a stimulus with repeated exposure. Similarly, another basic process of psychology is adaptation (Helson, 1964), which is often demonstrated by having students notice how putting their hand in warm water will feel quite different depending on whether that hand was previously in either cold or hot water. In a dramatically different field of study, economic theory has a core tenet of diminishing marginal utility (Bernoulli, 1954) in which each additional dollar of wealth adds less and less to overall utility. Likewise, marketers have incorporated the well-known topic of advertising wear-out in which an ad steadily loses its effectiveness after being seen many times (Pechmann & Stewart, 1988). Finally, food scientists understand the importance of energy regulation (Benelem, 2009) whereby food is more valued and liked when one is in a state of hunger versus a state of satiety. Although these effects all span quite a broad range of domains, they all share one critical defining characteristic - a decreased response after repeated exposure. That is, there is satiation as it is defined here.

Recovery from Satiation

Upon getting satiated with a favorite experience, a simple remedy is consuming something different (i.e., variety). Although variety is an effective response to satiation in some cases, it is often not an ideal solution. First, variety requires expanding the set of less preferred options (i.e., trading down). For instance, one might find they are bored with their favorite restaurant so they instead go to a second restaurant that is not generally liked as much. Second, variety may be absent in many situations where there is little choice. Examples include small children having food prepared by their parents, employees completing the tasks assigned by their supervisor, or news channels that all incessantly focus on the same hot news story of the day. Third, variety can work against an overall goal by increasing consumption. For example, adding variety to a four-course meal increased overall food intake by over 40% (Rolls, van Duijvenvoorde, & Rolls, 1984), presumably an undesirable outcome for many on a restrictive diet. These examples are not isolated cases, but rather they reflect the fact that variety is not an ideal response to recover from satiation.

More generally, it is widely assumed that the effects of satiation naturally dissipate over time as shown in Figure 1. In their seminal work on habituation, Thompson and Spencer (1966) called this process “spontaneous recovery”. For example, in one of the few studies of this process, people did not experience satiation effects when eating the same macaroni & cheese dish once a week for five weeks (Epstein, Carr, Cavanaugh, Paluch, & Bouton, 2011). The recovery period here of seven days apparently provided enough time for people to recover from any past satiation. However, it should be noted that other work suggests that spontaneous recovery is not always quite so spontaneous. After hearing the chorus of their favorite song 20 times, participants seemingly showed little recovery in satiation even after three weeks (Galak, Redden, & Kruger, 2009). Regardless, satiation is not permanent, and people typically recover from it at some point.

The Benefits and Consequences of Satiation

The dynamic nature of desire resulting from satiation and recovery serves at least three vital purposes that each could have provided great value in our evolutionary development. First, satiation helps focus attention on changes in the environment, which are likely to be more important than constants. Here, a novel experience elicits an increased response and interest that die off through satiation if the experience remains unchanged and poses little ongoing threat or opportunity. Second, satiation encourages variety seeking which would have been necessary to ensure that an ancestor consumed an adequate amount of various needed nutrients. Third, satiation reduces the potential for overconsumption that could leave one less mobile and more vulnerable to predators. Regardless of these distal mechanisms, it is clear that satiation is a valuable adaptation that now extends to virtually every stimulus.

Although satiation is both necessary and important for well-being, it also presents a number of challenges for a wide range of audiences. For those focused on general happiness and well-being, satiation has been portrayed as a "hedonic treadmill" in which people must constantly find new and different experiences just to maintain a steady level of happiness (Brickman & Campbell, 1971). Policy makers and health workers must overcome satiation to keep people in compliance with interventions, while marketers face a similar challenge in increasing the usage and brand loyalty of their products. Finally, and perhaps of most significance, satiation poses a particular challenge for people trying to attain goals. Satiation makes it increasingly challenging to adhere to a restricted diet (e.g., eating salads for lunch every day), or a beneficial exercise regimen (e.g., going to the gym five times a week). Although people may find it particularly enjoyable when they initially start these endeavors, the inexorable march of satiation virtually guarantees that this enjoyment will be fleeting. Of course, when the activity no longer provides enjoyment, the likelihood of compliance invariably falls.

The Nature of Satiation

General Intuition

People often attribute satiation to physiological causes. For instance, after eating a large amount of food makes it less enjoyable, people often state that they “feel full” (Mook & Votaw, 1992). This view implies that food physically fills the stomach, and this distension signals to the body that the food should no longer be rewarding. The widespread acceptance of this account is reflected in aphorisms such as “his eyes were bigger than his stomach” or saying “unbuckle your belt” before a good meal. More generally, the intuitive belief is that the body provides feedback about consumption, and this feedback becomes less positive over the course of repeated consumption.

Although physiological mechanisms may contribute to satiation, they struggle to fully account for the various phenomenon (McSweeney & Murphy, 2000). For instance, the food domain is where one might expect physiological explanations to be particularly appropriate, yet there are quite a few aspects this account cannot explain. First, eating a food can decrease the liking of that food in a matter of a couple minutes (Hetherington, Rolls, & Burley, 1989), which is far too fast for any type of digestive process. Second, though a large meal can satiate one on that food, a novel food can instantly restore salivation (Epstein, Caggiula, Rodefer, Wisneiwski, & Mitchell, 1993) and seemingly eliminate effects of satiation. A common example of this is salivating over a dessert after becoming “full” from the entrée. Third, the extent of satiation is not closely linked to the caloric or macronutrient content of what has been eaten (Johnson & Vickers, 1993; Rolls, Hetherington, & Burley, 1988), indicating that a physiological inventory is not the driver of satiation. More generally, beyond the domain of food, physiological accounts would be less applicable to non-ingested stimuli such as art, aromas, cognitive work tasks, or social interactions (Galak et al., 2009; McSweeney & Swindell, 1999; Rolls & Rolls, 1997). The sum of this evidence makes a strong case that satiation is not just a physiological effect; in fact, it seems to be largely non-physiological.

