

The Role of Emotion, Tradeoff Recall, and Self-Regulation in Pre-Decisional Processing

by

Stephanie Marita Carpenter

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Doctoral Committee:

Professor J. Frank Yates, Co-Chair
Associate Professor Carolyn Y. Yoon, Co-Chair
Professor Richard P. Bagozzi
Professor Phoebe C. Ellsworth
Associate Professor Ethan F. Kross

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ABSTRACT

Three chapters demonstrate previously unexplored contextual and emotional factors that critically and systematically affect the way in which people construct value and generate choice options in the pre-decision phase of the decision process. This pre-decision phase occurs in the time before an individual makes a choice. In particular, emotions, the recall of prior tradeoffs, and self-regulation all play an important role during this pre-decision phase and consequently influence decision making. Chapter I indicates that negative, aversive emotions associated with stress and anxiety are evoked by difficult multi-attribute decisions, which some people regulate by shifting their values before making a decision. In Chapter II, recalling a past tradeoff situation leads to the activation and carry over of a valued attribute onto a subsequent, unrelated choice. This value carryover process occurs in a manner that suggests people may balance the prioritization of different values across tradeoff contexts. Chapter III reveals that under conditions of reduced inhibitory control, both younger and older adult participants become vulnerable to distracting information. In these circumstances, the distracting information is especially likely to lead to more creative construction decisions when it is relevant to the decision domain (e.g., when the distracting information is food-related and the construction decision is a creative recipe generation task). This dissertation demonstrates the importance of studying the pre-decision phase in order to better understand the decision process, and has important implications for how people construct value and choice options.

INTRODUCTION

Much research to date has focused on how context effects influence our decisions in the moment that a choice is made (e.g., framing of the required decision; e.g., Fischhoff, Slovic, & Lichtenstein, 1980; Hsee, 1996; Slovic, 1995), as well as how we manage choice conflict and justify our decisions immediately following a choice (e.g., Cooper, 2007; Croyle & Cooper, 1983; Festinger & Carlsmith, 1959; Harmon-Jones, Harmon-Jones, Fearn, Sigelman, & Johnson, 2008; Kiesler & Pallak, 1976). Less research, however, has explicitly examined what factors influence the pre-decisional process, that is, what contextual and emotional factors are relevant to and important for the decision maker *before* committing to a choice.

Extant research on the pre-decision process largely focuses on how the decision maker can simplify the required decision problem. For example, research on coherence shifting (Simon, Krawczyk, & Holyoak, 2004; see also pre-decisional distortion of choice information: Russo, Meloy, & Medvec, 1998) describes circumstances under which individuals face difficult tradeoff decisions where no choice option is initially superior to its competitors. These and other related accounts have assumed that pre-decisional processes aim primarily at reducing the cognitive effort expended during the decision process (Gigerenzer & Goldstein, 1999; Glöckner, Betsch, & Schindler, 2010; Montgomery & Svenson, 1976; Russo, Meloy, & Medvec, 1998; Simon, Krawczyk, & Holyoak, 2004) without attention to how emotional factors, past experiences, or cognitive resource constraints might also significantly influence pre-decisional processing and subsequent choice behavior.

Three chapters will examine how previously unexplored contextual and emotional factors critically affect the way in which we construct value (i.e., the extent to which a given decision outcome is desired) and generate choice options prior to actually making a choice. This is of particular importance because our decisions are not only influenced by contextual factors at the moment of making a choice, but also those present before any choice commitment. This dissertation focuses specifically on three factors that are proposed to play an important role in the pre-decisional process: emotion, recall of prior decision experiences, and diminished inhibitory control. Each chapter of this dissertation tackles a different factor in an effort to provide a more comprehensive and complete understanding of how people construct value and choice options during the pre-decision phase. The remainder of this introduction describes the content of each chapter, highlighting the proposed theoretical frameworks and research findings.

Chapter I. The first chapter of this dissertation examines how the pre-decisional process generates emotions and influences self-regulation strategies. Emotions are important in the decision process because they guide the way we appraise our environment and make decisions (cf. Lerner & Keltner, 2000; Smith & Ellsworth, 1985). The majority of extant work has considered how incidental (i.e., task-irrelevant) emotions carry over to influence the choice process at the time that a choice is made. Research has rarely considered how the decision tradeoffs themselves evoke integral (i.e., task-relevant; Lerner & Keltner, 2000) emotions, and especially how these integral emotions influence the decider during the pre-decision process, which in turn influences value construction and choices.

This chapter proposes that the anticipation of “difficult” decision problems involving tradeoffs often evoke negative emotions, and this may occur before an individual is even asked to make a choice. Given that research to date has not examined how negative emotions are

generated by difficult tradeoffs during the pre-decision process, or how these negative emotions influence the way we construct value and subsequently make choices, an investigation into how people manage negative emotions during the pre-decision process would make an important contribution to the field. This is the goal of Chapter I.

The research proposed here relies on the premise that almost all real-life decisions entail attribute conflict. That is, every serious choice alternative is better than its competitors on some attribute dimensions but worse on others. One proxy for pre-decisional value construction is observed in a phenomenon commonly known as “coherence shifting” (Simon et al., 2004), where the decision maker gradually softens attribute conflict psychologically to the point that one alternative is seen as dominant over its competitors, or nearly so. When this occurs, weaknesses of the eventually chosen alternative come to be perceived as less severe and less important while its strengths seem more desirable and significant.

The majority of extant research describes coherence shifting as a cold, cognitive process that does not involve the generation or regulation of negative emotion states. In an attempt to importantly contribute to the literature on emotion, self-regulation, and pre-decisional processing, Chapter I proposes that attribute conflict evokes negative emotions in the pre-decision phase of the process. Some individuals are able to regulate the arousal associated with this negative affect, but others are not. The ability to regulate negative emotions and arousal is proposed to be associated with greater shifts in value, as the value shifting process is a method through which individuals reduce their subjective perception of attribute conflict. Less perceived attribute conflict is predicted to contribute to lower levels of arousal and fewer negative emotions before the decision is even made.

