Deciding Without Resources:
Psychological Depletion and Choice in Context

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ABSTRACT

Consumer choices are a result of an interplay of two systems: fast and intuitive thinking (System 1) and more deliberative reasoning (System 2). The present research examines the implication of the interplay between the two systems for context effects in choice by exploring the consequences of resource depletion. Building on a substantial body of psychological literature that points to one underlying resource used in self-regulation and decision-making, this paper demonstrates that resource depletion has a systematic influence on choices. Specifically, we demonstrate that resource depletion enhances the role of intuitive System 1 influences by impairing the effortful and deliberate overriding role of System 2. In five experiments, we find that resource depletion increases the share of reference-dependent choices, decreases the compromise effect, magnifies the attraction effect, and increases choice deferral. The results shed light on both the mechanism underlying context effects on choices and the scope of the depleted resource.

Human life is filled with big and small decisions that steer a course through the complex social world. While good decisions can result in happiness, good relationships, and material comforts, bad decisions can lead to regret, misery, and emotional stress. In recognition of the far-reaching importance of decision-making, researchers from multiple perspectives have paid increasing attention to the processes that underlie good decisions (Kahneman 2003). Much of the descriptive research in decision-making has focused on the processes and consequences of limited information processing in comparison to an ideal decision-maker with unlimited processing capabilities (cf. Bettman, Luce and Payne 1998; Mullainathan and Thaler 2000).

In contrast to the standard treatment of rationality in economics (McFadden 1999), a decision-maker is viewed as a "cognitive miser" (Fiske and Taylor 1984) with a limited capacity to process information, who relies on effortless and intuitive thoughts over slow deliberative reasoning. To account for this dichotomy between quick intuitive responses and careful deliberate reasoning, many theories suggesting dual quasi-independent process emerged (Chaiken and Trope 1999). Consistent with this dual processing viewpoint, Kahneman and Frederick (2002) proposed that modes of thinking can be classified into two categories: System 1 that is relatively effortless and automatic and System 2 that is more effortful and resource dependent that monitors and updates System 1's assessment through more careful consideration of information (Kahneman and Frederick 2002; Sloman 1996). The present research examines the implications of the interplay between the two systems on consumer choice by exploring a source of resource depletion that is unrelated to the choice options. Specifically, we examine the role of the two systems in determining the effects of the decision context on choice, as a result of a prior seemingly unrelated activity that uses executive resources. An extensive body of research

by Baumeister and colleagues (Baumeister et al. 1998; Muraven and Baumesiter 2000) shows that people's executive resources are limited, and when these resources have been depleted by prior exertion, the decision-making process is likely to rely on more intuitive processing.

We explore the interplay of resource depletion and its consequence for the two mental systems in determining choices in the domain of choice in context (Dhar and Simonson 2003; Huber, Payne and Puto 1982; Simonson and Tversky 1992). A number of different effects on choice have been identified in the literature demonstrating that the preference for an option in a choice set depends on the other alternatives provided or the choice context. There is some controversy as to whether context effects arise due to simplification in response to choice complexity or due to effortful tradeoffs among the alternatives that are salient in the choice task. Thus, the effect of resource depletion should help clarify whether, and which, context effects in choice arise from intuitive, simplified processing versus more controlled, deliberative thinking. Specifically, by manipulating executive resources in manner that is unrelated to the choice task, we provide insights into the integration of the dual mental systems that underlie context effects in choice. We investigate the implications of resource depletion on reference-dependent choice (Study 1), the compromise effect (Studies 2 and 3), the attraction effect (Study 4) , and choice deferral (Study 5). Using these four choice contexts as illustration, we demonstrate that the depletion of executive resources by an unrelated task leads to a decrease in the tendency to choose a compromise option and an increase in reference-dependence, the attraction effect, and choice deferral. The pattern of results helps support the premise that reference-dependence and the attraction effect are a consequence of relatively effortless intuitive processing (System 1) whereas the compromise effect is rooted in more effortful processing (System 2).

The remainder of the paper is organized as follows. We first review key findings from the research on resource depletion and dual processes, and relate the uncovered principles to an understanding of context effects in choice. We draw the theoretical predictions for the effect of resource depletion on choice in context, and provide experimental evidence for our claims. We conclude with a discussion of the implications of the sensitivity of choice to prior, seemingly unrelated, exertion for decision making in general, and for the study of the processes underlying choice in context.

DECIDING WITHOUT RESOURCES: CHOICE IN CONTEXT

While choices can occur after careful deliberation, many everyday choices are usually effortless and are guided by System 1 or intuitive thinking. The decision outcome of System 1 is, however, monitored by System 2 responsible for more effortful processing. Such monitoring requires additional mental resources beyond those used by System 1. The capacity to monitor System 1's responses effectively is determined by the willingness to exert and the availability of mental resources for System 2 operation. This view of the human self as employing a limited resource for its executive activities is also consistent with research on goals and self-regulation (Baumeister 2002). Self-regulation can be viewed as the self's efforts to monitor its own intuitive responses, such as by trying to bring careful reasoning into the decision process. This monitoring process is impaired by resource depletion, when a prior task has used up the resource required for effective self-regulation.

In the resource depletion paradigm (Baumeister 2002; Muraven and Baumeister 2000; Vohs and Heatherton 2000), participants after an initial self-regulation task (or not) are confronted with a second, ostensibly unrelated demand for self-regulation. The usual finding is that people who had done the first self-regulation task performed worse on the second task. This

pattern suggests that self-regulation uses some limited resource, akin to strength or energy that becomes depleted via effortful self-regulation. Apparently, the exercise of self-control used up some vital resource, leaving those individuals subsequently less able to make themselves persist in the face of failure. Recent work suggests that the self's limited resource is used not only for self-regulation but also for other executive functions, including choice and decision-making. In one study based on the cognitive dissonance research paradigm (see Linder, Cooper and Jones 1967) participants who actively decided to make a counter-attitudinal speech were subsequently more prone to give up quickly on difficult puzzles than were participants who were assigned to make the same speech without choice (Baumeister et al. 1998). These findings pointed tentatively toward the conclusion that both self-regulation and cognitively effortful choice draw on the same limited resource required for System 2 processing. The present examination was designed to investigate the possibility that resource depletion can influence choice under context that requires confronting effortful tradeoffs among the alternatives.