Specificity of Satiation

A core finding in the satiation literature is that satiation is greatest for the stimulus consumed and less for stimuli not consumed. This characteristic has been extensively studied as a phenomenon called sensory-specific satiety (Rolls, Rolls, Rowe, & Sweeney, 1981). This research paradigm involves first eating and rating liking of several samples from a range of different foods, next eating only one of those foods until choosing to stop, and then eating and rating liking for each of the sample foods again. The key finding is that liking drops much more for the food eaten in the middle step than any of the other samples. In fact, this increased drop also extends to other foods that share the same flavor (Johnson & Vickers, 1993), texture (Guinard & Brun, 1998), shape (Rolls, Rowe, & Rolls, 1982), or odor (Rolls & Rolls, 1997). These effects of sensory-specific satiety seem to peak a couple of minutes after ingestion, and subsequently diminish very little even after 60 minutes (Hetherington et al., 1989).

The core notion of sensory-specific satiety is that people satiate on a particular aspect of an experience. For food, this aspect is often flavor (Epstein et al., 1993; Johnson & Vickers, 1993), perhaps because flavor is highly salient. More generally, satiation appears to be greatest for the particular aspects garnering focal attention. For example, when eating jellybeans with labels that focused on the specific flavor (e.g., cherry or lemon) rather than the general candy type (e.g., jellybean), people satiated less quickly with the specific labels (Redden, 2008). Although everyone ate the same exact assortment of jellybeans, the more specific categorization made the experience seem less repetitive within that category. This indicates that the specificity of satiety depends on the focus of attention and the framing of an experience – a finding consistent with a non-physiological view of satiation.

Constructed Aspect

Satiation does not simply reflect a running inventory of attributes that accumulates through consumption and depletes over time with physiological processing and forgetting (McAlister, 1982). A growing body of evidence indicates that satiation is instead largely constructed in the moment. For example, people show less satiation when they have less memory for past consumption, whether it be due to distractions that reduce encoding (Higgs & Woodward, 2009) or impairments causing amnesia (Rozin, Dow, Moscovitch, & Rajaram, 1998). In fact, merely imagining consumption can produce effects of satiation for subsequent consumption (Larson, Redden, & Elder, 2014; Morewedge, Huh, & Vosgerau, 2010). Satiation apparently arises in part from mental processes that recall and simulate past consumption.

Recent work posits that the construction of satiation entails a subjective sense of the extent of past consumption. After people viewed the same beach photo for five minutes, making them place themselves on a scale with altered ranges to make their level of exposure seem higher than others made that same beach photo less enjoyable on a subsequent exposure (Redden & Galak, 2013). Satiation was similarly increased by speeding up an online running clock to make it seem like less time had passed since the last consumption occasion (Galak, Redden, Yang, & Kyung, 2014). People seemingly construct satiation based on an observation of whether they have consumed the same thing repeatedly.

Insight into Satiation

Given that people often cite "being full" as the reason they stop eating (Mook & Votaw, 1992), it is perhaps not surprising that people seem to have little insight into the course of satiation over time. People who ate yogurt every day over the course of a week expected to like it less over time, but instead actually came to like this previously unfamiliar food more (Kahneman & Snell, 1992). Likewise, people expected that having the same snack repeatedly each week would be much more satiating than it actually was (Simonson, 1990). People similarly do not realize that they could reduce their satiation by slowing down their rate of consumption (Galak, Kruger, & Loewenstein, 2013), or inserting breaks (Nelson & Meyvis, 2008; Nelson, Meyvis, & Galak, 2009); they instead chose faster satiation and no breaks in both cases.

More generally, people find it difficult to imagine how their future desire will differ from their current desire (Loewenstein & Schkade, 1999). That is, when in a "hot" state of desire it is hard to imagine being in a "cold" state of satiation, and vice versa. As a result, people seemingly overestimate the satiating effect of consuming a favorite once again (Ratner, Kahn, & Kahneman, 1999), yet also underestimate the extent to which they will satiate on a product once they buy it and start using it in the future (Wang, Novemsky, & Dhar, 2009). In sum, people do not have an accurate insight into their future satiation as it can easily be over or under estimated.

Factors Influencing the Satiation Rate

Given that people apparently have little ability to predict satiation based on insight and intuition, controlled experimentation is required to identify the factors that can influence the satiation rate. It is important for people to understand how a factor affects satiation because this allows one to strategically manage desire. That is, for something one wants to consume less (e.g., chocolate ice cream), increasing the rate of satiation would contribute toward attaining the goal of improved long-term health. In contrast, for a virtue one wants to consume more (e.g., running on a treadmill), the opposing strategy of decreasing satiation would be more beneficial toward goal achievement and health. Using satiation as a means to encourage or discourage virtues and vices respectively could prove quite effective, especially given the ubiquity of chronic self-control failures due to a lack of willpower (Baumeister, 2002; Carver & Scheier, 1998). Of course, the strategic use of satiation first requires an understanding of the factors that influence the rate of satiation.

The remainder of this section discusses factors that have been shown to affect the rate of satiation (see Table 1). In some instances, the researchers explicitly measured enjoyment (or liking, desire, etc.) at multiple points in time so that satiation is clearly captured. However, in other cases, the only dependent measure was a behavior such as repeated choice or quantity consumed. The latter are still cited here as evidence of altering satiation because satiation likely contributed to the resulting behavior; of course, factors beyond satiation could instead be the drivers of those effects. These findings have still been included here because the behavioral data is compelling and quite relevant to important outcomes (e.g., consumer health). They also serve to underscore the opportunities and importance of measuring ongoing enjoyment to understand if satiation plays a critical role.

--- Insert Table 1 about here ---

Accelerants of Satiation

Salient sensory aspect. A number of different aspects of the stimulus have been shown to influence satiation. In the domain of food, an obvious shared flavor has been found to increase sensory-specific satiety. People satiated more when two foods shared a flavor of blueberry over a creamy texture (Johnson & Vickers, 1993), and consumers tended to switch their purchases among flavors of chips more than brand (Inman, 2001). However, when eating bread, sharing the same hardness led to greater sensory-specific satiety than the flavor (Guinard & Brun, 1998). More generally, though, it seems that repeated consumption of a conscious sensory aspect leads to the greatest satiation (Raynor & Epstein, 2001). For many foods (perhaps not bread), this is likely the flavor. There is also evidence that satiation is faster for foods with a strong savory or sweet aspect (Rolls et al., 1984), and less satiation when the repeated aspect is a color shared by foods (Rolls et al., 1982) or a common macronutrient (Rolls et al., 1988).

