Feeling and Thinking in Memory-Based versus Stimulus-Based Choices

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We contrast memory-based and stimulus-based choices, using dual-process theories such as Kahneman and Frederick's system 1/system 2 dichotomy. Systems 1 and 2 are conceptualized as distinct modes of thought, the former automatic and affective, the latter controlled and deliberate. Cognitive load impedes system 2, yielding greater reliance on system 1. In memory-based choice, consumers must maintain relevant options in working memory. Thus, memory-based choices are associated with greater cognitive load than stimulus-based choices. Indeed, we find that memory-based choices favor immediately compelling, affect-rich system 1 options, whereas stimulus-based choices favor affect-poor options whose attractiveness emerges from deliberative system 2 thought.

Consider a consumer who is perusing the frozen desserts stocked at a local grocery store, intending to purchase one of these desserts for a dinner later in the week. Now, suppose that this same consumer is not at the grocery store but is instead at home drawing up a shopping list of items, including frozen desserts, that she will purchase on her next grocery store visit. In the former circumstance, the consumer is selecting from items that are lined up in front of her at the store itself; in the latter circumstance, the consumer must attempt to recall the items available at the store and only then can select which item to include on her shopping list. Under which circumstance will the consumer be more likely to opt for a sinful dessert, such as chocolate cake or cheesecake, over a healthy alternative, such as fruit salad?

Such questions were first suggested by Lynch and Srull (1982) in a seminal article in which they contrasted decisions in which relevant choice options were specified or listed for consumers (as when the consumer peruses options stocked at the grocery store) from decisions in which consumers on their own recalled the identity of relevant options (as when the consumer draws up a shopping list while at home). Lynch and Srull classified the former type of decisions as "stimulus based" and the latter type as "memory based." In this article, we examine differences in stimulus-based and memory-based choices that may be explained by dual-process theories of mental processing. Although the terms *stimulus based* and *memory based* are commonly used to refer to a number of distinctions, we use these terms to refer only to whether choice options are specified or must be recalled by the consumer.

Recent research has identified two distinct modes of thought, one associative and feeling based, the other deliberate and rule based (Chaiken and Trope 1999; Epstein 1994; Peters and Slovic 2000; Sloman 1996; Stanovich and West 2002). For instance, Kahneman and Frederick (2002) contrast what they call system 1 and system 2 mental processing. They describe system 1 as automatic, rapid, associative, and affective and system 2 as controlled, slow, deliberative, and deductive. Moreover, they view system 2 as an effortful check on the more reflex-like system 1. They write: "System 1 quickly proposes intuitive answers . . . system 2 monitors the quality of these proposals, which it may endorse, correct, or override" (Kahneman and Frederick 2002, 51).

We argue that memory-based choices tend to reflect relatively more system 1 processing, whereas stimulus-based choices reflect relatively more system 2 processing. Thus, memory-based choices tend to favor immediately compelling, affect-rich options, whereas stimulus-based choices tend to favor affect-poor options whose attractiveness emerges only given more deliberative thought. A key premise underlying our claim is that memory-based choices are made in a context of relatively depleted processing capacity.

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Recalling a consideration set of relevant options is effortful. More critical, in memory-based choice, a consumer engages in the task of identifying a favorite from his or her consideration set while also devoting resources to maintaining this set in working memory. In contrast, under a stimulus-based procedure, there is no need to recall the relevant options and no need to maintain them in working memory; thus, the task of identifying a favorite occurs in a context of relatively plentiful mental resources.

Much theorizing asserts that controlled, system 2 processing is easily impeded by cognitive load but that automatic, affective, system 1 processing is unaffected by cognitive load (Drolet et al. 2005; Schriffin and Schneider 1977). That is, system 1 is able to operate whether or not cognitive resources are strained, whereas system 2 is more likely to operate only when cognitive resources are plentiful. As a result, system 1 may tend to guide memory-based choices, whereas system 2 may tend to guide stimulus-based choices.

Our analysis builds on an important experiment by Shiv and Fedorikhin (1999; Ward and Mann 2000). These authors had participants memorize either a two-digit or seven-digit number. While they were walking to another room to report this number, participants were offered a choice between two snacks, chocolate cake (which the authors characterized as yielding relatively favorable feelings [tasty] but unfavorable cognitions [unhealthy]) and fruit salad (unfavorable feelings [less tasty] but favorable cognitions [healthy]). Shiv and Fedorikhin predicted that taxing cognitive resources (by having participants memorize seven digits rather than just two) would reduce deliberative capacity and thus increase the likelihood that the affectively favorable chocolate cake would be chosen over the cognitively favorable fruit salad. Indeed, chocolate cake was selected more often when cognitive resources were taxed than when they were not.

