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The Properties and Antecedents of Hedonic Decline

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Abstract

We review the phenomenon of hedonic decline, whereby repeated exposure to a stimulus typically reduces the hedonic response (e.g., enjoyment). We first discuss the typical trajectory of hedonic decline and the common research paradigms used to study it. We next discuss the most popular theories regarding general mechanisms widely believed to underlie hedonic decline. We then propose a taxonomy to organize these various general theories and to incorporate more recent work on top-down, self-reflective theories. This taxonomy identifies three general classes of antecedents to hedonic decline: physiological feedback, perceptual changes, and self-reflection. For each class, we review the supporting evidence for specifically identified antecedents and recent developments on how each antecedent influences hedonic decline. Our review focuses especially on more recent work in the growing area of self-reflection.

Contents

INTRODUCTION

The field of psychology has long been interested in understanding the dynamics of how individuals respond to repeated exposure to a stimulus. This is especially true for liked stimuli that people most often seek out and consume. With a few exceptions, research in this area has shown that repetition of most affectively relevant stimuli eventually leads to a prominent attenuation of response (and sometimes a small initial increase). That is, at some point, people respond less and less to every additional exposure to a stimulus. We focus our review on this attenuating response, given that it is more ubiquitous than any fleeting increase in response, and review the current understanding of this phenomenon of hedonic decline.

The topic of hedonic decline is important for a variety of reasons. First, it creates a so-called hedonic treadmill (Brickman & Campbell 1971), whereby people must continually find new and better experiences merely to maintain their current level of satisfaction. Thus, a diminished hedonic response has clear implications for general well-being. Second, a core tenet of economics is that people try to maximize the utility of their experiences. Obviously, a changing hedonic response presents a dynamic aspect that makes maximizing enjoyment more difficult. Third, a diminishing hedonic response also creates difficulties for those trying to encourage behavioral change. These could include policy makers hoping for continued compliance, marketers trying to sustain satisfaction with a product, or educators struggling to maintain student interest in a topic. In sum, the ubiquitous and consequential nature of hedonic decline makes it an important phenomenon to understand.

This diminished response has typically been characterized with two particular manifestations: the desire to reconsume a stimulus and the continued enjoyment of that stimulus. Specifically, with repetition, an individual's willingness to reconsume an affectively relevant stimulus and their subsequent enjoyment of that stimulus typically decreases. Various literatures have used different terms to describe this reduction, but it has most commonly been described as homeostasis (or physiological set points), satiation, habituation, or adaptation. Although the physiological and psychological mechanisms that underlie each of these various accounts differ somewhat, the conclusions are the same: Repetition ultimately leads to a decreased hedonic response in the form of less desire and less ongoing enjoyment. To unify the literature, we call this general phenomenon hedonic decline without regard to any particular underlying mechanism.

In this review, we synthesize multiple literatures to develop a coherent understanding of how humans respond to repeated exposure to affectively relevant stimuli. We do this by first fleshing out the typical properties of hedonic decline, the common research paradigms used to investigate it, and the widely accepted general mechanisms that underlie it. We then provide a taxonomy that organizes these broad theories to incorporate both long-established findings and recent developments. Specifically, we identify three classes of antecedents to hedonic decline: physiological feedback, perceptual changes, and self-reflection. By doing so, we are able to span several siloed literatures to provide a unifying view that we hope will fuel future research in the general area of hedonic decline.

TYPICAL TRAJECTORY OF HEDONIC DECLINE

Although changes in hedonic response tend to vary considerably when viewed at the individual level, in aggregate, there are three common patterns for hedonic changes with repeated exposure to a stimulus (**Figure 1**). These are (*a*) steady decline in response (**Figure 1*a***), (*b*) protracted increased response (**Figure 1*b***), and (*c*) increased response followed by greater decline (**Figure 1*c***). The decrease in response is typically attributed to satiation (Raynor & Epstein 1999, Rolls et al. 1981, Sorensen et al. 2003), habituation (Groves & Thompson 1970, McSweeney 2004), or hedonic adaptation (Diener et al. 2006, Frederick & Loewenstein 1999, Kahneman & Snell 1992, Nelson & Meyvis 2008, Nelson et al. 2009). Any increase in response is typically attributed to arousal (Bizo et al. 1998, Killeen 1995), familiarity (Zajonc 1968), or sensitization (Crolic & Janiszewski 2016, McSweeney & Murphy 2009). The existence of the two offsetting effects of decreased and increased response, sometimes referred to as the dual process theory (Groves & Thompson 1970) or opponent process theory (Soloman & Corbit 1974), can then lead to a wide-ranging variety of patterns over time for any individual.

The most prominent response, however, is the ongoing decline observed with sufficient exposure to a stimulus. Whereas an increased response is only occasionally observed, sufficient

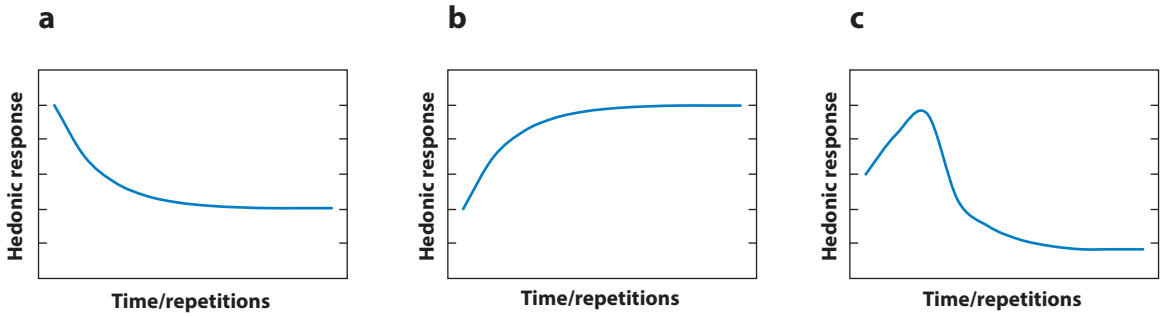

Figure 1

Three typical trajectories of hedonic response. (*a*) Steady decline in response. (*b*) Protracted increased response. (*c*) Increased response followed by greater decline.

exposure nearly always makes a decline in hedonic response inevitable. It should be noted that hedonic decline means that an initially liked stimulus becomes less pleasant with repetition, whereas an initially disliked stimulus becomes less unpleasant. For example, people derive less pleasure after repeated exposure to their favorite food (Epstein et al. 2009), music (Schellenberg et al. 2008), art (Redden 2008), or even close others (Galak et al. 2009). Likewise, participants report declines in their aversion to tart yogurt over 8 days (Kahneman & Snell 1992), decreases in irritation with an unpleasant sound after a few minutes (Nelson & Meyvis 2008), increases in manageability of incarceration over the years (Zamble 1992), and largely unchanged life satisfaction years after becoming paraplegic or quadriplegic (Schulz & Decker 1985, Wortman & Silver 1987). Although exceptions may exist (Zajonc 1968), the strong initial hedonic response from either a positive or negative stimulus eventually fades. Therefore, as a general rule, regardless of the valence, response to a stimulus inevitably diminishes with prolonged repeated exposures (i.e., hedonic decline).