Greater stimulus complexity. Although not widely tested, it is likely that more complex and intense experiences lead to more stimulation and less satiation (Berlyne, 1971; O'Donohue & Geer, 1985). For instance, a more complicated musical composition would satiate at a slower rate than a simple acoustic piece (Berlyne, 1971). Likewise, people adapt faster to material possessions than experiences (Nicolao, Irwin, & Goodman, 2009), perhaps because experiences are rich and constantly change with each episode.

Greater stimulus strength. Similar to stimulus complexity, another factor increasing the rate of satiation is stimulus strength. For instance, it is obvious that weakening a flavor to the point it can not be detected would likely slow satiation on that flavor. More subtle evidence has found that people show a greater drop in liking for spaghetti bolognese over five occasions when eating a lower calorie versus the regular version (O'Sullivan, Alexander, Ferriday, & Brunstrom, 2010). Similarly, the mere perception of a change can matter as people reported being hungrier after eating a sample simply labeled as healthy versus not (Finkelstein & Fishbach, 2010). However, it should be noted that the seminal work on habituation states that a defining characteristic is slower habituation to a stronger stimulus (Thompson & Spencer, 1966). To the extent satiation derives from habituation in a context, the stimulus strength and satiation may have a more complicated relationship.

Faster consumption rate. The rate of consumption would be an obvious candidate to accelerate satiation, and it does (Herrnstein, 1990; McAlister, 1982; Thompson & Spencer, 1966). Surprisingly though, people seem largely unaware of the effect of consumption rate. People satiated less quickly to a massage prolonged by inserting breaks into it (Nelson & Meyvis, 2008; Nelson et al., 2009), even though they would choose beforehand to have no breaks. A similar lack of insight can also be seen in the rate of eating as people left to their own devices satiate faster than those explicitly instructed to slow down (Galak et al., 2013). In a similar vein, in an effect called melioration (Herrnstein & Prelec, 1991), people tend to consume a favorite too frequently though they would benefit from slowing down their rate of consumption to allow more time for recovery from satiation.

Comparatively frequent consumption. There is also recent work showing that the mere perception of greater past consumption can increase the rate of satiation. In one study of this (Redden & Galak, 2013), participants were asked to indicate their frequency of seeing a beach photo using a scale in which the endpoints were designed to make them appear high or low on the scale. Participants made to respond higher on the scale (though actual usage was the same) then experienced greater satiation when seeing the same photo again. Similarly, using an online clock that made time appear to pass faster than reality, satiation increased when people felt the experience itself seemed shorter (Sackett, Meyvis, Nelson, Converse, & Sackett, 2010), or they had less time between consumption episodes (Galak et al., 2014).

Increased attention on consumption. A growing body of evidence indicates that the rate of satiation increases with greater monitoring of the quantity consumed. For example, people ate less of a candy when the wrappers of previously eaten pieces remained visible on the table rather than being thrown in the trash (Polivy, Herman, Hackett, & Kuleshnyk, 1986). People similarly ate less potato chips when there was a red chip to serve as a quantity cue every 5^{th} chip versus every 10^{th} chip (Geier, Wansink, & Rozin, 2012). In fact, a study focused on satiation indeed found that explicitly asking people to count the number of times they swallowed while eating a food led to a faster decline in enjoyment (Redden & Haws, 2013). This satiation from greater monitoring may even be triggered by merely thinking about consumption. People experienced greater satiation on cheese after imagining eating a cheese cube 30 times versus moving a cube (Morewedge et al., 2010), or even just rating the attractiveness of a food in an ad 60 times versus 20 times (Larson et al., 2014). These findings indicate that satiation increases as one thinks more about how much they have consumed something (even hypothetically) in the past.

Retardants of Satiation

Increased variety. One obvious remedy for satiation is to increase variety. People indeed ate over 40% more calories when a four-course meal had a different food versus the same food for each course (Rolls et al., 1984). People also showed less decline in the liking of a food when their free eating was briefly interrupted to sample another food (Hetherington, Foster, Newman, Anderson, & Norton, 2006). The effect of variety on satiation and intake is so strong that it has often been cited as a contributing factor to the growing obesity rate (Raynor & Epstein, 2001). Variety can even affect satiation when it should be a “trivial” change that does not change the sensory experience. For example, people showed greater satiation on the color of M&M’s eaten even though the color is merely cosmetic and does not alter the flavor (Rolls et al., 1982).

Cues of variety. Beyond actual changes in variety, satiation also slows with the mere perception of greater variety and less repetition. People ate more M&M’s when the large number of colors was made more evident by organizing the candies by color or varying the distribution of the colors (Kahn & Wansink, 2004), and poured more for consumption when variety was present due to quantity misperceptions (Redden & Hoch, 2009). Likewise, when nature photos were categorized more specifically (e.g., arctic wildlife, bird, beach, desert) versus more generally (animal or nature), people experienced less satiation while viewing them (Redden, 2008). Though not exactly a measure of satiation, similar differences in hedonic contrasts also depend on whether experiences are placed into a shared category (Brown, 1953; Raghunathan & Irwin, 2001).

Interestingly, people apparently need cues to fully appreciate the variety in their consumption and experience the reduced satiation it potentially brings. People given a bowl of a single candy and then a bowl of varied candy showed less satiation when eating the first candy again if first asked to reflect on the varied candy (Galak et al., 2009). It seems that satiation largely arises from thoughts about consumption of just the target stimulus, but this focus can be easily expanded by redirecting attention to appreciate the available variety.

Less encoding. Effects of satiation that span the days between consumption occasions likely depend at least somewhat on memory. As a result, factors that inhibit encoding consumption into memory can reduce satiation. For example, distractions such as watching television during lunch led to greater intake at a later meal (Higgs & Donohoe, 2011; Higgs & Woodward, 2009), presumably because of poor encoding and less lingering satiation. Similarly, people showed less drop in salivation to pizza stimuli while completing a hard versus an easy visual memory task (Epstein, Saad, Giacomelli, & Roemmich, 2005), and they showed less drop in the desire to eat after eating snack cakes while playing a computer game (Brunstrom & Mitchell, 2006). These findings all demonstrate that the rate of satiation decreases as encoding the consumption experience becomes increasingly difficult.