Five studies were conducted to test the proposed theory. Results from Study 1 indicated that skin conductance responses and decision difficulty ratings indeed decreased in participants who coherence shifted. In Study 2, greater attribute conflict generated more aversive negative emotions. Study 3 indicated that a given individual's shifting behavior is consistent across decision problems, and coherence shifting is associated with the emotional suppression regulation strategy. Study 4 demonstrated that coherence shifting is diminished among decision makers depleted of regulatory resources, suggesting that the process of regulating negative emotions through coherence shifting requires cognitive effort. In Study 5, attribute conflict induced decision makers to speed up the decision process in an effort to escape conflict, which is again in line with the notion that difficult tradeoff decisions involving attribute conflict are aversive. The data across all five studies suggest that pre-decisional processes, such as coherence shifting, aid decision makers in regulating the discomfort generated by attribute conflict.

Chapter II. Turning to the next proposed contextual factor, past experience recall, Chapter II seeks to demonstrate that recalling prior tradeoff experiences during the pre-decision process can systematically influence subsequent, unrelated choices. Investigating the recall of prior experiences is especially important because few decision contexts are entirely novel. Rather, decision makers often reflect back on prior tradeoff experiences when faced with difficult choices. Although prior tradeoff experiences may not always appear directly relevant to our choices at hand, recalling details from these decisions may influence how we construct value and make current choices. This is the focus of Chapter II.

Much extant decision scholarship typically takes only the current context into account during value construction. This chapter proposes a process that we call “complementary value carryover,” which is a dynamic valuation procedure that automatically integrates the particulars

of past tradeoffs with new choice problems. Specifically, it is proposed that when recalling particulars of a past tradeoff experience, the value that was foregone in that tradeoff will become activated and carry over to influence decisions about subsequent, unrelated choice options that have superficially related attributes. Once a frustrated value has been satisfied, however, it is proposed to then allow another valued attribute to become prioritized in a subsequent choice context.

For example, recalling a past restaurant experience where a tradeoff existed between the quality of the food (high) and the speed of the service (slow) will activate in mind the speed value that was foregone in that restaurant experience. This activated speed value will then carry over to influence the choice of an unrelated product in a different domain, e.g., a camera with a faster shutter speed at the cost of a lower number of megapixels. Once speed has been satisfied, however, it should become deactivated and allow for the choice of other options that are not superior on the speed value. The proposition that complementary value carryover occurs for both frustrated and satisfied value suggests that people may wish to balance their values across tradeoff contexts. Time is a common and important domain in which it may be particularly easy to balance value across tradeoff contexts because people think of time in quantifiable units (e.g., hours, minutes, seconds), relative to more abstract domains, such as the friendliness of a server. Thus, the complementary value carryover process was tested specifically using the valued attribute of time.

Findings across five studies and a meta-analysis suggest that tradeoffs involving time are susceptible to context effects that extend beyond the incidental circumstances surrounding a given decision context. In Study 1, recalling a prior tradeoff situation involving time reliably reminded decision makers that one side of that tradeoff entailed both the satisfaction of one value

and the frustration of another value. This tradeoff recall activated the time values, which then carried over to financial decisions in contexts that were unrelated to the original tradeoff situations. This effect was enhanced by greater knowledge in the choice domain (Study 2), which was at least partly driven by increased tradeoff processing (Study 3). Study 4 indicated that the attribute dimension of time was particularly important for a tradeoff to carry over and influence subsequent, unrelated decisions, whereas Study 5 demonstrated that value satiation provided a strong account for the activation of time and carryover effects when the recall and subsequent choice tasks were perceived to be highly similar. Finally, a meta-analysis showed that effects were robust across studies and medium in size, and suggested support for a balance mechanism whereby both value satiation and deprivation influence complementary value carryover.

These results demonstrate previously undocumented influences of prior time related value experiences on current decision behavior. In particular, recalling tradeoffs involving the value of time influences the choices that we make across unrelated contexts. Future directions for this project will seek to extend our findings to attribute dimensions beyond time. Although the current data suggest that there may be something special about the valuation of time-related attributes, it is also plausible that something about how we think about or perceive time may be leading to the value carryover observed in these studies. As stated above, one possibility is that value activation and carryover may occur more frequently when the valued attribute domain represents a limited resource that can be mentally accounted for (e.g., time can be accounted for in quantifiable units of hours, minutes, and seconds). Other, more abstract attributes (e.g., friendliness) that do not have a clearly perceived limit may be more difficult to compensate for with later choices. This possibility warrants future investigation.

As a whole, this chapter contributes importantly to both our understanding of factors that systematically influence pre-decisional value construction, and how the perception of time affects choice behavior. It also provides a new way to understand how people think about, account for, and manage perceptions of value.

Chapter III. The third chapter examines how inhibitory control, an important component to self-regulatory behavior, influences the pre-decision process. Reduced inhibitory control processes are often considered detrimental to everyday functioning because they lead to greater distraction and an inability to focus on tasks at hand (Kim, Hasher, & Zacks, 2007). However, decision problems involving creativity may actually benefit from moments of greater distractibility.

In this chapter we propose that diminished inhibitory control, which is typically considered a negative consequence of normal cognitive aging, will benefit creative construction decisions where several small choices lead to a larger decision outcome (e.g., generating and selecting ingredients for a creative recipe). We hypothesized that reduced inhibitory control, because of its link to the use of divergent thinking (e.g., an attention to unique, distracting information) in the creative process, would facilitate performance on a creative construction choice task, especially one in which convergent (i.e., experienced based) thinking is also relevant.

The proposed process through which increases in creativity occur can be described as follows: Reduced inhibitory control leads both older and younger adults to become vulnerable to distracting information. This distracting information then becomes activated in the participants' minds because they are unable to properly inhibit distractions. On subsequent, unrelated construction decisions that require creativity, the activated information carries over and leads to

more creative outcomes. If, however, the distracting information has no relevance to the creative task at hand, then the activated information cannot be used in a meaningful way and increased creativity effects should not be observed.

Four studies were conducted to test our proposed model. Younger (i.e., 18-25) and older (i.e., 65-85) adult participants who were induced to be more vulnerable to distracting information during a reading task were found to generate more creative options on a subsequent recipe task (Study 1, Study 2, and Study 4). This observed increase in creativity could not be explained by resource depletion alone (Study 3), suggesting that only relevant information activated under conditions of reduced inhibitory control increases creativity. It was also found that under conditions of diminished inhibitory control creativity was preserved, if not slightly enhanced, in older adults relative to younger adults (Study 4).

