

Emotion

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Divergent Temporal Courses for Liking Versus Wanting in Response to Persuasion

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Liking and wanting are two foundational processes underlying the individual's reward system. Whereas the differences between liking and wanting have been studied extensively in the context of substance addiction, there have been few empirical studies of their manifestation in ordinary, nonaddictive contexts of behavior. In particular, previous research showed a temporal divergence of liking and wanting over repeated exposures to drugs; however, the temporal progression of liking versus wanting in response to ordinary stimuli remains less understood. This research tests the temporal divergence of liking versus wanting responses in a prevalent domain—namely, in response to persuasive messages—using a highly powered field experiment involving over 1,000 real-life stimuli and 100,000 subjects. Subjects were exposed to sequences of TV advertisements in random orderings and indicated how much they liked the persuasive messages and wanted the promoted items. We found, not surprisingly, an overall positive correlation whereby greater message liking was associated with greater wanting of the item. However, underlying the overall correlation, we found a sharp divergence with respect to the serial progression of liking versus wanting. Specifically, message liking was highest early in the sequence, whereas wanting of the promoted item was highest late in the sequence. We posit and provide evidence that this divergence is due to an appetizing effect for wanting, in contrast to a habituation and reference adaptation effect for liking. We discuss the implications of our results for theories of liking versus wanting for addictive as well as ordinary substances.

Keywords: liking and wanting, field experiment, serial position effect, sequential affective experiences, sequential goal activation

Liking and wanting are two foundational processes underlying the individual's reward system that drives evaluations and actions. Neural and behavioral research increasingly shows that they are distinct processes with divergent properties (e.g., Berridge, 2009; Garbinsky, Morewedge, & Shiv, 2014; Litt, Khan, & Shiv, 2010). Wanting is generated by the appetitive anticipation of a rewarding outcome, whereas liking refers to the actual affective impact of an experienced event (Berridge & Robinson, 2016). However, to date, existing research on differences between liking and wanting has mainly focused on the case of addictive substances and behaviors (e.g., Evans et al., 2006; Olney, Warlow, Naffziger, & Berridge,

2018). In contrast, studies of liking and wanting responses to common, nonaddictive stimuli are scarce (e.g., Dai, Brendl, & Ariely, 2010; Garbinsky et al., 2014; Litt et al., 2010; Volkow et al., 2002). Further, an understanding of the conditions and mechanisms under which liking versus wanting reactions diverge is lacking. In particular, studies of addiction based on incentive-sensitization theory predicted that liking and wanting responses to repeated exposures to drugs tend to diverge in their temporal progression: Whereas liking is highest at initial use but then dips and asymptotes, wanting is lowest at initial use but steadily grows stronger over time due to incentive sensitization (Robinson & Berridge, 1993).

However, what remains unknown is whether this temporal divergence applies to liking and wanting responses to ordinary, nonaddictive stimuli and, further, whether it only applies to repeated exposures to the exact same stimuli or if the same temporal pattern (strengthening of wanting and weakening of liking response) obtains for a sequence of liking and wanting responses that are generated by a sequence of different stimuli. Additionally, if the temporal divergence applies to ordinary stimuli in broader contexts, an interesting question is what might be the mechanism(s) driving the divergence. In particular, incentive sensitization for drugs, which is based on conditioning from repetition of the same stimuli, may not apply to sequences where multiple stimuli and rewards are involved. Thus, by examining the temporal progression of liking versus wanting responses to ordinary stimuli

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in a substantially different context, we may identify (dis)similarities compared to response to drugs, which can contribute to a more general theory of the temporal course of liking versus wanting.

The current research examines this question by studying a prevalent context in which liking and wanting responses arise, namely, when being exposed to persuasive messages. In particular, we do this in a highly powered, fully randomized field experiment involving over 1,000 real-life stimuli and over 100,000 individuals. Individuals responded to randomized sequences of persuasive messages in terms of their liking of the message stimuli versus wanting of the promoted item. Results show, perhaps not surprisingly, an overall positive correlation whereby greater message liking is associated with greater wanting of the promoted item; however, interestingly, underneath the overall correlation, we found a sharp divergence with respect to the sequential progression of liking versus wanting responses. Specifically, message liking was greatest at the beginning of the sequence whereas wanting of the promoted item was greatest at the end of the sequence. Replication analysis further demonstrated this pattern to be extremely robust across diverse stimuli. We posit that this pattern is due to an appetizing effect for wanting, in contrast to a habituation and reference adaptation effect for liking. Process evidence provided supports for our theory.

Our results demonstrate that, similar to responses to addictive substances, liking and wanting responses to persuasion stimuli also diverge along the temporal dimension. Further, our findings suggest that in addition to incentive sensitization, there could be other mechanisms, such as an appetizing effect, that also increase wanting over sequential exposures. Thus, our results point to the potential for a broader theory of wanting characterized by cumulative activation under certain conditions.

Liking and Wanting in Persuasion Response

Persuasive messages underlie many aspects of the media as well as interpersonal communications, leading the typical person to encounter large numbers of persuasive messages each day. Hence, the encounter with persuasive messages is one of the most common contexts in which liking and wanting responses arise and coexist. For each persuasive message, the person directly experiences the persuasion stimulus. The overall affective impact of this experience, which can derive from both emotions and cognitions generated by the persuasion stimulus, results in a liking response to the persuasion stimulus. In addition to message liking, the persuasive message may also elicit a wanting response that is distinct from the liking response. Specifically, through experiencing the persuasion stimulus, the individual may form an anticipation or urge for a positive reward or relief from a state of deficiency, resulting in a wanting response for the promoted object. Certainly, the message may also prompt other responses, such as learning and changes in perceptions. However, in this research, we focus on the contrast between liking and wanting responses. Importantly, one may expect a positive correlation between message liking and wanting of the promoted item. For example, a very appealing visual image might both increase liking of the message and create a stronger approach motivation toward the promoted object. However, because of the distinct nature of liking and wanting, it is also possible that there will be factors in the persua-

sion context that would impact message liking versus item wanting differently. We propose that the temporal progression over a sequence of stimuli may be one important dimension by which liking and wanting diverge.