DECISIONS WITHOUT RESOURCES: CONTEXT EFFECTS IN CHOICE

Previous research on consumer decision-making reveals the use of not a single decision strategy, but a myriad of different strategies, depending upon the motivation and the availability of resources such as time and cognitive capacity (Bettman, Luce, and Payne 1998; Dhar and Nowlis 1999). A two-system view of contingent decision-making captures these differences in strategies employed and further postulates that the two systems operate in parallel. Within this framework low-level intuitive processes are primary whereas higher-level reasoning is slow and deliberative and requires more resources. When such resources are depleted it becomes too effortful to engage in deliberate tradeoffs, which results in more intuitive choices. While intuitive

top-of-the head responses may sometimes lead to sub-optimal choices, intuitive choices are not necessarily inferior to those made deliberatively (Dijksterhuis 2004; Kahneman 2003). As stated above, context effects in choice can arise from either careful deliberative decisions or from simple effortless processing. Therefore, the depletion of mental resources may enhance or reduce the context effects in choice depending upon the source of the specific bias. Conceptually, if a context effect arises from System 1 type automatic processing, depleting resources decreases effortful System 2 processing and can increase such biases. Conversely, when a context effect arises from System 2 type, more effortful processing and careful tradeoff comparisons among the alternatives, depleting resources increases the reliance on System 1 processing and consequently, decreases the extent of the bias observed. The main hypothesis for the present investigation was that resource depletion would increase the propensity to rely on lower-level, more simplistic processing that avoid confronting tradeoffs, because these make fewer demands on the executive resources. We predict that such reliance on System 1 processing would lead to an increase in reference-dependent choices and the attraction effect that rely on easy comparisons. Further, choice effects such as the compromise effect that are a consequence of making effortful consideration of tradeoffs (Dhar and Simonson 2003) will be reduced under resource depletion. Next, we elaborate on these three predictions.

Resource Depletion and Reference Dependent Choices

One of the most consistent findings in behavioral decision research is that choice among options is influenced by the options standing relative to a reference point. Previous research has shown that consumers evaluate attribute levels of choice options as gains or losses relative to the existing reference levels and not as absolute values (Tversky and Kahneman 1991). Furthermore, due to loss aversion, the option further below the reference point on the dimension framed as a

loss will be greatly disadvantaged when the two are compared (Tversky and Kahneman 1991). Since a reference point determines whether the value of a specific attribute is seen as an advantage or a disadvantage, a change in the reference point affects the choice between the two options. For example, as seen in Figure 1, option *x* would be more likely to be preferred over *y* when the reference state is *a* rather than *a*'. However, the reverse is true for option *y*. Simply put, because of loss aversion, option *x* seems so much better if viewed from *a* as opposed to *a*'.

Although it has not been explicitly shown, such reference-dependence is thought to be rooted in intuitive System 1 judgments (Kahneman 2003). We examine how resource depletion affects reference-dependent choice. When a reference point shifts from *a* to *a'* it changes the perception of the attribute levels in the form of gains and losses, but does not affect the actual value of the product attributes. Since resource depletion enhances the likelihood of relying on intuitive System 1 processing, it should lead to more reference-dependent choices when our ability to engage in more effortful System 2 processing is limited. Accordingly, we predict the following:

H1: The effect of a reference point will be larger when participants are depleted by a prior self-regulation task.

Our second hypothesis involves the compromise effect (Simonson 1989). As illustrated in Figure 2, the compromise effect occurs when an option is preferred more when it is a middle option (such as option *b* in a set *abc*) then when it is an extreme option (such as option *b* in a set *bcd*). According to Dhar and Simonson (2003), the choice of a compromise option is a cognitively complex choice, because it draws value from both of the traded-off dimensions. Furthermore, the mixture of evaluative dimensions that forms the compromise does not represent the best choice on any single dimension. In a similar vein, Simonson (1989) notes that

compromise choices are difficult because they seek to reconcile conflicting criteria, as opposed to simply choosing one decision criterion and basing the decision on it. Using think-aloud protocols, he found that compromises required longer, more complex, and more elaborate thought processes than non-compromise decisions, and they were also described by participants as more difficult.

These findings provide some guidelines as to the effect of resource depletion on the magnitude of the compromise effect. Consider separately a 2-option set *bc* and the expanded 3-option set *abc*. In the 3-option choice set, decision makers need to recognize the trade-offs that favor different options in order to choose the compromise alternative. Those steps make more demands on the person's executive resources, as compared to the simpler process of using a single criterion (e.g., buy the best or the cheapest) and picking one of the extreme options. Under resource depletion, participants will be more likely to rely on simpler, less effortful processing and become less susceptible to the tradeoff comparisons that favor the compromise alternative. The prediction therefore, is that the depletion of resources (caused by previous self-regulation) would make one less likely to choose a compromise option.

H2: The compromise effect will be weaker when participants are depleted by a prior self-regulation task.

The third hypothesis pertains to the effect of resource depletion on the attraction effect (Huber, Payne, and Puto 1982; Simonson 1989). According to the attraction effect (see Figure 3), the addition of an asymmetrically dominated third alternative, *a*, to a core set of two alternatives *bc*, increases the (absolute) share of the dominating alternative, in violation of the property of regularity. This seems surprising because, logically, the addition of an inferior option should not alter the standoff between *b* and c. Recent research into the processes underlying the attraction

effect suggested that it is rooted in lower level perceptual processes, and that the effect of the addition of a dominated alternative may be non-conscious (Dhar and Simonson 2003). Consistent with this notion, Simonson (1989) found that when responders were asked to explain their choices, unlike in the case of the compromise effect, few justified their choice on the basis of the tradeoff comparisons between *a* and *b*. This suggests that the initial assessment of the choice set makes the dominating alternative stand out perceptually and is different from the compromise effect where the preference for the middle option is based on careful comparison of tradeoffs among the alternatives.

This relatively effortless process of choosing the asymmetrically dominating option produces a choice that potentially could be corrected by a more effortful System 2 like process. However, because the preference for the dominating option is more perceptual and is easy to reach, the System 1 outcome can persist when such initial preference is held with high intuitive confidence (Simmons and Nelson 2006). Such intuitive confidence comes from the enhanced attractiveness of the asymmetrically dominating option. If resource depletion reduces one's ability to override simpler System 1 processes, then it should increase perceptual influences and amplify the attraction effect. The prediction therefore, is that the depletion of resources would enhance the attraction effect in choice.

H3: The attraction effect will be stronger when participants are depleted by a prior self-regulation task.