This research has important implications for how diminished inhibitory control and creativity influence behavior across the adult lifespan, especially in complex or distracting decision environments. It suggests that the reduced inhibitory control typically associated with normal cognitive aging may not always provide a detriment to older adults' cognitive performance, and may in fact boost creativity in domains where an older adult has experience.

Overall, the chapters presented in this dissertation seek to investigate how contextual and emotional factors influence the decision process *prior* to any choice commitment. This research aims to expand our understanding of the decision making process and uncover previously unexplored factors that have a powerful influence on choice behavior.

References

- Cooper, J. (2007). *Cognitive dissonance: Fifty years of classic theory*. London: Sage.
- Croyle, R. T., & Cooper, J. (1983). Dissonance arousal: Physiological evidence. *Journal of Personality and Social Psychology, 45*, 782-791.
- Festinger, L., & Carlsmith, J. M. (1959). Cognitive consequences of forced compliance. *Journal of Abnormal and Social Psychology, 58*, 203-210.
- Fischhoff, B., Slovic, P., & Lichtenstein, S. (1980). Knowing what you want: Measuring labile values. In T. S. Wallstein (Ed.), *Cognitive processes in choice and decision behavior* (pp. 117-141). Hillsdale, NJ: Erlbaum.
- Gigerenzer, G. & Goldstein, D. G. (1999). Betting on one good reason: The take the best heuristic. In Gigerenzer, G., Todd, P. M. & the ABC Research Group, *Simple Heuristics That Make Us Smart* (pp. 75-95). New York: Oxford University Press.
- Glöckner, A., Betsch, T., & Schindler, N. (2010). Coherence shifts in probabilistic inference tasks. *Journal of Behavioral Decision Making, 23*, 439-462.
- Harmon-Jones, E., Harmon-Jones, C., Fearn, M., Sigelman, J. D., & Johnson, P. (2008). Left frontal cortical activation and spreading of alternatives: Tests of the action-based model of dissonance. *Journal of Personality and Social Psychology, 94*, 1-15.
- Hsee, C. K. (1996). The evaluability hypothesis: An explanation for preference reversals between joint and separate evaluations of alternatives. *Organizational Behavioral and Human Decision Processes, 67*, 247-257.
- Kiesler, C. A., & Pallak, M. S. (1976). Arousal properties of dissonance manipulations. *Psychological Bulletin, 83*(6), 1014-1025.
- Kim, S., Hasher, L., & Zacks, R. T. (2007). Aging and benefit of distractibility. *Psychonomic Bulletin & Review, 14*, 301-305.
- Lerner, J. S., & Keltner, D. (2000). Beyond valence: Toward a model of emotion-specific influences on judgement and choice. *Cognition and Emotion, 14*, 473-493.
- Montgomery, H., & Svenson, O. (1976). On decision rules and information processing for choices among multiattribute alternatives. *Scandinavian Journal of Psychology, 17*, 283-291.
- Russo, E. J., Meloy, M. G., & Medvec, V. H. (1998). Pre-decisional distortion of product information. *Journal of Marketing Research, 35*(4), 438-452.
- Simon, D., Krawczyk, D. C., & Hoyoak, K. J. (2004). Construction of preferences by constraint satisfaction. *Psychological Science, 15*(5), 331-336.
- Smith, C. A., & Ellsworth, P. C. (1985). Patterns of cognitive appraisal in emotion. *Journal of Personality and Social Psychology, 48*, 813-838.
- Slovic, P. (1995). The construction of preference. *American Psychologist, 50*, 364-371.

CHAPTER I

Coherence Shifting in Multiattribute Choice: In the Service of Emotion Regulation?

Picture yourself as a college senior facing the following decision problem (after Simon, Krawczyk, & Holyoak, 2004): You must choose between two job offers that differ from each other on four attribute dimensions. As described in Table 1.1a, Job Offer 1 is for an entry-level marketing position at the “Splendor” department store chain, and Job Offer 2 is for a similar opportunity at the “Bonnie’s Best” (BB) chain. You recognize that the Splendor offer is superior to the BB offer with respect to the office (private vs. cubicle) and commute time (18 vs. 40 min) dimensions. On the other hand, the BB offer is better on salary (\$800 above the industry average of \$40,000 vs. \$600 less than that average) and vacation package (superior vs. minimal time off). You have already concluded that the offers are comparable with respect to every other attribute dimension that you care about, and therefore you ignore those other factors.

Your Splendor/Bonnie’s Best conundrum illustrates a fundamental concern in decision scholarship: “attribute conflict,” that is, the absence of dominance. Consider, for example, Benjamin Franklin’s famous 1772 letter to his friend Joseph Priestly concerning “moral or prudential algebra,” in which he recommended a pro-vs.-con list approach to tough decision problems (Chaplin, 2012, pp. 259-260). One choice alternative “dominates” another if it is at least as good as that competitor with respect to every attribute dimension that matters to the decision maker and is better on at least one of those dimensions. In nearly every real-life decision situation, deliberations eventually reach a point where attribute conflict becomes

apparent. As in the Splendor/BB scenario, if one attribute dimension (e.g., office) favors Alternative A, then one or more other dimensions (e.g., salary) favor some competing alternative. A key challenge in descriptive decision scholarship has been to determine *how* people resolve attribute conflict in actual practice, thereby arriving at their ultimate choices. Another has been to understand *why* decision makers resolve such conflict as they do. The latter is our focus here.