In Shiv and Fedorikhin's setting, system 1 may express an urge for chocolate cake, which system 2 overrides, if it can, say, by sticking to the consumer's diet by enunciating a preference for fruit salad. However, because system 2 is more effective given plentiful cognitive resources, it is capable of ensuring the choice of fruit salad given low cognitive load (i.e., two-digit memorization) but not high cognitive load (i.e., seven-digit memorization). Although Shiv and Fedorihkin examined only stimulus-based choice, their insights may imply a systematic relationship between memory-based choice and stimulus-based choice. If differences in cognitive load yield differential influence of systems 1 and 2, memory-based choices may tend to reflect the workings of system 1 and stimulus-based choices may tend to reflect the workings of system 2.

We present three studies testing this analysis. Our first two studies examine decisions that pit immediately compelling, higher-affect, hedonic, fun options (e.g., chocolate cake) against lower-affect but more sensible or appropriate options (e.g., fruit salad). As predicted, we find that memory-based choices favor the higher-affect, hedonic options, whereas stimulus-based choices favor the more sensible or appropriate options.

Note that the conception of a system 2 that may be somewhat disabled when resources are drained is reminiscent of Baumeister and colleagues' theory of self-control. Muraven and Baumeister (2000, 237) write that "controlling one's own behavior requires the expenditure of some inner, limited resource . . . people have a limited quantity of resources available . . . [and] tend to fail at self-control when recent demands and exertions have depleted their resource." Dual process theories, such as Kahneman and Frederick's, propose a general dichotomy of automatic, reflex-like, affective processing versus controlled, deliberate processing meant to apply to many different domains. These theories are thus compatible with, and in some respects generalize, Baumeister's model, which focuses on self-regulation. Our third experiment thus tests implications of the system 1/system 2 dichotomy outside the domain of self-regulation.

In that experiment, we find that price changes yield a standard negative price elasticity under memory-based choice but a surprising positive price elasticity under stimulus-based choice. We suggest that, given taxed mental resources, memory-based participants may rely on relatively reflexive assessments. Thus, they may be repelled by higher-priced items. By contrast, given ample mental resources, stimulus-based participants may supplement reflexive responses with deliberate reflection. In particular, our data suggest that, in the context we study, stimulus-based participants infer that high prices signal high quality. Such an inference constitutes a system 2 override of system 1's aversion to high prices and implies that stimulus-based participants may be attracted to higher prices rather than repelled by them.

Throughout our presentation, we rule out a number of alternative accounts. In closing, we address the connections between our results, trade-off aversion, and preference malleability.

EXPERIMENT 1: DESSERTS

In this experiment, we examine dessert choices, as Shiv and Fedorikhin did. However, we examine choice among four desserts (chocolate cake, cheesecake, crème, and fruit salad) rather than just between two. We study a four-option set because recall and maintenance of just two options may not strain mental resources enough to engender meaningful stimulus-memory differences. Indeed, in a pilot study, we had participants make either a stimulus-based or a memory-based choice between the two desserts studied by Shiv and Fedorikhin, chocolate cake and fruit salad. Participants were not presented with the actual desserts but were merely given a written list of the desserts (experiment 1 also followed a written format). Stimulus-based and memory-based choices showed little difference; the market share of fruit salad was 47% when stimulus based ($n = 117$) and 45% when memory based ($n = 119$). These results led us to study a four-option choice set.

Following Shiv and Fedorikhin, we expected (and con-

firmed in manipulation checks discussed later) that fruit salad would be viewed as healthier but less tasty than the other desserts. Fruit salad should thus be more popular in stimulus-based choice than memory-based choice:

H1: Stimulus-based choices will tend to favor healthy desserts, whereas memory-based choices will tend to favor tasty desserts.