Following this hedonic decline, in the absence of stimulus exposure, spontaneous recovery, or the return of hedonic response, typically occurs (Groves & Thompson 1970, Thompson & Spencer 1966). We know of no work directly examining any factors that influence the speed of spontaneous recovery following protracted hedonic decline. There is work in physiology showing that reaction recovers more quickly for responses that declined faster in the first place, often due to the rate of exposure (Rankin et al. 2009). Work on significant life events (such as the death of a loved one) indicates that recovery happens more quickly when one can more easily explain and understand the event (Wilson & Gilbert 2008). However, it is notable that none of this work explores ongoing hedonic decline specifically. More generally, little is known about either the rate of recovery from hedonic decline or the factors driving it.

COMMON RESEARCH PARADIGMS

Given that hedonic decline manifests with repeated exposure, any study of it will necessarily consider the roles of exposure quantity and time. However, the manners in which these two dimensions are manipulated greatly vary. We discuss the most common paradigms in the next sections, as well as some examples of research within each paradigm. These paradigms primarily differ on two dimensions: (*a*) whether the timing of the stimulus exposure is within a single session or across multiple sessions and (*b*) whether the hedonic response is measured once or repeatedly. We detail some of the differences among these methodologies below. However, in spite of these differences, all of these paradigms ultimately share the same goal of measuring hedonic decline (albeit in different ways).

Within-Session Paradigms

In within-session settings, there are typically two methodological approaches. First, a stimulus is repeatedly experienced to the point where consumption is typically no longer pleasurable or desired. Then, following this preload, participants are exposed to both similar and dissimilar stimuli, and either their subjective hedonic evaluations or their desire to reconsume are assessed. When subjective evaluations and desire are lower for similar stimuli than for dissimilar stimuli, one concludes that a decline in response has occurred. Alternatively, different preloads can be administered across different participants, and desire to consume a focal stimulus can be measured. If desire is lower for one of the preloaded stimuli but not the other, then decline in hedonic response is once again inferred.

For instance, in a recent study, participants were asked to consume either sweet or savory rice meal equivalent to about 10% of their daily energy needs. Following this, they were exposed to both sweet and savory snacks. Whether measured in terms of subjective evaluations, willingness to work for more snacks, or ad libitum consumption of the snacks, the same pattern of results emerged: When participants first ate the sweet rice meal, their evaluation of and desire to reconsume sweet snacks declined, whereas their evaluation of and desire to reconsume savory snacks was unaffected. In contrast, when participants first ate the savory rice meal, the opposite was true (Griffioen-Roose et al. 2010). When exposed to sufficient quantities of a stimulus, enjoyment of and desire to consume stimuli of the same type declines, and this decline is taken as a measure of decline in hedonic response.

In general, this methodology and this type of result are ubiquitous primarily in the food literature (Havermans et al. 2009, Johnson & Vickers 1993, Rolls et al. 1981, Weijzen et al. 2009). Importantly, in this paradigm, decline in hedonic response is inferred from a reduction in desire to consume the preloaded stimulus. When desire for consumption of a similar item is observed, it is inferred that this is due to a decline in hedonic response, even though this decline is only sometimes actually directly observed.

In contrast to the preload approach, the second-most-common within-session approach is to repeatedly expose participants to a stimulus. Explicit measures of the change in response are then taken using subjective ratings either after each instance or at the beginning and end of the consumption session. The decline in subjective ratings over time is taken as a measure of the decline in hedonic response.

Whereas the previous methodology is primarily observed in the context of food, this approach is prevalent in a range of contexts. For instance, in the domain of food, participants' salivation in response to and hedonic ratings of lemon and lime juice declined across 10 repetitions (Epstein et al. 1992). In the domain of music, when focused on listening to a happy song, participants initially increased their hedonic ratings, but their ratings sharply decline after sufficient exposures (Schellenberg et al. 2008). In the domain of art, participants' enjoyment of attractive photographs declined across 16 repetitions (Redden 2008). In the domain of video games, participants' hedonic ratings of a pleasurable video game declined across six rounds of play when pacing of play was sufficiently fast (Galak et al. 2013). In all of these cases, a decline in response to an affectively relevant stimulus was assessed as a function of the change in response from the first encounter to the last encounter with that stimulus. Thus, rather than exposing participants to a stimulus and then using a measure of future consumption intent as a proxy for decline in response, these studies (and many others) directly measured the change in response either via subjective ratings or through measurable physiological changes (e.g., salivation).

Across-Session Paradigms

In across-session paradigms, there are, again, two typical approaches taken. The first involves observing response decline in a relatively short testing period and then remeasuring response to the

target stimulus some time later. For instance, in the context of food, women's consumption of an oil high in linoleic acid decreased following a two-week consumption period (Kamphuis et al. 2001). In a slightly different food-related context, Ethiopian refugees reported decreased pleasantness for three foods that they had been consuming for the previous 6 months compared to three novel foods (Rolls & de Waal 1985). In the context of music, participants exposed to 20 repetitions of a favorite song showed strong decline in enjoyment over these 20 within-session iterations and also showed continued suppression of enjoyment following a two-week period (Galak et al. 2009, study 1). In the context of sexual arousal, men showed decreased sexual arousal in response to sexually explicit audio recordings across six sessions spaced one week apart (O'Donohue & Plaud 1991). In all of these cases, there was an initial decrease in hedonic response that was observed to last for a long period of time. Importantly, hedonic responses were always assessed at least twice, allowing for direct observation of hedonic decline.

In contrast, the second approach involves comparing the subjective evaluations of individuals who have experienced a long-lasting stimulus to individuals who have not. If a decline in response has occurred, then one would expect those individuals to have different hedonic responses over time. For example, lottery winners were shown to be no happier than non–lottery winners after sufficient time had elapsed (Brickman et al. 1978). In other words, although the lottery winners were likely much happier immediately after winning the lottery, as time passed, their happiness returned to a lower baseline level, and thus, their response to the lottery itself declined. In most cases, it is difficult (if not impossible) to obtain a measure of hedonic response at the onset of such an affectively relevant life event. Therefore, the lack of difference between those who experienced the event and a reasonable control sample is typically taken as evidence of a decline in response. For instance, in the above example, it is quite difficult to measure hedonic response immediately following the fateful moment when an individual wins the lottery (e.g., they are unlikely to fill out a questionnaire). However, it is reasonable to believe that their affective state is likely quite elevated (at least temporarily) as compared to someone who did not recently win the lottery. The fact that, following sufficient passage of time, their affective response is no different from individuals who did not win the lottery is quite telling in regards to how fleeting the influence of even extreme life events are on hedonic responses.