STUDY 1: THE EFFECT OF DEPLETION ON REFERENCE-DEPENDENT CHOICES

Our main proposition states that resource depletion would lead to a greater reliance on intuitive processing in choice. We first test this proposition by examining reference-dependent

preferences under resource depletion. If reference dependence is rooted in System 1 (Kahneman 2003), we predict an increase in the choice of an option favored by the reference point. To examine this, we used a reference-dependent choice set designed by Tversky and Kahneman (1991, p. 1045). In this choice set participants are choosing between two jobs, which vary on the dimensions of commute time and social contact. In addition, a reference point is given to the participants in the form of their prior job. This prior job is either better than the two new jobs on the commute time dimension and worse on the social interaction dimension or the reverse. This resulted in 2 (depletion) × 2 (reference point) between subjects design.

Method

Procedure. Two hundred and eighty four participants were recruited from an online subject pool as well as individually on a university campus. The online subject pool consisted of participants ages 18-65, with the largest proportion being within the 35-45 age group. 65% of the participants were females. All the participants completed the experiment in return for a lottery prize ($50 Amazon.com gift certificate). The study lasted about five minutes.

The experiment comprised of two parts: a resource depletion task and a choice task. The resource-depletion task was adapted from Webb and Sheeran (2003), based on the Stroop (1935) self-regulation task. Participants were presented with a word on a computer screen that represented the name of a color (e.g., “Yellow”, “Red”, White”, Magenta”) that was displayed using a font of a mismatching color. For example, the word “Yellow” might be colored green. At the bottom of the computer screen were six buttons, one for each color, corresponding to the six colors used. The names of the colors on the buttons were colored black.

Half of the participants were instructed to click the button corresponding to the meaning of the written word and not its color. The other half, assigned to the resource depletion condition,

was instructed to click on the button matching the color of the font and not the word's lexical meaning. Thus, when the word "yellow" was presented in green type, control participants were supposed to respond "yellow" but depletion participants were supposed to respond "green." The Stroop (1935) test relies on the fact that for the latter task, one has to override one's initial tendency to read the semantic meaning of the word (which is automatically activated) and say its color instead. Hence, the participant must use self-regulation to override the first response, which is to respond by saying the word itself, in order to substitute the response of naming the print color. All participants had to click the appropriate button as fast as they could, and they received feedback displaying their speed and whether they pressed the correct button. Participants completed 40 such screens.

Following the Stroop task, the participants we presented with one of the two choice problems. Half of the participants had to pick one of the two target jobs, when their previous job was better on the commute time dimension and worse on the social contact dimension. The other half saw the same target jobs, but the previous job was better on the social contact dimension and worse on the commute time dimension. Participants' choices of the two target jobs served as a main dependent measure for this study. In addition, we measured the time it took each participant to make a choice. Finally, as a manipulation check, we measured the time and the error rate for each screen of the Stroop task.

Results

Manipulation checks. The depletion condition was based on the premise that participants in this condition need to override the automatic response. If this is indeed the case, we should observe longer response times and an increased error rate compared to those participants in the control condition who were required to provide answers congruent with

automatic process. The data supported this premise; participants in the depletion condition responded slower on the Stroop task than those in the control condition (3.12 seconds vs. 2.82 seconds, $t(9904)=4.69$, $p<.01$) and they also committed more errors (i.e., were more likely to click on the wrong color) (12% vs. 6%, $t(9904)=10.97$, $p<.01$).

Choice. We predicted that resource depletion would lead participants to rely on more intuitive processing and therefore make choices that are more sensitive to the reference points. We find that 52.1% of the control participants preferred the reference-dependent option across the two sets of choices (job *x* in the first set and job *y* in the second). At the same time significantly more participants in the depletion condition preferred the reference-dependent option (64.3%, $\chi^2[1]=4.34$, $p<.05$). The difference between the choice share of job *y* in first set and the second set was 27.8% in the depletion condition, whereas the same difference was 5.9% in the control condition (Table 1). We further conducted a probit regression analysis of the choice of options as a function of three independent variables: dummies for the condition and the choice set, and their interaction. As predicted, the interaction between depletion and the choice-set was significant ($\beta=-0.73$, $z(284)=2.11$, $p<.05$).

Finally, there was no significant difference between the participants' time spent completing the choice task ($M_{depletion}=37.5$ seconds vs. $M_{control}=34.9$ seconds, $p>.10$). This helps rule out possible alternative explanations, such as that participants in the resource depletion condition made a different choice because they spent less time on the second (choice) task. If they felt they had already done enough and simply wanted the experiment to be over, they would have chosen faster and gone on their way.

Study 1 tested the hypothesis that resource depletion from a prior unrelated task would alter decision-making toward a simpler, less effortful process and decrease the ability to engage

in System 2 type of reasoning. The participants in the depletion condition were much more likely than the control respondents to be influenced by the reference point. The compromise effect, however, requires making elaborative tradeoff comparisons, which as we suggested points to System 2 elaborative processing. Therefore our prediction for Study 2 was that depleted people should be less prone to select a compromise than control participants.

To test the effect of resource depletion on the compromise effect we created a choice set of four laptops, involving trade-off between price and quality. Each participant had to choose among three of the laptops, either set *a b c* or set *b c d* (Figure 2). To assess compromise tendencies, we focused on the middle two options (*b* and *c*). Option *b* was thus a compromise for the participants who saw set *abc* but a non-compromise extreme for the participants who choose from set *bcd*. Conversely, option *c* was a compromise in the *bcd* set but a non-compromise extreme in the *abc* set. As predicted by the compromise effect, option *b* would have a higher relative share in the choice set *abc* than in the choice set *bcd*. We predict that resource depletion decreases the likelihood of choosing the compromise option, hence, the difference between the choice share of option *b* in the choice sets *abc* and *bcd* will be smaller for depleted participants.

The next study was also aimed to test for possible alternative accounts for the data. First, completing a tedious Stroop task may have induced negative mood, which subsequently resulted in different processing for the participants in the depletion condition. Second, the depletion task may have made the participants tired, which subsequently decreased the time spent on the choice task. To rule out these alternative explanations, participants were asked to rate their current mood and level of tiredness and we tested the mediating effects of those variables.

STUDY 2: THE EFFECT OF DEPLETION ON THE COMPROMISE EFFECT

Method

Five hundred and one participants from an online subject pool completed the experiment in return for a lottery prize ($50 Amazon.com gift certificate). The study lasted about five minutes. As before, the experiment comprised of two parts: a resource depletion task and a choice task. The resource depletion task was a Stroop task identical to that used in Study 1. In the second part of the experiment, participants were asked to indicate their choice among three laptop computers. The laptops were described by three attributes: CPU speed, RAM size, and price (see Table 2). Half of the participants chose from set *abc*, and the other half from set *bcd*. This resulted in a 2 (depletion vs. no depletion) ×2 (set *abc* vs. *bcd*) between subjects design. The main dependent measure was the actual choices participants made in the second part of the experiment. Before moving on to the choice task, the participants were also asked to rate their level of tiredness (on a 5-point scale from 1=not at all tired to 5=very tired), the difficulty of the first task (on a 5-point scale from 1=very easy to 5=very difficult) and also reported their mood using the Positive and Negative Affectivity Schedule (PANAS, Watson, Clark, and Tellegen 1988). Finally, as in Study 1, we measured error rate and time spent on the Stroop task.

