# Buying Beauty for the Long Run: (Mis)predicting Liking of Product Aesthetics

EVA C. BUECHEL

CLAUDIA TOWNSEND

*Accepted at Journal of Consumer Research*

Eva C. Buechel (eva.buechel@moore.sc.edu) is Assistant Professor of Marketing, Moore School of Business, University of South Carolina, 1014 Greene Street, Columbia, SC 29208.
Claudia Townsend (ctownsend@bus.miami.edu) is Associate Professor of Marketing, School of Business Administration, University of Miami, 5250 University Drive, P.O. Box 248147, Coral Gables, FL 33124. The authors thank Ben Borenstein, Vamsi Kanuri, and the behavioral labs at the University of Miami and the Moore School of Business for their help with data collection. They thank Chris Janiszewski, Anastasiya Pocheptsova Gosh, the editor, the associate editor, and the three reviewers for their helpful comments on previous versions of the manuscript.
Supplementary materials are included in the web appendix accompanying the online version of this article.

## Abstract

How well can consumers predict future liking of different product designs? The present research identifies a systematic error in consumers' preferences and predicted liking for product aesthetics. Consumers predict a faster decrease in liking for high (vs. low) arousal potential product designs (i.e., intense colors or intense patterns) over repeat exposure because high arousal potential designs are expected to become increasingly irritating. These predictions are misguided, however, falsely leading consumers to avoid products with high arousal potential designs when making decision for extended product use. Seven studies test this conceptualization in the lab and in the field. The first five studies examine predicted liking for product designs of varying arousal potential levels over repeat exposure and how these intuitions influence product design preferences for long (vs. short) term use. The last two studies then investigate the accuracy of these intuitions by directly comparing predicted versus experienced liking for product designs of varying arousal potential levels over repeat exposure. The studies reveal a systematic error in prediction whereby consumers overestimate satiation from high arousal potential product designs. Managerial and theoretical applications are discussed.


*Keywords:* Affective Forecasting, Predicted and Experienced Utility, Aesthetics, Product Design, Visual Satiation

The cars we drive, the toothbrushes in our medicine cabinets, and the couches in our living rooms are all examples of products we purchase one day and then repeatedly see for months or even years to come. Thus, for any durable good, consumers must not only identify their current preferences, but also predict if and how these preferences may change over time. After all, the quality of consumer decisions depends on the accuracy of these predictions (Kahneman and Snell 1992).

One increasingly important product attribute that consumers are tasked to consider when making these predictions is product aesthetics. Indeed, because it is increasingly difficult to differentiate products solely on the basis of function, marketers are becoming ever more cognizant of the impact of aesthetic design elements - such as color and pattern - on decision-making (Hoegg and Alba 2008; Page and Herr 2002; Patrick and Peracchio 2010; Townsend and Shu 2010; Yamamoto and Lambert 1994). An important question is therefore how well consumers can predict future liking for different product designs.

We know from prior research that consumers have difficulty predicting hedonic value (Wilson and Gilbert 2003, 2005) and that they have erroneous beliefs about how it changes over time (Kahneman and Snell 1992; Snell, Gibbs, and Varey 1995; Wilson and Gilbert 2003, 2005). Yet, most of this research has focused on the accuracy of forecasting affective reactions to non-sensory stimuli, whereas research comparing predicted and experienced liking of sensory stimuli is surprisingly inconsistent and sparse. For example, research in this area has not yet investigated how characteristics of sensory stimuli (e.g., their intensity) might influence predicted and experienced hedonic value. And despite the importance of aesthetics in marketing and consumer decision-making, previous research has not systematically examined the accuracy of consumers' predictions about the dynamics of hedonic value in the visual domain.

To fill these gaps, the present research examines how visual stimuli characteristics influence predicted and experienced satiation to product aesthetics. Specifically, we focus on two common and important product design elements: the intensity of color and the intensity of pattern. We examine how a design's potential to arouse (i.e., its intensity) differently influences predicted versus experienced liking over repeat exposure and how these differences impact the nature and quality of consumer decision-making. We show that consumers anticipate that high (vs. low) arousal potential designs will lead to greater irritation and, as a result, faster decrease in liking over repeat exposure. Consequently, consumers tend to choose simple (i.e., low arousal potential) over intense (i.e., high arousal potential) designs when making decisions for products with extended use. Further, we demonstrate these predictions and product preferences to be misguided. Contrary to consumers' intuitions, experienced liking decreases at a slower rate for high (vs. low) arousal potential designs, leading to errors in predicted utility and suboptimal decision-making.

In doing so, we make at least two significant contributions to the understanding of how consumers predict and experience hedonic value. Substantially, we are the first to examine how and how well consumers predict their hedonic responses to product design (and visual stimuli more generally), a sensory stimulus that is important to consumers and marketers (Hoegg and Alba 2008; Page and Herr 2002; Patrick and Peracchio 2010; Townsend and Shu 2010; Yamamoto and Lambert 1994). Theoretically, we are the first to examine how tractable differences in stimuli characteristics, in this case their arousal potential (i.e., intensity), differently influence predicted and experienced hedonic value over time, thus shaping forecasting errors. And while we focus our investigation on the visual domain, and more specifically colors and patterns, our findings may potentially be extrapolated to other equally poorly understood sensory stimuli and other sources of arousal potential. Next we provide an overview of previous research on the dynamics of predicted and experienced hedonic value over time. We then focus on the concept of arousal potential to understand how it may differently influence hedonic value in prospect and experience.

## DYNAMICS OF HEDONIC VALUE

Repeat exposure can change the subjective experience of a stimulus (Redden 2015). Subjective hedonic intensity[1] (i.e., the strength of the psychological response) of a stimulus can decrease (adaptation, habituation, or desensitization) or increase (sensitization) as a function of exposure (Frederick and Loewenstein 1999; Redden 2015). For most stimuli and circumstances, hedonic adaptation is the norm (Nelson and Meyvis 2008; Redden 2015). People adapt to numerous stimuli and circumstances, including smells, pains, wealth, incarceration, and even paraplegia (for a review, see Frederick and Loewenstein 1999). Notably, there are also instances where hedonic adaptation is absent or where the subjective intensity of a stimulus increases over time (i.e., sensitization; Weinstein 1982). For example, individuals have been shown to have difficulty adapting to traffic noise (Weinstein 1982) and exhibit sensitization to dormitory noises (Weinstein 1978) and sexual stimuli (Heiman 1977; Laan, Everaerd, and Evers 1995).

Given that our decisions about which products to buy are based, in part, on our predictions about how these products will make us feel over time, it is important for consumers to be able to predict the direction of hedonic value (i.e., whether adaptation or sensitization

[1] While for sensory stimuli these changes over repeated exposure can also occur on a neural level (i.e., the firing of sensory neurons can change over time), we describe changes in the corresponding psychological response that determine the subjective hedonic experience of the stimulus.

occurs) and the rate with which hedonic value changes over time. Yet, while we know that people are generally not very adept at predicting hedonic value (Wilson and Gilbert 2003, 2005), many aspects of hedonic value in prospect and experience are still poorly understood.

Most existing work on predicted and experienced hedonic value has focused on stimuli in the non-sensory domain. Specifically, research on affective forecasting suggests that in many cases, people overestimate how much and for how long products, events, and circumstances will impact their happiness and well-being (for overviews see Wilson and Gilbert 2003, 2005; Buechel, Morewedge, and Zhang 2017). Research in this area has uncovered several sources for this forecasting error. Most relevant to the present investigation is the finding that forecasters underestimate hedonic adaptation to future events, either because they overlook their ability to rationalize, make sense of, and cope with changes in their environment (i.e., immune neglect; Gilbert et al. 1998) or because they neglect to incorporate beliefs about adaptation into judgments and decisions (Wang, Novemsky, and Dhar 2009).

In contrast to the rich body of work on affective forecasting in the non-sensory domain, there is little research comparing predicted and experienced liking for *sensory stimuli* over repeat exposure[2] – the specific topic of the present research. Perhaps the most comprehensive and relevant investigation in the domain of sensory stimuli is that of Kahneman and Snell (1992), who directly compared predicted and experienced liking of isolated gustatory and auditory stimuli over time. In each of two experiments, participants first predicted and then reported their liking for one auditory stimulus (music) and one gustatory stimulus (bland yoghurt or ice cream, respectively), which were simultaneously experienced in a lab session over seven consecutive

[2] Note that in the context of liking of sensory stimuli, adaptation occurs when a liked stimulus is liked less over time (i.e., referred to as satiation) or when a disliked stimulus is liked more over time. Sensitization describes an increase in liking of a liked stimulus, and a decrease in liking of a disliked stimulus.

days. They found that participants correctly anticipated that they would adapt to the taste of ice cream and the sound of music, such that liking of the stimuli would decrease over time, but overestimated how much they would adapt to both of these stimuli. That is, they predicted liking to decrease more than it actually did. This finding mirrors earlier research in the negative domain, suggesting that people overestimate to what extent they will adapt to some noises (Weinstein 1982). For the yoghurt, however, the pattern differed. Kahneman and Snell's participants anticipated the tastiness of the unpalatable yoghurt to grow increasingly unpleasant (i.e., sensitization), while experience ratings revealed the taste to become increasingly pleasant over time (i.e. adaptation). In other words, unlike errors found in the non-sensory domain, which consistently finds *underestimation* of adaptation, errors in the sensory domain are less systematic and more poorly understood: participants either *overestimated* adaptation (in the case of music and ice cream) or failed to predict even the direction of how hedonic value would change over time (in the case of yoghurt).

Work building on this initial and (relatively rudimentary) understanding of predicted and experienced utility in the sensory domain has largely focused on how consumers mispredict to what extent external and contextual factors influence enjoyment of sensory stimuli. For instance, consumers fail to predict how other present and previously experienced stimuli influence enjoyment of sensory stimuli (Morewedge et al. 2010; Novemsky and Ratner 2003; Ratner, Kahn, and Kahneman 1999), and fail to intuit that inserting breaks into auditory and somatic experiences will disrupt adaptation (Nelson and Meyvis 2008).

What has received little to no attention, however, is to what extent stimuli characteristics (e.g., the intensity of the stimulus) influence predicted versus experienced liking over time.

Moreover, no research has compared predicted and experienced liking of visual stimuli over time.

In the following, we will argue that the arousal potential of stimuli (i.e., their intensity) differently influences liking of sensory stimuli in prospect and experience. We conduct our investigation in the marketing relevant domain of visual stimuli, focusing on color and pattern as the sources of intensity. Note, however, that our conceptualization may potentially generalize to other sensory stimuli and others sources of intensity that are currently equally poorly understood, as we further discuss in the General Discussion.

## AROUSAL POTENTIAL IN VISUAL STIMULI

In the present research, we examine predicted and experienced liking (i.e., the hedonic response) as a function of stimulus intensity. Specifically, we focus on "arousal potential", a property of a stimulus that describes the degree with which it can disturb, alert, and arouse an organism (Berlyne 1971, page 70). Stimuli that are intense, loud, colorful, novel, complex, or difficult to process, for example, have greater potential to arouse (Berlyne 1960).

In our investigation, we examine arousal potential in the domain of visual sensory stimuli by focusing on two common product designs elements: color and pattern. We do this for two reasons. First, color and pattern are of practical importance for consumer behavior because both have a strong impact on overall beauty and aesthetics, an important but understudied criterion by which consumers evaluate products (Alba and Williams 2013; Hagtvedt and Brasel 2017; Hoegg and Alba 2008; Page and Herr 2002; Patrick and Peracchio 2010; Postrel 2003; Townsend and Shu 2010; Yamamoto and Lambert 1994). Second, color and pattern together offer a broad theoretical examination of "arousal potential" within the context of visual aesthetics (Berlyne, 1971; Hagtvedt and Brasel 2017). Colors vary in their arousal potential primarily via saturation – the amount of pigment in a color – with highly saturated colors being more vivid, pure, bright, and colorful (i.e., they have higher chroma[3]; Küller, Mikellides, and Janssens 2009; Zieliṅki 2016), thus increasing their potential to alert and arouse an organism (Hagtvedt and Brasel 2017; Labreque and Milne 2012; Valdez and Mehrabian 1994). Patterns vary in their arousal potential via their complexity, amount of contrast, puzzlement, or visual busyness (Cox and Cox 2002), again increasing the potential to alert and arouse (Berlyne 1971). Indeed, higher levels of both types of design elements (i.e., brighter and more saturated colors; more complex patterns) have repeatedly been shown to lead to greater measured physiological arousal (Baker and Franken 1967; Berlyne 1970; Berlyne and McDonnel 1965; Holtzschue 2011; Küller, Mikellides, and Janssens 2009; Nicki and Gale 1977; Zieliṅki 2016) and greater self-reported arousal (i.e., they are rated as more arousing, exciting, attention-grabbing, anxiety-producing, upsetting, and less calming; Hagtvedt and Brasel 2017; Janiszewski and Meyvis 2001; Labreque and Milne 2012; Weller and Livingston 1988; Wright and Rainwater 1962; Zieliṅki 2016). It is important to emphasize that while stimuli properties differ in their arousal potential, a stimulus' ability to arouse is not absolute (i.e., a certain level of saturation or pattern structure does not necessarily correspond to a particular level of arousal response). Instead, the response to a given stimulus's properties might differ from one situation to another and from one individual to another (Berlyne 1971).

[3] Two important dimensions of color are the hue (wavelength) and the chroma (saturation), whereby lower chroma is associated with less pure colors (i.e., pastels or dark colors). According to our conceptualization, arousal potential is mostly determined by chroma, whereby arousal potential is higher for highly saturated colors. Nevertheless, it is important to highlight that within hue – thus keeping saturations constant – there can be differences in arousal potential such that longer wavelengths (e.g. red) are associated with higher arousal compared to shorter wavelengths (e.g. blue; Walters, Apter, and Svebak 1982). These differences, however, are much subtler than the more extreme differences in saturation (Küller, Mikellides, and Janssens 2009; Zieliṅki 2016). Our investigation thus focuses on chroma.

Critically, an examination of previous research suggests that arousal potential might influence predicted liking and experienced liking differently. Specifically, while little research has directly compared predicted and experienced liking over time in the sensory domain, research examining each separately points to important discrepancies in how they may be influenced by arousal potential. We first review literature on predicted liking and then turn to the literature on experienced liking.