This type of observation is not limited to lottery winners. For instance, academic recipients of tenure were no happier than their untenured counterparts following sufficient passage of time (Gilbert et al. 1998, study 2). Again, the inference is that individuals were likely quite happy immediately after receiving tenure, but their hedonic response declined with time. Similarly, despite a likely strong hedonic response immediately following the election of a favored politician, after as little as 1 month, participants were just as happy whether their favored politician won or lost, suggesting that decline in response had occurred (Gilbert et al. 1998, study 3). Another example that, in fact, does allow for direct assessment of both initial response and eventual decline is that of the influence of marriage on hedonic response. Although marriage initially results in an increase in hedonic response, longitudinal data from 24,000 individuals demonstrates that, within as little as 2 years, individuals' hedonic response tends to revert to premarriage levels (Lucas & Clark 2006, Lucas et al. 2003). In other words, despite an observed initial increase in hedonic response following marriage, this major life event seemingly has little impact in the long run. Of course, a more robust measurement approach (more frequent measurements, longer time frames, different constructs) could find some evidence of a larger continuing benefit, but we would still expect this benefit to decline somewhat as the years pass.

The same type of evidence has been used to show that hedonic response to a voluntary job change is not long lived. Although researchers initially observed a boost in hedonic response following such a job change, with enough time, there was no evidence of any lasting hedonic

influences on the individuals making the change (Boswell et al. 2005). In other words, hedonic response declined with time. Importantly, none of the studies discussed in this section directly assessed the decline in hedonic response; they, rather, inferred it from a comparison between a measured response to a stimulus and a control population.

GENERAL MECHANISMS OF HEDONIC DECLINE

Given the breadth of research on hedonic decline, it is no surprise that a number of general theories have been proposed as potential mechanisms. Historically, these general theories have developed within siloed research programs with slightly different methods, terminology, and mechanistic explanations. These include approaches rooted in physiology (e.g., homeostasis, negative alliesthesia), the senses (e.g., sensory-specific satiety, adaptation), and attention (e.g., habituation, monitoring). Going forward, we first provide descriptions of the most prominent theories to provide an overview of how each can underlie hedonic decline. We later present a general taxonomy for these mechanisms to help organize them to reveal common patterns and properties and to provide a structure for reviewing the breadth of recent (and future) findings.

Homeostasis

The defining characteristic of the mechanism of homeostasis is the maintenance of an ideal point through physiological feedback. This idea of satiation, which comes from the Latin word satis, meaning having enough, has long been used for feeding behaviors in nonhuman animals (Glanzer 1953). The term was appropriated for use in the study of food consumption in humans to describe the cessation of consumption following satiety factors. These factors typically take the form of physiological feedback cues such as oral stimulation, stomach filling and distension, and cellular hydration (Mook & Votaw 1992). These feedback cues are then translated into a reduced sensation, which some researchers have termed negative alliesthesia (Cabanac & Duclaux 1970). We present a more detailed account of these considerations in the section titled Physiological Feedback Factors.

The homeostasis approach holds that hedonic decline represents an excess relative to some desired physiological state (e.g., eating until one no longer has nutritional deficiencies or hunger pangs). Beyond specific physiological needs, set point theory proposes that each person also has a relatively stable overall level of subjective well-being that serves to mute deviations (Fujita & Diener 2005). That is, people seem to have limits on how long they can feel particularly happy or sad (versus an inherent baseline level). As a result, repeated exposure to a stimulus will lead to hedonic decline.

Sensory-Specific Satiety

Whereas original theories of satiation were focused on explaining the influence of physiological considerations (e.g., macronutrients such as calories), sensory-specific satiety posits that hedonic decline is also a function of sensory properties (e.g., color or flavor). In other words, hedonic decline for a given food is primarily a function of past consumption of that specific food, rather than the macronutritional accumulation of all previously consumed foods.

The seminal work on this account was developed in the food sciences by Rolls and colleagues (1981), and their core result is that ratings of pleasantness decrease considerably more for a food just eaten than for uneaten foods. More specifically, after eating a particular food, hedonic decline extends largely to other foods sharing the same flavor, rather than to foods sharing the same macronutritional content (Johnson & Vickers 1993) or the same brand name (Inman 2001).

Similar sensory-specific satiety has also been found to extend to color, saltiness, sweetness, and shape (Hetherington & Rolls 1996). In addition, using the effects of eating on ratings of food odors, researchers have neurologically traced sensory-specific satiety to the orbitofrontal cortex (Kringelbach et al. 2000), an area linked to sensory integration and affective value.

Perhaps the best illustration that macronutritional content does not drive satiation is the example of sham feeding. In this case, participants are asked to simply hold food in their mouths for a fixed period of time but never actually ingest the food. In this way, they experience only the sensory properties of the food (taste, smell, appearance) without receiving any of the nutritional benefits. Following this sham consumption procedure, preference for the food held in the mouth versus food not held in the mouth is assessed. As the theory predicts, even though no consumption has taken place, merely experiencing the food through a sham feeding procedure produces hedonic decline for that food but not other foods (Nolan & Hetherington 2009). Therefore, across all of these findings, hedonic decline clearly has a sensory component, reflected in the notion of sensory-specific satiety.

Adaptation

In addition to effects related to food consumption, more general perceptual effects have also been linked to hedonic decline. One of the earliest proposed mechanisms was adaptation (Helson 1947), which led to a wealth of further exploration and applications (Frederick & Loewenstein 1999, Parducci 1995). The core notion of this mechanism is that stimuli are perceived relative to an adaptation level that reflects past exposures. For instance, eating a sweet chocolate bar now makes every other food seem a little less sweet by comparison. However, this adaptation goes beyond sensory aspects and can include virtually any stimulus, such as the number of dots in a pattern or the weight of a barbell (Helson 1971).

According to the theory of adaptation level, repeated exposure to a stimulus will necessarily diminish the ongoing response. For example, returning to the chocolate bar, the first bite will typically taste quite sweet and bring enjoyment. However, with each additional bite, the reference point that defines what is perceived as sweet is rising. As this adaptation level keeps increasing, the constant level of sweetness in the chocolate bar will necessarily seem less and less sweet by comparison. The net result is eventual hedonic decline.

Hedonic Adaptation

Leveraging the concept of the reference point that lies at the core of the theory of general adaptation, the theory of hedonic adaptation considers the long-term influences of large life events on overall well-being (Brickman & Campbell 1971, Frederick & Loewenstein 1999). There are a few unique aspects to this work. First, hedonic adaptation emphasizes the shifting importance of different reference points. For instance, a new relationship may be quite enjoyable if one regularly notices how one's new mate improves on dimensions that a previous partner lacked. Of course, the salience of this reference point will fade over time, and the focus may even eventually shift to attributes lacking in the new mate. Second, hedonic adaptation also considers that one may dynamically alter their behavior in response to repeated exposures. For instance, if a person starts regularly drinking an afternoon smoothie, then they may compensate by reducing how much they eat at lunch each day. The result of this could be greater hunger in the afternoon, which could slow down the hedonic decline with the smoothie. Third, hedonic adaptation typically focuses on overall well-being rather than on a momentary response to a stimulus. For instance, in the case of marriage, the central question is typically not how much one enjoys marriage per se, but rather

how much being married influences well-being and life satisfaction. In this case, as with most experiences, considerable evidence shows that the influence of marriage on well-being declines with time (Lucas & Clark 2006). In fact, although not the primary interest of this review, much research on well-being focuses on the hedonic decline (or occasional lack thereof) over time in response to negative life events. Work in this area shows that people seemingly come to understand these events and explain them away, leading to a lessening impact over time (Wilson & Gilbert 2008).