The most common traditional decision theoretic approaches to resolving attribute conflict (implicitly, even Ben Franklin’s approach) rest on “weighted additive” (WADD) value representations such as the following for the Splendor/BB problem (cf. Fishburn, 1967):

$$T(\text{Splendor}) = W_{\text{Off}} \times A_{\text{Off}}(\text{Splendor}) + W_{\text{Comm}} \times A_{\text{Comm}}(\text{Splendor}) + W_{\text{Sal}} \times A_{\text{Sal}}(\text{Splendor}) + W_{\text{Vac}} \times A_{\text{Vac}}(\text{Splendor}) \quad (1)$$

$T(\text{Splendor})$, Eq. 1, can be interpreted as a score representing the overall, total appeal of the Splendor job offer in the situation described above. W_{Off} is your importance weight for the office dimension, and $A_{\text{Off}}(\text{Splendor})$ is a measure of your appraisal of the Splendor job offer on that feature dimension—essentially how much you like Splendor’s private office. The corresponding terms with the Comm, Sal, and Vac subscripts have similar interpretations for the commute, salary, and vacation dimensions, respectively. Note that a parallel score, $T(\text{Bonnie’s Best})$, could be derived for the competing job offer at BB. The final element of the traditional scheme for resolving attribute conflict is the “decision rule,” which specifies that the decision maker select the alternative that has the best overall score. Thus, you would choose Splendor if $T(\text{Splendor}) > T(\text{Bonnie’s Best})$ or instead pick Bonnie’s Best if the opposite were true (and you would be indifferent if $T(\text{Splendor}) = T(\text{Bonnie’s Best})$). It is important to recognize that the magnitude of the difference between $T(\text{Splendor})$ and $T(\text{Bonnie’s Best})$ does not matter, only the direction.

Let us now recall your job choice dilemma. Suppose that something, perhaps that you learned about the Splendor option first, induces you to lean slightly toward that offer (cf. Hogarth & Einhorn, 1992). Table 1.1b depicts two snapshots of your early (Time 1) and later (Time 2) deliberations in the decision episode. These snapshots include numerical representations of your attribute appraisals and dimension weights, using the kinds of ratings elicited by Simon et al. (2004) as well as the WADD value function. Notice that the attribute weights and appraisals have yielded overall scores such that, at Time 1, $T(\text{Splendor})_{\text{Time 1}} = +2$ and $T(\text{Bonnie's Best})_{\text{Time 1}} = -2$, slightly in favor of Splendor. Later, at Time 2, things have changed markedly. Observe that $T(\text{Splendor})_{\text{Time 2}} = +18$ and $T(\text{Bonnie's Best})_{\text{Time 2}} = -23$. Also observe *how* this occurred. First, your weights for the dimensions (e.g., commute) on which your initially favored alternative (Splendor) was strong have increased, while those for dimensions upon which it was weak (e.g., salary) have decreased. In addition, you now appraise more favorably than before those Splendor attributes that are objectively stronger than their BB counterparts (e.g., small office versus noisy cubicle). You also do the opposite for BB attributes that are stronger than the corresponding Splendor attributes (e.g., salary, vacation), seeing them as less favorable than you did initially. That is, you have shifted your appraisals and importance weights to be even more “coherent” with your initial choice leaning than they were at the outset. Put another way, the severity of the prior attribute conflict has been softened; psychologically, at least, you are now closer to experiencing a dominating alternative (cf. Montgomery & Svenson, 1976). Note how this process differs significantly from the traditional view in that it highlights the notion that the simple marginal superiority of one alternative over another is not enough: the goal is dominance.

In relatively recent times, several investigators, most notably Russo and his colleagues (e.g., Russo, Medvec, & Meloy, 1996) as well as Simon and his associates (e.g., Simon et al., 2004), have demonstrated that this “coherence shifting” is a reliable phenomenon, one with exceptional (and generally unacknowledged) importance for decision scholarship. It amounts to a means of resolving attribute conflict that is fundamentally different from the approach posited in traditional decision theories. It does not assume that the decision maker’s attribute assessments and dimensional importance weights are either fixed or stochastic. Rather, they shift systematically during the course of a decision episode. The most significant unmet challenge is to explain why this happens.

There have been several proposed drivers of coherence shifting, along with some evidence. In one form or another, the most prominent proposals suggest that the phenomenon at least partly reflects the decision maker’s aim of reducing the cognitive effort expended during the decision process (e.g., Gigerenzer & Goldstein, 1999; Montgomery & Svenson, 1976; Russo, Meloy, & Medvec, 1998). One version of this idea, proposed by Simon et al. (2004) as well as Glöckner, Betsch, and Schindler (2010), entails a “constraint satisfaction” mechanism. This mechanism is presumed to be an automatic, Gestalt perception-like process that rapidly makes sense of the decision maker’s situation (Glöckner et al., 2010, p. 442). This allows for quick, efficient, and confident action since most, if not all, the pertinent considerations are consistent with the selection of one particular alternative. Russo, Carlson, Meloy, and Yong (2008) proposed an especially interesting extension of this idea, that consistency serves as a goal for decision makers, in and of itself, and coherence shifting helps decision makers achieve that goal. The results described by Russo et al. agree with such an interpretation.

All of the various proposed contributors to coherence shifting are plausible. However, the present research was predicated on doubt that such proposals constitute the whole story. We considered a conceivably independent, additional role for emotions. Based partly on interviews and think-aloud protocols of people making multiattribute choices, we conjectured that coherence shifting can help decision makers resolve the emotional discomfort engendered by the attribute conflict entailed in many decision situations. That is, even if not consciously, some individuals actively use coherence shifting as a tool for minimizing unpleasant affect. Others, who coherence shift minimally, if at all, are not relieved of that discomfort.

At first blush, coherence shifting may seem to be the same as the post-decisional spreading of alternatives that is often attributed to cognitive dissonance reduction (see Cooper, 2007, for a review). The feelings of discomfort the decision maker experiences post-choice are assumed to arise from an inconsistency between the decision maker's attitudes and choices, feelings the individual successfully eliminates by changing his or her attitudes (Croyle & Cooper, 1983; Kiesler & Pallak, 1976). Critically, coherence shifting and cognitive dissonance reduction differ on the timing of the preference shifts. Theories of cognitive dissonance posit that preference changes occur *after* the choice is made (Cooper, 2007). Coherence shifting, on the other hand, emphasizes changes in assessments that begin *prior* to the choice commitment and that actually assist the person in arriving at a decision. To our knowledge, no prior research has sought to determine whether managing feelings of discomfort is indeed a driver of pre-decisional coherence shifting.