Results

Manipulation checks. Consistent with the results of Study 1, the participants in the depletion condition responded more slowly than those in the control condition (3.43 vs. 2.97 seconds; $t(10168) = 6.57$, $p < .001$), and committed more errors (14% vs. 8%; $t(10168) = 10.09$, $p < .001$) during the Stroop task. Also, consistent with the notion that participants in the depletion condition had to exert themselves more in order to regulate their behavior, participants

rated the Stroop task as significantly more difficult than those in the control condition ($M_{depletion}$=2.66 vs. $M_{control}$=1.86; t(186)=3.78, p<.001).

The compromise effect. The compromise effect refers to a relative increase in choosing an option when it is presented as a middle option compared to when it is an extreme option. The compromise effect was tested in the following manner. Following Simonson and Tversky (1992), P_a(b;c) and P_d(b;c) represents the proportion of consumers who chose *b* relative to *c* from the set *abc* and the set *bcd* respectively. Thus, the compromise effect can be tested by examining whether (P_a(b;c) – P_d(b;c)) is positive and statistically significant.

Consistent with previous literature we observe the compromise effect in the control condition: 65% of participants chose option *b* relative to *c* when it was a compromise but only 42% chose it relative to *c* when it was not a compromise (χ^2[1]= 5.91 , p <.02). We predicted, however, that the share of the compromise option would decrease after resource depletion due to participants' limited capacity to engage in elaborate trade off comparisons which are required to choose a compromise option. As is evident in Table 3 we find that in fact option *b* was less popular with depleted participants, although not significantly, when it was a compromise (41%) than when it was an extreme (49%, χ^2[1]= 1.01, p = .31). We run a probit regression analysis of the choice of alternative *b* (out of the set of *b* and *c*) as a function of three independent variables: dummies for the condition and the choice set, and their interaction. As predicted, the interaction between depletion and the choice set was significant (β = -.178, z(328) = 2.43, p <.02), which means that the depletion manipulation decreased the share of the compromise option relative to the share of the extreme options. This supports our conclusion that resource depletion reduces the contextual effect of the compromise alternative.

Finally, participants were asked to rate how tired they were after completing the Stroop task. A *t* test revealed no difference between the two conditions ($M_{depletion}$=2.49 vs. $M_{control}$=2.52; t(188)=1.06, *p*=.29). Our mood measure, PANAS, yielded two separate scores of positive affect (PA) and negative affect (NA). There was a significant difference in positive affect between conditions. Participants in the depletion condition reported lower positive affect than did participants in the control condition ($PA_{depletion}$=27.32 vs. $PA_{control}$ =32.35; t(185)=3.66, *p*<.001). However, there was no difference between conditions in the reported negative affect ($NA_{depletion}$=13.52 vs. $NA_{control}$ =13.72; t(185)=0.28, *p*=.78). A mediation test of the possibility that a decrease in compromise was caused by the decrease in positive affect showed that there was no such effect. Positive affect across conditions was neither a predictor of compromise nor of its reversal (z(116) = 0.62, *p* = .53).

The results of Study 2 confirm that the participants in the resource depletion condition were subsequently less likely to choose the same laptop when it was presented as a compromise option than when it was presented as an extreme option. Additional analyses indicated that the depletion manipulation (hard vs. easy Stroop task) had no significant effect on self-reported tiredness or negative affect. It did however produce a significant reduction in positive affect, which appeared to be a side effect of the manipulation rather than part of the underlying process.

In summary, resource depletion led to a reduction in the compromise effect. Consistent with the notion that the compromise effect arises from more effortful tradeoff comparisons, the implication is that the Stroop task has used up some important resource, leaving fewer resources required for System 2 processing available for the subsequent choice task. If this resource is indeed as general as we have hypothesized, we should be able to observe a similar effect for another unrelated task that depletes the underlying resource. Study 3 was intended to test this

generality while providing a conceptual replication. The depletion manipulation used in Study 3 was an attention regulation task, in which participants are asked to direct their attention away from salient visual stimuli. We predicted that similar to Study 2 participants whose resources were depleted by this attention regulation task would be less likely to select a compromise option.

STUDY 3: EXTENDING THE EFFECT OF DEPLETION ON THE COMPROMISE EFFECT

Method

Procedure. One hundred and five students, enrolled in a northeastern university, were approached on campus and asked to complete a computer-based study for a chance to win an iPod in a lottery drawing. The study lasted about eight minutes. The experiment comprised of two parts: a resource depletion task and a choice task. The resource depletion task was adapted from Schmeichel, Vohls, and Baumeister (2003), based on a self-regulation task developed by Gilbert, Krull, and Pelham (1988). The participants were asked to watch a 3:40 min video (without audio) of a man giving a presentation. During the presentation, a series of eye-catching current media news phrases (unrelated to the interview, such as "Michael gets court date") appeared in the lower part of the screen. Each phrase appeared for 5-6 seconds. Participants were told that the purpose of the study was to evaluate the non-verbal behavior of the presenter, and that at the end of the video clip they would be asked to evaluate the presenter. In the resource depletion condition participants were given explicit instructions before the video to ignore the phrases, ostensibly because it might interfere with the assigned task. Participants were strongly urged not to read the words and to redirect their attention to the presenter if they found themselves looking at the phrases. Participants in the control condition were not given any

instructions regarding the phrases prior to watching the video clip. Based on previous research, participants who consciously seek to control their attention would subsequently be in a state of resource depletion as directing attention away from the printed phrases uses self-regulatory resources resulting in fewer resources available for other activities (Gilbert, Krull, and Pelham 1988; Schmeichel, Vohls, and Baumeister 2003).

In the second part of the experiment, participants were told that it was important to allow some time to pass between watching the video and evaluating of the presenter, and the experimenter would use this time interval to have them do an ostensibly unrelated task for a different project. The compromise choice set design was identical to that used in Study 2, except we used a different product category. Specifically, participants were presented with a choice between three digital cameras that were described on a list of attributes, and reflected a trade-off between price and quality (Table 2). Half of the participants chose from set *ab*c, and the other half from set *bcd*. This resulted in a 2 (resource depletion vs. no depletion) × 2 (set *abc* vs. *bcd*) between subjects design.