Habituation

Habituation captures the decreased responsiveness to a stimulus after repeated exposure (Groves & Thompson 1970). Habituation does not involve sensory adaptation or fatigue; rather, it has been characterized as a learned suppression (Kandel 1991). The core notion of habituation is that a repeated stimulus elicits a lessening response as one learns that the stimulus is not critical and does not require much attention. This learned suppression then extends beyond the stimulus to other stimuli that are highly similar.

It is critical to note that this learning can apply to any stimulus, and that it is not tied to any particular physiological feedback or sensory aspect. As a result, habituation can readily account for long-lasting effects of hedonic decline for virtually any type of stimulus. In fact, the mechanism of sensory-specific satiety has been referred to as a particular application of habituation (Epstein et al. 2009, Higgs et al. 2008).

The seminal work on habituation studied cat leg muscles and sea slugs (e.g., Thompson & Spencer 1966), but habituation has proven just as instrumental to understanding hedonic decline for humans. For instance, habituation has been used to explain a wide range of eating behaviors and disorders such as obesity and bulimia nervosa (Epstein et al. 2009). Likewise, habituation was enlisted to explain why participants experienced spontaneous recovery from hedonic decline with the presentation of a novel food (Temple et al. 2008b). Broadly speaking, the general nature of habituation suggests that it likely plays some role in most settings with hedonic decline.

One of the most interesting properties of habituation is the degree of specificity, as laid out over 50 years ago by Thomson & Spencer (1966). This specificity helps researchers separate habituation from adaptation, as has been done in limited instances (Bernhard & van der Kooy 2000, Schifferstein & Kuiper 1997). For example, more intense stimuli should have slower habituation but faster adaptation. Of course, in many other cases, habituation and adaptation would both simultaneously contribute to hedonic decline in a similar fashion.

The notion of habituation has been expanded over time to now include 14 empirical characteristics (see **Table 1**; McSweeney & Murphy 2000). These essential properties that define habituation have been repeatedly demonstrated in countless studies. Habituation theory has remained relatively stable and powerful in its ability to predict hedonic response to repeated exposure to a myriad of stimuli across a myriad of organisms.

Self-Reflection

In addition to these well-established literatures, a relatively recent body of work has focused on self-reflection as a contributor to hedonic decline. The core notion of this work is that simply reflecting on past consumption can lead to the sense of having more exposure, which lessens the future response (Redden 2015). This reflection can arise in a variety of ways, including better initial encoding (Higgs & Donohoe 2011) and easier retrieval (Galak et al. 2014), cues of past consumption (Robinson et al. 2013, Wansink et al. 2005), cues of past variety (Galak et al. 2009),

Table 1 Empirical characteristics of habituation

Characteristic	Description
Spontaneous recovery	Responsiveness to an habituated stimulus recovers when that stimulus is not presented for an extended period of time.
Stimulus specificity	Habituation is disrupted by changes in the presented stimulus.
Variety effects	Habituation occurs more slowly to stimuli that are presented in a variable, rather than a fixed, manner (e.g., after variable, rather than fixed, interstimulus intervals).
Dishabituation	Presenting a strong, different, or extra stimulus restores responsiveness to an habituated stimulus.
Dishabituation habituates	Repeated presentation of dishabituators reduces their ability to restore habituated responding.
Stimulus rate	Faster rates of stimulus presentation yield faster and more pronounced habituation than slower rates.
Stimulus rate and recovery	Spontaneous recovery may be faster after faster rates of stimulus presentation than after slower rates.
Stimulus exposure	Responsiveness to a repeatedly presented stimulus decreases with increases in stimulus exposure.
Long-term habituation	Some habituation is learned and persists over time.
Repeated habituations	Habituation may become more rapid with repeated habituations.
Stimulus intensity	Habituation is sometimes, but not always, faster and more pronounced for less intense stimuli than for more intense stimuli.
Generality	Habituation occurs for most, if not all, stimuli and species of animals. The exact rate of habituation depends on the species, the stimulus, the response, and the individual subject.
Sensitization by early stimulus presentations	An increase (sensitization), rather than a decrease (habituation), in responsiveness may occur during the first few presentations of a repeatedly presented stimulus.
Sensitization by stimuli from another modality	An increase in responsiveness to a stimulus may be produced by the introduction of a stimulus from another modality (e.g., a light or noise). Both sensitization and dishabituation may involve the introduction of a stimulus from another modality. Results are conventionally described as dishabituation if the added stimulus restores responsiveness to an already habituated stimulus and as sensitization if the added stimulus increases response before substantial habituation occurs to the other stimulus.

Table adapted from McSweeney & Murphy (2000).

and comparing exposure levels to those of other people (Redden & Galak 2013). All of this work shows that, as past consumption is more easily recalled or framed as more recent or greater, hedonic decline will likewise increase.

It is notable that this self-reflection is likely a much higher-order cognition than all of the previously discussed mechanisms. Whereas other mechanisms may operate spontaneously and automatically, self-reflection is likely very sensitive to the context and individual. Thus, we expect that a great deal of the work showing differences in the rate of hedonic decline across people (as measured by the rate of change in rated enjoyment) likely results from changes in this self-reflection. We review some of this recent work in the section titled Self-Reflection Factors.

A TAXONOMY OF ANTECEDENTS OF HEDONIC DECLINE

The previous section provided a summary of the most popular theories contributing to research on hedonic decline. These various theories have often been cited as competing accounts that operate independently with unique predictions. We propose instead that these theories describe processes that often jointly contribute to hedonic decline and that, in some cases, they may even simply represent multiple ways of describing a single underlying mechanism. To deal with this inherent ambiguity, we present a limited set of classes of factors that drive hedonic decline. As a result,