## Arousal Potential and Predicted Liking of Product Design Elements

Snell and colleagues (1995) investigated consumer intuitions about how hedonic value changes over time for a variety of stimuli (e.g., pains, noises, tastes, and smells). A broad consideration of all previously studied stimuli reveals that expectations of adaptation seem to generally prevail (in line with Frederick and Loewenstein 1999; Nelson and Meyvis 2008; Redden 2015): Consumers anticipate positive stimuli to become less pleasant and negative stimuli to become less unpleasant over time. Importantly, though, if one limits the scope to sensory stimuli that one might categorize as having high arousal potential, a different pattern emerges; decision-makers seem to anticipate sensitization for this type of stimuli. For example, while not noted by the authors, a post-hoc categorization of different types of noises included in Snell and colleagues' investigation reveals that participants seem to intuit adaptation for low arousal noises (e.g., noise from a highway) but to intuit sensitization for high arousal noises (e.g., a loud stereo, high-pitched noise, or a pneumatic drill), such that these noises become more unpleasant over time. Likewise, Nelson and Meyvis (2008) found that consumers expected an annoying (i.e., high arousal potential) noise to become increasingly irritating over time.

Based on this suggestive (and admittedly limited) evidence in the domain of auditory stimuli, we conjecture that a similar pattern may emerge for visual stimuli. We speculate that consumers will anticipate greater sensitization for high arousal potential design elements than low arousal potential design elements. Specifically, we expect that consumers anticipate high arousal potential design elements (intense colors and patterns) to become increasingly arousing (i.e., they intuit sensitization). That is, while the stimulus (i.e., the design) stays constant over time, consumers anticipate that they will become increasingly sensitive to it such that the design's subjective ability to arouse will increase with exposure. Furthermore, we suggest that consumers expect this increase in arousal over time to eventually become unpleasant, such that these product designs grow to be increasingly aversive and irritating (Berlyne 1970; Bornstein 1989; Nelson and Meyvis 2008). We expect that this anticipated irritation, in turn, leads consumers to anticipate faster decrease in liking (i.e., faster adaptation; more commonly referred to as *satiation* in the context of sensory liking) from high (vs. low) arousal potential design elements. We will use the term satiation to describe adaptation in our context of sensory liking from here on out. More formally:

> **H1a**: Consumers predict faster decrease in liking over repeat exposure (i.e., faster satiation) for high arousal potential design elements (intense colors and patterns) than for low arousal potential design elements.
>
> **H1b:** Consumers predict greater increase in irritation over repeat exposure (i.e., sensitization) for high (vs. low) arousal potential design elements.
>
> **H1c:** Predicted increase in irritation (i.e., sensitization) mediates predicted decrease in liking (i.e., satiation) for high (but not for low) arousal potential design elements.

Moreover, we expect these predictions to influence pertinent consumer behaviors and decisions. Specifically, consumers should be more likely to avoid products with high arousal potential designs when purchasing products that are intended for extended use. We therefore hypothesize the following:

**H2a**: Expected product exposure influences preferences for products, such that preference for high (vs. low) arousal potential design elements decreases as exposure increases.

**H2b**: Expectations of increased irritation (i.e., sensitization) and decreased liking (i.e., satiation) for high arousal potential design elements (see H1a-H1c) mediate this preference.

These consumer intuitions, along with the resulting product preferences, we argue, may be misguided. In contrast to the fairly sparse research on arousal potential and predicted liking over time, there is a more extensive and reliable body of work suggesting that arousal potential may curb experienced satiation over repeat exposure.

## Arousal and Experienced Liking of Product Designs Elements

Past research on visual satiation shows that, as in other sensory consumption domains, the intensity of liking of stimulus generally decreases as a function of exposure (i.e., satiation), (Coombs and Avrunin 1977), be it photographs (Redden 2008) or geometric shapes (Cantor 1968). While this pattern of decreased liking is prevalent and considered the norm (Nelson and Meyvis 2008), there is also evidence for the opposite pattern. Research on the mere exposure effects shows that liking of visual stimuli can increase with repeat exposure (Zajonc 1968).

Reconciling both patterns, Berlyne and colleagues argue that the direction and the rate of change in liking depend on the arousal potential of stimuli (Berlyne 1968, 1970; Berlyne and Lawrence 1964; Berlyne and McDonnel 1965). Consumers experience greatest hedonic value when arousal is at a moderate level (Wundt 1874), suggesting that optimal arousal occurs for stimuli with medium arousal potential (Cox and Cox 2002). That is, stimuli should not be too simple, making them boring and tedious, yet also not too complex, raising arousal to an uncomfortable level (Berlyne 1970; Bornstein 1989). Importantly, repeat exposure to stimuli generally decreases their subjective complexity and intensity and therefore their potential to arouse (Cox and Cox 2002). For simple stimuli, repeat exposure quickly moves the stimuli away from the optimal arousal potential, leading to boredom, tedium, and thus decreased liking (Berlyne 1970). For equally liked intense and complex stimuli, repeat exposure moves the stimuli toward optimal arousal potential, thus increasing liking. In line with this, mere exposure effects have been shown to be strongest for unfamiliar and complex stimuli (Bornstein 1989). For highly complex stimuli, a large number of exposures are necessary for subjective arousal potential to decline enough to move past the optimal level, thus eventually decreasing liking (Zajonc et al. 1972).

The stimuli and procedures used by Berlyne, Zajonc, and others to test this theory about optimal arousal potential were relatively contrived and differed from the current investigation (e.g., they used complexity rather than color and pattern). Thus, the inverted u-shape put forth by Berlyne may be difficult to detect, especially considering the general pervasiveness of satiation effects (Coombs and Avrunin 1977; Redden 2008). Still, the broad implication for product aesthetics is that consumers may not satiate as quickly from high arousal design elements as they expect. Moreover, consumers may satiate from high arousal designs similarly or even at a slower rate than from low arousal designs. Specifically, we hypothesize the following:

**H3:** Consumers experience at least similar, if not slower, decrease in liking over repeated exposure (i.e., slower satiation) from high arousal potential design elements than from low arousal design elements.

Together with hypothesis 1a, positing that consumers intuit faster satiation for high arousal design elements than for low arousal design elements, we therefore predict that:

**H4a:** Consumers overestimate decreases in liking over repeat exposure (i.e., satiation) from high arousal potential design elements, leading to errors in predicted utility.

**H4b:** Overestimation of irritation over repeat exposure (i.e., sensitization) to high arousal potential design elements mediates this effect.

## Overview

Seven studies offer support for our hypotheses. The first three studies (pilot study, studies 1a and 1b) focus on product design preference as a function of anticipated product exposure. In hypothetical (pilot study, study 1b) and real choice contexts (study 1a), they reveal that consumers are more likely to avoid products with intense (i.e., high arousal potential) designs when the product is intended for extended use (i.e., greater exposure; hypothesis 2a). The next two studies more closely examine the process underlying this preference (hypotheses 1a-1c) by showing that consumers anticipate greater irritation and faster satiation for products with high (vs. low) arousal potential designs (study 2). Accordingly, they expect to use these products less frequently and retain these products for a shorter period of time (study 3). Consistent with our theory and proposed underlying process, we find that these latter two effects are particularly pronounced among individuals who are more sensitive to and less comfortable with arousal (study 3). The final two studies (studies 4 and 5) compare predicted and experienced liking of high and low arousal potential design elements over repeat exposure to show that consumers overestimate how much liking will decrease (i.e., satiation) for high arousal potential design elements because they overestimate how much irritation will increase (i.e., sensitization) for these designs, leading to errors in predicted utility (hypotheses 3 and 4).

We test our hypotheses using numerous design stimuli, with arousal potential stemming from both color and pattern. Note that because perceived arousal potential is relative (vs. absolute) and therefore might vary across contexts and individuals (Berlyne 1971), for each study we used pretests to select stimuli such that they were equally liked but reliably differed in arousal potential (high vs. low). Stimuli pretests, along with auxiliary information (ancillary analyses, determination of sample sizes, preregistration reports, replications) can be found in the Web Appendix.

## PILOT STUDY: MULTI-CATEGORY EXPLORATION

In an initial pilot study, we examine product design preferences as a function of product exposure across multiple product categories. We predicted that as expected exposure for a product category increases (i.e., longer ownership; greater number of product exposures), consumers would be less likely to select intense (i.e., high arousal potential) designs (hypothesis 2a). We test this prediction across 50 product categories, while at the same time controlling for various alternative explanations that likely influence the choice of high arousal potential designs in addition to our process. We expect the predicted relationship between expected exposure and design choice to persist even in the presence of additional motives that may determine design preference, which undoubtedly exist.

Methods

Participants consisted of 1818 U.S. Mturk workers (49.94% female, $M_{age}$ = 35.18; $SD$ = 10.95). Participants were randomly assigned to evaluate one of 50 product categories, which were selected to represent a broad set of products that varied in usage length. (See Web Appendix for complete list.) Participants were shown the product category and were asked to imagine that they were "looking to get a new one" and to select one of 36 available designs for the product. Product designs were selected based on pretests such that half of the designs were considered to have high [vs. low] arousal potential, and such that the high and low arousal potential designs did not differ on liking or attractiveness; see pretest in Web Appendix.

After making their choice, participants then responded to questions about the predicted exposure, assuming they were to use the product in a typical manner. First, they rated expected ownership length on a 12-point scale (1 = Less than 1 day [24 hours], 12 = More than 10 years). Using a sliding scale (0 to 1,000), they then estimated the number of times they would see the product before getting rid of it. Participants then completed an attention check (Oppenheimer, Meyvis, and Davidenko 2009).

Subsequently, participants rated the extent to which the product category is consumed in public (vs. private), should match the consumption environment (per Patrick and Hagtvedt 2011), is influenced by design trends, and whether there are norms dictating the product's design

(1= No, not at all, 9 = Yes, very much; for each question participants were given a brief description). These four questions served as control variables. Lastly, in this and all other studies (except for study 1a), participants indicated their age and gender.

Results

We report the results for estimated view times (VT) and estimated product ownership length (OL). For the OL measure we converted the 12-point scale into days using the midpoint of the range associated with each scale point (e.g., 3 months - 6 months = 135 days). Given that all high and low arousal designs are theoretically equivalent, in this and all further studies we collapse across designs with the same arousal potential unless otherwise specified.

*Choice.* Individual binary logistic regressions revealed that estimated ownership length ($Wald_{OL} = 78.34$, $p < .001$, $R^2=.06$) and number of view times ($Wald_{VT} = 64.04$, $p < .001$, $R^2=.04$) both predicted a decreased preference for high arousal potential designs; see figure 1. (For full category descriptions and category-level results, see Web Appendix). The result held when both variables, along with their interactions, were included in the model ($Wald_{OL} = 9.61$, $p < .001$, and $Wald_{VT} = 4.40$, $p = .04$, respectively; interaction Wald < 1; $R^2= .05$).

---------------------------------

Insert figure 1 about here

--------------------------------

Importantly, both predictor variables, ownership length ($Wald_{OL} = 66.67$, $p < .001$; $R^2 = .08$), and view times ($Wald_{VT} = 51.93$, $p < .001$; $R^2 = .07$) remained significant when the four control variables were included in the respective models (public consumption [Wald = 1.82, $p =$

.18; Wald = 7.37, $p = .01$, respectively], environment matching [Wald = 57.42, $p < .001$, Wald = 55.38, $p < .001$, respectively], trends [Wald = 7.78, $p = .005$; Wald = 8.60, $p = .003$, respectively], and norms [Wald = 6.96, $p = .008$; Wald = 7.23, $p = .007$], respectively).

### Discussion

The results show that preference for high (vs. low) arousal potential designs decreases as expected exposure to a product category increases, supporting hypothesis 2a. This is true when expected exposure is operationalized as expected ownership length and when it is operationalized as expected number of times the product is viewed. Moreover, both operationalizations of product usage were significant predictors even when controlling for other factors that likely also influence product design preference, such as considerations about public consumption, matching the environment, trends, and norms. Thus, while certainly not the sole driver of product design preference, expected exposure seems to be one driver of preference for high versus low arousal product designs. Furthermore, while various alternative explanations might explain the results for one or a few product categories, and while the pattern might not hold for all product categories, the overall hypothesized trend exists across 50 product categories.

## STUDIES 1A AND 1B:

## DESIGN PREFERENCES AS A FUNCTION OF CONSUMPTION DURATION

In study 1a and study 1b, we more directly examine how expected consumption duration influences consumer preferences for product designs, namely whether consumers choose less intense product designs (i.e., lower arousal potential) when making decisions for products with higher expected exposure (hypothesis 2a). Unlike the pilot study, in studies 1a and 1b we keep product category constant, directly manipulate product exposure, and examine its influence on choice.

## Study 1a: Field Study

Study 1a examines product design choice as a function of exposure in a consequential field setting.

### Methods

Participants were 186 undergraduates (41.40% female) enrolled in six sections of a semester-long introductory business course at a large US university. Participants were in one of two conditions (usage length: short, extended) in a between-subjects design.

Participants entered their classroom and were asked to select one of four nameplates to write their name on, two of which featured a low arousal potential design (plain white or pale green) and two of which featured a high arousal potential design (abstract pattern or strong green); see Appendix for stimuli and see Study 1B, Study 5, and a conceptual replication of Study 5 reported in Web Appendix for results repeatedly confirming that the stimuli differed in arousal potential but not in initial liking.

In the short-usage condition, this choice occurred on a day on which students were to make presentations. A note next to the nameplates said, “Pick a nameplate to use in today’s class." Students in this condition were told that the nameplates would be used during this one class to aid students in calling on their classmates during the presentation and discussion. In the extended-usage condition this occurred on the second day of a semester-long class. A note next to the nameplates said, "Pick a nameplate to use in class this semester". Students in this condition were told that the nameplates would be used throughout the semester to aid the professor and other students in calling on the students during lectures and class discussion. At the end of each class, the professor collected the selected nameplates; in the extended-usage condition, the nameplates were redistributed at the beginning of each subsequent class.

## Results

Supporting hypothesis 2a, participants were less likely to select a high arousal potential design when choosing a nameplate to use for the entire semester (30.85%) than when choosing one to use for only one class (58.70%, $\chi^2(1) = 14.59$, $p < .001$).