Sequential Response of Message Liking Versus Wanting

Individuals frequently experience multiple persuasive messages presented in close succession, such as a series of TV commercials, sales presentations, or speeches in a primary election debate. Although much past research has examined how temporal sequence affects evaluative judgments (Bruine de Bruin & Keren, 2003; Glazer & Cunitz, 1966; Li & Epley, 2009; MacFie, Bratchell, Greenhoff, & Vallis, 1989), existing studies have seldom considered multiple response dimensions and have not differentiated between liking versus wanting responses. In this research, we posit that because liking relies on affective experience and evaluation, affective mechanisms such as habituation and reference adaptation may have a stronger effect on persuasion stimuli liking; in contrast, motivational mechanisms such as goal activation may have a stronger effect on wanting.

Specifically, we argue that affective mechanisms are fundamentally reference based and that there are several potential different reference changes over the sequence that may lead to diminished liking over a sequence of likable stimuli. First, based on research on hedonic adaptation, we argue that when likable stimuli are experienced in succession, each experience may lead to some degree of adaptation to the pleasure level, leading the next one to be experienced less intensely (Lyubomirsky, Sheldon, & Schkade, 2005; Nelson, Meyvis, & Galak, 2009). Therefore, the affective impact of message stimuli may decrease due to adaptation, leading to an advantage in stimuli liking for earlier positions. Of note, we would expect hedonic adaptation to operate on disliked stimuli as well, leading to less dislike, and hence an advantage for later options in such cases. However, we focus on generally likable stimuli in this research because creators of persuasive messages aim to create likable messages. In such likable cases, we would expect hedonic adaptation to favor early options. Second, independent of the particular pleasures evoked by the stimuli, in the persuasion context, one inherent source of positive affect may be the novelty of the stimuli. In contrast, a lack of novelty may lead to a feeling of boredom. In particular, the first stimulus in a sequence may enjoy the greatest perception of novelty due to its greatest departure from the background experience (whatever the person was experiencing before the stimuli exposure). Thereafter, to the extent that the sequence of stimuli shares certain similarities (e.g., they are all TV ads with glossy production), the feeling of novelty will be reduced for subsequent ads, particularly after the first stimuli exposure. Third, liking has an evaluative component (e.g., how impressive was the visual), and the evaluative reference could change after the first stimulus (Li & Epley, 2009). In particular, whereas the first stimulus is evaluated against a global background reference (e.g., general sense of impressiveness of visuals), the later stimuli may be evaluated against the preceding stimuli in the sequence. To the extent the sequence is more attractive than general expectations, then the first stimulus would receive a high evaluation due to its lower reference, whereas the later stimuli would receive a dampened evaluation in comparison

to the first stimulus. In sum, we argue that liking is inherently a reference-dependent value, and through one or more of the above reference-based mechanisms, liking is expected to diminish in intensity over a sequence of likable stimuli. Further, such diminishing trend may not be linear—in particular, the loss of novelty and shift to relative reference may be the most substantial after the exposure to the first stimuli and tapers off somewhat thereafter.

In contrast, motivational mechanisms may work differently for wanting responses. Specifically, persuasive messages seek to activate a wanting response in the audience toward adopting the promoted object or enacting the promoted behavior. Wanting can be achieved by either activating low-level physiological drives (Berridge, 2009) or activating or creating higher-level cognitively appraised goals (Bagozzi & Dholakia, 1999; Kruglanski et al., 2002; Markus & Ruvolo, 1989; van Osselaer et al., 2005). Therefore, a sequence of different persuasive messages may be experienced as sequential activations of different drives and goals.

Previous literature has provided several insights into sequential activations of the motivation system from several different perspectives. First, research on addictive substances has demonstrated an incentive sensitization effect in repeated exposure to drugs (Berridge & Robinson, 2016). This effect is thought of as a type of conditioning effect in which a stimulus, such as the visual cue of white powder, has been repeatedly paired with the drug reward. Over a sequence of such paired experiences, the stimulus becomes an increasingly strong cue for the drug, and consequently the sequential exposure to this stimulus creates increasingly strong wanting for the drug. Further, research shows that wanting may also be generated by conditioning in ordinary persuasion contexts as well (Schachtman, Walker, & Fowler, 2011), if the sequential persuasions all involve the pairing of the same kind of stimulus (e.g., a beach scene) and reward (e.g., a beer). Thus, after watching a sequence of ads that repeatedly pair beaches with beers, the next instance the person is exposed to the image of a beach, it might activate an even stronger wanting for beer.

Nevertheless, in the persuasion context, a sequence of stimuli such as a sequence of ads shown during a commercial break often involves different stimuli and different goals, rather than the repetition of a single stimulus-reward pair. Thus, the strengthening of a stimulus-response pairing does not occur in such a sequence. In contrast, other sequential motivation activation dynamics across different drives and goals may apply. In particular, two streams of research speak to this question and yet make opposing predictions. One stream of research has demonstrated a devaluation effect (Brendl, Markman, & Messner, 2003) whereby the activation of one need lowers the subsequent motivation for actions serving other goals. For example, when smokers had been prohibited from smoking for a long period of time, their intense need for smoking was activated. Under this high-need state, they were significantly less interested in buying raffle tickets that would win them money. Thus, activating a smoking goal had made smokers less interested in other rewards such as money. The devaluation effect is also consistent with the theorizing of wanting of addictive substances, whereby wanting leads to a narrowing of interest (Berridge & Robinson, 2016)—for example, when wanting for a drug is activated, the person becomes narrowly focused on obtaining the drug and disinterested in anything

else. The devaluation or interest-narrowing effect would suggest that, when a first ad activates one wanting, the person should become less interested in other goals promoted in subsequent ads.