To reinforce our analysis, we supplemented the basic stimulus-based and memory-based conditions with two additional conditions. One of our aims was to disentangle the impact of recalling options from the impact of maintaining options in working memory. We do not believe that merely tapping memory changes preferences. Rather, we believe that the critical factor is the strain that maintenance of options places on mental resources. To test this belief, we had some participants recall all four options, write down a list of these options, and then identify the listed option that was their favorite. In this memory-based-without-maintenance condition, participants engaged in recall, but, because they created a list for themselves and subsequently chose from this list, they did not need to maintain options in working memory while selecting a favorite. In other words, these participants actually made their choice under stimulus-based conditions. Memory-based-without-maintenance participants should thus show essentially the same pattern of choices as standard stimulus-based participants:

H1a: Recalling a list of options, writing down the list, and selecting a favorite from the list will yield choices that are equivalent to standard stimulus-based choices.

Finally, we had some participants make a stimulus-based choice while maintaining seven digits in working memory. Participants in this stimulus-based-with-maintenance condition made a stimulus-based choice but did so under cognitive load (because they had to maintain seven digits in memory). If memory-based choices are affected by the taxing of mental resources associated with maintaining information, stimulus-based-with-memorization participants should show essentially the same preferences as memory-based participants:

H1b: Making a stimulus-based choice while performing the digit-maintenance task will yield choices that are equivalent to memory-based choices.

Method

Participants, students at University of California, Los Angeles, were randomly assigned to one of four between-subject conditions: stimulus based ($n = 195$), memory based ($n = 105$), memory based–without maintenance ($n = 162$), and stimulus based–with maintenance ($n = 340$). Each participant received cash for completing a questionnaire packet that also included other unrelated studies.

Near the beginning of the packet, participants encountered a blue sheet that listed the four desserts. To encourage involvement with these options, participants were asked to indicate whether they had eaten each of these desserts in the previous 2 months. Near the end of their packet, after several intervening, unrelated tasks, participants encountered a questionnaire that reminded them that they had earlier been presented with four desserts on the blue sheet, and now they were asked to select their favorite dessert. We introduced the options on a special blue sheet (all other pages in the packet were white) to enhance their prominence and facilitate their recall.

Memory-based participants were asked, "Of the four desserts you saw listed on the blue page, which would you most prefer to have?" Stimulus-based participants were asked, "Which of the following desserts would you most prefer to have?" and this question was followed by a listing of the four desserts. Stimulus-based-with-maintenance participants were asked the same question and saw the same list but with cognitive load. Specifically, these respondents were asked to memorize a seven-digit sequence of numbers while indicating their choice among the desserts on the list. Memory-based-without-maintenance participants encountered instructions that asked them to list the four desserts they had seen listed on the blue page, and then, on the subsequent page in the packet, they encountered instructions stating: "Please review the desserts that you listed. Then, please circle the listed dessert that you would most prefer to have."

Several pages later, memory-based participants were asked to list all four desserts; 108 of 157 were able to do so correctly. A much larger percentage of memory-based-without-maintenance participants, 138 out of 155, were able to do so ($p < .0001$ by chi-square). It is not surprising that more memory-based-without-maintenance participants remembered all four options; these participants were asked to list all four options earlier than memory-based participants. Still, the juxtaposition of memory-based-without-maintenance and memory-based participants is instructive; it suggests that all four options were recallable by almost all participants at the time of choice. Our analyses drop participants who did not correctly list all four options. Including these participants does not change the qualitative pattern of results.

Finally, using 10-point scales, a separate group of participants rated how tasty and healthy each dessert was. As expected, fruit salad was seen as healthier ($M = 7.9$) than chocolate cake, cheesecake, and crème brulée ($M = 2.4$, $M = 2.5$, and $M = 2.6$, respectively; $p < .01$ for each of the three pairwise differences with fruit salad). Fruit salad was also seen as less tasty ($M = 6.4$) than either chocolate cake or cheesecake ($M = 7.1$ and $M = 7.5$, respectively; $p < .05$ for each of the two pairwise differences with fruit salad); crème brulée ($M = 6.3$; NS) was seen as about equally tasty as fruit salad.