## Study 1b: Laboratory Study

Study 1b examines a product design choice similar to that in study 1a. However, study 1b occurred in a lab setting, thus allowing for a deeper analysis of the drivers of the design choice in three ways: First, study 1b teases apart whether the results observed in study 1a were due to considerations about the usage time frame (1 day versus 3 months) or product exposure (1 class vs. 26 classes). While often correlated in everyday life (longer usage period is generally associated with greater exposure), we disentangle the two in this study by orthogonally manipulating expected usage time frame and expected overall exposure. If, as we suggest, the choice pattern we observed in study 1a was the result of greater anticipated satiation for high arousal potential designs, then choice should be driven by expected exposure and not by expected usage time frame. Second, study 1b provides process evidence by directly measuring anticipated liking and anticipated irritation (hypothesis 2b). Third, we further test our process against a variety of alternative explanations.

Methods

Participants were 295 undergraduates (52.1% female, $M_{age}$ = 20.52; *SD* = 1.55), randomly assigned to one of four conditions in a 2 (exposure: low, high) x 2 (time frame: short-term, long-term) between-subjects design. Depending on condition, participants were asked to imagine they had signed up for a course that either met for 5 hours over 4 days (i.e., one 1 hour and 15 minute class a day for 4 days; low exposure, short-term condition), 5 hours over 12 weeks (one 1 hour and 15 minute class every 4 weeks; low exposure, long-term condition), 30 hours over 4 days (six 1 hour and 15 minute classes a day for 4 days; high exposure, short-term condition), or 30 hours over 12 weeks (two 1 hour and 15 minute classes a week for 12 weeks; high exposure, long-term condition). To probe whether they had read the scenario instructions, participants were asked to indicate which course descriptors matched the course described in the instructions: 5 hours, 30 hours, 12 weeks, 1 month (distractor), 4 days.

Participants were told that they would be using a nameplate, which would sit on the desk in front of them throughout the duration of the course. They were then presented with a choice of two nameplates, a randomly selected one of the two low arousal potential designs from study 1a and a randomly selected one of the two high arousal potential designs from study 1a (presentation order randomized).

After making their choice, participants rated their anticipated liking and anticipated irritation for the high arousal potential item (target item) and then for the low arousal potential item. Specifically, they indicated how much they would like the nameplate at the end of the consumption period (i.e., the last class; 1 = Dislike very much, 9 = Like very much), and how the nameplate would make them feel at the end of the consumption period (1 = Calm, 7 = Irritated; see Nelson and Meyvis 2008; Zielińki 2016). In addition to this main irritation measure, to test for generalizability of our irritation construct, we also asked participants to what extent the design would be obnoxious, annoying, and irking at the end of the consumption period (1 = Not at all, 7 = Very much; High arousal potential (HAP): $\alpha(4) = .91$, Low arousal Potential (LAP): $\alpha(4) = .93$).

We then tested our process against a variety of alternative explanations by asking participants to rate how much the following considerations influenced their choice (1 = Not at all, 7 = Very): the extent to which the nameplate would become irritating (our process: irritation), their confidence regarding the liking of the nameplate (confidence), opportunity to use the nameplate (versatility), the extent to which the nameplate matches the environment (matching), whether others would like the nameplate (others), and lastly, considerations about standing out (stand out).

As a manipulation check, participants then rated the arousal potential of each nameplate (order counterbalanced), namely whether the nameplate was intense, novel, colorful, complex, and difficult to process (1= Not at all, 7 = Very much; adapted from Berlyne 1960; HAP: $\alpha(5) =$

.65; LAP: α(5) = .83). Finally, participants estimated how much they would be exposed to the nameplate (1= Very little, 7 = A great deal).

Results

*Manipulation checks.* A within-subject ANOVA revealed that the arousal potential index was greater for the high arousal potential nameplates ($M = 3.51$, $SD = 1.28$) than for the low arousal potential nameplates ($M = 2.19$, $SD = 1.30$; $F(1, 289) = 155.78$, $p < .001$, $\eta_p^2 = .35$).

A between-subject ANOVA with the factors exposure and time frame on estimated exposure revealed only a main effect of exposure such that the perceived exposure was greater in the high exposure condition ($M = 4.27$, $SD = 1.86$) than in the low exposure condition ($M = 3.71$, $SD = 1.76$; $F(1, 289) = 7.04$, $p = .01$, $\eta_p^2 = .02$). There was no main effect of time frame ($F < 1$) or exposure x time frame interaction ($F(1, 289) < 2.70$, $p > .10$).

*Choice.* Consistent with hypothesis 2a, participants in the two high exposure conditions were less likely to choose the high arousal potential nameplate designs (30.4%) than participants in the two low exposure conditions (46.9%; $\chi 2$ (N=295) = 8.50, $p = .004$). Choice shares did not differ as a function of time frame ($\chi 2$ (N=295) = 1.12, $p = .29$). Note that choice shares for the two low exposure conditions (i.e., the short-term/low exposure condition [41.3%] and long-term/low exposure condition [52.8%]) and the two high exposure conditions (i.e., the short-term/high exposure [29.6%] and the long-term/high exposure condition [31.2%]) did not differ ($\chi 2$s (N=295) < 2.00, *ps* > .16).

*Predicted liking.* As predicted (hypothesis 1a), a between-subject MANOVA with exposure as a factor revealed that participants anticipated liking the high arousal potential nameplates less at the end of the course in the high exposure conditions ($M = 3.68$; $SD = 1.99$) than in the low exposure conditions ($M = 4.50$, $SD = 1.93$); $F(1, 290) = 12.87$, $p < .001$, $\eta_p^2 = .04$). For the low arousal potential nameplates, there was no effect of exposure ($M_{\text{High Exposure}} = 5.51$, $SD = 1.69$; $M_{\text{Low Exposure}} = 5.32$, $SD = 2.01$; $F < 1$). The same analysis using time frame as a factor did not yield any significant main effects (*Fs* < 1).

*Predicted irritation.* As predicted (hypothesis 1b), a between-subject MANOVA with exposure as a factor revealed that participants anticipated being more irritated by the high arousal nameplates at the end of the course in the high exposure conditions ($M = 4.93$; $SD = 1.49$) than in the low exposure conditions ($M = 4.44$, $SD = 1.48$); $F(1, 290) = 8.00$, $p = .005$, $\eta_p^2 = .03$). For the low arousal nameplates, there was no effect of exposure ($M_{\text{High Exposure}} = 3.31$, $SD = 1.32$; $M_{\text{Low Exposure}} = 3.36$, $SD = 1.48$; $F < 1$). The same analysis using time frame as a factor did not yield any significant main effects (*Fs* < 1). The analyses held for all alternative measures of irritation, as well as when all measures were combined to from an index.

*Mediation.* To examine whether choice was driven by anticipated irritation with the high arousal potential nameplates and the resulting predicted decrease in liking (hypothesis 2b), we tested for sequential mediation (model 6 of the PROCESS macro; Hayes 2013). Exposure was used as the predictor variable, anticipated liking and anticipated irritation for the high arousal potential nameplate (target item) as mediators, and choice as the dependent variable. The model tested the indirect effect for three causal chains for the high arousal nameplates: exposure to predicted irritation to choice (1; indirect effect, B = -.14, SE = .07; 95% CI = -.33 to -.03), exposure to predicted liking to choice (2; indirect effect, B = -.09, SE = .05; 95% CI = -.23 to -.02), and exposure to predicted irritation to predicted liking to choice (3; indirect effect, B = -.09, SE = .06; 95% CI = -.23 to -.01), which supported sequential mediation (Zhao, Lynch, and Chen 2010). Evidence for sequential mediation held for the alternative measures of annoying and obnoxious and held up marginally (90% CI) for irking and the overall index measure. The indirect effects for the same three causal chains for the low arousal designs were not significant (all CI included zero, thus not supporting mediation; Zhao, Lynch, and Chen 2010).

*Alternative explanations.* Model 4 of the PROCESS macro (Hayes 2013) allows the simultaneous assessment of the indirect effects of multiple mediators. Using exposure as the predictor variable and choice as the dependent variable, we directly pitted our proposed process (irritation) against a variety of alternative explanations (confidence, versatility, matching, others, standout). Anticipated irritation with high arousal potential design was a significant mediator of choice (B = -.25, SE = .14; 95% CI = -.55 to -.04), whereas confidence (95% CI = -.08 to .14), versatility (95% CI = -.05 to .15), matching (95% CI = -.20 to .02), others (95% CI = -.04 to .07), and standing out (95% CI = -.40 to .22) were not. The same ratings for low arousal designs did not yield any significant mediators.

## Discussion

When making choices for high (vs. low) exposure use, consumers were less inclined to select high (vs. low) arousal potential designs, supporting hypothesis 2a. This pattern was observed in a consequential choice context (study 1a) as well as a hypothetical one (study 1b). Choice shares were driven by greater anticipated increase in irritation and greater anticipated decrease in liking for high arousal designs over repeat exposure, supporting hypotheses 1a, 1b, and 2b. The results of study 1b further show that the pattern results from considerations over repeat exposure, rather than the decision time frame, and simultaneous mediation analyses ruled out a host of alternative explanations: Choice in this context was not driven by confidence in liking, considerations of versatility, matching, liking by others, nor standing out. Thus, while these factors may certainly influence preferences for product design in some domains, as observed in the pilot study, anticipated liking and irritation seem to better account for product design preferences in this more controlled setting.

## STUDY 2: PREDICTED PRODUCT LIKING OVER TIME

The pilot study, studies 1a, and 1b all reveal that as anticipated product usage increases, preference for high arousal potential product design decreases. Study 1b also offers initial evidence that this preference is driven by expectations of increased irritation with high (vs. low) arousal potential designs, leading to predictions of faster decreases in liking (hypotheses 1a-1c). In study 2, we directly test hypotheses 1a -1c by manipulating the arousal potential of product designs for two product categories viewed on a daily basis (beds and plates) and examine the effect on predicted liking and predicted irritation over time. We manipulate arousal potential from color and pattern orthogonally to ensure that our proposed effects hold across both design elements. We expected that, across both product categories, participants would predict faster decrease in liking and faster increase in irritation for high arousal potentials designs than for low arousal designs. We also expected predicted irritation to mediate predicted decrease in liking for high arousal designs, but not for low arousal potential designs.

Methods

Participants consisted of 300 U.S. Mturk workers (46.9% female, $M_{age}$ = 35.48; *SD* = 12.12) who were randomly assigned to two of 10 conditions in a 5 (product design: low arousal potential [plain white], high arousal potential pattern [striped white or abstract white], high arousal potential color [strong green or strong orange]) x 2 (within factor product category: bedding and plates) nested mixed-subjects design. Only the high versus low arousal manipulations were of theoretical interest; product and design variations were included to ensure generalizability.

Participants were instructed to imagine they had recently moved into a furnished apartment for the foreseeable future. They were then shown a product that they would be using for the time they lived in the apartment. In the bedding conditions, participants were shown an image of a bed with bedding. In the plate conditions, participants were shown an image of a plate that was said to be part of a larger set. The products were presented in one of the five condition-consistent product designs (plain white, striped white, abstract white, strong green, or strong orange); see Appendix. Note that participants saw one bed and one plate (in randomized order), and that the design was randomly determined for each product (i.e., there was about a 20% chance participants saw the same design for the two different products).

For each product, participants were asked to indicate how much they liked the displayed product at that very moment (t1; 0 = Dislike extremely, 100 = Like extremely). Next, participants were asked to imagine using the product for the foreseeable future and to indicate their liking relative to t1 at six points in the future (in one week (t2), one month (t3), six months (t4), one year (t5), two years (t6), four years (t7; -50 = much less, +50 much more).

The procedure was then repeated for the mediator measure of irritation. Participants were asked to indicate to what extent the displayed product made them feel irritated at that very moment (t1; 0 = Not at all irritated (Calm), 100 = Very irritated). Next, participants were asked to imagine using the product for the foreseeable future and to indicate their expected irritation relative to t1 at the same six points in the future (-50 = Much less, +50 = Much more).

Results

Because participants likely evaluated different product designs for the bedding and the plate, responses for the bedding and plate were treated as individual observations (i.e., the responses for each were stacked such that each participant was represented twice in the data set, once for their bedding response, once for their plate response). This led to 600 observations with variables indicating participant number, the product category, and the presentation order.

Participants' current liking/irritation (t1) represented absolute liking/irritation at T1. Absolute liking/irritation ratings for T2-T7 were calculated by adding the indicated relative change in liking/irritation to T1 (T1+t2 = T2, T1+t3 = T3, etc.); see table 1 for all absolute liking and irritation measures. As our main dependent measure and mediator measure, for each observation, we then calculated the linear regression coefficient for liking and irritation over time (Pfister et al. 2013), both using T1-T7 (1, 2, 3, 4, 5, 6, 7), and the corresponding days (1, 7, 30, 180, 360, 720, 1140) as predictor variables. That is, we calculated a slope for liking and irritation over time for each observation.

A 2 (product: bedding, plates) x 2 (order: first, second) x 2 (arousal potential: low arousal, high arousal) ANOVA on the regression coefficients for liking and irritation revealed that arousal potential did not significantly interact with product ($Fs < 2.9$, $p > .09$) or order ($Fs > 1$), and there was no product x order x arousal potential interaction ($Fs < 2.57$, $ps > .11$). We therefore report the results collapsed across products and order in all analyses.

*Predicted liking*. An ANOVA on the individual regression coefficients revealed that participants anticipated greater decrease in liking for high arousal potential designs (HAP, $M = -3.21$; $SD = 4.42$) than for the low arousal potential design (LAP, $M = -1.86$; $SD = 4.59$; $F(1, 598) = 11.97$, $p = .001$, $\eta_p^2 = .02$), supporting hypothesis 1a. This was also true when the regression coefficients were calculated with the corresponding days as predictor variables ($M_{HAP}$ - .013; $SD = .017$; $M_{LAP} = -.008$; $SD = .018$; $F(1, 598) = 10.29$, $p = .001$, $\eta_p^2 = .02$), and when liking at T1 was used as a covariate ($F(1, 597) = 7.93$, $p = .005$, $\eta_p^2 = .01$). Importantly, all analyses held when the low arousal potential design was compared to high arousal potential designs from color only ($Fs > 4.10$, $p < .04$, $\eta_p^2 > .01$) and to high arousal potential designs from pattern only ($Fs > 8.00$, $p < .01$, $\eta_p^2 > .02$).