After participants made their choices, they were presented with a list of the media phrases that flashed during the video along with media phrases that were not shown during the video. They were asked to indicate which of the phrases they recognized from the video clip. Since participants in the depletion condition might be reluctant to admit they remembered the phrases they had been explicitly asked to ignore, we followed the procedure recommended by Gilbert, Krull, and Pelham (1988) to reduce this bias. Participants were told that "It is a well-known scientific fact that some people are capable of peripheral processing" and "such people are capable of processing the peripheral words (or images) they were not precisely focused on" prior to the recognition task. Finally, participants rated the facial expressions of the protagonist in the

video clip. The main dependent measure was the actual choices participants made in the second part of the experiment, and in particular, the relative popularity of the compromise option. We also measured the time participants took to complete the choice task (data available for most participants) and the number of recognized phrases that were shown in the video.

Results

Manipulation checks. The attention regulation task was designed in such a manner that it was virtually impossible to ignore the media phrases therefore making the task depleting. Consistent with this proposition, we found no difference in the number of correct recognitions between the depletion and the control conditions. Both groups were equally accurate in recognizing the phrases. On average only 12% of the participants in the control condition and 10% of those in the depletion condition made false positive identifications ($t(103) = 0.66$, $p = .51$). Similarly, there was no significant difference between conditions in correctly recognizing the phrases that did appear in the video: 45.1% for the control condition and 41% for the depletion condition ($t(103) = 0.65$, $p = .65$).

The compromise effect. As in Study 2, we analyzed the compromise effect by comparing the choice shares of option *b* relative to option *c* in the choice set *abc* with that of choice set *bcd*. As can be seen in Table 3, consistent with the results of Study 2, we find that among control participants the relative share of option *b* was 65% when it was a compromise but only 31% when it was not a compromise (χ^2 [1]=3.96, $p<.05$). This pattern was reversed in the depletion condition: the relative share of option *b* was lower when it was a compromise (58%) than when it was an extreme (75%), although this difference did not reach significance (χ^2 [1]=0.94, $p=.33$). The summary analysis was conducted using a probit regression analysis of the choice of alternative *b* over alternative *c* as a

function of the following independent variables: dummies for the condition and the choice set, and their interaction. As predicted, the interaction between depletion and the choice-set was significant ($\beta = -1.34$, $z(62) = 2.02$, $p < .05$), which means that the preference for the compromise option present in the control condition no longer existed in the depletion condition.

In addition, we measured the time it took each participant to make a choice. Although there was a trend such that participants in the depletion condition took slightly longer to decide (28.61 seconds) than those in the control condition (22.43 seconds), the difference did not reach significance ($t(69) = 1.78$, $p < .08$). The fact that the participants did not spend less time when depleted suggests that they were equally involved in the task.

So far we have demonstrated that exertion of resources in an unrelated task led to a decrease in the preference for the compromise option and an increase in reference-dependence. This finding is consistent with our proposition that resource depletion increases reliance on low-level processing (System 1) and therefore would decrease context effects that are more likely to arise from more effortful comparisons associated with System 2 processing. However, not all System 2 processes are biasing. In fact, much of System 2 processing is aimed at overriding the simple System 1 processes when necessary. Therefore, if prior depletion hinders System 2 processing, we should find an increase in System 1 biases, as corrective override is far less likely. An example of the above, the attraction effect, has been suggested to stem from a perceptual effect of dominance identification. If our account of depletion is correct, we should find an increase in the attraction effect (System 1) when participants are depleted. We test this proposition in Study 4.

STUDY 4: THE EFFECT OF DEPLETION ON THE ATTRACTION EFFECT

As stated previously, the attraction effect suggests a simplistic style of thinking, because the asymmetrically dominating option does not alter the trade-off between the two viable options but people simply turn to the easy choice and let that stand for the full choice. If this simplified style of deciding is indeed what underlies the attraction effect, then it should be especially appealing to people whose resources are depleted.

Method

Procedure. Sixty-four students in a northeastern university were approached on campus and asked to complete a computer-based study on a laptop for a chance to win a $50 Amazon.com gift certificate in a lottery drawing. The study lasted about eight minutes. Similar to previous studies, Study 4 consisted of two parts: a resource depletion task followed by a choice task. First, participants were asked to complete the same attention regulation task as in Study 3. In the second part of the experiment, participants were told that before they could complete the evaluation of the presenter, it was important to allow some time to pass. Therefore participants were asked to complete another seemingly unrelated study. Participants were asked to make a choice between three apartments. The apartments were described by two attributes: size and walking distance from school in minutes (Table 4). Half of the participants chose from set *abc*, and the other half from set *bcd*. In the *abc* set, alternative *a* was dominated by alternative *b* on both attributes (i.e., apartment *b* was larger and also closer to school than apartment *a*), but not by alternative *c*. In the *bcd* set, alternative *d* was dominated by alternative *c* on both attributes, but not by alternative *b* (i.e., apartment *c* was larger and also closer to school than apartment *d*). This resulted in a 2 (depletion vs. no depletion) × 2 (set *abc* vs. *bcd*) between subjects design.

The main dependent measure was the actual choice the participant made in the second part of the experiment. In addition, participants rated their current mood on a 7-point scale (1=very unhappy to 7=very happy). The mood was measured right after watching the video and before completing the choice task. We also measured the time it took participants to perform the choice task, and whether they could recognize the phrases shown during the presentation. Finally, participants rated the facial expressions of the protagonist in the video clip.

Results

Manipulation checks. At the end of the experiment, as in Study 3, participants were asked to recognize the media phrases that flashed during the video. We found a significant difference in the number of both correct recollections and false positives between the control and depletion conditions. Participants in the control condition were more accurate in recalling the phrases. On average 68% of the participants in the control condition and only 40% of the participants in the depletion condition correctly recognized phrases that were shown in the video ($t(62) = 2.72$, $p < .01$). There was also a significant difference between the conditions in false positive identifications: 14% for the control condition and 7% for the depletion condition ($t(62) = 2.46$, $p < .02$). Altogether, participants in the depletion condition recalled fewer phrases than did participants in the control condition[1] ($t(62) = 3.38$, $p < .001$).