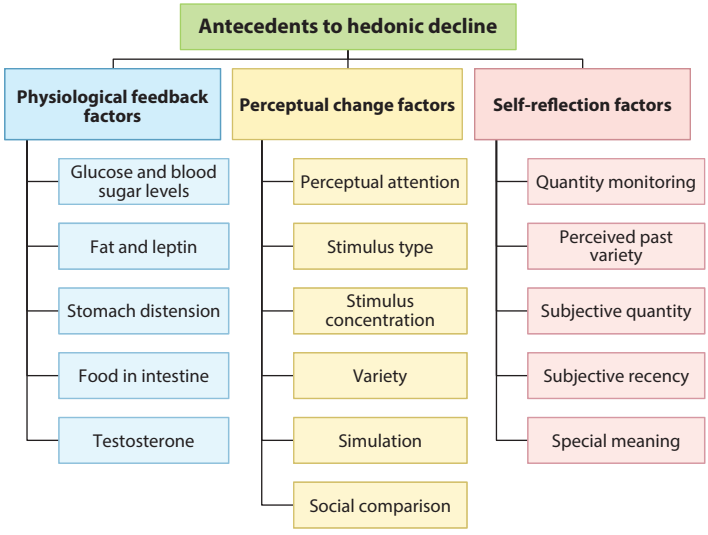

Figure 2

Taxonomy of antecedents to hedonic decline. Individual factors are representative of the antecedent category; we have outlined only the major antecedents in each category. Additionally, there are likely other antecedents within each category that have yet to be discovered and studied.

we can span these highly related yet relatively siloed literatures and provide a comprehensive account focused on the various antecedents of hedonic decline. We distinguish between three general types of factors affecting hedonic decline: physiological feedback, perceptual changes, and self-reflection (**Figure 2**). This approach and taxonomy then lets us synthesize the predictions and findings of these numerous literatures into a single comprehensive collection of factors driving hedonic decline.

Past work on hedonic decline has typically not explicitly demonstrated the presence of a particular mechanism. Given this, rather than add to any growing debates, we instead treat a set of related phenomena as a class of factors serving as an antecedent to hedonic decline. For instance, we do not try to distinguish between habituation and adaptation; rather, we treat both as perceptual change factors. Of course, realizing that many findings likely involve multiple mechanisms, we have discussed each finding in the section dealing with the mechanism that we expect was likely the primary contributor. We base this classification largely on whether the finding referred to bodily processing, set points, or ingestion (physiological feedback); adaptation, general attention, or sensory experiences (perceptual changes); or memory, metacognitions, or delayed effects (self-reflection).

PHYSIOLOGICAL FEEDBACK FACTORS

Most research examining physiological influences on hedonic decline involves nonhuman subjects, as the direct observation of physiological change in humans is quite difficult. Moreover, because most of this work deals with nonhuman subjects, hedonic measures are nearly impossible to obtain. Instead, most of this work deals with motivational responses that take the form of goal-directed behavior, such as the decision to continue consuming. In order to make the conceptual leap to hedonic response, we must necessarily make the following assumption: Motivational response, such as desire to consume, is at least somewhat correlated with hedonic response, such as pleasure

derived from consumption. This assumption accords with general intuition as well as with past findings, such as a study indicating that the time an individual takes before eating again is predicted by the most recent rating of enjoyment (Garbinsky et al. 2014). However, it is worth noting that divergences between liking and wanting have been intermittently demonstrated (Berridge 2009), both in common contexts such as eating and in abnormal behaviors such as drug addictions. Regardless, in most instances, we expect behavior will be at least somewhat affected by the hedonic response.

Under this assumption, there are a host of physiological inputs in observed hedonic decline, the majority of which deal with food consumption. Because there have been several recent reviews of these physiological factors (e.g., Benelam 2009, Berthoud 2011), we only briefly detail the more prominent physiological inputs, and instead focus our review on the other two primary inputs to hedonic decline: perceptual changes and self-reflection. We also note that much of the research on physiological feedback has been in the food domain, perhaps because food is essential to health and ingestion is an inherently physiological process.

Glucose and Blood Sugar Levels

One of the primary physiological inputs determining when to consume food is blood glucose levels. When these levels decline, desire to consume increases (Grossman 1986). For instance, when the amount of energy derived from glucose is decreased by the exogenous introduction of insulin, desire to consume food dramatically increases (Lotter & Woods 1997). Conversely, as the body processes glucose from consumed food, the desire to consume, and presumably hedonic response, declines (Woods et al. 2000).

Fat and Leptin

Glucose, although central to the regulation of food intake, is only one source of energy for the body. Fatty acids are also critically important to food regulation. As the body accumulates adipose tissue, a store for excess fat, a hypothalamic signal is released to indicate that consumption should decrease (Zhang et al. 1994, 2005). This is accomplished via the leptin hormone. As the body accumulates fat reserves, leptin is introduced into the blood stream, resulting in decreased desire to consume (Peters et al. 2005). Whether this decline in motivation to consume then results in a decrease in experienced enjoyment, however, is an open question.

Stomach Distension

Independent of the glucose or fat content of food, merely filling the stomach results in decreased desire to consume more food (Geliebter 1988, Wang et al. 2008). This filling can take the form of water, food, or even an inflated balloon. When a balloon is inserted into the stomach, the volume of the balloon acts as a signal that inhibits consumption (Kissileff et al. 2003). Similarly, in the case of the decline in hedonic response, there is suggestive evidence that stomach distension not only influences the desire to consume food, but also the enjoyment of that food. In one study, sensory-specific satiety was observed for the olfactory properties of food to a larger extent when the food was consumed as compared to when it was merely smelled (Rolls & Rolls 1997). Although it is difficult to dissociate the influence of nutrition from that of the volume of food consumed because the pleasantness ratings for the food were measured relatively shortly after consumption, it is more likely that distension contributed to the decline in hedonic response, as nutritional factors take longer (perhaps 30 minutes) to manifest.

Food in the Intestine

Like stomach distension, presentation of food directly to the duodenum, the portion of the small intestine closest to the stomach, results in decreased desire to consume food (Liebling et al. 1975, Moran & Dailey 2011). The hormone cholecystokinin (CCK) is primarily responsible for this decline in desire (Gibbs et al. 1973), although the additional distension of the stomach by food or drink is required for CCK to have an influence on food consumption in humans (Lieverse et al. 1995; see Benelam 2009 for a more detailed discussion of other hormones that play a role in the decline in response to food). This decline has yet to be linked to a decline in any form of hedonic response, but when cessation of consumption occurs due to food entering the intestine, a decline in the palatability of food presumably follows.

Testosterone

Moving away from food consumption, there is evidence that testosterone levels are a predictor of male sexual arousal and interest (Rupp & Wallen 2007). Specifically, in one study, although hedonic decline to sexual images occurred in all participants, the degree of endogenous testosterone moderated this decline such that those men who had high levels of testosterone exhibited a much slower hedonic decline (Rupp & Wallen 2007). In other words, the presence of higher levels of testosterone slows the decline in hedonic responses, suggesting that it is a principal physiological input in sexual arousal. Interestingly, testosterone also plays a role in female sexual arousal, but its influence on the hedonic decline that women experience with repeated exposure to sexual stimuli has yet to be documented (Tuiten et al. 2000).