*Predicted irritation*. An ANOVA on the individual regression coefficients revealed that participants anticipated greater increases in irritation for high arousal designs ($M = 1.70$; $SD = 5.19$) than for the low arousal potential design ($M = .35$; $SD = 4.82$; $F(1, 595) = 9.15$, $p = .003$, $\eta_p^2 = .02$), supporting hypothesis 1a. This was also true when the regression coefficients were calculated with the corresponding days as predictor variables ($M_{HAP}$ = .007; *SD* = .019; $M_{LAP}$ = .002; *SD* = .019; $F(1, 595) = 7.53$, $p = .006$, $\eta_p^2 = .01$) and when irritation at T1 was used as a covariate ($F(1, 594) = 4.53$, $p = .03$, $\eta_p^2 = .01$). Importantly, all analyses held at least marginally when the low arousal potential design was compared to high arousal potential designs from color only ($Fs > 3.80$, $p < .05$, $\eta_p^2 > .02$) and to high arousal designs from pattern only ($Fs > 3.60$, $p < .06$, $\eta_p^2 > .01$).

---------------------------------

Insert table 1 about here

--------------------------------

*Mediation.* To test whether predicted increases in irritation mediates predicted decreases in liking for high arousal designs but not for low arousal potential designs (hypothesis 1c), we used model 4 of the PROCESS macro (Hayes 2013) with arousal potential as the predictor variable, individual regression coefficients for irritation as the mediator variable, and individual regression coefficients for liking as the dependent variable. Supporting our prediction, the pathway from arousal potential to anticipated liking through anticipated irritation was significant and did not exclude zero, (indirect effect, B = -.39, SE = .14; 95% CI = -.70 to -.14; Zhao et al. 2010). The analysis held for coefficients using days as the predictor variable (indirect effect, B = -.001, SE = .0005; 95% CI = -.0003 to -.0004). Mediation was also observed for high arousal potential due to color only (indirect effect, B = -.29, SE = .14; 95% CI = -.63 to -.05) and high arousal due to pattern only (indirect effect, B = -.52, SE = .19; 95% CI = -.99 to -.19), both of which show robustness for coefficients using days as the predictor variable.

Discussion

Participants expected liking to decrease at a faster rate for high (vs. low) arousal potential product designs because they anticipated growing increasingly irritated with high arousal potential designs over time, thus providing direct evidence for hypotheses 1a-1c. Importantly, we separately and systematically varied color and pattern in this study to ensure that our effect holds independent of whether the arousal potential stems from color or pattern.

A caveat of this study is that despite having been pretested to be liked equally, the initial liking of the patterned designs was lower than the white and colored designs ($ts > |2.8|$, $ps < .04$), potentially raising the concern that consumers simply predict faster decrease in liking for less liked designs. Mitigating this concern, the effect was observed when controlling for initial liking, and the effect was also observed for high arousal from color only, for which initial liking did not differ from the low arousal design ($t = 1.47$, $p = .14$). Furthermore, a conceptual replication reported in the Web Appendix provides evidence for the effect even when initial liking did not differ as a function of arousal potential. Studies 4 and 5 will rule out this alternative account further.

Having established that consumers anticipate faster decrease in liking for high arousal potential designs, we next explore several expected product usage measures to examine whether the results extend to more behavioral, and thus marketing relevant, dependent variables. We also examine a theoretically relevant individual difference as a moderator.

## STUDY 3: PREDICTED PRODUCT USAGE OVER TIME

Study 3 examines whether the arousal potential of a product design influences predicted product usage over time. If participants think that their liking will decrease at a faster rate for product with a high (vs. low) arousal potential design, they should a) anticipate using it less frequently in the future, b) anticipate using it a fewer number of times (i.e., cease use after fewer uses), and c) be less likely to predict using it at a distant (vs. a proximate) point in the future than a product with low arousal potential design.

If our theory is correct that this is due to participants anticipating to grow increasingly irritated from high arousal potential designs over time, leading to faster predicted decrease in liking, then the effect should be moderated by individuals' comfort with arousal. On average, we predict less anticipated usage for products with high (vs. low) arousal designs, in line with previous studies. However, this should be particularly pronounced for individuals who are less likely to enjoy arousal (e.g., people who score low on the Arousal Seeking Tendency Scale; Mehrabian, and Russell 1973). These individuals should anticipate arousal to become aversive and irritating more quickly than individuals who enjoy arousal. Therefore, we predict that, compared to those who are high arousal seeking, low arousal seeking individuals will be more likely to anticipate lower usage for products with high arousal potential designs.

Thus, in this study, we manipulate arousal potential of a product (exercise clothing) and measure anticipated product use as well as individuals' Arousal Seeking Tendency (AST; Mehrabian and Russell 1973). We expected that, on average, participants would anticipate lower usage of high (vs. low) arousal potential product designs (consistent with the choice results in study 1a and 1b), but that the effect of arousal potential on predicted usage would be stronger for individuals who score low on the AST scale (Mehrabian and Russell 1973).

Methods

Participants were 225 undergraduate students (74.1% female, $M_{age}$ = 20.70, *SD* = 1.96) who were randomly assigned to a condition in a 2 (arousal potential: low [black, gray, gray dots, dark green, navy], high [strong green, green pattern, purple orange pattern, red, neon ombre]) nested between-subject design, with Arousal Seeking Tendency as a measured variable.

Participants were asked to imagine that they had just received the workout shirt displayed on their computer screen. Depending on condition, they were shown one of five shirts with a high arousal potential design or one of five shirts with a low arousal potential design; see Appendix for stimuli. These stimuli were selected based on a pretest such that they differed on arousal potential while being equally liked; see Web Appendix. Note that participants who indicated being male (female) at the beginning of the survey saw a men's (more fitted women's) shirt.

Participants were then asked about their anticipated use of the workout shirt as follows: "Thinking about this workout shirt in the context of all of the workout shirts you own, how often would you use this shirt in the future?" (1 = Never, 9 = All the time) and "After how many wears do you think you'll stop wearing it or get rid of it?" (0 - 500 wears). In addition, as a proxy for current liking they were asked "How likely are you to wear the workout shirt to your next workout?" (t1), and as a proxy for anticipated satiation over time they were asked "How likely are you to wear the workout shirt to a workout one year from now?" (t2; 1 = Very unlikely, 7 = Very likely). Participants also rated how much they liked the shirt (1 = Dislike very much, 7 = Like very much). In line with the pretest, liking did not differ as a function of arousal potential, AST, or their interactions (*p*s > .1). Lastly, participants filled out an abbreviated version of the

Arousal Seeking Tendency scale (original scale: Mehrabian and Russell 1973). The items measured the extent to which individuals seek out visually stimulating environments using items such as "I like to look at pictures that are puzzling in some way" and "My ideal home would be peaceful and quiet" (reverse scored).

Results

*Predicted frequency of usage.* Regression analysis revealed that main effects of arousal potential (AP; B = -3.98, SE = 1.53, $t(221) = -2.59$, $p = .01$; 95% CI = -7.01 to -.95) and AST (B = -.87, SE = .43, $t(221) = -2.04$, $p = .04$, 95% CI = -1.71 to -.03) were qualified by a significant AP x AST interaction (B = .59, SE = .27, $t(221) = 2.14$, $p = .03$, 95% CI = .04 to 1.14); see figure 2a. Further examining this interaction, slope analysis (Aiken and West 1991; Fitzsimons 2008) revealed that arousal potential influenced low AST individuals' (-1SD) usage frequency estimates such that low AST individuals predicted less frequent usage for high (vs. low) arousal potential designs (B = -1.35, SE = .39, $t(221) = -3.39$, $p < .001$, 95% CI = -2.13 to -.56). In contrast, it did not influence usage frequency estimates for high AST individuals (+1SD; $t < 1$). This pattern persisted when current liking was used as a covariate in the analyses, revealing that the results are not driven by differences in liking for the product designs. Instead, they are consistent with the results being driven by low (vs. high) AST individuals anticipating greater increases in irritation and greater decrease in liking for high arousal potential designs.

*Predicted wears until discarded.* Again, regression analysis revealed that main effects of arousal potential (AP; B = -271.64, SE = 106.07, $t(207) = -2.56$, $p = .01$, 95% CI = - 480.78 to -

62.50) and AST (B = -68.75, SE = 28.85, *t*(207) = -2.38, *p* = .02, 95% CI = -125.63 to -11.86) were qualified by a significant AP x AST interaction (B = 40.02, SE = 19.21, *t*(207) = 2.08, *p* = .04, 95% CI = 2.13 to 77.91); see figure 2b. Further examining this interaction, slope analysis revealed that arousal potential influenced low AST individuals' (-1SD) predicted number of total wears such that low AST individuals predicted lower numbers of wears for high (vs. low) arousal potential designs (B = -94.02, SE = 27.04, *t*(221) = -3.47, *p* < .001, 95% CI = -147.34 to -40.71). In contrast, arousal potential did not influence predicted number of wears for high AST individuals (+1SD; *t* <1). Again, this pattern persisted when current liking was used as a covariate in the analyses.

*Likelihood of wearing in one year.* For likelihood of wearing in one year (t2), a main effect of AP (B = -3.54, SE = 1.48, *t*(221) = -2.38, *p* = .02, 95% CI = -6.47 to -.62) and a marginal main effect of AST (B = -.79, SE = .41, *t*(221) = -1.93, *p* = .054, 95% CI = - 1.60 to .01) were qualified by a AP x AST interaction (B = .56, SE = .26, *t*(221) = 2.11, *p* = .04, 95% CI = .04 to 1.09); see figure 2c . Slope analysis revealed that while arousal potential influenced low AST individuals' (-1SD) predicted likelihood of wearing the shirt in one year such that they predicted lower likelihood of wearing the high (vs. low) arousal potential designs (B =-1.04, SE = .38, *t*(221) = -2.71, *p* = .01, 95% CI = -1.80 to -.28), it did not influence likelihood estimates for high AST individuals (+1SD; *t* <1).

-----------------------------------

Insert figure 2a-c about here

-----------------------------------

*Likelihood of wearing to next workout*. Importantly, for the likelihood of wearing the shirt to the next workout (t1), there was no main effect of arousal potential, no main effect of AST, and no arousal potential x AST interaction ($|ts| < 1.50$, $ps > .13$). The fact that AST only influenced likelihood of wearing the shirt in the distant future (t2) suggests that the different pattern observed for high and low AST individuals likely resulted from low (vs. high) AST individuals anticipating greater increases in irritation and, as a result, greater decreases in liking for high arousal designs over time, and not simply from differential propensities to use high versus low arousal potential product designs more generally.

Discussion

On average, participants anticipated lower usage of workout shirts (lower frequency, fewer total number of wears) for high (vs. low) arousal potential designs despite the designs being liked equally in a pretest (see Web Appendix). Furthermore, participants anticipated lower likelihood of wearing the high arousal shirts at a time in the distant future, while there was no difference in predicted usage for a time in the near future (when considerations about decreased liking over time was less relevant). These results support our theory that liking for high arousal potential designs are, on average, anticipated to decrease at a faster rate than low arousal potential designs.

Importantly, this study also reveals a theoretically relevant moderator. Arousal potential had greater influence on anticipated product usage for people who scored low on the Arousal Seeking Tendency scale (i.e., who do not seek out arousal), even when controlling for liking. Furthermore, arousal potential and AST had greater influence on usage estimates in the distant (vs. near) future, suggesting that individual differences in sensitivity to arousal potential are driving predicted product usage over time. The difference in anticipated product usage between low and high AST individuals seems to be driven by low AST individuals anticipating a greater decline in usage for high arousal potential designs over time.

## STUDIES 4 AND 5: COMPARING PREDICTED AND EXPERIENCED LIKING

Thus far, our investigation has focused on predicted decreases in liking for high and low arousal potential product designs and how these predictions influence product choice and anticipated product usage (hypotheses 1 and 2). The remaining two studies examine the soundness of these predictions and decisions by directly comparing these predictions to experienced liking of high and low arousal potential designs..

Contrary to consumers' intuition, we have theorized that consumer liking for high arousal potential designs might decrease at a similar or even at a slower rate than for low arousal potential designs (hypothesis 3). As a result, we hypothesized that forecasters overestimate the extent to which liking decreases as a function of exposure for high arousal potential design elements (hypothesis 4), leading to errors in predicted utility. To test this, the next studies directly compare predicted and experienced liking of high and low arousal potential product designs over repeat exposure in both a lab (study 4) and a field setting (study 5).

### Study 4: Comparing Predicted and Experienced Liking

Study 4 directly compares predicted and experienced liking and irritation of a product (a screen background) with either a high or low arousal potential designs over repeat exposure in a controlled laboratory setting.

Replicating previous studies, we expected forecasters to predict greater increases in irritation and greater decreases in liking for high (vs. low) arousal potential product designs. In contrast, we expected experiencers to report similar or lower decreases in liking for high (vs. low) arousal potential designs. The discrepancy, we predicted, would lead to forecasting errors whereby forecasters overestimate the extent to which liking would decrease and overestimate the extent to which irritation would increase for high arousal potential designs. Furthermore, the latter was expected to mediate the former.

Methods

Participants were 407 undergraduates (50% female, $M_{age} = 20.64$, $SD = 5.71$) randomly assigned to one of four conditions in a 2 (mode: forecaster, experiencer) x 2 (arousal potential: low [light gray minimal pattern, light green minimal pattern], high [black and white pattern, colored pattern]) nested between-subject design.

All participants were instructed to imagine they were considering a new screen background for their computer. They were then told that in this study, they would see the screen background 15 times for five seconds each time to simulate usage over time. Then all participants saw a randomly assigned screen background, either one of two high arousal potential designs or one of two low arousal potential designs (see Appendix) for five seconds and rated their liking of the screen background on an analog scale (T1; 0 = Not at all, 100 = Like extremely), followed by their experienced irritation with the screen background (T1; 0 = Not at all, 100 = Extremely irritated). After these initial ratings, participants were again told that they would see the same screen background 14 more times for 5 seconds each time. Forecasters were asked to predict their liking and irritation with the screen background on their last exposure relative to their initial liking/irritation on an analog scale (T15; -100 = A lot less than now, 100 = A lot more than now; anchored at 0), and then they saw the screen background 14 times for five seconds each time. Experiencers, by contrast, saw the screen background 14 times for five seconds each time. On their last exposure (T15), they rated their liking and irritation of the screen background using the same scales as forecasters. We only asked participants about their liking and irritation at the beginning and at the end of product exposure (as opposed to repeatedly assessing liking as in study 2) to minimize possible demand effects. To ensure that experiencers viewed each exposure (i.e., did not leave the survey or look elsewhere), they were asked to press an "I am still looking" button displayed below the product image for four of the 14 exposures.