The attraction effect. We measured the attraction effect as an increase in the relative share of option b in the set where it was the dominating option relative to its share in the set, in which it was not a dominating option ($P_a(b;c) - P_d(b;c)$). None of the participants in any condition selected the dominated alternative (a or d). Since resource depletion increases reliance

[1] This self-reported measure is limited because of its potential to be subject to a demand effect.

on simplistic less effortful ways of processing, we predicted that the choice share of the dominating option would increase after the depletion manipulation. As evident from Table 5, we find an increase in the relative share of option b from 25% to 31%, when the choice set includes a dominated option (χ^2 [1]=0.13, p=.72). The effect is however much larger and statistically significant in the depletion condition: the relative share of option b jumped from 0% to 42% with the addition of an option dominated by it (χ^2 [1]=9.20, p<.002). As predicted, a probit analysis of the choice of alternative b (out of the set of b and c) including dummies for the condition and the choice set, and their interaction yielded a significant interaction (β = -0.36, z(62) = 1.99, p <.05), confirming that the attraction effect was stronger in the depletion condition than in the control condition. The probit analysis also yielded a significant main effect of the set (β = -0.70, z(62) = 3.91, p < 0.001), which corroborates an attraction effect for both conditions.

We also measured the time it took each participant to make a choice between apartments. Participants in the depletion condition took longer (16.44 seconds) than participants in the control condition (11.88 seconds) (t(62) = 1.95, *p* <.06). We found no difference in reported mood between the two conditions ($M_{depletion}$=4.42 vs. $M_{control}$=4.04; t(62)=1.43, *p*=.16). These findings are consistent with the results of Studies 2 and 3 and suggest that neither mood nor low involvement with the choice task can explain participants' reliance on more simplistic System 1 type processing which is the result of resource depletion.

Study 4 replicated the previous findings of the attraction effect. Also as predicted, we found that the attraction effect was significantly higher in the resource depletion condition. People who had performed an initial exercise requiring conscious control of attention showed the effect much more strongly than people who had performed an easier initial exercise. As a result,

participants in this depleted state seem to have relied much more on System 1 type processing, unable to employ a System 2 override on the initial effect of dominance identification.

The studies thus far demonstrate that resource depletion enhances the preference for the option that is favored by System 1. In many choice situations, System 1 or intuitive processing may not result in an intuitive preference for any one option. Specifically, many choice situations confront consumers with options that look relatively equally attractive and none that is easily seen as the best (Shafir & Tversky 1992; Dhar & Simonson 2003). In such cases, consumers often choose the no-choice option, and more so when difficult trade-offs need be made (Dhar 1997). If resource depletion indeed inhibits System 2 processes and if this reduced ability to perform compensatory analyses is perceived in any way by the decision maker, we should expect avoidance of such tradeoff making whenever possible. The design of the first four experiments did not allow participants to do that, hence, this prediction was left untested. Study 5 was designed to test this hypothesis by allowing participants not to commit to any given choice alternative, and avoid making the decision altogether.

Dhar and Simonson (2003) pointed out a methodological peculiarity that has plagued much decision research, namely that the participant is *required* to make a selection from the array of options presented by the researchers. In contrast, many decisions made in everyday life (such as consumer goods, dating partners, and investments) contain the additional option of not choosing any of the immediate options, possibly with a view of searching out more options or maintaining the status quo. Their findings confirmed that preferences among arrays of options are often altered by the possibility of choosing "none of the above." Other work has shown a variety of choice patterns that indicate a common preference for doing nothing and deferring

decisions. Some people prefer to do nothing because they fear they will regret making a choice, whereas others anticipate less regret over failing to act (Anderson 2003).

Probably the easiest and most common way to minimize one's exertion on a difficult decision is to postpone the decision. If the self is unwilling or unable to put forth high effort on a decision task when its resources have been depleted, as we have hypothesized, then resource depletion should make people especially prone to defer a decision. Deferral is possibly a rational or adaptive response, because the decision could perhaps be made in the future, when the self has more resources with which to consider all options and make a better-informed decision.

STUDY 5: THE EFFECT OF DEPLETION ON CHOICE DEFFERAL

Study 5 was intended to test the effect of depletion on choice deferral. Similar to Studies 3 and 4, we used an attention control task as a manipulation of resource depletion. Study 5 featured a choice between two cell phones offered to purchase on a website. Participants were instructed to choose between the two, based on pictures and descriptions. Crucially, however, they were also given the option of not selecting either of those phones and deferring the decision by going to another website. Thus, as with many consumer and other decisions, the participant could either make a selection from the two main options or could choose to keep looking. We predicted that depleted participants would be more likely than others to decide to keep looking.

Method

Procedure. One hundred and sixty one students in a northeastern university completed this study and were compensated for the participation. The experiment comprised of two parts: a resource depletion task and a choice task. We used the same attention regulation task as in Studies 3 and 4 as the resource depletion manipulation. Right after completing the depletion task,

participants were presented with a seemingly unrelated study. The cover story stated that in order to let some time pass between the video clip and the evaluations of the speaker in it, other researchers were interested in understanding how consumers make choices, and the task involved making (hypothetical) purchase decisions. It was emphasized that there were no right or wrong answers and that the respondents should consider only their personal preferences. We presented participants with a choice between two equally priced cell phones, described by their pictures and a list of attributes. They were further told that, as in normal purchase situations, they had the option of not choosing either of the two alternatives and looking for other options. Thus, participants had an option of either selecting one of the cell phones or deferring the choice by indicating they would rather "continue searching in other websites, and decide in the future".

The main dependent measure, as before, was the actual choices participants made in the second part of the experiment, and in particular, the proportion of participants who decided not to purchase one of the cell phones provided at the present time. We also measured the time it took participants to make the choice (excluding the participants who completed this task during one study session in which they completed the choice task in a pencil & paper format) and the number of recognized phrases that were shown in the video.

Results

Manipulation checks. At the end of the experiment participants were asked to recognize the media phrases that flashed during the video. We found a significant difference in the number of correct recognitions between the control and depletion conditions. Participants in the control condition were more accurate in recognizing the phrases. On average 79.6% of the participants in the control condition and only 41.2% of the participants in the depletion condition correctly

recognized the phrases that were shown in the video ($t(159) = 7.01$, $p < .001$). There was no significant difference between conditions in false positive recognitions: 7% for the control condition and 10% for the depletion condition ($t(159) = 1.53$, $p = .13$).

Decision deferral. The depletion manipulation significantly increased the tendency to put off a decision. Only 27% of the control participants opted to defer the decision by going to another website, but as many as 42% of the depleted participants did (χ^2 [1] = 4.12, $p<.05$). In addition, we measured the time it took each participant to make a choice. Although the participants in the control condition took slightly longer (25.3 seconds) than the participants in the depletion condition (22.10 seconds), the difference was not significant ($p>.10$). Participants in the depletion condition were much less likely than control participants to make a selection of either of the cell phones. Instead, they were much more likely to take the option of continuing the search thus deferring the current choice.