Let us return to the decision problem sketched in Table 1.1a. If you choose the Splendor job offer, you can expect to enjoy the experience of working in a private office and having a short commute. On the other hand, taking the Splendor job would also require you to live with a

lower salary and a minimal vacation package. You would have complementary good and poor experiences if you took the Bonnie's Best job. Thus, it appears that, no matter which alternative you choose, you are condemned to suffering from your decision, comparatively speaking. There is empirical evidence that managing and potentially having to "make do" with such unresolved attribute conflict is among the major reasons why people experience some decision problems as "hard" rather than "easy" (Yates, Veinott, & Patalano, 2003). We therefore proposed that, for some people, coherence shifting allows one to avoid or assuage (not necessarily deliberately or consciously) the emotional discomfort created by attribute conflict, which also facilitates the decision process. The studies described here were intended to provide evidence bearing on that possibility.

Study 1: Associations Between Coherence Shifting and Arousal

If our proposal is correct, then the more an individual coherence shifts, the less emotional discomfort that person should experience while making a decision. This association plausibly could arise from either or both of two mechanisms:

The "self-treatment" idea entails the following event sequence: *Attribute Conflict* → *Emotional Discomfort* → *Coherence Shifting* → *Weaker Attribute Conflict* → *Reduced Emotional Discomfort*. Thus, some time after a decision episode begins, the decision maker recognizes attribute conflict, which induces emotional discomfort ("This decision could hurt me"). In order to "self-treat" that discomfort, the decision maker coherence shifts (again, this need not be a conscious process). This shifting weakens the perceived attribute conflict, which in turn reduces the emotional discomfort.

An alternative “preemption” mechanism involves this event sequence: *Anticipated Attribute Conflict* → *Anticipated Emotional Discomfort* → *Pre-emptive Coherence Shifting* → *Minimal Actual Emotional Discomfort*. Here, early on in a decision episode, the decision maker anticipates attribute conflict and the attendant emotional discomfort. In order to head off that discomfort, the decision maker attempts to coherence shift, that effort succeeds, and therefore emotional discomfort is never actually experienced.

It is reasonable that a decision maker learns to use the preemption approach primarily via repeated prior experiences of self-treatment, a mechanism that might well eventually automatize and become habitual (Gyurak, Gross, & Etkin, 2011). Regardless of which mechanism occurs in a given situation, our prediction is that coherence shifting and emotional discomfort in multiattribute decision making will be inversely associated.

Method

Participants

Fifty-nine undergraduates at the University of Michigan volunteered in return for course credit or a \$10 fee. The responses of one participant were excluded from analyses because this individual had skin conductance responses greater than four standard deviations from the mean, leaving 58 cases for analysis.

Procedure and Materials

The methods were adapted from those described by Simon et al. (2004) and discussed in the introduction of this article, administered via computer. The stages of the procedure, along with the materials, are summarized in Table 1.2. Here we provide an overview.

Stage 1. We took as our measure of discomfort participants’ skin conductance responses (SCR), similar to the approach employed by Croyle and Cooper (1983) for assessing emotional

distress post-choice. Skin conductance responses were recorded via electrodes that were attached to the palm of the non-dominant hand, which remained inactive throughout the experiment. The system used was a Biopac MP150, and SCR sample acquisition was set to 500 Hz (samples/second).

Stage 2. To establish each participant's SCR baseline, SCR was measured during a 5-minute handwriting judgment exercise. On each trial, the participant's task was to provide a probability judgment for the gender of the person who wrote a short, randomly selected handwriting sample.

Stage 3. A priori, it seemed plausible that effects on coherence shifts might be stronger when a person anticipates having to justify his or her decision to another, respected individual (cf. Lerner & Tetlock, 1999). Thus, participants were randomly assigned to either a "standard" condition, adapted from Simon et al. (2004), or a "justification" condition that was identical except that each participant was told to imagine that he or she would have to justify the impending decision to a close other (e.g., relationship partner, parent, best friend) in a short post-choice speech. We found no effect of this manipulation on coherence shifting or choices. Although other research has found that accountability can influence pre-decisional shifting behavior (cf. Russo, Meloy, & Wilks, 2000), the samples of interest were comprised of working professionals and subjects interacting with each other in dyads. In our study, participants were undergraduate students who were tested one-on-one and interacted only with an experimenter. Future research should explore the boundary conditions of choice justification on coherence shifting.

Stage 4. The participant was asked to imagine being in a post-graduation job search situation as described in the introduction.

Stage 5 (Decision Time 1). This was the first point, Time 1, at which the participant reported his or her attribute appraisals and dimensional importance weights. Attribute appraisals were rated on an 11-point scale ranging from -5 (highly undesirable) to +5 (highly desirable). Dimensional importance weights were rated on a 9-point scale ranging from 0 (no weight) to 8 (maximum weight) for each of the four dimensions (i.e., salary, commute, office, and vacation). Each attribute was presented individually on the screen until the participant responded. Participants made assessments in blocks whereby they provided all of the desirability ratings first and then all of the importance weights.

Stage 6. This first distraction task was intended to divert the participant's attention from the appraisals and weights just provided.

Stage 7. Here the participant learned of a complication in the scenario: Splendor and Bonnie's Best were being considered for purchase by another, larger company, in which case one of the job offers might be rescinded. The experimental design objective was to delay the participant's final decision.

Stage 8 (Decision Time 2). This was the first opportunity, at Time 2, for the participant to exhibit coherence shifting from the attribute appraisals and dimension weights reported at Time 1 in Stage 5. It also allowed the participant to indicate a tentative "choice leaning" between the job offers.

Stage 9. This healthcare decision making task was another occasion when the participant's attention was purposely drawn away from his or her prior decision-related responses.

Stage 10 (Decision Time 3). In this stage, at Time 3, the participant learned that neither company would be bought out and thus each job offer remained available and a final decision and related assessments were required.

Stage 13. Several individual difference measures were acquired to explore theoretically plausible correlates of coherence shifting.

Results and Discussion

Coherence Shifting Measurement and Classification

Simon et al. (2004) created separate measures of coherence shifting for each of eight attribute desirability ratings (DRs), i.e., attribute appraisals, and for each of four dimensional importance ratings (IRs), interpreted as importance weights. They observed some degree of consistency among those measures. Not surprisingly, there was considerable variability, too. To address the comprehensiveness and stability challenges, we modified and extended the Simon et al. measurement approach. We first computed coherence shifting scores separately for all DRs and all IRs. We then combined them to construct an overall coherence shifting index that we used throughout subsequently. The specific steps in creating this composite measure of coherence shifting were as follows.