PERCEPTUAL CHANGE FACTORS

A wide variety of research has demonstrated that, beyond physiological processes, the ongoing perception of a stimulus also affects the rate of hedonic decline. This nondigestive antecedent to hedonic decline has proven both important and prevalent. Whereas physiological antecedents to the decline in hedonic response are relatively slow processes, often taking tens of minutes to take effect, perceptual-based antecedents are rather quick, often influencing hedonic decline almost immediately as part of the subjective experience itself. In the next sections, we detail several examples of how these perceptually based antecedents influence the rate of hedonic decline. As is the case with physiological antecedents, hedonic response is not always directly measured, requiring us to infer, in some cases, that a decline in desire to consume translates to a decline in the hedonic response.

Perceptual Attention

Much of the work showing the influence of attention to the stimulus on hedonic decline has again focused on food consumption. For instance, in one study, participants consumed either pizza or macaroni and cheese ad libitum while either watching television (a highly involved experience) or listening to classical music (a less involved experience). While watching television, when their attention was presumably averted more from eating, participants ate 36% more pizza and 71% more macaroni and cheese (Blass et al. 2006). Participants conversely reported both a lower desire to consume and lower ratings of the pleasantness of Jaffa Cakes when their attention was not diverted from consumption (Brunstrom & Mitchell 2006). However, when attention was diverted via an involving video game, no such decline was observed. In other words,

perceptual attention to the stimulus being consumed was an antecedent to hedonic decline. However, the notion of perceptual attention may be multifaceted, as a recent study found an exception: Having knowledge of the duration of the stimulus (versus not having this knowledge) increased attention to the final exposure and led to greater hedonic savoring toward the end (Zhao & Tsai 2011). This suggests that numerous factors may moderate the effect of attention on hedonic decline, making different types of attention and their effects potentially fruitful areas for future research.

Stimulus Type

The type of stimulus being consumed can also lead to perceptual changes that affect hedonic decline. For example, hedonic decline tends to happen more rapidly for simple versus complex stimuli (Berlyne 1971, Cox & Cox 2002). Researchers have also documented that the rate of satiety systematically, and sometimes quite dramatically, differs across a range of common food types (Holt et al. 1995). Beyond food, other recent work has found that material goods cause a greater hedonic decline than experiences (Nicolao et al. 2009). In this case, experiences presumably possess more unique aspects, ongoing memories, group consumption, etc. Similarly, Yang & Galak (2015) showed that gifts imbued with sentimental meaning (versus items bought for oneself) are more resistant to hedonic decline, even over long periods of time. These findings suggest, more generally, that stimuli tapping into higher-order cognitive functions may serve to slow hedonic decline.

Stimulus Concentration

Past research on hedonic decline has explored the construct of concentration along two dimensions. The first dimension is the dosage level for each exposure of a stimulus and has led to mixed results for hedonic decline. In some cases, more intense stimuli can lead to greater decline. For example, a well-liked beer led to lower local evaluations of the next beer but higher overall ratings of the global experience (Ghosal et al. 2014). People were similarly less satiated with a lower-calorie version of spaghetti Bolognese (O'Sullivan et al. 2010), yet caloric content had no effect on salivation to repeated exposures of a lemon gelatin (Epstein et al. 1993). Perhaps not surprisingly, two of the core theories of hedonic decline even make opposing predictions. Adaptation predicts that increasing the intensity of the stimuli would increase hedonic decline by raising the adaptation level to which everything is subsequently compared. In contrast, one of the properties that define habituation is that hedonic response declines less for a more intense stimulus (see **Table 1**, stimulus intensity). Future work (and theories) will need to tease out under what conditions each outcome emerges and dominates.

The second dimension examines the frequency or rate of consumption, with the clear finding that more concentrated consumption leads to faster hedonic decline. For example, when eating six chocolate candies, people became satiated faster when eating them at their own pace over 20 minutes versus being forced to space them out at the maximal 200-second intervals (Galak et al. 2013). Hedonic adaptation similarly slowed when breaks were inserted into a consumption experience, whether the breaks were empty time (Nelson & Meyvis 2008) or television commercials (Nelson et al. 2009). Likewise, when participants ate chocolate in two sessions a week apart, those told to abstain from chocolate in the intervening period experienced less hedonic decline than those given no instructions or those told to eat as much as possible during the intervening week (Quoidbach & Dunn 2013). These findings all show that hedonic decline accelerates as consumption is more concentrated over time.

Variety

The introduction of nonfocal stimuli (i.e., variety) reduces the rate of hedonic decline, which has been shown in a myriad of studies and contexts (Brondel et al. 2009, Epstein et al. 2009, Galak et al. 2011, Havermans & Brondel 2013, Inman 2001, Sorensen et al. 2003, Temple et al. 2008a). In fact, even eating varied foods beforehand can reduce the subsequent rate of satiation when eating a different food later (Hetherington et al. 2006). The fact that variety reduces hedonic decline is intuitive and directly follows from the property of dishabituation (see **Table 1**, dishabituation). Given this, more recent research has tended to focus on the question of what qualifies as variety and to what extent it reduces hedonic decline.

The ability of variety to slow hedonic decline has been shown to increase as people subcategorize the stimuli more (Raghunathan & Irwin 2001, Redden 2008) and as people are asked to explicitly recall past variety that they have experienced (Galak et al. 2009). It seems that people must view variety as different from, yet somewhat related to, the stimulus on which they have previously experienced hedonic decline. Variety also does more to counter hedonic decline when people consume the stimuli at a faster rate, which leads to more satiation (Galak et al. 2011). The effect of variety on hedonic decline also depends on the attribute being varied. For example, consumers became satiated more quickly on a particular flavor than on a particular brand name of chip (Inman 2001). More generally, it could be that any sensory aspect is more prone to perceptual changes (and hence hedonic decline) than more abstract attributes. In fact, once a food undergoes sensory-specific satiety after an individual repeatedly eats it, the hedonic decline for this food persists even after the individual eats another food (Havermans 2012).

Within the context of perceptual changes, we also offer a different interpretation of why variety slows hedonic decline. A new stimulus may act as a distractor from the focal stimulus and divert attention away from consumption, which could then reduce the resulting hedonic decline. Interestingly, the same logic could also apply to the previously noted effect of more frequent exposure accelerating hedonic decline. That is, as interconsumption intervals increase, there is more opportunity for one to attend to other stimuli in the environment (not just other somewhat related stimuli, as is the case with variety). This shift in attention may then be responsible for the observed hedonic decline.

Simulation

Recent work has also shown that hedonic decline can occur even without any actual consumption. For example, people had a lower desire to earn a cheese reward after imagining eating a cheese cube 20 times in a row (Morewedge et al. 2010). Subsequent work further established that simply viewing advertisements with salty (versus sweet) foods lowered the subsequent enjoyment of eating salted peanuts (Larson et al. 2014). Alternatively, the knowledge that future consumption would offer an opportunity for a novel food served to slow the current rate of hedonic decline (Sevilla et al. 2016). These findings show that the mere perceptual experience of consumption can mimic the hedonic decline (and recovery) found with actual consumption.