Results

Participants' choices, summarized in table 1, supported our predictions. Consistent with hypotheses 1, the market

TABLE 1

RESULTS OF EXPERIMENT 1

	Chocolate cake	Cheesecake	Crème brulée	Fruit salad
Memory based	37	40	11	12
Stimulus based	31	36	12	21
Memory based without maintenance	30	29	19	21
Stimulus based with maintenance	44	24	24	9
Difference (Memory based − Stimulus based)	−6	−4	1	9
Difference (Memory based without maintenance − Stimulus based)	−1	7	−7	0
Difference (Stimulus based with maintenance − Memory based)	7	−16	13	−3
Tasty rating	7.1	7.5	6.3	6.4
Healthy rating	2.4	2.5	2.6	7.9
Rating difference (Tasty − Healthy)	4.7	5.0	3.7	−1.5

NOTE.—The top four rows present the market share of each option under memory-based, stimulus-based market, memory-based-without-maintenance, and stimulus-based-with-maintenance procedures. The difference in market shares across various conditions is indicated in the next few rows. Ratings of how tasty and healthy each option is can be found next, followed by differences in these ratings.

share of fruit salad was only 12% when memory based, but that rose to 21% when stimulus based ($z = 1.99$, $p < .05$). Consistent with hypothesis 1a, the market share of fruit salad in the memory-based-without-maintenance condition was 21%, equivalent to its stimulus-based market share (the comparison with the memory-based condition was marginally significant, $z = 1.90$, $p = .06$). This observation appears to rule out the notion that merely having to recall options changes preferences. Evidently, the critical factor is the need to maintain options in working memory. Finally, consistent with hypothesis 1b, the market share of fruit salad in the stimulus-based-with-maintenance condition was 9%, slightly lower than its memory-based market share ($z = 3.64$, $p < .01$, for the comparison with the standard stimulus-based condition). This observation reinforces the argument that maintaining information in memory taxes mental resources in a way that biases choices against the healthy option and toward the tasty options.

In sum, the observed results are consistent with the notion that memory-based choices are guided relatively more by feeling-based considerations (say, an urge for tasty food), whereas stimulus-based choices are guided relatively more by cognitive or deliberation-based considerations (say, the need to obey a sensible diet) and that this difference arises because, as compared to stimulus-based choices, memory-based choices are made in circumstances in which cognitive resources are relatively depleted.

Our results cannot disentangle two distinct mechanisms by which system 1 could operate. First, system 1 processing could rely on affective reactions per se; the very emotions that consumers experience as they encounter relevant choice options might guide their preferences. Second, system 1 processing could rely on consumers' recall of stored memories of feelings about choice options or stored attitudes about these options; remembered emotions may guide consumers' preferences (Schwarz and Clore 1988; Wright 1975). Note that the simple fact that memory-based choice induces memory processes to operate may smooth the way to recall of affective information; retrieving relevant options from memory may prime the pump to retrieval of affective information.

We wish to emphasize that memory-stimulus differences are likely to arise only when choice sets are large enough but not too large. With very small choice sets (say, only two options), memory requirements are unlikely to appreciably tax mental resources. When very many options may be recalled (e.g., tens of options), consumers may economize on mental effort in a pronounced way, say, by considering only the few options that most readily come to mind.

Two alternative accounts draw on the notion that memory-based choice may engender attempts to economize on mental effort. First, it could be (*a*) that more tasty desserts are more readily accessible from memory and (*b*) that memory-based choices favor tasty desserts because participants save mental effort by choosing any satisfactory option that quickly comes to mind.

To evaluate this accessibility hypothesis, we examined memory-based-without-maintenance participants' option listings. Of these 155 participants, five did not include chocolate cake on their list, 11 did not include crème brulée, two did not include cheesecake, and 15 did not include fruit salad. By this measure, fruit salad may be slightly less accessible than the other options, but it is clear that all four options are highly accessible. We also computed the average listed position (1–4) of each option (across participants listing all four options). These were 1.8 for chocolate cake, 2.0 for crème brulée, 2.4 for cheesecake, and 3.6 for fruit salad. Again, by this measure, fruit salad might seem less accessible. However, because fruit salad is different from the other three options and because those three options are similar to one another and are more prototypical desserts, one should expect fruit salad's listed position to fall below that of the other options. Even if fruit salad were only slightly less accessible than the other desserts but was highly accessible in absolute terms, its listed position would be relatively low.

In sum, whether the accessibility hypothesis plays a role in the present experiment is an open question. There is little evidence either for or against this mechanism. Accordingly,

in experiments 2 and 3, we use methodologies that allow us to cast doubt on the accessibility hypothesis as an important mechanism underlying our results.

A second alternative account holds that memory-based participants economize on mental effort by selecting the option that is best on the most prominent attribute. Indeed, when we asked new participants to evaluate how important tastiness and healthiness were in dessert decisions, using seven-point scales, they gave mean ratings of 6.3 to tastiness and 5.4 to health ($t(102) = 4.32$, $p < .001$). Thus, it is possible that the prominent attribute hypothesis plays some role in the present experiment. However, just as the methods of the following experiments allow us to cast doubt on the accessibility hypothesis, they also allow us to cast doubt on the prominent attribute hypothesis.