We first defined

$$S_{Des} = (1/8)[DR_{Off,S} + DR_{Com,S} + DR_{Sal,S} + DR_{Vac,S} - DR_{Off,B} - DR_{Com,B} - DR_{Sal,B} - DR_{Vac,B}], \quad (2)$$

where each rating was linearly transformed to a -1 → +1 scale, per Simon et al. (2004). In this equation, $DR_{Off,S}$ denotes the desirability rating the participant gave to the office (Off) attribute for the Splendor (S) alternative and $DR_{Sal,B}$ represents the desirability rating for the salary (Sal) in the Bonnie's Best (B) job offer. The remaining expressions on the right-hand side of Eq. 2

have similar meanings for the rest of the attributes. S_{Des} is the same as the statistic described as the “S score” by Simon et al. (2004). It reflects the overall attractiveness of Splendor’s attributes compared to those of Bonnie’s Best. S_{Des} was calculated for the participant’s Time 1 as well as Time 2 assessments of attribute desirability, yielding $S_{Des,1}$ and $S_{Des,2}$, respectively. From these, we computed

$$CS_{Des} = S_{Des,2} - S_{Des,1}, \quad (3)$$

a “raw” desirability coherence shifting measure for the participant. This allowed us to define

$$ACS_{Des} = | S_{Des,2} - S_{Des,1} | \quad (4)$$

as an absolute measure of desirability coherence shifting. Taking the absolute value allows us to capture appropriately the magnitudes of the shifts, irrespective of their direction. Finally, we specified

$$NACS_{Des} = z(ACS_{Des}), \quad (5)$$

as a “normalized” measure of the participant’s desirability coherence shifting, relative to that exhibited by his or her co-participants.

In analogy with S_{Des} , we defined

$$S_{Imp} = (1/4)[IR_{Off} + IR_{Com} - IR_{Sal} - IR_{Vac}], \quad (6)$$

where IR_{Off} represents the importance rating for the office attribute dimension and the remaining expressions have similar interpretations for the other dimensions, with each rating having been transformed linearly to a $0 \rightarrow 1$ scale. S_{Imp} indexes the overall importance the participant attached to the dimensions on which Splendor was better than Bonnie’s Best, relative to those on which Bonnie’s Best was better than Splendor. Taking the same approach as with desirability, we specified

$$CS_{Imp} = S_{Imp,2} - S_{Imp,1}, \quad (7)$$

$$ACS_{Imp} = | S_{Imp,2} - S_{Imp,1} |, \quad (8)$$

and

$$NACS_{Imp} = z(ACS_{Imp}), \quad (9)$$

that is, a normalized absolute measure of coherence shifting with respect to dimension importance.

Finally, as a composite measure of each participant's extent of coherence shifting, with respect to both desirability and importance ratings, we defined

$$NACS_{Overall} = NACS_{Des} + NACS_{Imp} \quad (10)$$

For the purposes of further analyses, the distribution of $NACS_{Overall}$ scores was divided into thirds, classifying participants as low ($N = 18$), moderate ($N = 19$), or high ($N = 19$) coherence shifters, respectively.

Mean Skin Conductance Responses Per Coherence Shifting

Participants' mean SCR readings across each period of interest were interpreted as indicators of arousal and as potential proxies for emotional discomfort. Such readings were recorded and averaged for the 5-min baseline period. As expected, there were no significant differences in mean SCR among the low, moderate, and high coherence shifters at baseline, $F(2, 54) = .233, p = .793$. Thus, there was no reason to think that coherence shifting tendencies reflect chronic arousal levels.

According to the review by Figner and Murphy (2010), the onset of SCRs after cognitive stimulus presentation generally occurs in the range of 1–3 seconds. Thus, we assessed SCRs at 2000 ms after onset of the screens where participants rated desirability and importance during pre-choice Time 1, pre-choice Time 2, and post-choice Time 3.

Figure 1.1 shows the mean values of the SCRs, distinguished by coherence shifting magnitude classification—low, moderate, and high—and by assessment time—Time 1, Time 2, and Time 3. There was a significant main effect of coherence shifting classification on SCR, $F(2,54) = 3.196, p = .049, \eta^2 = .106$. The interaction of coherence shifting classification and assessment time was also statistically significant, $F(2,54) = 3.419, p = .040, \eta^2 = .088$. As the figure suggests, there were no significant differences among coherence shifting groups on SCR for Time 1, $F(2,54) = .166, p = .847$. This is consistent with the emotional discomfort proposition given that, at Time 1, the participant had not yet been presented with a specific, personal decision problem. As expected, differences across groups did emerge by Time 2, however, $F(2,54) = 4.420, p = .017, \eta^2 = .14$, in forms at least partly consistent with the emotional discomfort thesis. Arousal, as reflected in SCRs, was lower for moderate coherence shifters than for either high or low coherence shifters, $t(54) = -2.952, p = .005, d = .80$, whose discomfort indicators were similar, $t(54) = .661, ns$. Considered from another perspective, the data indicate that, although low and high coherence shifters remained in a relatively high state of arousal, the moderate coherence shifters did not.

By post-choice Time 3, however, significant differences emerged between the high and low coherence shifting groups, $t(54) = 2.071, p = .043, d = .56$, as high coherence shifters' arousal continued to decline between Times 2 and 3 (i.e., when the choice was being made) to low levels similar to those of the moderate coherence shifters, $t(54) = .491, ns$. Low coherence shifters' arousal levels remained substantial and essentially unchanged at all three time points. In contrast, both moderate and high coherence shifters eventually achieved significantly lower levels of arousal. It is worth noting that the pattern of data associated with the moderate coherence shifters appears consistent with the preemption mechanism of coherence shifting

proposed earlier. In contrast, that of the high coherence shifters more closely resembles what one would expect to arise from the self-treatment process.

Correlates of Coherence Shifting

As predicted, the more that participants coherence shifted (measured by their mean absolute coherence shifting scores), the less difficult they reported the decision to be post-choice, $r(57) = -.27, p = .039$. This, too, supports the possibility of coherence shifting being a mechanism for managing the emotional discomfort induced by attribute conflict.