GENERAL DISCUSSION

Five studies showed that people relied on simpler more intuitive styles of decision-making when their resources had been depleted by prior acts of self-regulation. Crucially, the self-regulation exercises had no apparent or implicit relation to the subsequent decisions. The self-regulation tasks involved directing one's attention away from extraneous phrases during an impression formation task (Studies 3, 4, and 5) or overriding the automatic semantic response to a written word, in order to indicate instead the color in which the word was printed (Studies 1, 2). These self-regulation tasks were designed to deplete the limited energy resources that the self has for its various agentic, executive functions. A central assumption of this investigation was that the same limited resource is used for self-regulation as for making decisions. Consistently

people who performed self-regulation tasks ended up using different decision strategies than those whose resources have not been depleted.

The common finding across five experiments was that resource depletion (created by self-regulation on the first task) decreased one's ability to engage in effortful and deliberative (System 2) processing leaving the decision-maker with only simpler System 1 decision strategies to rely upon. Study 1 showed that depleted participants were more sensitive to a reference point when making their choices. In Studies 2 and 3, depleted participants picked one dimension and the option that was best on it (exhibiting what might almost be seen as extremeness seeking), unlike control participants who tended to integrate multiple dimensions of value and select a compromise option. Study 4 used the attraction effect, in which a tough choice between two options is augmented by an easy choice between one of them and a clearly inferior third "decoy" option. Depleted participants were especially likely to be swayed by the decoy, in effect letting the winner of the easy choice stand as the overall winner. Lastly, lacking any clear intuitive favorite among two cell phones, depleted participants in Study 5 were more likely than control participants to put off the choice, preferring to defer the decision by continuing their search at other websites instead of making a selection from the currently available set.

Beyond demonstrating the effect of prior exertion of the self on choice, our results provide important evidence for the processes underlying choice in context. In particular, resource depletion lead to an increase in context effects which arise from System 1 type automatic processing, but decreased the biases that stem from the careful trade-off evaluations (System 2 processing). Therefore, by examining whether resource depletion leads to an increase (decrease) of a particular effect we shed some light on the underlying mechanism of this bias. Hence, our empirical evidence shows that the choice of a compromise option stems from more

effortful and careful processing and is not a result of a simplifying heuristic (while compromise may simplify justification, it is the more arduous task, Dhar and Simonson 2003; Simonson 1989). In contrast, the attraction effect is rooted in simpler automatic processing and may indeed be a perceptual effect – the dominating alternative just *seems* better. Finally, we show that dependence on a reference point is an automatic intuitive inclination and that choice deferral is indeed a simplifying path to avoid engaging in effortful processing.

Because there is no currently available direct measure of the subjective condition of resource depletion, that state can only be inferred, and therefore we cannot prove that resource depletion mediated our findings. Hence it is useful to consider other possible alternative explanations. One suggestion might be that the depletion manipulation put people in a bad mood, which preoccupied or distracted them, leading to changes in their decision processes. Mood effects do not however seem a promising candidate for explaining our results. First, there is no consistent pattern of evidence indicating that mood or emotional state leads to changes in decision-making similar to what we observed. Second, and more important, we measured mood in two of these studies. We did not find a difference in negative mood, so bad moods are apparently not relevant. There was a significant though slight reduction in positive mood in one study (Study 2), but this did not replicate in Study 4, moreover mediation analyses indicated that the change in positive mood was unrelated to the decision-making measure.

Another possible explanation would hold that the depleting tasks were somehow aversive or burdensome, and so participants may have felt that they had already done enough for this particular research project and therefore decided to do the remaining task in the easiest manner possible. This view could draw some support for the finding that participants in one study (Study 2) did rate the initial task as more difficult, as compared to participants in the non-depleting

control task. However, the data on the time spent on the choice task contradicts this alternative explanation. If the participants felt they had already fulfilled their obligation to the experimenter, one might have expected them to make a snap judgment on the second task to finish the experiment faster. The results in general suggest the opposite pattern: depleted participants typically spent more time, if anything, on the second (decision) task than control participants.

Could the extra time indicate extra effort, contrary to our hypothesis of reduced effort? Further analyses failed to show that the increased time mediated the change in decision outcomes. Thus, if depleted participants do take longer than controls to make some decisions, it appears that the extra time is spent floundering around or spinning one's wheels rather than engaging in a systematic cost-benefit analysis or other rational appraisal of the options.

Implications for Future Research and Marketing

The ability to make complex decisions with intelligent, logical reasoning may be uniquely human, and certainly it is a central feature of successful human functioning. Our results suggest that patterns of decision making can be altered by prior acts of self-regulation on tasks that are implicitly and explicitly unrelated to the decisions. The effects occur, we think, because the self draws on a limited resource, and it uses this resource for consciously managing a broad range of challenges, including overriding responses and reasoning through tough choices. The self's total capacity is limited, and so when resources have been depleted by one task, less remain available for subsequent tasks. Our results do not indicate that people may simply tire of one kind of activity while being fully able and willing to perform up to their best on new tasks. Instead, they suggest that having a state of depleted resources pushes people toward more simplistic styles of deciding on a broad variety of new tasks.

The potential relation between the two systems view and other mechanisms that hinder cognitive processing is an interesting one. There may be similarities between the effects of time pressure or cognitive load and the effect of resource depletion from a previous task. It would be interesting to find out whether other effects of cognitive load, for example, can be replicated by resource depletion. Moreover, it may be important to discern when and whether time pressure or cognitive load map onto the two systems view, as we demonstrated resource depletion to.

Many decisions involve trade-offs, and there is some evidence that people find it strenuous and aversive to face up to trade-offs (Drolet and Luce 2004), perhaps because they have to integrate multiple dimensions and decide how much of one valued attribute to sacrifice in order to get a modicum of the other. Four of the present experiments used trade-off decision dilemmas. In all cases, people avoided the trade-off more when their resources were depleted by previous acts of self-regulation. Depleted participants chose extreme options instead of compromise options (thus not trading off the attributes at all) in Studies 2 and 3. They avoided the hard trade-off and focused instead on the easy decision that did not involve a trade-off in Study 4. And they declined to choose between two products in Study 5, electing instead to defer the decision and move on to other websites. Trade-off decisions are apparently especially demanding, and depleted decision-makers cannot be relied upon to face up to them.