EXPERIMENT 2: COLLEGES

We again examine a decision pitting more hedonic options against a more sensible option. This time, however, we cross our manipulation of memory-based versus stimulus-based choice with a manipulation of the identity of the options under consideration. In particular, we ask participants, students at University of California, Los Angeles, to indicate which of four colleges they would most prefer to attend assuming that they did not attend their current school. Some participants encountered a choice set composed of Duke University; University of Michigan; University of California, Berkeley; and Princeton University. Others encountered a choice set in which Northwestern University replaced Princeton.

We expected (and confirmed in manipulation checks to be discussed) that Princeton would be seen as being of higher academic quality but less fun to attend than the other colleges. Thus, on a relative basis, Princeton constitutes the lone sensible or system 2 choice in this design; the other options constitute affective or system 1 choices. We, therefore, predicted that Princeton, but no other option, would be significantly more popular when choice is stimulus based rather than memory based. Put differently, we predicted that a memory-stimulus difference would emerge for the choice set including Princeton but not for the choice set including Northwestern.

H2: When schools are undifferentiated in fun and academics, no memory-stimulus difference will arise; when schools are differentiated, memory-based choice will favor fun and stimulus-based choice will favor academics.

Varying the option set allows us to circumvent the accessibility hypotheses. As long as Princeton and Northwestern are equally mentally accessible, differences across these options cannot be attributed to memory factors. The present design also allows us to circumvent the prominent attribute hypothesis. We surmised that academic quality is the most prominent attribute in college choice. Indeed, when a separate group of participants evaluated how important each attribute is in college decisions, using seven-point scales, they gave mean ratings of 6.4 to academic reputation and 4.0 to social atmosphere ($t(84) = 8.02$, $p < .0001$). Thus, in the present context, memory-based choices are predicted to favor the less prominent attribute.

Method

Participants ($n = 891$) were randomly assigned to one of four conditions in a 2 (choice process: memory based vs. stimulus based) × 2 (option set: differentiated vs. undifferentiated) between-subjects design. We used the (blue sheet) questionnaire packet format of experiment 1.

Checking memory-based participants' option listings revealed that about 63% of memory-based participants were able to correctly list all four options. The analyses we report drop participants who were unable to correctly recall all four options; including these participants does not change the qualitative pattern of results. The average listed positions (1–5, where 5 denotes nonrecall of the option) of Princeton and Northwestern were 2.5 and 2.8, respectively. Thus, Princeton and Northwestern were approximately equally mentally accessible. Differences across these options should thus reflect factors other than mental accessibility.

Using 10-point scales, a separate group of participants rated the colleges in terms of academic quality and how much fun they would be to attend. Princeton received the highest academic quality ratings ($M = 8.6$ vs. $M = 8.0$, $M = 6.7$, $M = 7.7$, and $M = 7.2$ for Duke, Michigan, Berkeley, and Northwestern, respectively; $p < .05$ for the first pairwise comparison, and $p < .01$ for the remaining three). Princeton received the lowest fun rating ($M = 5.6$ vs. $M = 6.3$, $M = 7.0$, $M = 6.0$, and $M = 6.1$ for Duke, Michigan, Berkeley, and Northwestern, respectively; $p < .05$, $p < .01$, $p = .30$, $p < .10$, respectively). Furthermore, there were minimal rating differences among the four options in the choice set that includes Northwestern. Thus, Princeton indeed appears to constitute the lone system 2 choice.

Results

Participants' choices, summarized in table 2, corroborate hypothesis 1. The choice set including Northwestern revealed essentially no stimulus-memory differences. Across the four options, the mean difference in market shares between memory and stimulus-based choices was only 2%, and the largest such difference was a scant 4%. A very different picture emerged for the choice set including Princeton. The market share of Princeton was only 33% under memory-based choice but rose to 52% under stimulus-based choice. Both the simple effect difference in market shares for Princeton ($z = 4.54$, $p < .01$) and the interaction involving Princeton and Northwestern market shares ($z = 3.58$, $p < .01$) were highly statistically significant.