Results

*Ratings at T1*. A 2 (mode: forecaster, experiencer) x 2 (arousal potential: low, high) between-subjects ANOVA on initial liking scores (liking at T1) revealed no significant main effects ($F$s < 1) or interactions ($Fs(1, 403) = 1.52$, $p = .22$), indicating that the high and low arousal potential designs were equally liked at T1. The same ANOVA on initial irritation scores (irritation at T1) revealed a significant main effect of arousal potential such that high arousal potential designs ($M = 47.77$; $SD = 35.25$) were perceived as more irritating than low arousal potential designs (*M* = 29.58; *SD* = 32.63; $F(1, 403) = 28.86$, $p < .001$, $\eta_p^2 = .07$). There were no other significant effects (*F*s < 1).

*Predicted and experienced liking.* The relative liking measure at T15 (as compared to T1) served as the main dependent measure of decreased liking as a function of exposure. A 2 (mode: forecaster, experiencer) x 2 (arousal potential: low, high) between-subjects ANOVA on relative liking at T15 revealed only a significant interaction ($F(1, 403) = 11.27$, $p = .001$, $\eta^2 = .03$); see figure 3a. Forecasters anticipated a greater decrease in liking for high arousal potential designs (*M* = - 32.29; *SD* = 44.59) than for the low arousal potential design (*M* = -19.45; *SD* = 40.54; $F(1, 403) = 4.57$, $p = .03$, $\eta_p^2 = .01$). Experiencers, however, showed a different pattern. Experiencers reported a lower decrease in liking for high arousal potential designs (*M* = -12.69; *SD* = 44.04) than for the low arousal potential design (*M* = -28.76; *SD* = 44.51; $F(1, 403) = 6.78$, $p = .01$, $\eta_p^2 = .02$).

Examining the accuracy of consumer predictions (hypothesis 4a), we then compared forecasts and experiencers at each level of arousal potential. As predicted, forecasters overestimated to what extent liking would decrease for high arousal potential designs when compared to experiencers ($F(1, 403) = 10.91$, $p = .001$, $\eta_p^2 = .03$). For low arousal potential designs, forecasts did not differ from experiences ($F(1, 403) = 1.42$, $p = .23$). All results hold if liking at T1 is used as a covariate.

*Predicted and experienced irritation*. A 2 (mode: forecaster, experiencer) x 2 (arousal potential: low, high) between-subjects ANOVA on relative irritation at T15 (as compared to T1) revealed only a significant interaction ($F(1, 403) = 15.50$, $p < .001$, $\eta^2 = .04$); see figure 3b. As predicted, forecasters anticipated a greater increase in irritation for high arousal potential designs (*M* = 32.64; *SD* = 47.62) than for the low arousal potential design (*M* = 8.79; *SD* = 47.90; $F(1, 403) = 14.56$, $p < .001$, $\eta_p^2 = .04$). We did not make specific predictions for experiencers, but we found that experiencers reported marginally lower increases in irritation for high arousal potential designs (*M* = 15.23; *SD* = 42.62) than for low arousal potential designs (*M* = 26.65; *SD* = 41.47; $F(1, 403) = 3.17$, $p = .08$).

Examining the accuracy of consumer predictions (hypothesis 4b), we then compared forecasts and experiencers at each level of arousal potential. As predicted, forecasters overestimated to what extent irritation would increase for high arousal potential designs compared to experiencers ($F(1, 403) = 7.50$, $p = .005$, $\eta_p^2 = .02$). We did not make specific predictions for low arousal potential designs, but we found that forecasters underestimated to what extent irritation would increase for these designs ($F(1, 403) = 8.00$, $p = .006$, $\eta_p^2 = .02$).

-------------------------------------------------

Insert figure 3a and figure 3b about here

-------------------------------------------------

*Mediation.* To test whether arousal potential moderated the influence of mode (the predictor variable) on liking at T15 (the dependent variable) by way of irritation (the mediator), we tested and found support for moderated mediation (model 8 of the PROCESS macro; Hayes 2013; index for moderated mediation, B = 11.39, SE = 3.61; 95% CI = 5.41 to 19.39).

As predicted, for high arousal potential designs, the pathway from mode to relative liking through relative irritation was significant and did not include zero (indirect effect, B = -5.62, SE = 2.40; 95% CI = 1.60 to -3.25), thus supporting mediation (Zhao et al. 2010) and hypothesis 4b. While we did not make predictions for low arousal designs, the analysis revealed that mode to relative liking through relative irritation was significant in the opposite direction (indirect effect, B = - 5.77, SE = 2.23; 95% CI = -10.70 to -1.95).

Discussion

Replicating the findings of study 2 and supporting hypothesis 1a and 1b, forecasters expected greater decrease in liking and greater increase in irritation for high arousal potential designs than for low arousal potential designs. Importantly, ratings from experiencers revealed forecasters' intuitions to be misguided. In contrast to forecasters' predictions, experiencers reported greater decrease in liking for low arousal potential designs than for high arousal potential designs, supporting hypothesis 3. As a result, and supporting hypothesis 4a and 4b, participants overestimated how much liking would decrease for high arousal potential designs because they overestimated how much irritation would increase for these designs.

Aside from showing errors in prediction, this study also serves to rule out potential alternative explanations in previous studies. Unlike the stimuli used in study 2, liking scores for low and high arousal potential designs were identical at time 1 ($F < 1$), further ruling out the potential alternative explanation that people simply predict faster decreases in liking from less appealing designs. And because stimuli exposures occurred in isolation and over a short period of time, these results also further rule out that differences in predicted decreases in liking for high and low arousal potential designs are driven by considerations about versatility, matching, or preferences of others.

Finally, by including low arousal potential designs involving (albeit minimal) color and pattern, this study generalizes the findings of study 2 to other low arousal potential designs and supports our conceptualization in that it is about the arousal potential of color and pattern and not simply the presence or absence of color and pattern.

## Study 5: Comparing Predicted to Experienced Liking and Irritation in the Field

Study 4 compared predicted and experienced liking in a relatively contrived experimental setting, whereby exposures occurred in a fairly abbreviated timeframe. Study 5 extends study 4 by testing hypotheses 3 and 4 in a real consumption domain over a longer period of usage time. In study 5, participants either predicted or reported experienced liking of a product (a nameplate) with a high or low arousal potential design over one semester. Again, we expected forecasters to predict greater decrease in liking for products with high (vs. low) arousal potential designs (hypothesis 1a). In contrast, we expected experiencers to report similar or lower decreases in liking for high (vs. low) arousal potential designs, (hypothesis 3), leading to errors in predicted liking whereby forecasters overestimate the extent to which liking would decrease for high arousal designs (hypothesis 4a).

### Methods

Participants were 306 undergraduates (49.4% Female; $M_{age}$ = 19.90, *SD* = 1.53) enrolled in ten sections of an introductory business course at a large US university. Participants were assigned to one of four conditions in a 2 (mode: forecaster, experiencer) x 2 (arousal potential: low [plain white or pale green], high [abstract pattern or strong green) nested mixed-subject design; see Appendix for stimuli images.

Experiencers (N = 122) were students in four sections of a course that met twice a week for 75 minutes over the course of 13 weeks. On the first day of class, participants were randomly assigned one of four nameplates (used in study 1a and 1b) to use during class throughout the semester. All sections featured all four designs, thus students were exposed to all four. The nameplates with their name on it were distributed at the beginning of every following class and sat on the students' desk for the entire class. Experiencers were given a brief questionnaire at three points in the semester: during the first week (T1), during the sixth week (i.e., before spring break; T2) and during the last week (i.e., before finals, T3). Among other questions related to the course, participants rated how much they currently liked their nameplates (1= Not at all, 9 = Very much). They also provided a code to match their responses over the three measurement times. Participants whose code could not be matched were excluded from the analyses.

Forecasters (N= 184) were students in six other sections of the same course who participated in a survey during the first week of the semester. They were exposed to all four nameplate used by experiencers, but they were only asked to evaluate a randomly assigned one. They were asked to imagine having been given the nameplate on the first day of class to use during class throughout the semester. Using the same scale as experiencers, they were then asked to rate how much they liked their nameplate (T1). They were then asked to imagine it being shortly before spring break (T2) and predict how much they would like the nameplate, having used it in every class. They repeated this exercise for the time before finals (T3).

Results

*Liking at T1*. A 2 (mode: forecaster, experiencer) x 2 (arousal potential: low, high) between-subjects ANOVA on initial liking scores (liking at T1) revealed no main effect of arousal potential (*F*s < 1), mode ($F(1, 273) = 1.80$, $p = .18$) or interaction (*F*s < 1), indicating that initial liking did not vary as a function of arousal potential or mode.

*Predicted and experienced liking.* As our main dependent measure, for each observation, we calculated the linear regression coefficient for liking over the three measurement times (Pfister et al. 2013), as in study 2. We did this using T1-T3 (1, 2, 3) as predictor variables as well as corresponding weeks (1, 7, 13) and days (1, 49, 91) as predictor variables.

A 2 (mode: forecaster, experiencer) x 2 (arousal potential: high, low) ANOVA on the regression coefficients of individual observations revealed only a significant interaction ($F(1, 274) = 8.49$, $p = .004$, $\eta_p^2 = .03$), see figure 4. This was also true when days and weeks were used as predictor variables ($Fs(1, 274) > 8.43$, $p \leq .004$, $\eta_p^2 = .03$).

Among forecasters, the analysis revealed a main effect of arousal potential, such that the (absolute) mean regression coefficient was greater for high arousal potential designs ($M = -.56$; $SD = 1.25$) than for low arousal potential designs ($M = -.23$; $SD = .99$; $F(1, 182) = 3.95$, $p = .05$, $\eta_p^2 = .02$), revealing that participants anticipated a greater decrease in liking from high vs. low arousal potential designs. This was again true when days and weeks were used as predictors of liking ($Fs(1, 182) > 3.93$, $p < .05$, $\eta_p^2 = .02$).

Among experiencers, the pattern was different. While the analysis also revealed a main effect of arousal potential, the regression coefficient was smaller for high arousal potential designs ($M = .06$; $SD = .98$) than for low arousal potential designs ($M = -.44$; $SD = 1.22$; $F(1, 92) = 4.83$, $p = .03$, $\eta_p^2 = .04$), thus revealing a lower decrease in liking for high vs. low arousal potential designs. This was again true when days and weeks were used as predictors of liking ($Fs(1, 92) > 3.79$, $p < .05$, $\eta_p^2 > .05$).

Examining the accuracy of consumer predictions (hypothesis 4), we then compared forecasts and experiences at each level of arousal potential. For high arousal potential nameplates, there was a main effect of mode, such that the mean absolute regression coefficient was greater for forecasters than for the experiencers ($F(1, 151) = 9.77$, $p = .002$, $\eta_p^2 = .06$), revealing that forecasters anticipated greater decrease in liking than experiencers reported. This was again true when days and weeks were used as predictors of liking ($Fs(1, 151) > 9.75$, $ps = .002$, $\eta_p^2 = .06$). Looked at differently, a between-subject MANOVA examining the effect of mode on reported liking scores for the high arousal potential designs at each time measurement revealed that while forecasters and experiencers liked the high potential arousal nameplate equally at the beginning of the semester (T1; $M_{\text{Forecast}} = 5.01$, $SD = 2.49$ vs. $M_{\text{Experience}} = 5.75$; $SD = 1.94$; $F(1, 151) = 1.96$, $p =.16$, $\eta_p^2 = .01$), forecasters underestimated how much they would like the high arousal potential nameplate at the midpoint of the semester (T2, $M_{\text{Forecast}} = 4.29$, $SD = 2.15$ vs. $M_{\text{Experience}} = 5.53$; $SD = 1.94$, $F(1, 151) = 11.90$, $p = .001$, $\eta_p^2 = .07$) and at the end of the semester (T3, $M_{\text{Forecast}} = 3.87$, $SD = 2.23$ vs. $M_{\text{Experience}} = 5.69$; $SD = 1.83$; $F(1, 151) = 25.12$, $p < .001$, $\eta_p^2 = .14$). For low arousal potential nameplates, there was no main effect of mode ($F(1, 123) = 1.08$, $p > .30$), suggesting that forecasters accurately predicted future liking for these designs.

---------------------------------

Insert figure 4 about here

--------------------------------

Discussion

Replicating the findings of studies 2 and 4 and supporting hypothesis 1a in a field experiment, forecasters in study 5 expected liking to decrease at a faster rate for high arousal potential designs over the course of a semester than for low arousal potential designs. Importantly, experiencer reports reveal this intuition to be misguided. In contrast to forecasters' predictions, experiencer reports revealed that liking decreased at a slower rate for low arousal potential than for high arousal potential designs, supporting hypothesis 3. Thus, forecasters underestimated liking of the high arousal potential design at the end of the semester (hypothesis 4a).

An ancillary study reported in the Web Appendix replicated the forecasting error found in study 5 using a within-subject design. This additional study also provides process evidence via irritation by first identifying "misprediction" as the difference between ratings in prediction and experience (hypothesis 4a), and then testing whether the influence of arousal potential on mispredicted liking over repeat exposure is mediated by mispredicted irritation (hypothesis 4b). Thus, using two different designs (a between-subject design and a within-subject design), we show that our hypotheses are supported for a product used in a real consumption context.

## GENERAL DISCUSSION

Focusing on two important design elements, color and pattern, seven studies examined how the arousal potential of product design elements (i.e., their intensity) differently affects predicted and experienced liking over time and how this influences the nature and quality of consumer decisions. We found that consumers are more likely to avoid products with high arousal potential designs when making decisions for extended use (pilot study, studies 1a and 1b). The reason for this is that consumers expect high arousal potential designs to become increasingly irritating (i.e., sensitization) over repeat exposure (studies 1b and 2), leading them to anticipate faster decreases in liking (studies 1b and 2) and lower product use (study 3) for high (vs. low) arousal potential designs. Importantly, however, these predictions seem to be misguided (studies 4 and 5). In both a lab and a natural field setting, we show that contrary to forecasters' predictions, experiencers report liking to decrease at a faster rate for low arousal potential designs than for high arousal potential designs. This leads to systematic errors in predicted utility: Forecasters overestimate irritation and satiation from high arousal potential designs and as a result underestimate the liking of high arousal designs over time.