Interestingly, however, another stream of literature has demonstrated the opposite effect, whereby activating the wanting for one reward can have an appetizing (i.e., strengthening) effect on subsequent wanting of unrelated rewards. For example, activating the motivation for sex (e.g., seeing the image of a sexy body) may lead to greater urgency to acquire money (Li, 2008) and take financial risks (Knutson, Wimmer, Kuhn, & Winkielman, 2008); trying a tasty food activates the desire to eat but also the wanting for a message (Wadhwa, Shiv, & Nowlis, 2008). It is theorized that these effects occur because rewards of the appetitive type share the same neural system of approach motivation, such that activating one wanting activates one's approach system in general (Inzlicht & Schmeichel, 2012; Knutson et al., 2008), thereby increasing the intensity of subsequent activations of wanting of other rewards.

An interesting question is, therefore, in the sequential persuasion context, would we observe a devaluation (interest-narrowing) or appetizing effect for wanting? Previous research has not discussed how to resolve this apparent contradiction. Based on the different stimuli involved in the different streams of literature, we observe that whether a later wanting is enhanced or suppressed by an earlier wanting seems to depend on the intensity of the previous wanting activated. Specifically, it appears the devaluation effect was typically demonstrated after the activation of specific, extremely intense, physiological drive states such as smoking deprivation, hunger, or drug craving. In contrast, the appetizing effect has been demonstrated in the context of moderate wanting activation by visual stimuli, such as a picture of a sexy body, rather than severe physiological deprivation (Li, 2008). Thus, the effect may depend on whether a specific and extremely intense wanting is induced. When an extremely intense wanting is initially activated, the person may wish to actively pursue this wanting to the exclusion of other interests; however, when a moderate wanting is activated, the person has not become fixated, and yet the overall appetitive system is activated and sensitized to further rewards. Based on this conjecture, we posit that in persuasion contexts where wanting is activated by persuasive messages, the wanting response to an earlier message may be moderate, and hence an appetizing effect rather than a devaluation effect is more likely to occur for later wanting. For example, a message that activates wanting for a beach vacation would tend to activate the person's appetitive motivation system in general and increase the potential for wanting activation by a subsequent message promoting a new car. In other words, whereas earlier persuasive messages are making "cold calls," later messages face audiences that are "warmed up."

Taken together, even though we expect a general convergence such that more liked messages will lead to greater motivation for the promoted action, we also predict a specific condition of divergence, namely, in temporal progressions of liking versus wanting across sequential persuasive messages. Specifically, appealing stimuli elicit less liking later in the sequence (due to habituation and reference adaptation) but generate greater wanting later in the sequence (due to an appetizing effect). We test our proposition in a highly powered field experiment.

Method

Design and Procedure

To examine the temporal course of stimuli liking versus wanting responses to persuasion in a real-life context, we partnered with a large national market research firm to conduct a field experiment. In addition to the realism of the stimuli, the field setting also afforded us superb power and robustness in results due to the large scale of the experiment. The firm is specialized in the testing of new TV commercials in the United States. For the experiment, the firm recorded 1,344 new commercials that debuted on TV networks in the United States between 2013 and 2016, representing a majority of all high-expenditure national advertising campaigns during that period and covering a broad cross section of products and services.¹

The ads were tested in groups of six (each group is referred to as a “series”), for a total of 224 series. Each series was shown to a nationally representative set of at least 500 online subjects (on average 507 subjects per series) retained by market research partner companies. All subjects were recruited using the same routine recruiting method used by these market research partner companies. No subject was exposed to more than one series to avoid learning. Thus, there were $507 \text{ (rounded)} \times 224 = 113,535$ unique subjects in the data, who each watched six ads. The sample size per series, and the number of series tested were determined by the firm based on their standard practices for their clients. We accepted their practice because we deemed the sample size to be adequate for our research purpose.

Each subject watched the series of six ads in a fully randomized order. After each ad, the subject indicated liking and wanting responses (described in detail below) before she could proceed to the next ad in the series. Thus, in essence, each series was a fully randomized experiment with serial position as the manipulated factor and wanting and liking responses as dependent variables, with an average $N = 507$. The full sample contained 224 replications of this design with unique sets of stimuli and subjects in each replication. These replications of the design allowed us to test the robustness of our findings.

Subjects responded to several questions shown in random order immediately after exposure to an ad. In each, subjects indicated agreement with a statement by moving a slider on a horizontal scale between 0 (*not at all*) and 100 (*very much*) from a default position of 50. Of note, because measures for each ad were taken after that ad was played, rather than at the end of the series, any effect for later positions should be interpreted as “late position effects” rather than “recency effects.” Further, subjects did not know how many ads in total they would watch—hence, the late-position effects should not be interpreted as “ending” effects.

Two questions, in particular, measured stimuli liking and wanting of the promoted item: “*I like this ad*” and “*I want that! (whatever you think the commercial is about)*” (the text in quotes, including parenthetical, reflect the original wording provided to subjects). The use of explicit measures of liking and wanting is consistent with methods used in previous research on liking and wanting of ordinary objects (e.g., Dai et al., 2010; Garbinsky et al., 2014). Further, because wanting represents a motivation to acquire the promoted object, a validation pretest, reported next, confirmed that the wanting measure predicted real approach behavior.