In sum, the observed results are again consistent with the notion that memory-based choices favor affect-rich, hedonic considerations (e.g., a fun social experience), whereas stim-

TABLE 2

RESULTS OF EXPERIMENT 2

	Princeton	University of California, Berkeley	Duke	Michigan	Northwestern
Choice set including Princeton:					
Memory based	33	46	16	5	
Stimulus based	52	35	7	5	
Difference (Memory based − Stimulus based)	−19	11	9	0	
Choice set including Northwestern:					
Memory-based		55	26	5	14
Stimulus-based		57	22	7	14
Difference (Memory based − Stimulus based)		−2	4	−2	0
"Fun to attend" rating	5.1	6.2	5.9	6.5	6.1
"Academic quality" rating	8.6	7.7	8.	7.	7.2
Composite rating (Fun − Quality)	−3.5	−1.5	−2.1	−.5	−.9

NOTE.—The top three rows present the market shares of each option under memory-based market and stimulus-based procedures, as well as the difference between the two for the choice set including Princeton University, University of California, Berkeley, Duke University, and University of Michigan; the middle three rows present the same data for the choice set including University of California, Berkeley, Duke University, University of Michigan, and Northwestern. The bottom three rows present the ratings of each school in terms of how much "fun to attend" that school is and the school's "academic quality."

ulus-based choices favor deliberate, prudent considerations (e.g., a high-quality academic experience). We have argued that this difference arises because memory-based choices are made given relatively depleted mental resources under which system 2 is relatively disabled.

To reiterate, two aspects of the present experiment buttress our argument by casting doubt on alternative hypotheses. First, because Princeton and Northwestern are equally mentally accessible, it appears that memory-stimulus differences do not emerge solely as a function of mental accessibility. Second, though memory-based choices favored options that were superior on the more important dimension in experiment 1 (tastiness), they favored options that were superior on the less important dimension in experiment 2 (social experience); thus, memory-stimulus differences do not arise only because memory-based choices favor prominent attributes.

Experiments 1 and 2 are set in the domain of self-regulation. Evidently, memory-based choices evince relative impulsivity (e.g., a preference for chocolate cake or a fun school), whereas stimulus-based choices evince relative self-control (e.g., a preference for fruit salad or academic quality). Recall that such findings are consistent both with the conception of a system 2 that may be disabled when mental resources are drained and with Baumeister and colleagues' (Muraven and Baumeister 2000) conception of self-control as an exhaustible resource.

Our next experiment juxtaposes memory-based and stimulus-based choices outside the domain of self-regulation. It does not pit hedonic or fun options against sensible options. Instead, in experiment 3, we study a setting in which stimulus-based choice is less reflexive and more deliberative than memory-based choice, in the sense that stimulus-based choice appears to engender an extra step of reasoning that memory-based choice appears to inhibit.

Specifically, we cross our manipulation of memory-based versus stimulus-based choice with a manipulation of the prices attached to various items. Participants indicate which of four sandwiches they most prefer to purchase. The sandwiches available are turkey, ham, roast beef, and tuna. The price of the latter three sandwiches is always $5. The price of the turkey sandwich is varied. Some participants are placed in high-price conditions in which a turkey sandwich costs $7, others in low-price conditions in which a turkey sandwich costs $3.

We suggest that, given taxed mental resources, memory-based participants may rely on relatively reflexive assessments to determine their sandwich preference. Thus, they may be repelled by higher-priced items. By contrast, given ample mental resources, stimulus-based participants may supplement reflexive responses with more deliberate reflection. In particular, we predict (and later corroborate via a manipulation check) that stimulus-based participants will often engage in a crucial step of logic, reasoning that, in the context they encounter, high prices signal high quality. This inference constitutes a system 2 override of system 1's aversion to high prices. As a result of this inference, stimulus-based participants may be attracted to higher-priced items rather than be repelled by them.

If stimulus-based participants have ample mental resources to engage in a spontaneous inference that constitutes a system 2 override of system 1 but memory-based participants do not, then we should observe a particular form of interaction:

H3: In our purchasing context, memory-based choices will show negative price elasticity, and stimulus-based choices will show positive price elasticity.