Less attention to quantity consumed. An emerging body of evidence identifies attention to the quantity consumed as an underlying driver of satiation. People satiate at a slower rate when left to themselves versus being instructed to monitor the quantity being consumed (Redden & Haws, 2013; Sevilla & Redden, 2014). However, there are instances when this natural monitoring system is less active and has less effect on satiation. For example, when eating soup from a bowl that refilled without their knowledge, people ate over 70% more soup yet did not indicate feeling more sated (Wansink, Painter, & North, 2005). Beyond being difficult (or nearly impossible) in some contexts, the attention to the quantity consumed can also be less active when satiation is maladaptive. When chocolate candy was available only for a limited time, people got less satiated because they paid less attention to the quantity consumed (Sevilla & Redden, 2014). These examples all indicate that satiation slows as people pay less attention to the quantity consumed.

Individual Differences in Satiation

It is clear that rates of satiation differ widely across people. For example, I satiate on sushi at a very slow rate and could likely eat it every day, but my wife would shudder at such an impoverished diet. Although there are clearly large individual differences, past research on satiation has not typically focused on them. Even so, there have been some traits that have been linked to changes in the rate of satiation.

Age. Rolls and colleagues (1991) found that people between 45 and 60 years old did not show typical sensory-specific satiety effects relative to their younger counterparts. Specifically, although older people did show signs of satiation, they were not greater for the eaten food versus other uneaten foods. This effect has also been replicated by others (Hollis & Henry, 2007).

Trait self-control. When measured using the Tangney et al.'s (2004) general trait self-control scale, with items such as “I am good at resisting temptation”, people with higher trait self-control satiated faster while eating an unhealthy candy bar versus a healthy snack of raisins.

Here, process evidence indicated that they do this because they pay more attention to the quantity consumed when a food is unhealthy and turn off this monitoring for a healthy food not requiring vigilance. People with higher trait self-control also show greater evidence of spreading satiation whereby eating one food leads to greater satiation on a broader range of uneaten foods (Haws & Redden, 2013). These differences in satiation potentially help those with high trait self-control more consistently exert restraint.

Emotional clarity. Satiation involves both the positive enjoyment of a liked stimulus as well as the negative feelings that can arise from repetition. People that are better able to separate these two emotions experienced less satiation when listening to instrumental music (Poor, Duhachek, & Krishnan, 2012). This suggests that people may be able to train themselves to reduce the impact of negative feelings from satiation.

Obesity. It would not be surprising to find a link between the rate of satiation and obesity given the former's effect on intake quantity. Indeed, adult women that were obese showed less reduction in salivation compared to non-obese counterparts when seeing the same food repeatedly (Epstein, Paluch, & Coleman, 1996). This effect was also replicated with children (Temple, Giacomelli, Roemmich, & Epstein, 2007), suggesting that satiation may somewhat contribute to the onset of obesity.

A Framework for Satiation

The previously cited examples illustrate the ubiquity and diversity of factors that can influence the rate of satiation. Such wide-ranging effects suggest that satiation is likely multiply determined; that is, there are multiple processes simultaneously contributing to satiation. Historically, research on satiation has generally fallen into one of two schools of thought. The first is the notion that experiences become less enjoyable as they satisfy a need, whether it be physiological hunger or cognitive boredom. The second is that satiation is largely driven by more psychological processes (e.g., adaptation, habituation) whereby nearly any stimulus loses it effectiveness to elicit a reaction with repeated exposure. Both schools of thought envision satiation as arising from automatic low-level processes that are largely unavoidable. The simple result is that satiation increases as past consumption increases. These leading accounts of satiation both can be called "metered" approaches in that satiation directly results from the lingering effects of accumulated past consumption.

I propose here a novel taxonomy for satiation that expands beyond these metered approaches and the physiological vs. psychological distinction. Specifically, it posits a homeostatic, perceptual, and reflective component that each contribute to satiation. These components taken together can readily account for the full range of satiation effects that have been found. As shown in Figure 2, each component is subsequently discussed in terms of potential mechanisms, stimulus types, onset delay, and core drivers.

--- Insert Figure 2 about here ---

Homeostatic Component

The homeostatic component maps largely onto a physiological account of satiation. This account proposes that the body has an internal set value (e.g., an optimal body weight), and that an internal signal indicates deviations from this internal target (Cabanac, 1971). Pleasure then reflects whether the current stimulus helps satisfy a lacking need state as indicated by the internal signal. In other words, pleasure indicates the usefulness of the stimulus to the body in reaching a desired homeostatic state of balance.

Given that repeated consumption satisfies such needs, it is invariable that satiation arises as the pleasure declines. Cabanac (1971) calls this "negative alliesthesia" to reflect the changing sensation that satiation and homeostasis brings. We can see how this component would work by imagining one who is quite thirsty after being outside on a hot day. If they then come inside and drink some lemonade, the first sip is undoubtably quite enjoyable as it quenches thirst. Of course, as they drink more of the lemonade, they quickly move out of a state of thirst and the enjoyment decreases in a corresponding manner.

This homeostatic account has been frequently employed to account for satiation and consumption quantities in the food domain (Benelem, 2009; Berthoud, 2004). As well, researchers have identified increasing levels of leptin during eating as a potential candidate as the internal signal for the hunger need (Kenny, 2013). Here, leptin modulates the sensitivity of the reward awards of the brain such that they are less responsive (i.e., produce less enjoyment) as increased leptin indicates greater past consumption.

Although it certainly could also apply to boredom with any task that induces cognitive fatigue and strained effort (O'Hanlon, 1981), the homeostatic component would be expected to primarily arise with ingested stimuli (e.g., food, drink). It is this physical material that the body will process to produce the internal signal to indicate a current need state. Of course, this feedback process will take time to develop, but its onset could be in a matter of minutes (perhaps 15-30 minutes for food). Regardless, the core driver of satiation here is bodily feedback about the extent to which a need state still has not been satisfied.

Perceptual Component

Beyond physiological drivers of satiation, there also exist well-known mechanisms of a more perceptual nature. The two predominant perceptual mechanisms would be adaptation and habituation. Adaptation decreases the sensory intensity of an experience as it deviates less from a point of reference (or adaptation level) that increases by incorporating recent exposures (Helson, 1964; Parducci, 1995). Similarly, yet not the same, habituation to a repeated stimulus reduces subsequent responses as people increasingly pay less attention to the stimulus (McSweeney & Swindell, 1999; Thompson & Spencer, 1966). We can clarify the distinction between these mechanisms by continuing the previous example of drinking lemonade on a hot day. The first few sips of lemonade provide great pleasure, but subsequent sips typically start to deliver less pleasure. This decline in pleasure occurs as the taste senses adjust such that lemonade and all other drinks now seem less sweet compared to the updated reference point (adaptation), and the conscious experience focuses on other more interesting aspects of the environment such as the sounds and people in the room (habituation). Of course, both mechanisms produce the key defining characteristic of satiation – a drop in enjoyment with repeated consumption.