Consumers in the marketplace rely on a variety of decision strategies when they chose what to buy or in which financial path to invest their savings. Our findings qualify the findings on the contextual dependence of such decisions by linking different type of effects to their underlying mechanisms. For example, our finding that the attraction effect is an intuitive System 1 type of effect suggests that it would be more prominent when consumers are unable (e.g., time constrained) or are not motivated to apply effortful processing strategies (e.g., low involvement

purchases). However, out findings further suggest that the opposite is true for the compromise effect: consumers are more likely to prefer the compromise when they are able and motivated to carefully consider the choice at hand (e.g., when purchasing a high ticket item). Marketers might therefore expect a different set of effects if people shop early in the day or when they return from a long arduous day at the office.

Finally, our finding that consumer decision making strategies depend on previous exertion of the executive functioning resource may be crucial to marketers. Resisting the urge to buy freshly baked cookies may later render customers to be more influenced by reference points. This is of particular importance when customers are required to make a sequence of decisions. If marketers would like customers to be able to process all the safety implications a new system installed in their brand of cars provides, they are more likely to succeed if those customers are not depleted by a previous task that required self-control (e.g., waiting a long time to be served).

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Table 1

The Effect of Resource Depletion on Reference-Dependent Choice

	Control		Depletion	
Reference point	job *x*	job *y*	job *x*	job *y*
a	23.0%	77%	39.1%	60.9%
a'	17.1%	82.9%	11.3%	88.7%

Table 2

Compromise Effect Stimuli for Experiments 2 and 3

Laptops			
	RAM	CPU	price
a	512MB	1.5GHz	$700
b	640MB	2.5GHz	$1300
c	1GB	3.2GHz	$3000
d	2GB	3.6GHz	$4000
Digital Cameras			
	megapixels		price
a	2.31		$199
b	3.34		$499
c	4.0		$799
d	8.0		$929

Table 3

The Effect of Resource Depletion on the Compromise Effect

	Control		Depletion	
Option	*abc* set	*bcd* set	*abc* set	*bcd* set
Study 2: Laptops				
a	42%		29%	
b	36%	27%	29%	36%
c	22%	38%	42%	37%
d		26%		26%
Study 3: Digital Cameras				
a	32%		24%	
b	44%	16%	44%	36%
c	24%	37%	32%	12%
d		47%		52%

Table 4

Attraction Effect Stimuli for Experiment 4

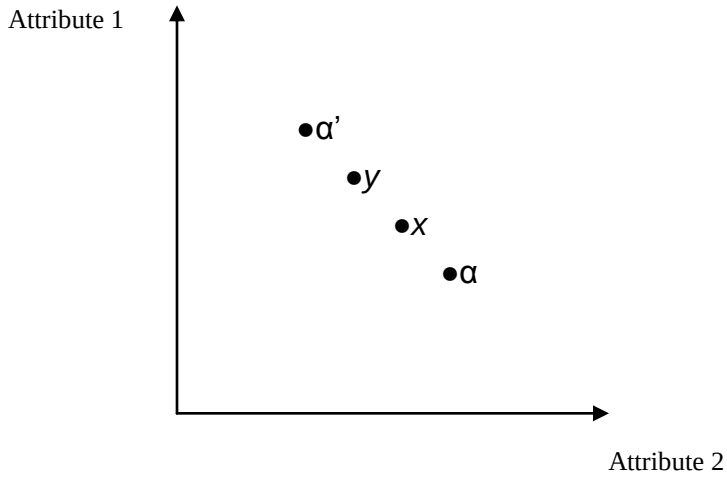
Apartments	Sq f	Distance (minutes)
a	350	10
b	450	7
c	800	15
d	700	18

Table 5

The Effect of Resource Depletion on the Attraction Effect

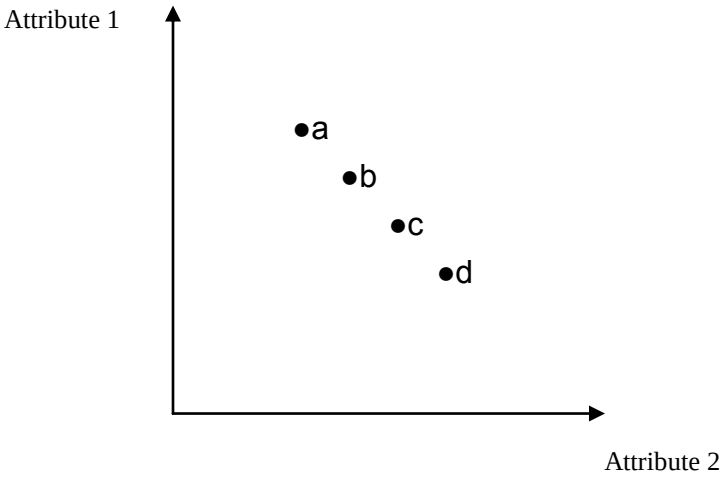
Option	Control		Depletion	
	choice set		*choice set*	
	abc	*bcd*	*abc*	*bcd*
a	0%		0%	
b	31%	25%	42%	0%
c	69%	75%	58%	100%
d		0%		0%

Figure 1:



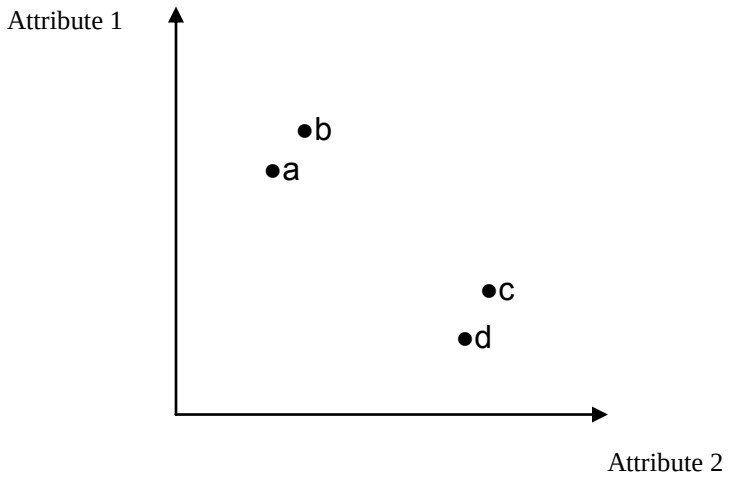
Reference Dependence: Options *x* and *y* present a loss on Attribute 2 from the perspective of *a* as the reference point as opposed to *a*'. The loss looms large because of loss aversion, rendering option *x* to be more likely to be chosen given *a* as the reference point. The reverse is true for *a*' as the reference point.

Figure 2:



The Compromise Effect: Option *b* is more likely than option *c* to be chosen in the presence of option *a* (choice set *abc*) than in the choice set *bcd*.

Figure 3:



The Attraction Effect: Option *b* seems much better relative to option *c* in the presence of option *a* which it dominates (choice set *abc*) than in the choice set *bcd*.