Note that this predicted pattern of preferences cannot be explained by any alternative account positing that memory-based choice simply induces a shift in attribute weights toward more immediately compelling affect-rich or hedonic attributes. Such a shifting-weights account may partly explain the results of our first two experiments. However, the

TABLE 3

RESULTS OF EXPERIMENT 3

	Favored sandwich type with price				
	Turkey ($3)	Ham ($5)	Roast beef ($5)	Tuna ($5)	Turkey ($7)
Memory-based (with turkey at $3, market share)	47	14	24	14	
Memory-based (with turkey at $7, market share)		13	33	19	34
Impact of price change (market share for $7 turkey − market share for $3 turkey)					−13
Stimulus-based (with turkey at $3)	35	16	30	19	
Stimulus-based (with turkey at $7)		6	29	6	58
Impact of price change (market share for $7 turkey − market share for $3 turkey)					+23
Stimulus based with maintenance (with turkey at $3)	50	7	36	7	
Stimulus based with maintenance (with turkey at $7)		10	41	24	25
Impact of price change (market share for $7 turkey − market share for $3 turkey)					−25
Quality rating when turkey is $3	5.2	6.6	6.6	6.5	
Quality rating when turkey is $7		6.2	5.7	6.3	7.6

NOTE.—The top three rows present memory-based market shares for both the choice set including the $3 turkey sandwich and the choice set including the $7 turkey sandwich, as well as the difference between the two. The next three rows present the corresponding data for stimulus-based choices. The three rows after that present the corresponding data for stimulus-based-with-maintenance choices; finally, the bottom rows present the quality rating for each sandwich.

pattern of preferences that we predict simply cannot be explained in terms of stimulus-based and memory-based participants striking a different balance between price and quality. No shift in the weights of price and quality can transform reactions to high prices from unfavorable to favorable.

As before, we reinforce our analysis by including a condition in which participants make a stimulus-based choice while maintaining a seven-digit number in memory. If memory-based participants do not have ample resources to override their reflexive aversion to high prices, then neither should stimulus-based-with-maintenance participants:

H3a: Stimulus-based-with-maintenance preferences should be largely equivalent to memory-based choices. Thus, in our context, stimulus-based-with-maintenance participants will reveal negative price elasticity.

EXPERIMENT 3: PRICE SENSITIVITY

Method

Participants ($n = 717$), students at University of California, Los Angeles, were randomly assigned to one of six conditions in a 3 (choice process: memory based, stimulus based, or stimulus based with maintenance) × 2 (pricing: lower price or higher price) between-subjects design. We followed the questionnaire packet format of the previous experiments. Participants were asked which of four sandwiches they preferred to purchase: turkey, ham, roast beef, or tuna. The prices of the latter three sandwiches were always $5. The price of the turkey was either $3 or $7.

In the memory-based conditions, 87 of 92 participants in the low-price condition and 81 of 91 in the high-price condition were able to correctly list all four options and their prices. The reported analyses drop participants who were unable to correctly list every option and every price.

Two separate groups of participants, one for each pricing condition, rated the quality of the four sandwiches. The mean rating of the $7 turkey sandwich was significantly higher than that of the $3 turkey sandwich on a 10-point scale ($M = 5.2$ vs. $M = 7.6$; $p < .0001$). The other sandwiches either received roughly equal ratings in both conditions or were deemed of higher quality when turkey was low priced ($M = 6.6$, $M = 6.6$, and $M = 6.5$ for roast beef, ham, and tuna, respectively, when turkey was $3; $M = 5.7$, $M = 6.2$, and $M = 6.3$ for these same three, respectively, when turkey was $7; the only significant cross-condition difference is for roast beef, $p < .001$). Moreover, the quality rating of the $7 turkey sandwich was significantly greater than that of the other three sandwiches ($p < .0001$ for each pairwise comparison), whereas the quality rating of the $3 turkey sandwich was significantly lower than that of the other three sandwiches ($p < .0001$ for each pairwise comparison). In sum, participants believed that lower-priced sandwiches were of lower quality than high-priced sandwiches.

Results

Participants' choices, summarized in table 3, corroborate hypothesis 3 and hypothesis 3a. Under memory-based choice, turkey received a 47% market share when it was low priced, and its market share fell to 34% when it was high priced ($z = 1.77$, $p < .05$, one-tailed test). In contrast, under stimulus-based choice, turkey received a 35% market share when it was low-priced, but its market share rose to 58% when it was high priced ($z = 3.32$, $p < .01$, one-tailed test). The interaction is highly significant ($z = 3.58$, $p < .01$). Furthermore, the stimulus-based-with-maintenance condition revealed negative price elasticity, similar to memory-based choice: turkey's market share was 50% when low priced and 25% when high priced ($z = 4.81$, $p < .01$ for the within-condition difference; $z = 5.51$, $p < .01$ for the interaction with the standard, stimulus-based condition).