Although other psychological mechanisms could also contribute to satiation, previous research has generally highlighted adaptation or habituation. For example, the lower satiation rate for experiences versus materials goods was linked to slower hedonic adaptation (Nicolao et al., 2009). Likewise, habituation can account for a wide range of the effects found in the satiation and motivation literatures (McSweeney & Swindell, 1999), even in the food domain that presumably involves a larger physiological component than most other domains. Furthermore, the richly-studied phenomenon of sensory-specific satiety has been tied to neural areas known to be active during habituation (O'Doherty et al., 2000). This evidence demonstrates that adaptation and habituation almost certainly contribute to the phenomenon of satiation.

The perceptual component of satiation exerts its influence nearly instantaneously. In fact, the very nature of it implies that its effects appear during the experience itself with which it is intertwined. As well, its contribution to satiation is likely greatest for experiences with a strong sensory aspect that potentially captures perceptual attention. This instantaneous effect and sensory focus suggest why the perceptual component likely accounts for sensory-specific satiety (O'Doherty et al., 2000), as well as a broad range of stimuli (McSweeney & Swindell, 1999). It can also easily account for why satiation decreases with distractions such as television (Higgs & Woodward, 2009) or difficult cognitive tasks (Brunstrom & Mitchell, 2006; Epstein et al., 2005) as these both impede habituation. More generally, the core notion of the perceptual account is that satiation reflects a muted response to a repeated, unchanging stimulus.

Reflective Component

The third component of satiation is more reflective in that it involves higher-order cognitions about the self and consumption. The general notion is that people reflect on their past consumption, and they feel more satiated if it seems like they have had the same thing over and over. For example, after listening to the chorus of their favorite song 20 times, people could once again enjoy their favorite song as much as ever only if they were asked to recall other musical artists heard during the intervening three weeks (Galak et al., 2009). This indicates that satiation is seemingly constructed in the moment partially based on judgments about past consumption.

Emerging evidence continues to provide growing support for a reflective component of satiation. Satiation decreased when people had difficulty recalling past consumption episodes of their favorite food because they inferred this indicated they had not consumed it much (Redden & Galak, 2013). Likewise, people had less lingering satiation when made to feel that more time had passed since the last consumption episode (Galak et al., 2014), or that their past consumption was less than that for other people (Redden & Galak, 2013). This reflective component also easily accounts for why increased tracking of the quantity consumed leads to greater satiation, as intermittent red potato chips (Geier et al., 2012), counting the number of swallows (Redden & Haws, 2013), or empty candy wrappers (Polivy et al., 1986) trigger reflection on the amount consumed. Beyond these and other examples, given that such reflective thoughts could apply to practically any repeated experience over any timeframe, the reflective component of satiation potentially underlies a wide range of satiation phenomena. The key driver here is a reflection on the fact that one is repeatedly consuming the same thing.

Multiply Determined

This framework posits that (at least) three different components contribute to satiation. The contribution of each component will understandably vary across the context. For example, imagine a large meal at a restaurant. At the start of the meal, satiation after the first few bites is almost certainly driven by the perceptual component. As the meal progresses, and physiological feedback develops from digestion, the homeostatic component may eventually contribute more to satiation. Finally, a week after the meal, the reflective component most likely drives satiation when one thinks about eating the same entrée at that same restaurant again. Of course, we could easily see different patterns in other domains (e.g., no homeostatic component for music) or timeframes (e.g., reflective component at the start if recently consumed).

Although the relevance of each component will vary across contexts, each of the multiple components likely operates in a simultaneous yet integrative fashion. That is, one might satiate from homeostatic, perceptual, and reflective processes with each contributing to an overall level of satiation. For instance, consider the finding that making the variety in a food assortment merely more salient increases intake (Kahn & Wansink, 2004). There would likely be digestive effects at some point, as well as perceptual effects that derive from less sensory-specific satiety (Rolls et al., 1982), and even reflective effects as the experience seems less repetitive (Redden, 2008). Perhaps the variety effect is so robust and strong precisely because it simultaneously taps into each component.

Furthermore, we can imagine that each component works together in other ways. To continue the food example of M&M's, one homeostatic account is that increased leptin levels reduce the sensitivity of neural reward areas (Kenny, 2013). It could also be that this reduced sensitivity in a general reward area also amplifies the perceptual and reflective components. Put another way, the three components may operate in not only an independent fashion but also an interactive fashion. This multi-faceted nature of satiation perhaps explains the ubiquity of satiation and the diversity of factors that moderate the rate of satiation.

Future Directions

The previous framework has identified three components of satiation: homeostatic, perceptual, and reflective. There are potentially several other components that future research will uncover. Or, more likely, these three components will be broken down into more specific sub-components. For instance, the perceptual component has already identified adaptation and habituation as underlying mechanisms, but there could certainly be others such as those related to categorization (Redden, 2008). Likewise, the reflective component may rely on very different inferences during the initial onset versus recovery from satiation, or whether there is a goal to increase consumption. Neural studies of satiation (e.g., fMRI) may prove useful in teasing out specific differences both between and within the three components.

One goal of this chapter is to highlight the dynamic changing aspect of desire created by satiation. An important implication of this is that desire and liking can not be captured with a snapshot at a single point in time. Instead, one must repeatedly measure desire over time to properly understand enjoyment and allow for the effects of satiation. For example, although people tend to want something more when it is scarce (Worchel, Lee, & Adewole, 1975), scarcity increased enjoyment only over time by slowing the rate of satiation (Sevilla & Redden, 2014). Therefore, one looking just at initial enjoyment would conclude that scarcity has no effect on ongoing temptation, when exactly the opposite is true. As a result of these changes over time, longitudinal studies with regular sampling will likely grow in popularity as a research tool (e.g., see Hofmann, Baumeister, Forster, & Vohs, 2011), and will potentially become a standard tool in the area of taste testing and product marketing.