Several other questions unrelated to this research (details regarding the number and content of these questions were not shared with us) were included for the firm’s clients. At the end, the survey asked subjects for demographic information. Subjects were 55% female with a mean age of 43.

Pretest: Predicting Real Acquisition and Approach Behavior

We captured wanting using a self-reported measure (“I want that”), which represented the degree of motivational force toward approaching and acquiring the promoted object. The ultimate measure of wanting would be to measure actual approach and acquisition behavior. Because we were not able to measure actual behavior in our field experiment, we conducted a pretest to ensure that our self-reported wanting measure can predict real approach and acquisition behavior. Each subject (recruited on MTurk; $N = 93$; obtained under a target of 100; screening for United States only and age < 35 for product relevance) viewed a TV commercial for the clothing retailer H&M and then indicated agreement with the same liking and wanting ad response questions as in the field experiment. After responding, participants were asked to make two choices with real incentives: first, to choose between receiving a \$50 H&M gift card versus receiving a \$50 GAP gift card—a behavioral measure of spending money to acquire the product—and, second, between seeing five pictures of in-season H&M clothing and seeing five pet pictures as a subsequent task—a behavioral measure of expenditure of time and energy to engage with the brand, which is a consequential action of approach.

Logistic regressions with wanting as the independent variable showed that the self-reported wanting measure indeed significantly predicted choosing the gift card from H&M ($\beta_{\text{wanting}} = .04$, $\text{Wald}(1) = 14.71$, $p < .001$), as well as choosing to view pictures of H&M clothing rather than pet pictures ($\beta_{\text{wanting}} = .03$, $\text{Wald}(1) = 15.70$, $p < .001$). Age and gender of participants were included as control variables in all models, but they did not reliably predict choice behavior. Of note, because wanting and stimuli liking were highly correlated ($r(91) = .74$, $p < .001$), when stimuli liking was used as an independent variable (without wanting in the model), it was also a significant predictor of both the gift card choice ($\beta_{\text{liking}} = .03$, $\text{Wald}(1) = 14.54$, $p < .001$) and the picture viewing choice ($\beta_{\text{liking}} = .04$, $\text{Wald}(1) = 12.73$, $p < .001$). However, when both stimuli liking and wanting were included in a logistic regression model predicting gift card choice, wanting was still a significant predictor ($\beta_{\text{wanting}} = .02$, $\text{Wald}(1) = 4.15$, $p = .04$), whereas stimuli liking was no longer significant ($\beta_{\text{liking}} = .02$, $\text{Wald}(1) = 2.66$, $p = .10$). Similar results were found for the picture viewing choice ($\beta_{\text{wanting}} = .02$, $\text{Wald}(1) = 4.55$, $p = .03$; $\beta_{\text{liking}} = .02$, $\text{Wald}(1) = 1.75$, $p = .19$). In sum, the pretest results suggest that the wanting measure indeed predicted actual

¹ The field experiment was not submitted to institutional review board (IRB) review because the experiment was run by the industry partner as a part of their routine business practice. Specifically, the data were collected as a part of routine market research for their commercial clients. The pretest, reported later, received approval from the IRB at Wendy Liu’s university.

acquisition and approach behavior, and further, wanting was a better predictor of acquisition and approach behavior than stimuli liking.

Results and Discussion

We proceed with reporting the results of the large-scale field experiment. First, we note that, as expected, there was a very high level of correlation between stimuli liking and item wanting ($r(681,208) = .79, p < .001$). However, we hypothesized that underneath this overall correlation, there may be a specific pattern of divergence with respect to temporal progression. To test this, we used a linear regression model to test the effects of serial position on liking and wanting measures, first separately and then in a unified model.

Specifically, in all tests, the regression model included fixed (i.e., categorical) effects for the six serial positions. We treated serial position as a categorical variable because we did not wish to impose any *a priori* restrictions on the position effect patterns (such as linear or quadratic shapes); instead, we tested for a categorical effect of each serial position in the series of six, which will give us the most complete and elemental information about the shape of the temporal progression. The model also included fixed effects for each stimulus and each subject to control for individual stimulus and subject effects.

Post hoc, we also tested several possible specific shapes (linear, exponential, quadratic) by treating serial position as a continuous variable. Tests showed that all three models (linear, exponential, quadratic) were significant for measures of both liking and wanting. Such results are not surprising because the actual curve of the position effects as plotted by the fixed effects of positions (Figures 1 and 2) resembles all three forms (Simonsohn, 2018). However, these specific model forms fit the data less well than the fixed-effects model and convey less complete information. Thus, rather than calling the effect of serial position linear, quadratic, or exponential, we simply report the fixed effect of each position to provide the fullest information and will not discuss these specific-form models further.

Serial Position Effect on Stimuli Liking

Using the above model with stimuli liking as the dependent variable, regression results showed a significant effect of serial positions. Specifically, stimuli liking was highest in the first slot of the series compared to all other serial positions, as shown in Figure 1 (t statistics ranging from -21.2 to $-26.5, ps < .001$). The effects of subsequent serial positions were not statistically distinguishable from each other, although all result in less liking than the first position. On average, a persuasive message in the first slot ($M = 65.23, SE = .08$) was rated at least 1.6 points higher on the liking scale than at any subsequent position, including the last position ($M = 63.48, SE = .08$).

Thus, consistent with the proposed habituation and reference adaptation mechanisms driving liking, we found liking to diminish over a series of exposures. In particular, the drop in liking occurred primarily between the first ad and the second ad. This pattern is particularly consistent with the mechanisms of loss of novelty, as well as a shift in reference from one's prior global expectations to the preceding ads.