To reiterate, these results cannot be explained by any alternative account concerning differential weighting across memory and stimulus-based choice. No shift in the weighting of price and quality can transform unfavorable reactions to high prices into favorable reactions.

Note that, on the basis of our analysis, one might expect memory-based participants and stimulus-based-with-maintenance participants to show highly similar preferences. Yet, there are discrepancies between these conditions. Price changes have a profound impact on the market share of tuna in the stimulus-based-with-maintenance condition (+17%, $z = 4.1$, $p < .01$) but not in the memory-based condition (+5%, $z = .83$, NS; interaction is significant, $z = 2.1$, $p < .05$). A similar conclusion holds when comparing the changes in relative shares of tuna to turkey across the two conditions with a multinomial logit model ($z = 2.3$, $p < .05$). This discrepancy may indicate that additional factors beyond cognitive load for system 1 and 2 processing affect our results.

GENERAL DISCUSSION

We conjectured that memory-based choices tax resources more than stimulus-based choices by requiring consumers to maintain options in working memory. When resources are taxed, system 2 is impeded. Thus, system 2 should more readily check system 1 under stimulus-based choice than under memory-based choice. Indeed, we observed that memory-based choices favor system 1 considerations, whereas stimulus-based choices favor system 2 considerations. We close by addressing connections to trade-off aversion and preference malleability.

Luce (1998; see also Luce, Bettman, and Payne 1997; Luce, Payne, and Bettman 1999) noted that decisions entailing a conflict between valued goals often evoke negative affective reactions (see Baron and Spranca 1997). Critically, consumers often attempt to cope with or minimize such negative emotions. Avoidant responses, such as maintaining the status quo or prolonging search, satisfy such needs by minimizing confrontation of aversive trade-offs.

It is interesting that Drolet and Luce (2004) found that cognitive load decreases the frequency of avoidant responses. They argued that cognitive load prevents consumers from considering their stored goals and thus renders more palatable trade-offs that are normally emotionally aversive. Thus, where our work reveals instances in which cognitive load accentuates affect's role, Drolet and Luce's work reveals instances in which cognitive load diminishes affect's role.

This contrast makes salient that not all affect is as quickly experienced as liking for chocolate cake may be. At the core of Drolet and Luce's work is affect produced by slower, controlled processes akin to system 2. Sometimes the very act of carefully considering potential trade-offs induces aversive emotional reactions. It is essential, then, to dichotomize one's notion of affect. Spontaneous affective evaluations of liking, which may be driven by immediately compelling factors such as tastiness, likely belong to system 1. More complex affective reactions, which are driven by consideration of factors like trade-offs, likely belong to system 2.

Perhaps the most fundamental insight of research in decision making is that choices are highly and systematically malleable. In our opinion, much preference malleability reflects the dichotomy of immediate system 1 processes versus deliberative system 2 processes, with distinct preferences arising when each type of process is in operation. The experiment of Shiv and Fedorikhin (1999) provides an especially stark example of such preference malleability.

Gilbert, Gill, and Wilson (1998) provide another compelling example. These authors had grocery shoppers draw up shopping lists, but only some shoppers were allowed to retain their list while shopping. Also, some shoppers were fed a quarter-pound of muffins before shopping. Among list-less shoppers, the unfed bought more unlisted items than the well fed. But, among shoppers with lists, the unfed did not buy more unlisted items. Presumably, list-less shoppers experienced more positive reactions to unlisted items when unfed (delicious cookies!) than when well fed (I'll never eat again). Shoppers with lists surely had the same reactions, but evidently they decided to purchase an item by checking their list to see if they were supposed to buy it, not by following their immediate reactions.

Those shopping with lists had a concrete mechanism guiding them toward choices they were supposed to make. The shopping lists facilitated reliance on system 2. In contrast, participants without lists were vulnerable to the influence of system 1. Without a system 2 facilitator, they often relied on affective reactions and made some relatively impulsive decisions.

Our work suggests that the distinction between memory-based and stimulus-based choices is of the same vein. The nature of these different processes may imply that, on a relative basis, stimulus-based choices are a system 2 facilitator, whereas memory-based choices leave consumers vulnerable to the vicissitudes of system 1. The preferences revealed by a consumer in a given situation may depend critically on capricious factors engendering one or the other process.

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