An understanding of the dynamics of desire over time will also be critical for designing effective interventions. Many people with self-control problems (e.g., obesity) suffer consequences primarily because of a pattern of chronic self-control failures. One way to limit such behavior is to increase satiation on the tempting item such that resisting it becomes quite easy and natural. This chapter has identified a framework for understanding and influencing satiation that a wide range of audiences (e.g., policy makers, consumers, and marketing organizations) can potentially leverage.

Although we have learned a great deal about satiation, and evidence continues to rapidly push our understanding, there are still many puzzling aspects of satiation that have defied clear answers. For example, why would people get so satiated with having the same entrée for dinner each night, yet these same people eat the same thing for breakfast each morning? How do experts overcome satiation and stay engaged so they can build up the hours of experience needed to gain expertise? Why do children often complain of being bored and having nothing to do when they are surrounded by a myriad of video games, books, toys, foods, etc.? Hopefully, at this point, the reader realizes that the answers may lie in the different components of satiation (esp. the reflective component in these instances). Future work is needed to truly uncover why these satiation phenomena happen, as well as many others, and the framework in this chapter provides a starting base for this endeavor.

References

Baumeister, R. F. (2002). Yielding to temptation: Self-control failure, impulsive purchasing, and consumer behavior. *Journal of Consumer Research, 28*(4), 670-676.

Benelem, B. (2009). Satiation, satiety and their effects on eating behaviour. *Nutrition Bulletin, 34*(2), 126-173.

Berlyne, D. E. (1971). *Aesthetics and psychobiology*. New York: Appleton-Century-Crofts.

Bernoulli, D. (1954). Exposition of a new theory on the measurement of risk. *Econometrica, 22*, 23-36.

Berthoud, H.-R. (2004). Mind versus metabolism in the control of food intake and energy balance. *Physiology & Behavior, 81*(5), 781-793.

Brickman, P., & Campbell, D. T. (1971). Hedonic relativism and planning the good society. In M. H. Appley (Ed.), *Adaptation-level theory* (pp. 287-302). New York: Academic Press.

Brown, D. R. (1953). Stimulus-similarity and the anchoring of subjective scales. *American Journal of Psychology, 66*, 199-214.

Brunstrom, J. M., & Mitchell, G. L. (2006). Effects of distraction on the development of satiety. *British Journal of Nutrition, 96*(4), 761-769.

Cabanac, M. (1971). Physiological role of pleasure. *Science, 173*(4002), 1103-1107.

Carver, C. S., & Scheier, M. F. (1998). *On the self-regulation of behavior*. New York: Cambridge University Press.

Epstein, L. H., Caggiula, A. R., Rodefer, J. S., Wisneiwski, L., & Mitchell, S. L. (1993). The effects of calories and taste on habituation of the human salivary response. *Addictive Behaviors, 18*(2), 179-185.

Epstein, L. H., Carr, K. A., Cavanaugh, M. D., Paluch, R. A., & Bouton, M. E. (2011). Long-term habituation to food in obese and nonobese women. *The American Journal of Clinical Nutrition, 94*(2), 371-376.

Epstein, L. H., Paluch, R., & Coleman, K. J. (1996). Differences in salivation to repeated food cues in obese and nonobese women. *Psychosomatic Medicine, 58*(2), 160-164.

Epstein, L. H., Saad, F. G., Giacomelli, A. M., & Roemmich, J. N. (2005). Effects of allocation of attention on habituation to olfactory and visual food stimuli in children. *Physiology & Behavior, 84*(2), 313-319.

Finkelstein, S. R., & Fishbach, A. (2010). When healthy food makes you hungry. *Journal of Consumer Research, 37*(October), 357-367.

Galak, J., Kruger, J., & Loewenstein, G. (2013). Slow down! Insensitivity to rate of consumption leads to avoidable satiation. *Journal of Consumer Research, 39*(5), 993-1009.

Galak, J., Redden, J. P., & Kruger, J. (2009). Variety amnesia: Recalling past variety can accelerate recovery from satiation. *Journal of Consumer Research, 36*(4).

Galak, J., Redden, J. P., Yang, Y., & Kyung, E. J. (2014). Feast today makes fast tomorrow? Influencing satiation through perceptions of temporal distance. *Journal of Experimental Social Psychology, In Press*.

Geier, A., Wansink, B., & Rozin, P. (2012). Red potato chips: Segmentation cues can substantially decrease food intake. *Health Psychology, 31*(3), 398-401.

Guinard, J.-X., & Brun, P. (1998). Sensory-specific satiety: Comparison of taste and texture effects. *Appetite, 31*(2), 141-157.

Haws, K. L., & Redden, J. P. (2013). In control of variety. High self-control reduces the effect of variety on food consumption. *Appetite, 69*(1), 196-203.

Helson, H. (1964). *Adaptation-level theory*. New York: Harper & Row.

Herrnstein, R. J. (1990). Behavior, reinforcement, and utility. *Psychological Science, 1*(4), 217.

Herrnstein, R. J., & Prelec, D. (1991). Melioration: A theory of distributed choice. *Journal of Economic Perspectives, 5*(3), 137-156.

Hetherington, M. M., Foster, R., Newman, T., Anderson, A. S., & Norton, G. (2006). Understanding variety: Tasting different foods delays satiation. *Physiology & Behavior, 87*(2), 263-271.

Hetherington, M. M., Rolls, B. J., & Burley, V. J. (1989). The time course of sensory-specific satiety. *Appetite, 12*(1), 57-68.

Higgs, S., & Donohoe, J. E. (2011). Focusing on food during lunch enhances lunch memory and decreases later snack intake. *Appetite, 57*(1), 202-206.

Higgs, S., & Woodward, M. (2009). Television watching during lunch increases afternoon snack intake of young women. *Appetite, 52*(1), 39-43.

Hofmann, W., Baumeister, R. F., Forster, G., & Vohs, K. D. (2011). Everyday temptations: An experience sampling study of desire, conflict, and self-control. *Journal of Personality and Social Psychology, 102*(6), 1318-1335.

Hollis, J. H., & Henry, C. J. K. (2007). Sensory-specific satiety and flavor amplification of foods. *Journal of Sensory Studies, 22*(4), 367-376.

Inman, J. J. (2001). The role of sensory-specific satiety in attribute-level variety seeking. *Journal of Consumer Research, 28*(June), 105-120.

Johnson, J., & Vickers, Z. (1993). Effects of flavor and macronutrient composition of food servings on liking, hunger, and subsequent intake. *Appetite, 21*(August), 25-39.