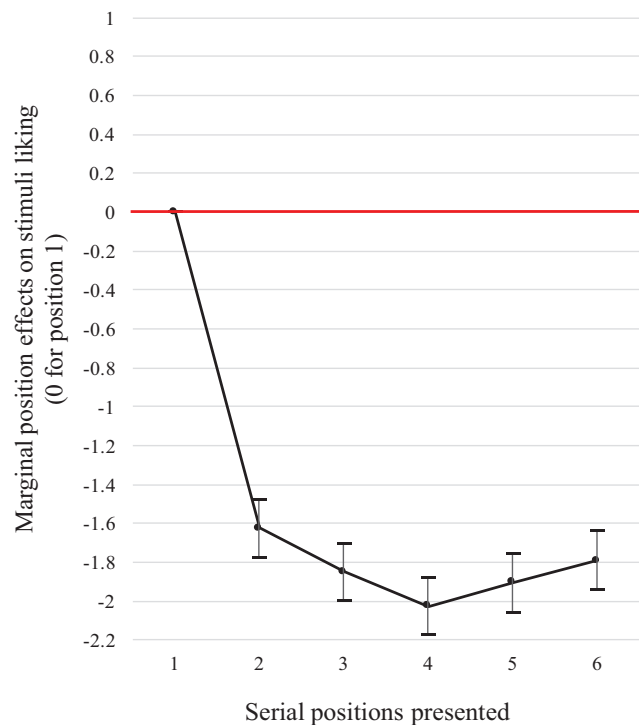


Figure 1. Serial position effect estimates on stimuli liking: marginal effects of all six positions. Error bars represent the 95% confidence intervals. The estimates are 0 for Position 1 (normalized); $\beta = -1.63$ for Position 2, $t(566,550) = -21.23, p < .001$; $\beta = -1.85$ for Position 3, $t(566,550) = -24.16, p < .001$; $\beta = -2.02$ for Position 4, $t(566,550) = -26.45, p < .001$; $\beta = -1.90$ for Position 5, $t(566,550) = -24.87, p < .001$; and $\beta = -1.79$ for Position 6, $t(566,550) = -23.38, p < .001$. See the online article for the color version of this figure.

Of note, the effect size is small—the mean difference (between first and last position) was 1.75 points out of 100 points (a 2.68% decrease—the average liking score at Position 1 was 65.23), and the standardized effect size (d) was 0.07; however, it is a meaningful difference. For example, the top-rated Super Bowl ad (rated by thousands of individuals on *USAToday's* polling site) often exceeds the second highest-rated ad by only hundredths of points in mean difference and yet receives a disproportional amount of postgame viewing due to the press and social media attention. In a small sample, such a small effect on stimuli liking may not be statistically detectable because it may be swamped by random noise²; however, in a large sample, a small but systematic shift would become detectable because random noise would have canceled out. Thus, if a manipulation such as serial position can slightly yet systematically shift a large sample's liking response to a persuasive message, this manipulation has made a meaningful impact on the liking response to persuasion. Also of note, because our experiment is so highly powered, the effect size estimate,

² Power analysis, based on our results, shows one needs over 3,730 subjects to achieve an 80% chance of detecting a difference in liking between the first and last position with 95% confidence.

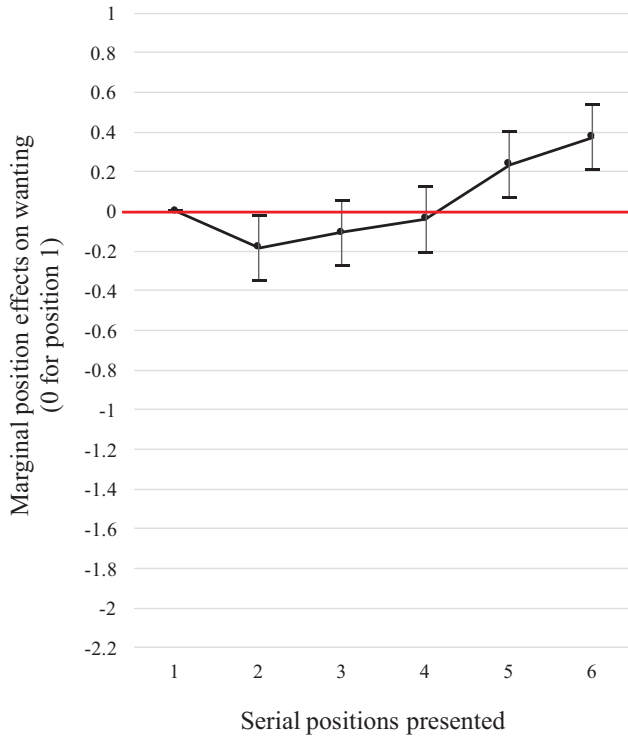


Figure 2. Serial position effect estimates on wanting: marginal effects of all six positions in response to “*I want this.*” Error bars represent the 95% confidence intervals. The estimates are 0 for Position 1 (normalized); $\beta = -.18$ for Position 2, $t(566,550) = -2.20$, $p = .03$; $\beta = -.11$ for Position 3, $t(566,550) = -1.28$, $p = .20$; $\beta = -.04$ for Position 4, $t(566,550) = -.47$, $p = .64$; $\beta = .24$ for Position 5, $t(566,550) = 2.81$, $p = .005$; and $\beta = .37$ for Position 6, $t(566,550) = 4.45$, $p < .001$. See the online article for the color version of this figure.

while small, is extremely precise (Simonsohn, Nelson, & Simmons, 2014), giving us confidence that this revealed effect size is a good representation of the true effect size (i.e., it is a small effect).