## Theoretical Contributions

By showing a new type of forecasting error, the present research contributes to the work on predicted and experienced utility in three significant ways. First, it examines how characteristics of sensory stimuli differently influence predicted and experienced liking over time. Previous research has established that consumers mispredict liking for isolated sensory stimuli over time (e.g., eating yoghurt, listening to music), but has not compared different levels of these discreet stimuli (e.g., the intensity of a flavor or complexity of music). By systematically manipulating the level of arousal potential for the same sensory stimulus, the present research provides important insight into when and why errors in predicted liking are more or less likely to occur. This focus on how characteristics of sensory stimuli determine forecasting errors complements and extends related efforts in the affective forecasting literature in the non-sensory domain, which has examined how characteristics of events (e.g., their probability or psychological distance) differently influence their emotional impact in prospect and experience (e.g., Buechel et al. 2014; Buechel, Morewedge, and Zhang 2017; Ebert and Meyvis 2014).

Second, the current research provides insight into the underlying mechanism that leads to misprediction of adaptation in the sensory domain and how it differs from misprediction of adaptation in the non-sensory domain. The present research shows that people overestimate to what extent they will sensitize to high arousal potential sensory stimuli, leading to overestimation of adaptation/satiation for such stimuli. Importantly, this forecasting error differs from misprediction of hedonic responses in the non-sensory domain in its manifestation and underlying mechanism: Research on misprediction of (non-sensory) affect and product enjoyment has established that people *underestimate* adaptation because they a) underestimate their ability to cope and make sense of events (Gilbert et al. 1998) and/or b) do not always incorporate existing beliefs about adaptation to products in their decision-making process (Wang, Novemsky, and Dhar 2009). Neither of these explanations are consistent with the findings in the sensory domain that consumers do seem to incorporate adaptation into their decision-making process and *overestimate* it. Furthermore, adaptation to sensory stimuli does not involve the same psychological coping strategies (e.g., sense-making, reframing) that give rise to the underestimation of adaptation in the non-sensory domain. Thus, the present research offers an important theoretical distinction between the sources of forecasting errors, which can also help reconcile the discrepancies in the type of forecasting errors that have been found in the sensory and non-sensory domains.

Third, this research identifies differences in predicted and experienced utility in a new and marketing relevant consumption domain: visual processing of aesthetics. Past research on predicted and experienced utility has examined a variety of hedonic experiences and sensations, ranging from more general measures of happiness to more specific sensory measures such as auditory and gustatory liking. The present research is, to the best of our knowledge, the first to compare predicted and experienced utility from visual stimuli (save for unrelated clinical work on phobias; Rachman 1994; Rachman, Lopatka, and Levitt 1988). In doing so, the current research also makes important contributions to the literature on aesthetics in consumer behavior. Some of the most basic work on aesthetics considers how perceptual processes influence evaluation and liking (e.g., how fluency determines ease of processing and liking; Winkielman et al. 2003). We show how two distinctive design elements – color and pattern – exhibit similarities in how they shape preferences and hedonic value because they similarly influence the arousal potential of the stimulus. It follows that the findings of this research may be extrapolated to other manipulations of visual arousal potential such as the magnitude of contrast or movement in visual stimuli. Furthermore, while literature on design and mere exposure has identified factors that influence experienced adaptation and satiation to visual stimuli, this past literature has not systematically examined predicted liking. This is notable, given that most consumption and purchase decisions are based on predicted hedonic value. By showing that forecasted liking does not match the dynamics of experienced liking, the present work fills an important gap that allows us to better understand how arousal potential influences judgments and decisions made for future consumption.

On a broader level, the current research might provide an important step to a better understanding of sensory/hedonic adaptation and sensitization. By showing how sensitization on one measure (e.g., increase in irritation) can lead to adaptation on a different measure (e.g., decrease in liking or general hedonic response), we show how the two can be interrelated and inform each other. This highlights the importance of clarity and specificity in terminology when talking about dynamics of sensory and hedonic adaptation. Further, while the current investigation is limited to visual stimuli, the findings might point to a more general overarching theory that can help predict the dynamics of anticipated (vs. experienced) hedonic value over time. Past research has identified isolated instances of sensitization and adaptation, but consumers and researchers seem to have a relatively poor understanding of the boundary conditions that determine when and to what extent each occurs (see Snell et al. 1995; Snell and Gibbs 1995). Our research suggests that arousal potential of a stimulus might be an important determinant of predicted and experienced hedonic value over time. If so, then our results might generalize to other modalities (e.g., gustatory, auditory). Supporting this notion, many of the more psychological processes that account for adaptation have been shown to share similarities across modalities (Redden 2015). Thus, consumers might expect to grow more irritated and satiate more quickly from intense sounds (e.g., a new type of techno) or flavors (e.g., an intense curry), when in reality, these might bring continued pleasure. We discuss the importance of further research in this area in “Limitations and Future Research”.

## Implications for Consumers and Marketers

Apart from being of theoretical interest, the present research has important implications for how consumers make decisions about aesthetic elements. When decorating homes and buying clothes, consumers often choose pale colors and simple designs (i.e., low arousal potential design items), presumably at least in part because they believe that this will increase long-term satisfaction with the product aesthetics. Contrary to people's intuition, however, our studies suggest that consumers satiate equally, if not more quickly, from low arousal potential designs than from high arousal designs. The implication for consumers is that when making long-term decisions, consumers can be bolder in their design choices (i.e., they should go for the intense colors and intense patterns they like) without jeopardizing hedonic value over time. Of course, consumers may want to shift their strategy when making choices on behalf of others. When preparing to sell a house, for example, sellers should recognize that a potential buyer unfamiliar with this research might falsely shy away from bold patterns, decreasing the resale value. Indeed, real estate and color consultants advise homeowners to "start with earth tones" and to "get rid of anything that's kind of obnoxious" (Moore 2010; realestate.aol.com).

The current research has equally significant implications for marketers. When designing logos, stores, websites, or any other design aspect associated with a product, marketers should again embrace bold product designs. Not only will they capture attention, but they are likely free of the feared downsides such as satiation and irritation. On the other hand, sales departments could profit from the sale of low arousal potential designs. Not only might the associated satiation decrease time until consumers return for replacement purchase, but consumers may be more likely to return to purchase modifying products (e.g., new decorative pillows for their sofa) to increase liking of their current product.

## Limitations and Future Research

We observed our hypothesized effects over a variety of product category and designs. Nevertheless, it is important to keep in mind the possible boundary conditions of our effects.

First, as with most findings and psychological theories, the predictive validity of our findings is relative rather than absolute in nature. Our findings allow us to forecast for what types of visual stimuli consumers may be more or less likely to mispredict liking over time, but it does not specifically address whether someone will mispredict liking for a precise level of aesthetic design or what level of arousal potential is necessary for overestimation of satiation to occur (e.g., whether a pattern should have one, two or three lines, etc.). One reason for this is that the level of subjective arousal from arousal potentialities might differ depending on context or across individuals. To mitigate this issue, we intentionally used stimuli that were extreme enough to elicit differential arousal across our participant population and across context, thus increasing the likelihood of observing the effect. For less extreme stimuli (e.g., designs with medium arousal potential), perceptions of arousal may be more context and individual dependent, leading to weaker and less consistent effects.

Second, as our pilot data indicates, the importance and nature of aesthetic considerations likely vary across product categories, thus providing important boundary conditions for the preferences for high (vs. low) arousal potential designs. Safety considerations might motivate consumers to choose bright colors independent of satiation concerns, for example. A decorative feature meant to attract attention might similarly motivate the choice of a high arousal design. For other products, consumers likely find additional motivation in selecting low arousal potential designs, be it because it makes matching different designs easier (e.g., clothes), because these designs are less likely to go out of style over time (e.g., furniture), or because the designs are more versatile over time (e.g., household items). To mitigate the influence of these alternative explanations, we controlled for them statistically and we selected products for which matching, trends, and versatility were not highly relevant (e.g., nameplates). And while each of these alternative explanations might influence product design preferences, they are less likely to influence anticipated satiation over time, a key dependent measure in studies 1b –5. Still, it is important to recognize that our effects might be weaker in some product categories than others, thus highlighting the potential for future research identifying systematic moderators.

Third, to reiterate, the current investigation is limited to the visual sensory domain. Future research is necessary to examine whether our results generalize to other sensory domains, and if so, which ones. In line with the current theorizing around arousal potential, this type of research could manipulate the loudness and complexity of auditory stimulus, the intensity and complexity of taste, as well as the intensity and pattern of touch or pain, for example. Of course, any testing of the generalizability of our results should consider similarities and differences across sensory modalities (e.g., physical properties/limitations, evolutionary function, etc.), which could inform potential boundaries for the generalizability of our effects.

Finally, future research might also delve more deeply into the mechanism behind the forecasting error. While our studies consistently showed that consumers' misprediction of satiation for high arousal potential designs was due to expectations of increased irritation, we did not identify the origins of these expectations. Might it be that there is adaptive value in this forecasting error and/or that consumers overly rely on atypical past experiences when making predictions about high arousal designs? We leave such questions for future research.

Overall, the results consistently show (misguided) expectations of satiation as a primary driver of the decreased preference for high arousal potential designs when making decisions for durable products. Importantly, as a high level of functional quality becomes standard across numerous product categories (Page and Herr 2002), more brands are looking to aesthetics as a point of differentiation. Therefore, this research is relevant to an increasingly diverse range of product purchases and usage experiences.

## DATA COLLECTION INFORMATION

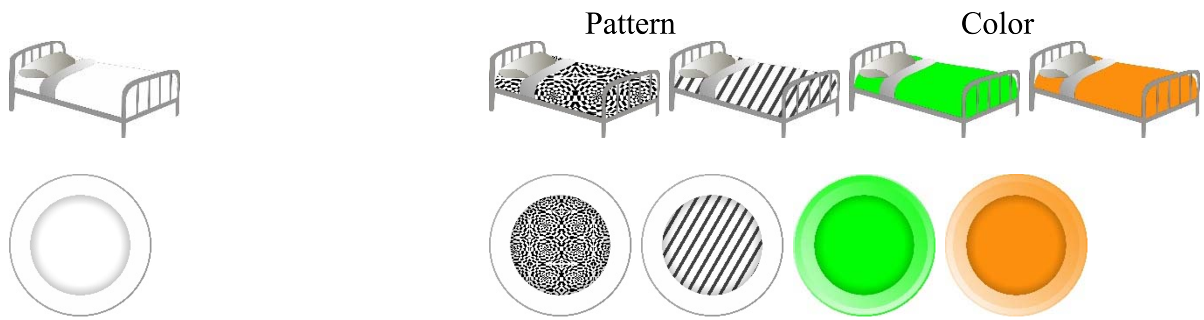
The data were collected using paper and pencil or Qualtrics software at the University of Miami, the University of South Carolina, and using Mturk between Fall 2012 and Spring 2017. The data were either collected by one of the authors or by a research assistant supervised by at least one of the authors. The first, second, or both authors analyzed the data and the data for all studies were discussed on multiple occasions by both authors. Ancillary information/analyses and links to preregistration reports can be found in the web appendix accompanying the online version of this article. Additional analyses and datasets may be requested at any time.

# APPENDIX: STIMULI USED

**Low Arousal** **High Arousal**

Study 1a, 1b, 5: Nameplates

Study 2: Beds and Plates




Study 3: Workout Shirts

Study 4: Screen Backgrounds

**REFERENCES**

Alba, Joseph and Elanor F. Williams (2013), "Pleasure Principles: Current Research on Hedonic Consumption," *Journal of Consumer Psychology*, 23 (1), 2-18.

Aiken, Leona and Stephen G. West (1991), *Multiple Regression: Testing and Interpreting Interactions*, Newbury Park, CA: Sage.

Baker, Garry and Robert Franken (1967), "Effects of Stimulus Size, Brightness and Complexity upon EEG Desynchronization," *Psychonomic Science,* 7 (9), 289-90.

Berlyne, Daniel E. (1960), "*Conflict, Arousal, and Curiosity*, New York, NY: McGraw-Hill.

_______ (1968), "The Motivational Significance of Collative Variables," in *Theories of Cognitive Consistency: A Sourcebook,* Ed. Robert Abelson, Chicago, IL: Rand McNally, 275-88.

_______ (1970), "Novelty, Complexity, and Hedonic Value," *Perception & Psychophysics*, 8 (5), 279-86.

_______ (1971), Aesthetics and Psychobiology, New York, NY: Appleton-Century-Crofts.

Berlyne, Daniel E. and P. McDonnell (1965), "Effects of Stimulus Complexity and Incongruity on Duration of EEG Desynchronization," *Electroencephalography and Clinical Neurophysiology,* 18 (2), 156-61.

Berlyne, Daniel E. and George H. Lawrence (1964), "Effects of Complexity and Incongruity Variables on GSR, Investigatory Behavior and Verbally Expressed Preference," *Journal of General Psychology*, 71 (1), 21-45.

Bornstein, Robert F. (1989), "Exposure and Affect: Overview and Meta-Analysis of Research, 1968–1987," *Psychological Bulletin,* 106 (2), 265 - 89.

Buechel, Eva C., Jiao Zhang, Carey K. Morewedge (2017), “Impact bias or underestimation? Outcome specifications predict the direction of affective forecasting errors,” *Journal of Experiment Psychology: General,* 146 (5), 746-61.

Buechel, Eva C., Jiao Zhang, Carey K. Morewedge, and Joachim Vosgerau (2014), “More Intense Experiences, Less Intense Forecasts: Why People Overweight Probability Specifications in Affective Forecasts,” *Journal of Personality and Social Psychology,* 106 (1), 20-36.

Cantor, Gordon N. (1968), “Children's ‘Like-Dislike’ Ratings of Familiarized and Non-familiarized Visual Stimuli,” *Journal of Experimental Child Psychology*, 6 (4), 651-57.

Coombs, Clyde H. and George S. Avrunin (1977), “Single-Peaked Functions and the Theory of Preference,” *Psychological Review*, 84 (2), 216 - 30.

Cox, Dena and Anthony D. Cox (2002), “Beyond First Impressions: The Effects of Repeated Exposure on Consumer Liking of Visually Complex and Simple Product Designs,” *Journal of the Academy of Marketing Science,* 30 (2), 119-30.

Ebert, Jane E.J and Tom Meyvis (2014), "Reading Fictional Stories and Winning Delayed Prizes: The Surprising Emotional Impact of Distant Events," *Journal of Consumer Research*, 41 (3), 794 – 809.

Fitzsimons, Gavan J. (2008), “Death to Dichotomizing,” *Journal of Consumer Research*, 35 (1), 5-8.

Frederick, Shane and George Loewenstein (1999), ‘‘Hedonic Adaptation,’’ in *Well-being: The foundations of Hedonic Psychology*, Ed. Daniel Kahneman, Ed Diener, and Norbert Schwarz, New York, NY: Sage, 302-29.