Kahn, B. E., & Wansink, B. (2004). The influence of assortment structure on perceived variety and consumption quantities. *Journal of Consumer Research, 30*(4), 519-533.

Kahneman, D., & Snell, J. (1992). Predicting a changing taste: Do people know what they will like? *Journal of Behavioral Decision Making, 5*, 187-200.

Kenny, P. J. (2013). The food addiction. *Scientific American, 309*(3), 44-49.

Larson, J. S., Redden, J. P., & Elder, R. S. (2014). Satiation from sensory simulation: Evaluating foods decreases enjoyment of similar foods. *Journal of Consumer Psychology, In Press*.

Loewenstein, G., & Schkade, D. (1999). Wouldn't it be nice? Predicting future feelings. In D. Kahneman, E. Diener & N. Schwarz (Eds.), *Well-being: The foundations of hedonic psychology* (pp. 85-105). New York: Russell Sage Foundation.

McAlister, L. (1982). A dynamic attribute satiation model of variety-seeking behavior. *Journal of Consumer Research, 9*(September), 141-149.

McSweeney, F. K., & Murphy, E. S. (2000). Criticisms of the satiety hypothesis as an explanation for within-session decreases in responding. *Journal of the Experimental Analysis of Behavior, 7*(3), 347-361.

McSweeney, F. K., & Swindell, S. (1999). General-process theories of motivation revisited: The role of habituation. *Psychological Bulletin, 125*(4), 437-457.

Mook, D. G., & Votaw, M. C. (1992). How important is hedonism? Reasons given by college students for ending a meal. *Appetite, 18*(1), 69-75.

Morewedge, C. K., Huh, Y. E., & Vosgerau, J. (2010). Thought for food: Imagined consumption reduces actual consumption. *Science, 330*(6010), 1530-1533.

Nelson, L. D., & Meyvis, T. (2008). Interrupted consumption: Disrupting adaptation to hedonic experiences. *Journal of Marketing Research, XLV*(December), 654-664.

Nelson, L. D., Meyvis, T., & Galak, J. (2009). Enhancing the television-viewing experience through commercial interruptions. *Journal of Consumer Research, 36*(August), 160-172.

Nestler, E. J., & Malenka, R. C. (2004). The addicted brain. *Scientific American, 290*(3), 78-85.

Nicolao, L., Irwin, J. R., & Goodman, J. K. (2009). Happiness for sale: Do experiential purchases make consumers happier than material purchases? *Journal of Consumer Research, 36*(August), 188-198.

O'Doherty, J., Rolls, E. T., Francis, S., Bowtell, R., McGlone, F., Kobal, G., et al. (2000). Sensory-specific satiety-related olfactory activation of the human orbitofrontal cortex. *NeuroReport, 11*(2), 399-403.

O'Donohue, W. T., & Geer, J. H. (1985). The habituation of sexual arousal. *Archives of Sexual Behavior, 14*(3), 233-246.

O'Hanlon, J. F. (1981). Boredom: Practical consequences and a theory. *Acta Psychologica, 49*, 53-82.

O'Sullivan, H. L., Alexander, E., Ferriday, D., & Brunstrom, J. M. (2010). Effects of repeated exposure on liking for a reduced-energy-dense food. *The American Journal of Clinical Nutrition, 91*(6), 1584-1589.

Parducci, A. (1995). *Happiness, pleasure, and judgment: The contextual theory and its applications*. Mahwah, NJ: Lawrence Erlbaum Associates.

Pechmann, C., & Stewart, D. W. (1988). Advertising repetition: A critical review of wearin and wearout. *Current Issues and Research in Advertising, 11*(1-2), 285-329.

Polivy, J., Herman, C. P., Hackett, R., & Kuleshnyk, I. (1986). The effects of self-attention and public attention on eating in restrained and unrestrained subjects. *Journal of Personality and Social Psychology, 50*(6), 1253-1260.

Poor, M., Duhachek, A., & Krishnan, S. (2012). The moderating role of emotional differentiation on satiation. *Journal of Consumer Psychology, 22*(4), 507-519.

Raghunathan, R., & Irwin, J. R. (2001). Walking the hedonic product treadmill: Default contrast and mood-based assimilation in judgments of predicted happiness with a target product. *Journal of Consumer Research, 28*(3), 355-368.

Ratner, R. K., Kahn, B. E., & Kahneman, D. (1999). Choosing less-preferred experiences for the sake of variety. *Journal of Consumer Research, 26*(1), 1-15.

Raynor, H. A., & Epstein, L. H. (2001). Dietary variety, energy regulation, and obesity. *Psychological Bulletin, 127*(3), 325-341.

Redden, J. P. (2008). Reducing satiation: The role of categorization level. *Journal of Consumer Research, 34*(February), 624-634.

Redden, J. P., & Galak, J. (2013). The subjective sense of feeling satiated. *Journal of Experimental Psychology: General, 142*(1), 209-217.

Redden, J. P., & Haws, K. L. (2013). Healthy satiation: The role of decreasing desire in effective self-control. *Journal of Consumer Research, 39*(5), 1100-1114.

Redden, J. P., & Hoch, S. J. (2009). The presence of variety reduces perceived quantity. *Journal of Consumer Research, 36*(3), 406-417.

Rolls, B. J., Hetherington, M. M., & Burley, V. J. (1988). Sensory stimulation and energy density in the development of satiety. *Physiology & Behavior, 44*(6), 727-733.

Rolls, B. J., & McDermott, T. M. (1991). Effects of age on sensory-specific satiety. *American Journal of Clinical Nutrition, 54*(6), 988-996.

Rolls, B. J., Rolls, E. T., Rowe, E. A., & Sweeney, K. (1981). Sensory specific satiety in man. *Physiology & Behavior, 27*(1), 137-142.

Rolls, B. J., Rowe, E. A., & Rolls, E. T. (1982). How sensory properties of foods affect human feeding behavior. *Physiology & Behavior, 29*(3), 409-417.

Rolls, B. J., van Duijvenvoorde, P. M., & Rolls, E. T. (1984). Pleasantness changes and food intake in a varied four-course meal. *Appetite, 5*(4), 337-348.

Rolls, E. T., & Rolls, J. H. (1997). Olfactory sensory-specific satiety in humans. *Physiology & Behavior, 61*(3), 461-473.