Robustness Check

Further, we test the robustness of this result by noting that, as mentioned earlier, the data in fact contained 224 replications of the same experimental design (i.e., 224 series with six ads in each), with different stimuli and subjects in each replication. We implemented a bootstrapping analysis by drawing 100 random groups of 20 series per group (from the 224 series available). We examined, for each bootstrapped group, whether the first position maximized stimuli liking. Indeed, we find that the first position produced the greatest liking in 100% of the bootstrapped groups (further, all of these 100 tests were statistically significant at $p < .05$). Thus, the aggregate pattern is extremely robust over a large number of replications involving diverse stimuli, demonstrating that the effect is not driven by any specific set of stimuli.

Serial Position Effect on Wanting

Applying the same model to wanting of the promoted item, regression results show a starkly different effect of serial positions.

Specifically, as shown in Figure 2, wanting is higher for persuasive messages presented later in the series and highest at the final position. On average, the last position ($M = 58.95$, $SE = .09$) is rated 0.4 points higher than the first position ($M = 58.56$, $SE = .09$, $\beta = .37$ for Position 6 with Position 1 as reference, $t(566,550) = 4.45$, $p < .001$). Thus, wanting followed a sharply different temporal progression than message liking. Consistent with an appetizing account, wanting increased over a series of exposures.

Of note, as in the case of liking, the effect size was small for wanting—the mean difference between first and last position was 0.4 points on a 100-point scale (a .66% increase from Position 1—the average wanting score at Position 1 was 58.56), and the standardized effect size (d) was .01. However, over a large population of thousands or millions, even a fraction of a percent (but systematic) shift as we have here can have a meaningful impact on aggregate outcome. Such a small shift will not be detectable in a small sample³ but becomes detectable and highly reliable in a large sample. Further, because of the high power of the experiment, the effect size estimate is precise (Simonsohn et al., 2014), giving us confidence that this revealed effect size is a good representation of the true effect size. More important, the shift in stimuli liking versus wanting, while both small, went in opposite directions, speaking to the distinct psychological processes underlying these two dimensions of the reward system.

Robustness Check

Further, we tested the robustness of the serial position effect on wanting using bootstrapping. As for stimuli liking, we constructed 100 groups of 20 randomly drawn series (out of the 224). Confirming the aggregate result, directionally, the last position yielded greater wanting than the first position in 95% of the 100 bootstrap replications (further, 27% of these 100 tests were statistically significant at $p < .05$). Thus, the late-position advantage in wanting was directionally highly robust across many diverse sets of stimuli and subjects.

Finally, we directly tested the divergence between stimuli liking and wanting of the item in one model. Specifically, we ran a regression with subject and stimulus fixed effects, serial position fixed effects, a response-type fixed effect (0 = *liking*, 1 = *wanting*; a within-subjects factor), and the interaction between position and response type. Results show a significant interaction between position and response type for each position (in particular, $\beta_{\text{wanting-Position1}} = -6.67$, $t(1,247,754) = -83.54$, $p < .001$; $\beta_{\text{wanting-Position6}} = 2.13$, $t(1,247,754) = 18.90$, $p < .001$; and $p < .05$ for all other interactions as well, consistent with Figures 1 and 2; see Figure 3 for illustration of divergence).

In conclusion, although overall stimuli liking and wanting of the promoted item correlate strongly ($r(681,208) = .79$, $p < .001$), underneath the aggregate pattern, there is in fact a stark divergence in terms of temporal progression of the two dimensions. Further, the temporal patterns are extremely robust across replications. Next, we seek to provide some evidence for the proposed mech-

³ Power analysis, based on our results, shows one needs over 86,619 subjects to achieve an 80% chance of detecting a difference in wanting between the first and last position with 95% confidence.

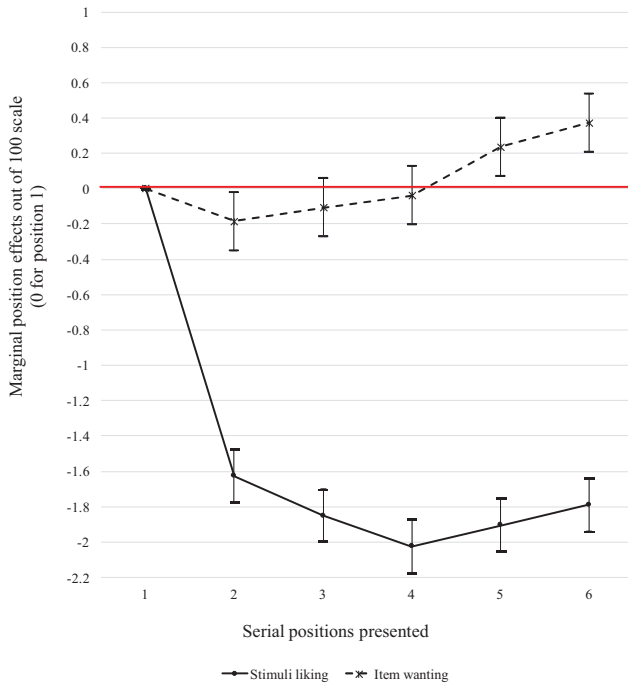


Figure 3. Divergent serial position effects for liking and wanting. See the online article for the color version of this figure.

anisms underlying the temporal patterns; in particular, we seek to probe the intriguing appetizing effect for wanting.

Appetizing Effect of Wanting

We hypothesized that wanting increases over the sequence of persuasive messages because the activation of the earlier reward goals can activate a person's reward motivation system in general, hence enhancing the motivation for subsequent rewards. If this is the case, then we would expect the increase in wanting for later goals to be particularly steep when earlier goal activations are particularly strong. In other words, if the earlier ads did not create significant wanting (i.e., failed to activate the wanting system), then they will have a weak appetizing effect for later goals in the sequence. Thus, we expect the serial position effect on wanting to be moderated by the level of wanting from preceding messages. To this end, we ran a regression model with wanting for each ad as the dependent variable, ad fixed effects, subject fixed effects, and position fixed effects as independent variables as before, while adding an additional interaction term between serial position and an index of "average level of wanting activated per preceding ad."