Gilbert, Daniel T., Elizabeth C. Pinel, Timothy D. Wilson, Stephen J. Blumberg, and Thalia P. Wheatley (1998), "Immune Neglect: A Source of Durability Bias in Affective Forecasting," *Journal of Personality and Social Psychology*, 75 (3), 617-38.

Hagtvedt, Henrik and S. Adam Brasel (2017), "Color Saturation Increases Perceived Product Size," *Journal of Consumer Research,* forthcoming.

Hayes, Andrew F. (2013), *Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-based Approach*, New York, NY: Guilford Press.

Heiman, Julia R. (1977), "A Psychophysiological Exploration of Sexual Arousal Patterns in Females and Males," *Psychophysiology,* 14 (3), 266-74.

Hoegg, JoAndrea and Joseph. W. Alba (2008), "A Role for Aesthetics in Consumer Psychology," in *Handbook of Consumer Psychology*, Ed. Frank Kardes, Curtis Haugtvedt and Paul Herr, New York, NY: Psychology Press, 733-54.

Holtzschue, Linda (2011), *Understand Color: An Introduction For Designers,* 4th Edition, Hoboken, NJ: John Wiley & Sons, Inc.

Janiszewski, Chris and Tom Meyvis (2001), "Effects of Brand Logo Complexity, Repetition, and Spacing on Processing Fluency and Judgment," *Journal of Consumer Research,* 28 (1), 18-32.

Kahneman, Daniel and Jackie Snell (1992), "Predicting a Changing Taste: Do People Know What They Will Like?" *Journal of Behavioral Decision Making*, 5 (3), 187-200.

Küller, Rikard, Byron Mikellides, and Jan Janssens (2009), "Color, Arousal, and Performance – A Comparison of Three Experiments," *Color Research & Application,* 34 (2), 141-52.

Laan, Ellen, Walter Everaerd, and Andrea Evers (1995), "Assessment of Female Sexual Arousal: Response Specificity and Construct Validity," *Psychophysiology*, 32 (5), 476-85.

Labrecque, Lauren I. and George R. Milne (2012), "Exciting Red and Competent Blue: The Importance of Color in Marketing," *Journal of the Academy of Marketing Science*, 40, 711-27.

Mehrabian, Albert and James A. Russell (1973), "A Measure of Arousal Seeking Tendency," *Environment and Behavior*, 5 (3), 315-33.

Moore, Christopher (2010), "Painting to Sell: What Color Homes Sell Best?" http://realestate.aol.com/blog/2010/07/16/painting-to-sell-what-color-homes-sell-best/.

Morewedge, Carey K., Daniel T. Gilbert, Kristian R., Myrseth, Karim S. Kassam, and Timothy D. Wilson (2010), "Consuming Experiences: Why Affective Forecasters Overestimate Comparative Value," *Journal of Experimental Social Psychology*, 46 (6), 986-92.

Nelson, Leif D. and Tom Meyvis (2008), "Interrupted Consumption: Disrupting Adaptation to Hedonic Experiences," *Journal of Marketing Research*, 45 (6), 654-64.

Nicki, Richard M. and Anthony Gale (1977), "EEG, Measures of Complexity, and Preference for Nonrepresentational Works of Art," *Perception*, 6, 281-86.

Novemsky, Nathan and Rebecca K. Ratner (2003), "The Time Course and Impact of Consumers' Erroneous Beliefs about Hedonic Contrast Effects," *Journal of Consumer Research*, 29 (4), 507–16.

Oppenheimer, Daniel M., Tom Meyvis, and Nicolas Davidenko (2009), "Instructional manipulation checks: Detecting satisficing to increase statistical power," *Journal of Experimental Social Psychology*, 45, 867-72.

Page, Christine and Paul M. Herr (2002), "An Investigation of the Processes by which Product Design and Brand Strength Interact to Determine Initial Affect and Quality Judgments," *Journal of Consumer Psychology*, 12 (2), 133-47.

Patrick, Vanessa A. and Henrik Hagtvedt (2011), “Aesthetic Incongruity Resolution,” *Journal of Marketing Research,* 48 (2), 393-402.

Patrick, Vanessa A. and Laura A. Peracchio (2010), “Curating the JCP Special Issue on Aesthetics in Consumer Psychology: An Introduction to the Aesthetics Issues,” *Journal of Consumer Psychology*, 20 (4), 393-97.

Pfister, Roland, Katharina Schwarz, Robyn Carson, and Markus Jancyzk (2013), “Easy Methods for Extracting Individual Regression Slopes: Comparing SPSS, R, and Excel,: *Tutorials in Quantitative Methods for Psychology,* 9 (2), 72-8.

Postrel, Virginia (2003), *The substance of style*. New York, NY: Harper Collins.

Rachman, Stanley (1994), “The Overprediction of Fear: A Review,” *Behaviour Research and Therapy*, 32 (September), 683-90.

Rachman, Stanley, Cindy Lopatka, and Kay Levitt (1988), “Experimental Analyses of Panic—II. Panic Patients,” *Behaviour Research and Therapy,* 26 (1), 33-40.

Ratner, Rebecca K., Barbara E. Kahn, and Daniel Kahneman (1999), “Choosing Less Preferred Experiences for the Sake of Variety,” *Journal of Consumer Research*, 26 (1), 1-15.

Redden, Joseph P. (2008), “Reducing Satiation: The Role of Categorization Level,” *Journal of Consumer Research*, 34 (5), 624-34.

_______ (2015), “Desire over Time: The Multi-Faceted Nature of Satiation,” in *The Psychology of Desire,* Ed. Wilhelm Hofmann and Loran Nordgren, New York, NY: Guilford Press, 82-103.

Snell, Jackie and Brian J. Gibbs (1995), “Do Consumers Know What They Will Like?” *Advances in Consumer Research*, 22, 277-79.

Snell, Jackie, Brian J. Gibbs, and Carol Varey (1995), "Intuitive Hedonics: Consumer Beliefs about the Dynamics of Liking," *Journal of Consumer Psychology*, 4 (1), 33-60.

Townsend, Claudia and Suzanne B. Shu (2010), "When and How Aesthetics Influences Financial Decisions," *Journal of Consumer Psychology*, 20 (4), 452-58.

Valdez*,* Patricia and Albert Mehrabian *(*1994*),* "Effects of Color on Emotions" *Journal of Experimental Psychology*, 4, 394-409.

Wang, Jing, Nathan Novemsky, and Ravi Dhar (2009), "Anticipating adaptation to products," *Journal of Consumer Research*, 36 (2), 149-59.

Weinstein, Neil D. (1978), "Individual Differences in Reactions to Noise: A Longitudinal Study in a College Dormitory," *Journal of Applied Psychology,* 63 (4), 458 -66.

_______ (1982), "Community Noise Problems: Evidence against Adaptation," *Journal of Environmental Psychology,* 2 (2), 87-97.

Weller, Leonard and Randy Livingston (1988), "Effects of Color of Questionnaire on Emotional Responses," *Journal of General Psychology*, 115 (4), 433-40.

Wilson, Timothy D. and Daniel T. Gilbert (2003), "Affective Forecasting," *Advances in Experimental Social Psychology*, 35 (December), 345-411.

Wilson, Timothy D. and Daniel T. Gilbert (2005), "Affective Forecasting: Knowing What to Want," *Current Directions in Psychological Science*, 14 (3), 131-34.

Wright, Benjamin and Lee Rainwater (1962), "The Meanings of Color," *Journal of General Psychology*, 67 (1), 89-99.

Wundt, Wilhelm M. (1874), "*Grundzüge der Physiologischen Psychologie [Translation: Principles of Physiological Psychology],"* Leipzig: Engelmann.

Yamamoto, Mel and David R. Lambert (1994), “The Impact of Product Aesthetics on the Evaluation of Industrial Products,” *Journal of Product Innovation Management,* 11 (4), 309-24.

Zajonc, Robert B. (1968), “Attitudinal Effects of Mere Exposure,” *Journal of Personality and Social Psychology,* 9 (2), 1-27.

Zajonc, Robert B., Philip Shaver, Carol Tavris, and David Van Kreveld (1972), “Exposure, Satiation, and Stimulus Discriminability,” *Journal of Personality and Social Psychology*, 21 (3), 270-80.

Zielińki, Piotr (2016), “An Arousal Effect of Colors Saturation: A Study of Self-Reported and Electrodermal Responses,” *Journal of Psychophysiology*, 30 (1), 9-16.

Zhao, Xinshu, John G. Lynch, and Qimei Chen (2010), “Reconsidering Baron and Kenny: Myths and Truths about Mediation Analysis,” *Journal of Consumer Research,* 37 (2), 197-206.

## TABLES

TABLE 1: RESULTS OF STUDY 2

Current (T1) and Predicted (T2-T7) Liking and Irritation for Bedding and Plates with Varying Design

| | T1<br>Current | T2<br>One Week | T3<br>One Month | T4<br>Six Months | T5<br>One Year | T6<br>Two Years | T7<br>Four Years |
|---|---|---|---|---|---|---|---|
| **(Predicted) Liking** | | | | | | | |
| Low Arousal Potential (White) | 46.6 | 45.9 | 45.4 | 44.4 | 42.1 | 38.3 | 35.5 |
| High Arousal Potential Total | 39.3 | 37.1 | 35.1 | 31.9 | 29.1 | 25.1 | 19.6 |
| Color Total | 43.1 | 42.1 | 40.9 | 38.7 | 35.9 | 32.2 | 25.4 |
| Strong Green | 40.8 | 38.3 | 37.2 | 35.3 | 32.2 | 28.3 | 20.6 |
| Strong Orange | 45.5 | 45.9 | 44.7 | 42.2 | 39.8 | 36.1 | 30.2 |
| Pattern Total | 35.6 | 32.1 | 29.4 | 25.2 | 22.4 | 19.1 | 14.0 |
| Striped | 41.0 | 38.6 | 36.2 | 32.5 | 29.3 | 25.0 | 19.9 |
| Abstract | 30.4 | 26.0 | 22.8 | 18.3 | 15.8 | 11.4 | 8.4 |
| **(Predicted) Irritation** | | | | | | | |
| Low Arousal Potential (White) | 46.0 | 45.4 | 45.3 | 45.3 | 45.3 | 46.6 | 48.2 |
| High Arousal Potential Total | 56.5 | 58.7 | 59.5 | 60.7 | 62.4 | 64.8 | 67.4 |
| Color Total | 50.0 | 51.9 | 52.7 | 54.1 | 55.2 | 57.6 | 58.8 |
| Strong Green | 51.4 | 52.9 | 53.4 | 55.6 | 57.6 | 59.0 | 60.6 |
| Strong Orange | 48.6 | 50.9 | 51.9 | 52.6 | 52.8 | 56.1 | 57.0 |
| Pattern Total | 63.0 | 65.5 | 66.3 | 67.2 | 69.6 | 72.1 | 75.9 |
| Striped | 62.9 | 66.8 | 67.2 | 67.4 | 70.3 | 73.2 | 78.0 |
| Abstract | 63.1 | 64.2 | 65.4 | 66.9 | 68.9 | 71.0 | 73.9 |

**FIGURES**

FIGURE 1

RESULTS OF PILOT STUDY

Figure 1a: Expected Ownership Length and Choice of High Arousal Potential Designs