Only one of the assessed individual difference measures was significantly correlated with coherence shifting: The less participants coherence shifted, the more they reported being “hypervigilant” on the hypervigilance subscale of the Melbourne Decision Making Questionnaire, $r(55) = -.29, p = .029$. Consider a brief characterization of the hypervigilance concept provided by Mann et al. (1997, p. 2): “The decision maker searches frantically for a way out of dilemmas ... hypervigilance is a ‘panic-like’ state in which the decision maker vacillates between unpleasant alternatives. Hypervigilance is associated with severe emotional distress.” Thus, one might reasonably speculate that low coherence shifters perceive attribute conflict to be a distressing “dilemma” that they are unable to resolve or find a means of escaping. This explanation is also consistent with our results demonstrating that low coherence shifters were aroused by the attribute conflict inherent in the decision problem they faced and were unable to successfully reduce their high arousal state at any point during the decision task.

Study 2: Is Attribute Conflict-Induced Arousal Aversive?

A skeptic pondering Study 1 might well voice the complaint that although skin conductance responses reflect arousal, that arousal could just as easily be positive as negative.

Thus, instead of distress, the elevated arousal levels associated with attribute conflict in Study 1 might have been indications of pleasant emotions such as intense interest or intellectual engagement. Study 2 was thus undertaken to test whether the arousal induced by attribute conflict in Study 1 was indeed unpleasant. Our strategy for examining this issue was to manipulate attribute conflict and then assess whether and how decision maker self-reports of negative emotions were affected by such manipulations.

Method

Participants

A total of 247 people, mean age = 27.3 years, served as participants in the study. They were recruited and took part in the study via Amazon's Mechanical Turk, for a fee of \$.40. Each participant was randomly assigned to one of five conditions. The mean amount of time participants required to complete their tasks was 4 minutes.

Materials

The basic scenario used in this study was the same as that employed in Study 1. That is, the participant assumed the role of a new college graduate considering job offers from department store companies "Splendor" and "Bonnie's Best," neither of which dominates the other. Table 1.3 describes the design as well as the decision alternatives presented to participants in each of five conditions. Start with the "Base" situation in the middle of Table 1.3. In simplified form, that is the same situation shown in Table 1.1a for Study 1. Note that the "Commute" and "Salary" rows in Table 1.3 are shaded. That is because they represent the dimensions used in manipulating attribute conflict across the conditions of the experiment. In the Base situation, note that Splendor has a 22-minute advantage over Bonnie's Best with respect to the Commute dimension. Countering that fact, Bonnie's Best has a \$1400 Salary advantage over

Splendor. These aspects of the attribute conflict in the Base situation are highlighted at the top of the Base section of Table 1.3 to facilitate comparisons with the other conditions.

Observe that, in an ordinal fashion, the intensity of the attribute conflict implicit in the situations described in Table 1.3 increases from the left of the display to the right. The Commute-vs.-Salary attribute conflict in the Minus 2 condition is rather slight while that in the Plus 2 condition is substantial. In the former, a 4-minute commuting time advantage is pitted against a \$400 annual salary advantage. In the latter, the parallel competing advantages are much greater—38 minutes of commute time (each way, every working day) and a \$3000 per year salary boost. Observe that the conditions to the left of the Base condition are labeled “Minus” situations because the intensity of attribute conflict they contain is less than that in the Base situation. The rationale for the descriptor “Plus” is analogous.

In order to assess potential self-reported unpleasantness experienced by participants, we developed a decision situation *aversiveness index* based on responses to the following items presented to the participant while he or she was deliberating a particular decision problem:

Anxious: Rate how anxious you feel as you try to make up your mind about which of these job offers to accept: *1 = Not Anxious At All ... 5 = Moderately Anxious ... 9 = Extremely Anxious*

Stressed: Rate how stressed you feel as you try to make up your mind about which of these job offers to accept: *1 = Not Stressed At All ... 5 = Moderately Stressed ... 9 = Extremely Stressed*

Unpleasant: Rate how unpleasant it feels as you try to make up your mind about which of these job offers to accept: *1 = Not Unpleasant At All ... 5 = Moderately Unpleasant ... 9 = Extremely Unpleasant*

Conflicted: Rate how conflicted you feel as you try to make up your mind about which of these job offers to accept: 1 = *Not Conflicted At All* ... 5 = *Moderately conflicted* ... 9 = *Extremely Conflicted*

A given participant's aversiveness index score was that individual's mean response, from 1 to 9, to these four items.

Procedure

The basic procedure was almost identical to that for Study 1. The only potential material difference concerned the features of the job offers from Splendor and Bonnie's Best, as described in Table 1.3. After being told the details of the job offers—first in paragraph form and then in matrix form—the participant was presented with the emotion rating task: “Before you make up your mind about which job to accept, we would like you to respond to a few statements. Keep the Splendor and Bonnie's Best job offers in mind as you respond to these statements. Please use the full range of each scale when indicating your response.” The participant responded to the four aversiveness index items as well as similarly worded items assessing negative (sadness, anger, pain, difficulty) and positive (happiness, excitement) states.

Results and Discussion

Figure 1.2 displays the results of interest, which were consistent with our predictions. First of all, there was a statistically significant overall effect of attribute conflict intensity on aversiveness index scores, $F(4, 242) = 2.784, p = .027, \eta^2 = .03$. The following planned contrast for mean aversiveness index scores by condition was examined: (Plus 1 + Plus 2) – (Minus 1 + Minus 2). That contrast was statistically significant, too: $t(242) = 2.870, p = .004, \eta^2 = .03$. It is also worth noting that the reliability of the aversiveness index was satisfactory: Cronbach $\alpha =$

.805. None of the other six affective state ratings differed systematically across attribute conflict intensity.

Figure 1.2 and the effect size measures suggest that the influences of attribute conflict were small. This recalls a key rationale for using an experimental manipulation. In typical real-life decision situations, as in this experiment, any one pair of attributes is severely limited in its ability to influence a given decision because there are so many other considerations that also matter to the decision maker. It is also important to keep in mind that the situations in Studies 1 and 2 were entirely hypothetical; there were no real jobs on the line to stimulate intense emotional reactions. Nevertheless, the observed effects still occurred.