We computed the index of "average level of wanting activated per preceding ad" as the following: For any given ad that is at serial position k in the sequence, for subject i , looking at ad_k , we took the average wanting score for each preceding ad_m ($m \in [1, k-1]$) given by all other subjects and then averaged across ad_1 through ad_{k-1} . That is, we first took the average wanting score received by each preceding ad across all subjects, and then we took the average of all preceding ads. This average is an index of the average level of wanting per ad before the focal ad was shown. The

average level of wanting per ad is then interacted with serial position.

Therefore, if a series offered preceding ads that (on average) generated the most wanting (e.g., by showing luxurious vacations, beautiful models), then the later focal ad would benefit from a greater appetizing effect and thus would be rated higher on the wanting dimension than if the focal ad were shown earlier without the benefit of the preceding ads. On the other hand, if (on average) each preceding ad generated little wanting (e.g., plain, informational ads), then little "appetite" would have been created prior to the focal ad, and therefore the focal ad would not benefit as much from a late-position boost in wanting response.

The regression results indeed supported this prediction: The moderation of the serial position effect (i.e., interaction terms between serial position and *average level of wanting activated per preceding ad*) was positive across all positions and significant for Positions 4–6. Specifically, Position 1 did not have a moderation effect term because there were no prior ads; Position 2 was used as reference level for interaction effects between serial position and *average level of wanting activated per preceding ad* (i.e., level zero in Figure 4); interaction coefficients were estimated for Positions 3–6: $\beta_{\text{Position}_3} = .01$, $t(567,665) = .39$, $p = .70$; $\beta_{\text{Position}_4} = .056$, $t(567,665) = 3.52$, $p < .001$; $\beta_{\text{Position}_5} = .061$, $t(567,665) = 3.78$, $p < .001$; and $\beta_{\text{Position}_6} = .063$, $t(567,665) = 3.90$, $p < .001$. Thus, for Positions 4–6, the greater the *average level of wanting activated per preceding ad*, the greater the total impact of position on wanting, consistent with the appetizing effect prediction. The interaction term for Position 3 was not significant (with Position 2 as reference), perhaps because the accumulation of appetizing effect up to that point was overall small such that variations in *average level of wanting activated per preceding ad* did not detectably moderate the magnitude of the (small) position effect at that point.

Figure 4 illustrates the moderated position effects. When the *average level of wanting activated per preceding ad* was high (i.e., one standard deviation above the mean value), wanting generated by the current ad increased over the positions. In particular, the 95% confidence intervals of wanting in Positions 4–6 did not include the 95% confidence interval of wanting in Position 2, indicating that later positions significantly boosted wanting compared to earlier positions. On the other hand, when the *average level of wanting activated per preceding ad* was low (i.e., one standard deviation below the mean value), there was no longer a boost in wanting for later positions—the 95% confidence intervals of all positions overlapped with each other. This result suggests the overall boost in wanting for later positions came entirely from cases where preceding ads generated high wanting, supporting the appetizing effect of wanting.

With the inclusion of the interaction terms, the main serial position effects on wanting no longer showed the increasing pattern ($\beta_{\text{Position}_3} = -.28$, $t(567,669) = -.30$, $p = .76$; $\beta_{\text{Position}_4} = -3.14$, $t(567,669) = -3.34$, $p < .001$; $\beta_{\text{Position}_5} = -3.17$, $t(567,669) = -3.32$, $p < .001$; and $\beta_{\text{Position}_6} = -3.15$, $t(567,669) = -3.31$, $p < .001$). Of note, even though some of these main coefficients became negative when the interaction terms were added, the *total* effect of each serial position, that is, the sum of the main and interaction effects for each position, was still positive, consistent with the original model where only the main effects but no interaction effects were entered.

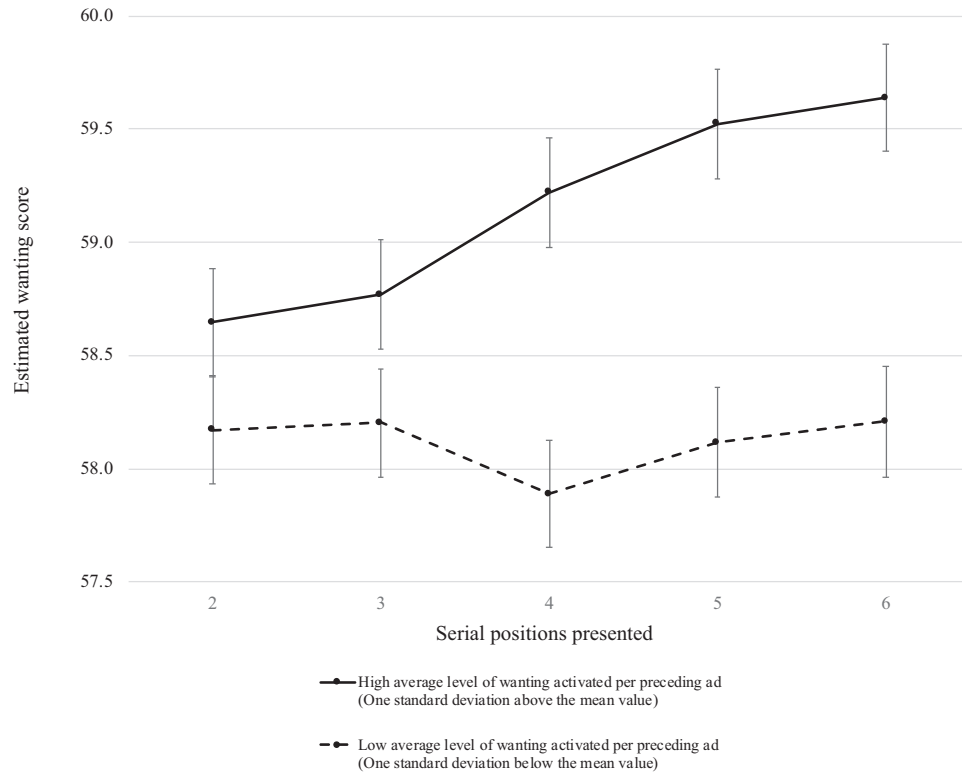


Figure 4. Moderation of the serial position effects for high and low values of the average level of wanting activated per preceding ad. Error bars represent the 95% confidence intervals of the wanting score estimates.