Rozin, P., Dow, S., Moscovitch, M., & Rajaram, S. (1998). What causes humans to begin and end a meal? A role for memory for what has been eaten, as evidenced by a study of multiple meal eating in amnesiac patients. *Psychological Science, 9*(5), 392-396.

Sackett, A. M., Meyvis, T., Nelson, L. D., Converse, B. A., & Sackett, A. L. (2010). You're having fun when time flies: The hedonic consequences of subjective time progression. *Psychological Science, 21*(1), 111-117.

Sevilla, J., & Redden, J. P. (2014). Perceived scarcity reduces the rate of satiation. *Journal of Marketing Research, In Press*.

Simonson, I. (1990). The effect of purchase quantity and timing on variety-seeking behavior. *Journal of Marketing Research, 27*(2), 150-162.

Tangney, J. P., Baumeister, R. F., & Boone, A. L. (2004). High self-control predicts good adjustment, less pathology, better grades, and interpersonal success. *Journal of Personality, 72*(2), 271-324.

Temple, J. L., Giacomelli, A. M., Roemmich, J. N., & Epstein, L. H. (2007). Overweight children habituate slower than non-overweight children to food. *Physiology & Behavior, 91*(2-3), 250-254.

Thompson, R. F., & Spencer, W. A. (1966). Habituation: A model phenomenon for the study of neuronal substrates of behavior. *Psychological Review, 73*(1), 16-43.

Wang, J., Novemsky, N., & Dhar, R. (2009). Anticipating adaptation to products. *Journal of Consumer Research, 36*(August), 149-159.

Wansink, B., Painter, J. E., & North, J. (2005). Bottomless bowls: Why visual cues of portion size may influence intake. *Obesity, 13*(1), 93-100.

Worchel, S., Lee, J., & Adewole, A. (1975). Effects of supply and demand on ratings of object value. *Journal of Personality and Social Psychology, 32*(5), 906-914.

Zajonc, R. B. (1968). Attitudinal effects of mere exposure. *Journal of Personality and Social Psychology, 9*(2), 1-27.

Table 1

Factors Influencing the Satiation Rate

Effect on Satiation	Factor	Examples
Accelerates	Salient sensory aspect	Guinard & Brun, 1998
		Inman, 2001
		Johnson & Vickers, 1993
		Raynor & Epstein, 2001
		Rolls et al., 1982
		Rolls et al., 1984
		Rolls et al., 1988
	Greater stimulus complexity	Berlyne, 1971
		Nicolao, Irwin & Goodman, 2009
		O'Donohue & Geer, 1985
	Greater stimulus strength	Finkelstein & Fishback, 2010
		O'Sullivan et al., 2010
		Thompson & Spencer, 1966
	Faster consumption	Galak, Kruger & Loewenstein, 2012
		Herrnstein, 1990
		Herrnstein & Prelec, 1991
		McAlister, 1982
		Nelson & Meyvis, 2008
		Thompson & Spencer, 1966
	Comparatively frequent consumption	Galak et al., 2014
		Redden & Galak, 2013
		Sackett et al., 2010
	Increased attention on consumption	Geier, Wansink & Rozin, 2012
		Larson, Redden & Elder, 2014
		Morewedge et al., 2010
		Polivy et al., 1986
		Redden & Haws, 2013
Slows	Increased variety	Heatherington et al., 2006
		Raynor & Epstein, 2001
		Rolls et al., 1982
		Rolls et al., 1984
	Cues of variety	Brown, 1953
		Galak et al., 2009
		Kahn & Wansink, 2004
		Raghunathan & Irwin, 2001
		Redden, 2008
	Less encoding	Brunstrom & Mitchell, 2006
		Epstein et al., 2005
		Higgs & Donohoe, 2011
		Higgs & Woodward, 2009
	Less attention to quantity consumed	Redden & Hawes, 2013
		Sevilla & Redden, 2014
		Wansink, Painter & North, 2005

Figure 1. The Consumption Cycle

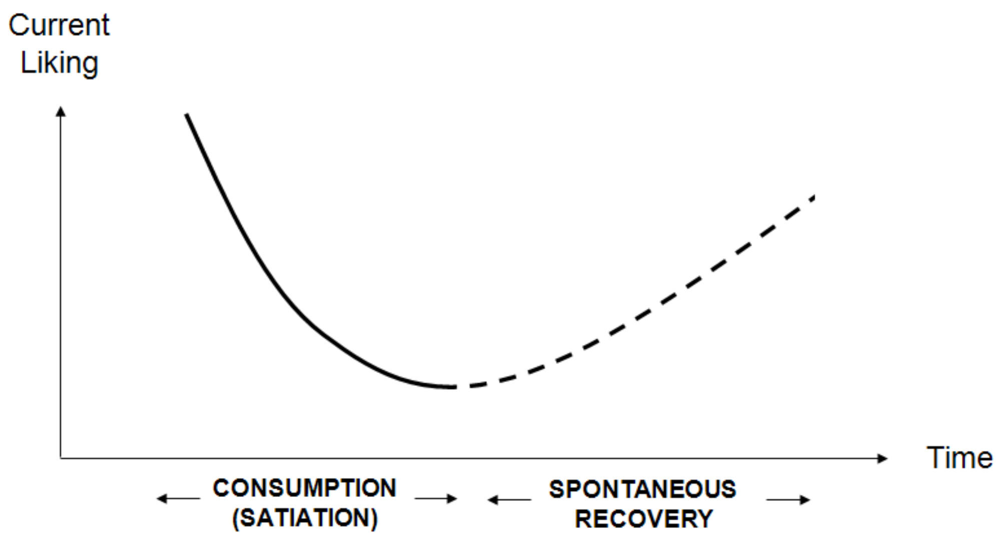

Figure 2. Taxonomy for Components of Satiation

	Homeostatic	***Perceptual***	***Reflective***
Potential Mechanisms	Internal set points Negative alliesthesia Hormones (e.g., leptin)	Adaptation Habituation	Memory recall inferences Metacognitions Top-down judgments
Stimulus Type	Ingested	Strong sensory aspect	Nearly all experiences
Onset Delay	Few minutes delay (depends on stimulus)	Instantaneous (interwoven with experience)	Milliseconds (linked to recall)
Core Driver	Bodily feedback	Muted response	Monitoring quantity