Social Comparison

One area of research that has garnered a great deal of attention is the influence of a change in social status on well-being. For example, does an increase in income (a temporary shock or a permanent change) result in a lasting change in happiness and well-being, or does such a change instead yield a temporary increase followed by the typically observed hedonic decline over time? Past research

has generally found mixed results, mostly suggesting that life changes do not have a strong (if any) lasting influence on well-being.

Past research has found little gain in national well-being with increased national real income (Campbell 1981, Diener & Biswas-Diener 2002, Easterlin 1995), little lasting effect for lottery winners (compared to nonwinners) 1 to 18 months later (Brickman et al. 1978), and only a mild correlation between income and well-being in the United States (Diener et al. 1993). In contrast, other research has found a log linear (i.e., diminishing) relationship for well-being as income increases (Stevenson & Wolfers 2013) and some evidence of longer-lasting gains in well-being with increased income for the very poor (Diener & Biswas-Diener 2002) as basic needs (e.g., shelter) are met.

Overall, though, the more common finding seems to be the lack of a lasting relationship. These diminishing effects of greater income (and the benefits it could potentially provide) are often attributed to the mechanisms underlying hedonic decline, as well as rising aspirations to which the current circumstances are compared (Sheldon & Lyubomirsky 2012).

SELF-REFLECTION FACTORS

Both physiological and perceptual antecedents to hedonic decline occur as a direct response to consumption itself. In contrast, a third class of antecedents to hedonic decline emerges from top-down processes that occur only upon reflection on present or past consumption. Specifically, people seemingly apply their lay beliefs about what should influence the trajectory of hedonic response in order to inform actual hedonic response, absent any change in actual consumption. These top-down beliefs then act alongside the many other signals (often low-level, bottom-up signals) that also contribute to hedonic decline. In many ways, reflecting on past consumption can produce and mimic the effects of hedonic decline in much the same way as actual consumption.

Given that this notion of self-reflection is relatively recent in the literature, these lay beliefs and antecedents have not yet been well explored and clearly defined. In the next sections, we provide a taxonomy and organization for those identified so far. This review also focuses on more detailed descriptions of the few initial studies providing evidence for these self-reflection effects. It is also noteworthy that many of these studies demonstrate these self-reflection factors for hedonic decline across a broad range of domains (music, art, food, social interactions), but we maintain our focus on just one prototypical example from any given paper.

Quantity Monitoring

In a seminal piece demonstrating that hedonic decline is not directly linked to ingestion, Wansink (2005) had participants eat soup from either a regular bowl or a bowl that was surreptitiously connected to a vat of soup that automatically and imperceptibly refilled the soup bowl as participants ate. Participants consumed 73% more soup when the bowl was refilled unbeknownst to them, even though they did not realize that they had consumed more than those who ate a fixed amount of soup from a regular bowl. Conversely, people ate fewer potato chips when special red chips were interspersed at regular intervals to act as a cue of the quantity eaten (Geier et al. 2012) and reduced their subsequent intake after first completing a brief mindfulness training to attune them to their physiological feedback (Van De Veer et al. 2015).

In another, more direct, assessment of hedonic decline, participants cued to attend to the number of times they swallowed reported greater decreases in enjoyment while eating cereal or candy bars than those not cued (Redden & Haws 2013). Similarly, people experienced greater

hedonic decline when explicitly choosing from three songs to hear prior to hearing them as compared to having the songs chosen for them at random by a computer (Redden et al. 2017). People also experience greater hedonic decline when regularly asked how many chocolate pieces they had eaten throughout a consumption experience as compared to when they are not asked (Sevilla & Redden 2014). In the latter case, it was shown that attention to the quantity being consumed increased the sense of how much had been consumed, which presumably trigged the lay belief that this should increase the hedonic decline (which it did).

Perceived Past Variety

Another class of self-reflective antecedents is belief about how much variety has been consumed. As previously discussed, there is ample evidence that greater variety slows hedonic decline (Brondel et al. 2009, Galak et al. 2011, Havermans & Brondel 2013). However, the belief of how much variety has been consumed may also affect hedonic decline, in addition to the objective variety in and of itself.

In one study (Galak et al. 2009), similar to a preload in food research, participants were exposed to the chorus of a favorite song 20 times to induce hedonic decline (45 points on 101-point scale). Two weeks later, the same participants were instructed to think of either all other musical artists they had listened to during the past two weeks (treatment) or all television programs they had watched during that time (control). Importantly, the actual variety of songs listened to during this two-week period did not vary across conditions. Participants in the treatment condition were instead merely reminded that they had consumed a variety of songs during this period of time. Participants who were not reminded of the variety of songs they listened to still exhibited hedonic decline (33 scale points) that had recovered little over the intervening two weeks. However, when merely reminded of the fact that they listened to other songs during the intervening period, these participants' enjoyment of the song returned nearly to their initial enjoyment level, and they showed little hedonic decline (9 scale points).

It seems that these participants engaged in a self-reflective thought process that incorporated their belief that if they did consume variety, then they should be able to once again enjoy their favorite song. In other words, these participants used their belief that variety reduces hedonic decline (Read & Loewenstein 1995, Simonson 1990) to actually influence their hedonic response when listening again to their favorite song. Likewise, people not cued to recall past variety seemingly engaged in a form of focalism that leads them to primarily focus on the stimulus at hand and neglect thoughts of alternative related stimuli (Kahneman & Miller 1986, Klayman & Ha 1987). That is, the mere consumption of variety, in and of itself, does not seem in all cases to be enough to spontaneously influence hedonic response.

Subjective Quantity

Another self-reflective antecedent to hedonic decline is subjective assessment of the quantity of past consumption. Actual quantity consumed clearly drives the extent of hedonic decline, with more consumption producing greater hedonic decline (Groves & Thompson 1970, Rolls et al. 1981). However, much like the case of variety, recent work has shown that the subjective assessment of consumption quantity may matter as much as the actual quantity.

Indeed, in one experiment (Redden & Galak 2013, study 3), participants were first exposed to an aesthetically pleasing photograph 20 times to produce a sizable hedonic decline (30 points on 101-point scale). Importantly, participants were never explicitly made aware of how many times

they were exposed to the photograph, but rather were told only that they would view it "several times." Following the final iteration, participants were led to believe that they either saw the photo many times or saw it only a few times, using a scale-based manipulation adapted from Shwarz et al. (1985). Upon subsequently seeing the photograph again, participants made to feel that they saw the photograph only a few times showed half as much hedonic decline (13 scale points) as those made to feel that they had seen it many times (25 scale points). In other words, merely changing how much these participants felt that they were exposed to the photograph influenced their actual level of subsequent enjoyment. Presumably, people believe that when one is exposed to a stimulus only a few times, hedonic decline should be less, and so their actual enjoyment, indeed, does not decline much at all.

Importantly, one reason that this type of intervention can influence the rate of hedonic decline is because perceived quantity of consumption is something that is, itself, quite malleable (Blair & Burton 1987, Menon et al. 1995). Given that people do not always keep running tabs on how much of a stimulus they have consumed, their lay beliefs play a key role in determining their hedonic response to subsequent exposures to the same stimulus. They reflect on what they believe to have been their level of past consumption, and this self-reflection ultimately acts as an antecedent to hedonic decline.