In sum, the main positive effect of serial positions on wanting was completely qualified by the extent to which the preceding ads had an appetizing effect.

General Discussion

A highly powered, fully randomized field experiment examined liking and wanting in an everyday, nonaddiction context, namely, in response to persuasive stimuli. Results revealed a nuanced way in which liking and wanting diverge in response to persuasion, namely, in their temporal progression across serial positions. We find liking to decline over multiple attractive stimuli consistent with a habituation/reference-adaptation account. In contrast, wanting increased over multiple desire-creating stimuli, consistent with an appetizing effect.

These results contribute to theories of liking versus wanting by expanding the evidence of their divergence to an ordinary, nonaddictive context that involves a sequence of multiple stimuli and rewards. In particular, results suggest that one fundamental difference between liking and wanting in sequential progression is that, whereas liking has a reference-based dynamic, wanting has a cumulative dynamic over multiple exposures. This general difference is also applicable to previous findings in incentive sensitization theory, whereby liking wanes due to hedonic habituation, whereas wanting grows with cumulative conditioning.

This research also speaks to the seeming contradiction between the devaluation (interest-narrowing) effect versus the appetizing effect when multiple reward goals are activated in sequence. We

conjectured that the effect of serial position on wanting may depend on the intensity of the first wanting activated, whereby the negative devaluation effect is more likely to occur in conditions of deprivation and resulting in extremely intense wanting; in contrast, the positive appetizing effect is more likely under moderate wanting without severe deprivation. We observe that the persuasion context is more similar to the moderate wanting contexts in which the appetizing effect has been demonstrated in the past. The results confirmed our conjecture. However, if the first ad generated intense wanting (e.g., an ad for gambling shown to a gambling addict), the question remains whether wanting generated by subsequent ads would increase or decrease. In general, much more research is needed to systematically theorize and test the antecedents and drivers of the devaluation versus appetizing effect in sequential wanting.

More broadly, future research may more deeply theorize and examine the difference between “wanting” (defined by the quotation marks and typically used in contexts of drugs) and ordinary wanting (some of which look more similar to “wanting,” such as the wanting of food, but others are different, such as the wanting of social status). One view may be that “wanting” constitutes the “core” (Berridge & Robinson, 2016) process that is the inner core of all wantings, including ordinary wanting. That is, the “core” refers to the part of the motivational process that is directly neurologically represented, without much cognitive appraisal. Then on top of this “core,” ordinary wanting also has additional cognitive appraisal and goal pursuit processes that govern the

overall motivational outcomes (whereas drug wanting is considered “pure wanting,” because it presumably consists more primarily of just the core process). This is a large theoretical gap, and much more work is needed to fully delineate the relationship between “wanting” and ordinary wanting. One way to begin to bridge the theoretical gap may be to accumulate greater empirical evidence, such as those provided in this research, of the ways in which “wanting” and ordinary wanting are (dis)similar.

Finally, our findings also contribute to theories of persuasion. Previous research on persuasion has examined the relationship between various persuasion outcomes, such as the affective outcome of liking, the cognitive outcomes of learning and memory, the motivational outcomes of wanting and intention, and actual behavioral change. Although these past works have examined the relationship among these variables, they have not focused on their theoretical differences or examined the potential conditions for their divergence, such as the temporal progressions of these variables. The current research shed light on this topic by focusing on the fundamentally different nature of the liking and wanting dimensions, thereby predicting and demonstrating their divergence in temporal progression across sequential persuasion.

Further, whereas we focused on liking of the persuasion stimuli and wanting of the promoted object, there could also be other objects of liking and wanting ensuing from the persuasion context. In particular, there could be “liking of the product.” However, because the person has only experienced an advertisement for the product (not the product itself), this liking is a more complex construct. In particular, this liking could come from two sources—namely, one’s “anticipatory liking” based on inferences from one’s experience of the current ad stimuli and, for some subjects, the “prior liking” of the product (if the person has actually consumed the product before). Because we would like to first study a direct liking response that ensues from the experience of the current stimuli (rather than “prior liking” or “anticipatory liking”), we did not focus on liking of the product in this research. However, future research can examine the temporal progression of liking of the product in sequential persuasion, and it may be important to differentiate between the case where the person has experienced versus not experienced the product before. Another somewhat different construct would be “liking of the brand.” The brand is typically understood as the symbolic aspect of a product. In this sense, brand liking may respond most to the symbolic features of the ad stimuli, and future research can examine the temporal dynamic of brand liking from persuasion and how it relates to wanting. In sum, our results prompt future research on persuasion to more deeply consider the different psychological systems underlying persuasion processes and to more deeply consider the measures used (which psychological systems they tap into), so as to better understand the factors that may lead them to converge or diverge in temporal progression. Additionally, whereas subjects in the present research responded to the ads in a marketing research setting, future research can seek to test persuasion response in *in-situ* persuasion contexts, such as during TV viewing.

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