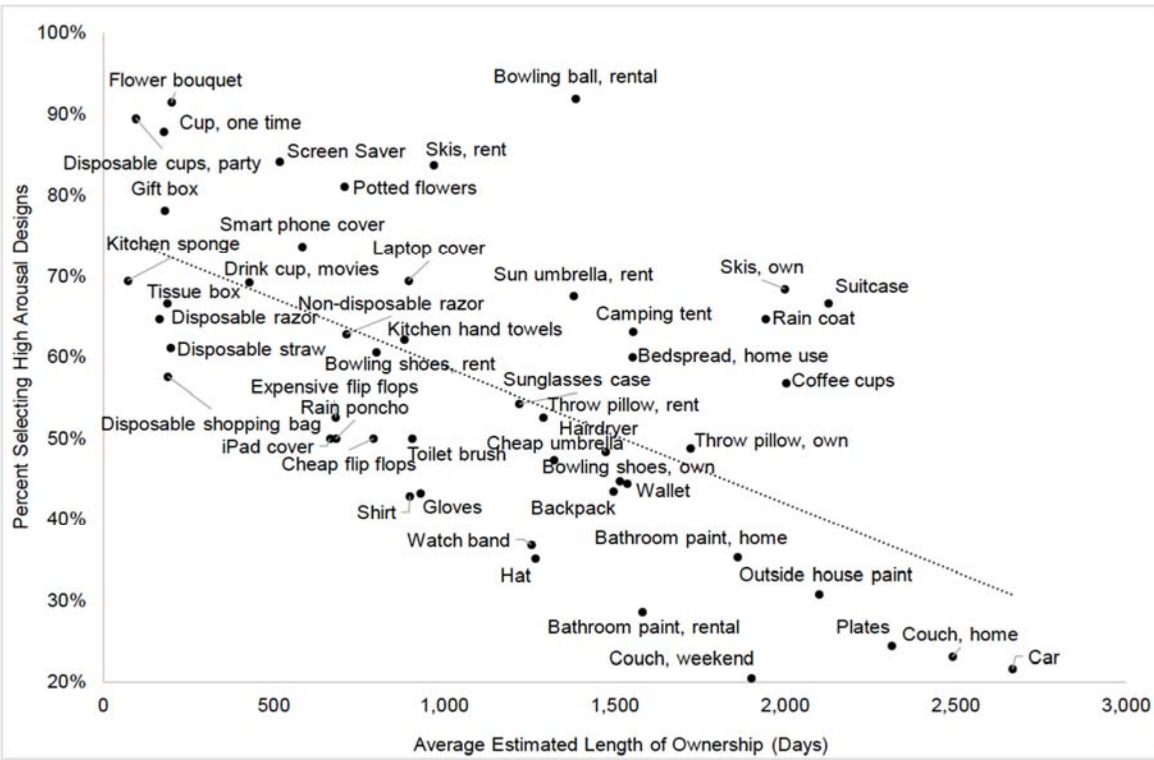


Figure 1B: Expected Product Views and Choice of High Arousal Potential Designs

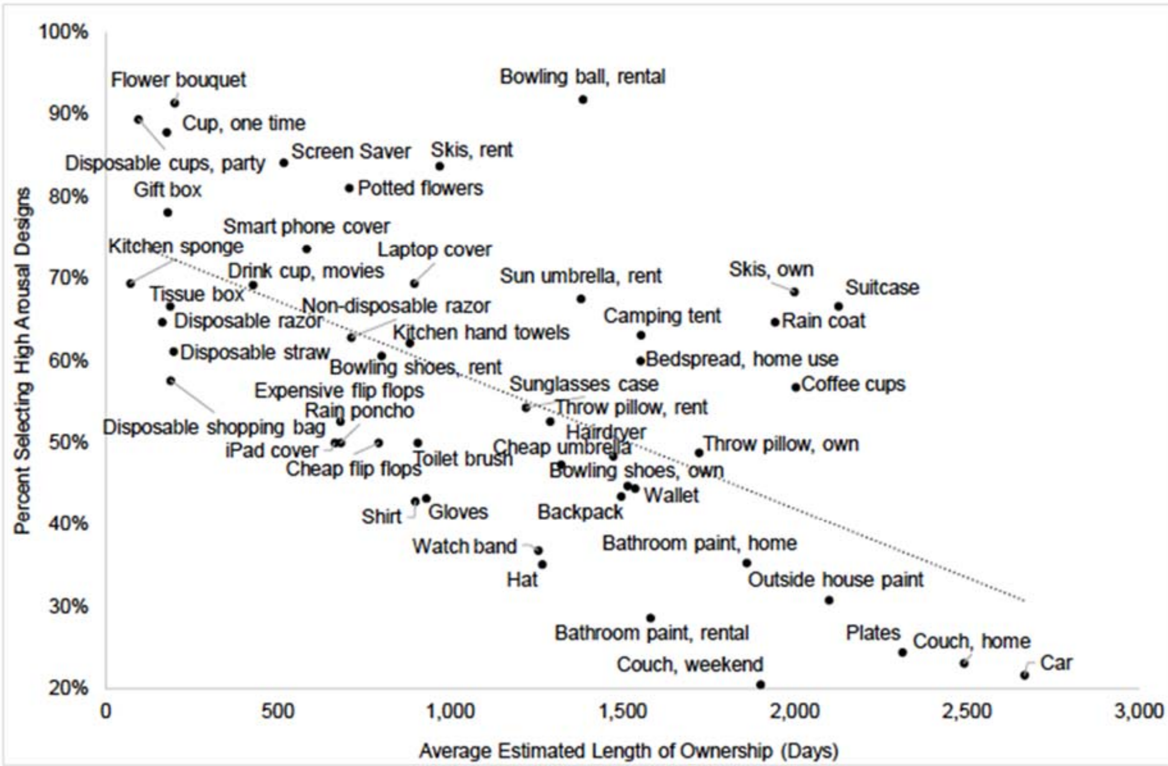


FIGURE 2: RESULTS OF STUDY 3

Figure 2a: Frequency of Use

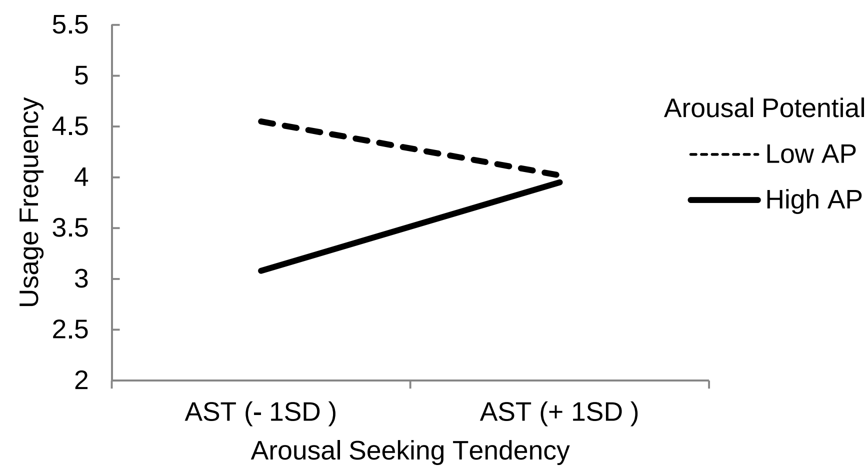



Figure 2b: Predicted Number of Wears (Until Discarded)

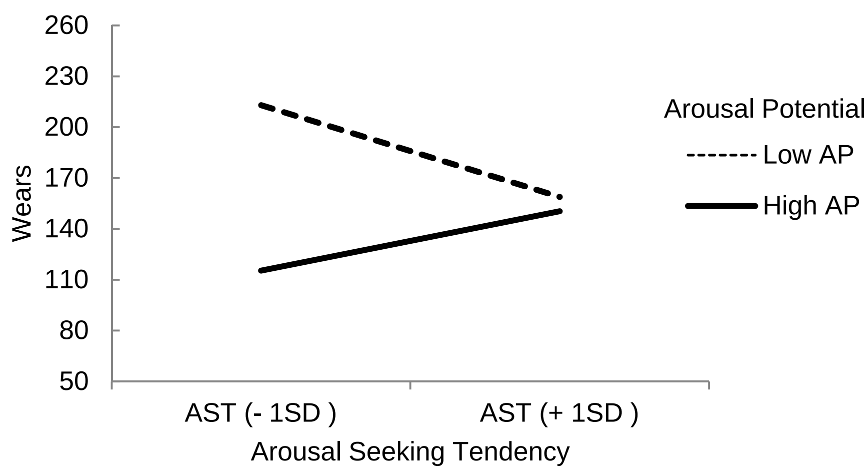



Figure 2c: Predicted Likelihood of Wearing in one Year

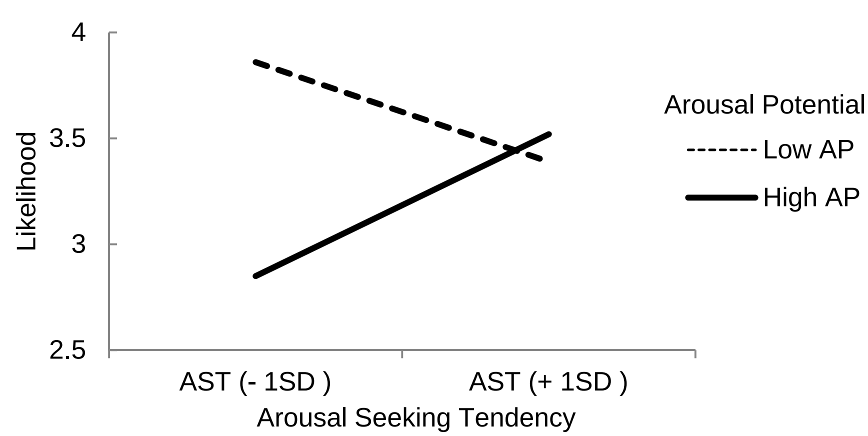


FIGURE 3

RESULTS OF STUDY 4

Figure 3A: Change in Liking as a Function of Arousal Potential

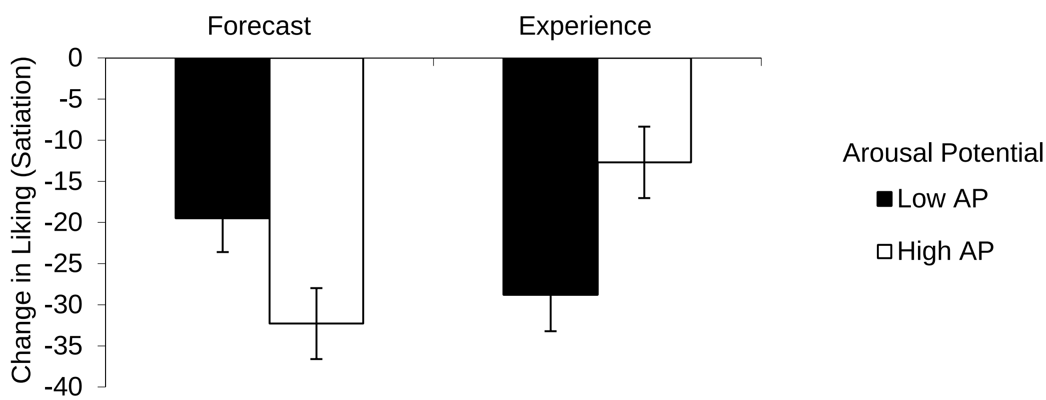



Figure 3B: Change in Irritation as a Function of Arousal Potential

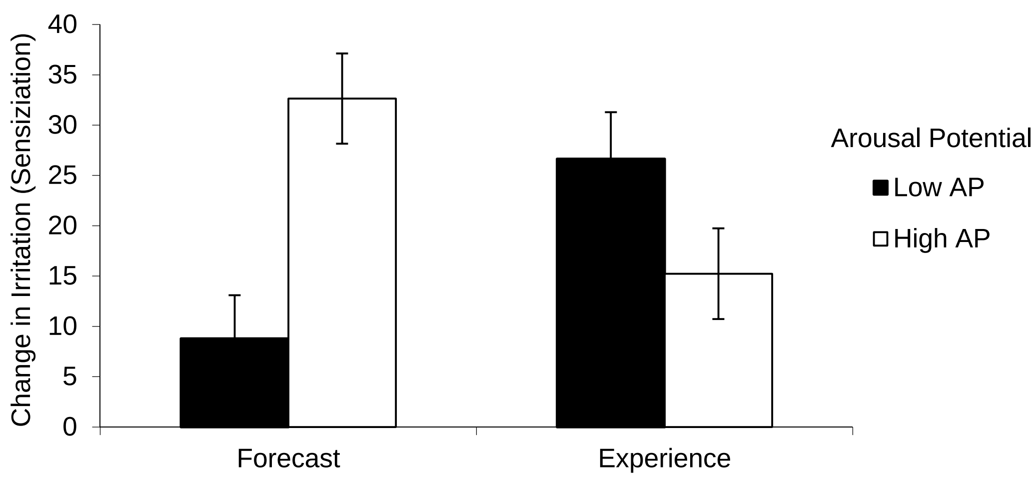
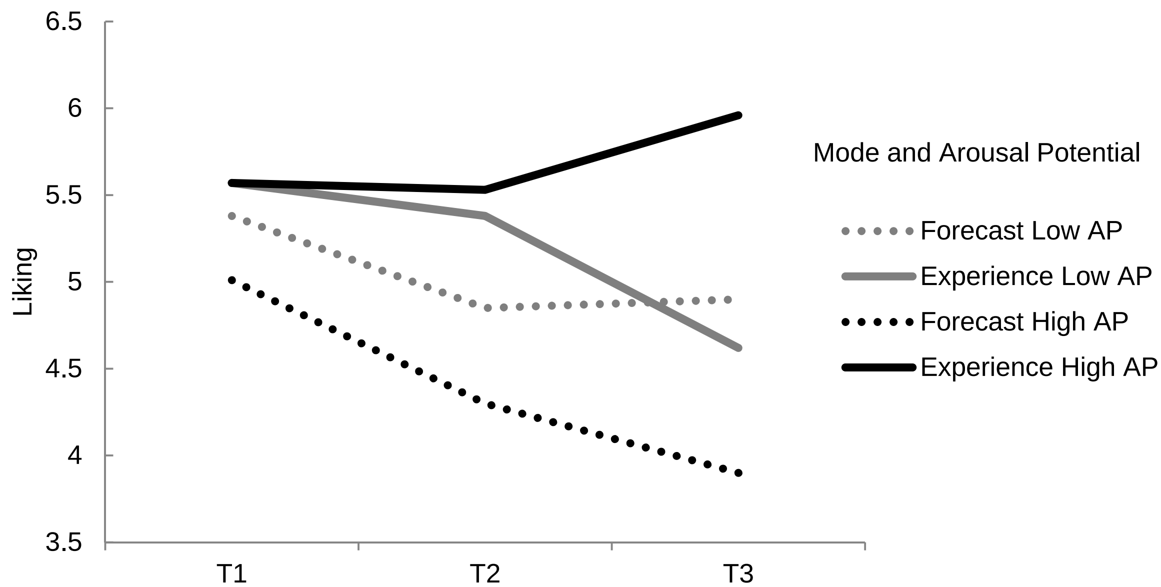


FIGURE 4

RESULTS OF STUDY 5:

Differences in Liking Over Time for Predicted versus Experienced Low and High Arousal Potential Designs



**HEADING LIST**

**1) DYNAMICS OF HEDONIC VALUE**
**1) AROUSAL POTENTIAL IN VISUAL STIMULI**
**2) Arousal Potential and Predicted Liking of Product Design Elements**
**2) Arousal and Experienced Liking of Product Designs Elements**
**2) Overview**
**1) PILOT STUDY: MULTI-CATEGORY EXPLORATION**
**2) Methods**
**2) Results**
*3) Choice.*
**2) Discussion**
**1) STUDIES 1A AND 1B: DESIGN PREFERENCES AS A FUNCTION OF CONSUMPTION DURATION**
**2) Study 1a: Field Study**
**2) Methods**
**2) Results**
**2) Study 1b: Laboratory Study**
**2) Methods**
**2) Results**
*3) Manipulation checks.*
*3) Choice.*
*3) Predicted liking.*
*3) Predicted irritation.*
*3) Mediation.*
*3) Alternative explanations.*
**2) Discussion**
**1) STUDY 2: PREDICTED PRODUCT LIKING OVER TIME**
**2) Methods**
**2) Results**
*3) Predicted liking.*
*3) Predicted irritation.*
*3) Mediation.*
**2) Discussion**
**1) STUDY 3: PREDICTED PRODUCT USAGE OVER TIME**
**Methods**
**2) Results**
*3) Predicted frequency of usage.*
*3) Predicted wears until discarded.*
*3) Likelihood of wearing in one year.*
*3) Likelihood of wearing to next workout.*
**2) Discussion**
**1) STUDIES 4 AND 5: COMPARING PREDICTED AND EXPERIENCED LIKING**
**2) Study 4: Comparing Predicted and Experienced Liking**
**2) Methods**
**2) Results**

*3) Ratings at T1.*
*3) Predicted and experienced liking.*
*3) Predicted and experienced irritation.*
*3) Mediation.*
**2) Discussion**
**2) Study 5: Comparing Predicted to Experienced Liking and Irritation in the Field**
**2) Methods**
**2) Results**
*3) Liking at T1.*
*3) Predicted and experienced liking.*
**2) Discussion**
**1) GENERAL DISCUSSION**
**2) Theoretical Contributions**
**2) Implications for Consumers and Marketers**
**2) Limitations and Future Research**