Subjective Recency

Another antecedent to hedonic decline is subjective assessment of the time that has passed since the last consumption episode. Generally speaking, the more time that passes between consumption episodes, the smaller is the hedonic decline (Groves & Thompson 1970, Hetherington et al. 1989). In addition, to the extent that people hold a lay belief that longer passages of time result in less hedonic decline (Galak et al. 2013), the perception of how much time has passed may matter just as much as the actual passage of time.

For instance, in one experiment (Galak et al. 2014), participants were first shown a photograph of a beach 12 times to induce hedonic decline (25 points on 101-point scale). Participants then watched a 10-minute video, but during the video, they were made to believe that either much time or little time had actually elapsed. By adapting a prior methodology (Sackett et al. 2010), an on-screen timer was sped up (or slowed down) to make participants feel that the video they watched was particularly short (or long). Upon subsequently viewing the beach photo again, those made to feel that little time had passed since they last saw the photograph showed more hedonic decline (15 scale points) than those made to feel that more time had elapsed (2 scale points). In other words, the mere belief about how much time had passed since a previous exposure to a pleasing photograph influenced actual enjoyment during a subsequent consumption episode. This same paper also conceptually replicated this effect, as restaurant patrons who were made to feel that their last meal was quite recent ate less food than those made to feel that their last meal was quite temporally distant.

In these findings, people seemingly self-reflected on the fact that either little or much time had passed and then applied their belief that hedonic decline should be smaller when more time has passed between consumption episodes. Importantly, one of the key reasons that such an effect is possible is that people's perception of time is generally quite malleable (Kyung et al. 2010, Semin & Smith 1999, Zauberman et al. 2010). That is, people do not always have a good sense of how much time has passed, and so they use external cues, such as those in the above-described experiments, to inform their subjective assessment of the passage of time. Coupled with the lay belief that the length of interconsumption intervals influences the rate of hedonic decline, it is clear how such a self-reflective antecedent can be influential.

Special Meaning

The final antecedent of hedonic decline related to self-reflection is the imbuing of consumption experiences with some special meaning. The general lay belief operating in this case is that some stimuli hold a special place in an individual's mind that slows the hedonic decline resulting from consumption. For instance, Yang & Galak (2015) showed, in one study, that people showed less hedonic decline for items they received as gifts (which are frequently sentimental) versus items they bought for themselves. Special meaning can also come from a rare opportunity to consume, as people told that a chocolate was only available at certain times of the year showed less hedonic decline while eating it than those told that the same chocolate was always available (Sevilla & Redden 2014). Finally, another study showed that hedonic decline slowed when it threatened an important self-identity (Chugani et al. 2015). Undergraduates continued enjoying chocolates longer and ate more of them when the chocolates were in their university's school colors versus when they were in other, nonimportant colors. Participants seemingly resolved the cognitive dissonance that arises from the conflict between hedonic decline and a stimulus that one's identity dictates should be liked. More generally, it is likely that any stimulus imbued with a property suggesting it should be permanently liked will similarly prove more resistant to hedonic decline.

CONCLUSIONS

Over the many decades of research trying to understand how both human and nonhuman animals respond to repeated exposure to hedonic stimuli, the core finding has been that hedonic responses decline with repetition. However, this conclusion has been spread across a number of siloed literatures, making it difficult for researchers to produce a single coherent understanding of what drives such decline. Indeed, work rooted in explanations such as homeostasis, satiation, habituation, and adaptation have all tackled the same basic problems yet have largely treated each differing approach as idiosyncratic rather than related. In this review, we have summarized the main findings of these varied literatures and provided a taxonomy of what factors influence hedonic decline. Specifically, we have demonstrated that all of these diverse research streams can fit within just three categories of antecedents to hedonic decline: physiological feedback, perceptual change, and self-reflection. These three categories comprehensively organize the drivers of hedonic decline, as well as past and potential future findings in this rich area.

The intent of this review is to provide a taxonomy to not only synthesize previous work but also to provide direction for future research. To that end, we have several specific recommendations for researchers interested in studying hedonic decline. First, the phenomenology of hedonic decline is poorly understood. That is, across all the literature that we cite, the results are shallow with regard to its explanations of how humans actually experience hedonic decline with stimuli. The literature clearly observes that hedonic decline occurs for many different stimuli and under many different contexts, but it is mute as to how people actually experience this decline. For example, is hedonic decline explicitly felt? Is it below conscious awareness? Does it operate more on emotions or cognitions? Generally, we know little about the actual experience of hedonic decline. We speculate that feelings of boredom and irritation are likely candidates in some cases, but hedonic decline likely involves a much larger range of experiences. Second, there are clearly differences in the underlying psychological explanations provided by the myriad of theories that attempt to explain not just hedonic decline, but response decline more generally. As mentioned above, it is unlikely that these mechanisms operate independently and in isolation. Rather, it seems far more plausible that all forms of response decline are multidetermined and should be studied as such. By focusing on the similarities between these approaches rather than their differences,

future research may develop better models to both understand and predict hedonic decline. Third, several of our conclusions are based on assumptions that the decline in response to hedonic stimuli likely mirrors a decline in response to nonhedonic stimuli. There is plenty of evidence to believe that this is so, but such a core assumption must be empirically tested in a thorough fashion. To that end, future research should examine cases in which the principles outlined by the various theories that explain response decline apply differentially to hedonic versus nonhedonic stimuli. Such an understanding will not only allow for more precision in prediction but will also allow for a deeper understanding of the core psychological processes that govern human behavior. Finally, we document a host of antecedents to hedonic decline but do not, in any way, suggest that we have been exhaustive. Indeed, there are likely many other antecedents to hedonic decline that have yet to be systematically investigated. Future research should continue to expand on our taxonomy in hopes of documenting the full breadth of influence on hedonic decline.

SUMMARY POINTS

1. Hedonic decline is the phenomenon whereby continued and repeated exposure to a stimulus typically leads to a reduced hedonic response.
2. The effects of hedonic decline can be studied using a variety of measurements across different time periods (within a single session versus across multiple sessions) and measurement occasions (single measurement versus repeated measurement).
3. Hedonic decline has been attributed to myriad mechanisms that include homeostasis (set points), sensory-specific satiety, adaptation, habituation, and self-reflection.
4. We provide a taxonomy of three classes of antecedents of hedonic decline: physiological feedback, perceptual changes, and self-reflection.
5. Physiological antecedents largely result from bodily feedback that reflects the extent of consumption (e.g., leptin levels or stomach distension).
6. Perceptual change antecedents alter the rate of hedonic decline by changing the ongoing experience itself (e.g., through attention redirection or shifting reference levels).
7. Self-reflection antecedents influence hedonic decline by incorporating lay beliefs (e.g., subjective quantity of past consumption) about what hedonic decline should be, which shapes the subsequent hedonic decline actually experienced.

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