Study 3: Consistency of Coherence Shifting and Associations with General Emotion Regulation Tendencies

Together, Studies 1 and 2 provided initial evidence that coherence shifting can reliably reduce the unpleasant emotional discomfort instigated by the attribute conflict. However, a key feature of our procedures in Studies 1-2 suggested reason for pause before drawing such conclusions. Recall that each participant in those studies had the opportunity to display coherence shifting behavior for only one decision situation, the job offer problem of Simon et al. (2004). Thus, the first aim of Study 3 was to seek evidence as to whether a given individual is indeed likely to be consistent in his or her inclination to exhibit coherence shifting from one distinct decision situation to the next. In addition, you may recall in Study 1 that participants who coherence shifted reduced arousal over the course of the decision task. If these reductions in arousal are in fact indicative of emotion regulation strategy use, then we should also observe correlations between coherence shifting inclinations and general emotion regulation tendencies.

There is compelling evidence that people sometimes consistently adopt either of two broad approaches to regulating unpleasant emotions (Gross, 1998; Gross & John, 1997). A common response-focused regulation approach, referred to as “emotional suppression,” occurs when an individual inhibits the expression of affect that is already being experienced. When using this strategy, it is as if the person reasons, “If I don’t show it, this bad feeling will just go away.” This regulation strategy is often observed in high-arousal emotional situations (Gross, 1998). An alternative regulation approach, often described as antecedent, is called “cognitive reappraisal.” It occurs when a person reframes the situation at hand in order to preclude or quickly change negative feelings. Here, the individual might say, “If I think about this situation differently, I might realize that there’s actually no reason for alarm.” This regulation strategy tends to be selected when individuals are experiencing low-arousal emotional states (Sheppes et al., 2011) that are relatively easy to reappraise. The data in Studies 1 and 2 were consistent with the idea that coherence shifting can serve to prevent or reduce the emotional discomfort arising from the attribute conflict inherent in many challenging decision problems. This suggests the hypothesis that coherence shifting is a special case of the kinds of emotion regulation tools that for some time have been known to exist.

To the extent that this hypothesis is true, it is reasonable to expect that personal tendencies for exhibiting coherence shifting should be also associated with tendencies for invoking more general emotion regulation devices. Given its standard characterization, it seems that emotional suppression corresponds conceptually to our proposed self-treatment mechanism for how coherence shifting can be used to manage the discomfort generated by attribute conflict. In contrast, cognitive reappraisal seems more similar to the proposed preemption process. Thus,

in Study 3 our second aim was to provide evidence as to whether coherence-shifting tendencies are, in fact, associated with tendencies toward the use of emotion regulation tactics generally.

Method

Participants

Thirty-three undergraduates at the University of Michigan volunteered in return for course credit or a \$10 fee.

Procedure and Materials

Each participant completed two decision making exercises similar in structure to the one used in Study 1, in separate sessions held approximately one week apart, with the order of the two problems counterbalanced. One of those exercises was the same as the job offer exercise employed in Studies 1-2. The second was structurally the same but substantively different. It involved a choice between two apartments that the participant might rent in the city where the university is located. The apartments differed on four attribute dimensions: distance from campus, amenities, the cost of rent, and apartment square footage.

At the end of the second session, the participant provided demographic information and also completed the Emotion Regulation Questionnaire (ERQ; Gross & John, 2003) and the Berkeley Expressivity Questionnaire (BEQ; Gross & John, 1997). Recall that in cognitive reappraisal approaches, the person tries to manage unpleasant emotions by re-construing the given situation such that any potential emotional impact is lessened (Gross & John, 2003, p. 349), as articulated in an item such as, “I control my emotions by *changing the way I think* about the situation I’m in.” In contrast, expressive (emotional) suppression entails the person actively inhibiting the display of an emotion being experienced currently (Gross & John, 2003, p. 349), e.g., “I control my emotions by *not expressing them*.” The negative expressivity scale of the

BEQ assesses the degree to which a person tends to exhibit outward displays of experienced negative emotions, e.g., “Whenever I feel negative emotions, people can see exactly what I am feeling.” The aim of the positive expressivity scale is similar except applied to positive emotions (Gross & John, 1997), e.g., “When I'm happy, my feelings show.”

Results and Discussion

Consistency of Coherence Shifting Behavior

Coherence shifting was assessed for both the job offer and the apartment decision problems, using the overall, composite measure of coherence shifting described previously, $NACS_{Overall}$. The correlation between $NACS_{Overall, Job}$ and $NACS_{Overall, Apartment}$ was $r(33) = .612, p < .001$. This statistic supports the proposition that people do indeed have consistent, trait-like tendencies to exhibit coherence shifting across different decision situations.

Coherence Shifting and Emotion Regulation

Table 1.4 displays the correlations between overall coherence shifting measures for each decision exercise and participants' emotion regulation scale scores. The results suggest that an association did not exist between coherence shifting and emotional reappraisal tendencies. However, there were strong associations between coherence shifting and measures of the degree to which people desire and seek to express emotions, in both emotion regulation and expressivity scales. In general, the more strongly participants coherence shifted, the more they reported utilizing emotional suppression and the less likely they were to express both positive and negative emotions. These results suggest that decision makers' inclinations to coherence shift in the face of decision problems involving attribute conflict are strongly correlated with their tendencies to rely on particular emotion regulation devices throughout their daily lives. Specifically, our data speak to the notion that coherence shifting might be a regulation strategy

that is related to the expressive suppression tools used for emotion regulation. The observed correlations plausibly might exist because coherence shifting is, at least partly, simply a special variety of such devices.

Study 4: Coherence Shifting, Emotion Regulation, and Resource Depletion

Studies 1-3 provided evidence that coherence shifting is a consistent strategy people use across contexts that reduces the aversive emotional arousal instigated by difficult decisions involving feature conflict. We now turn to an examination of the processes that might disrupt coherence shifting. In Study 1 we found that participants who coherence shifted little or not at all remained highly physiologically aroused across the decision task and never benefited from arousal reduction. The first aim of Study 4 was to begin exploring why coherence shifting was disrupted in these subjects. A second aim was to observe if coherence shifting behaves the way that previously recognized emotion regulation devices do and to replicate the associations between coherence shifting tendencies and emotion regulation strategy use that we observed in Study 3.

Implicit in the present discussion are distinctions among the kinds of distress that might be present in a decision situation. Those distinctions are reminiscent of the difference between what are sometimes called “task stress” and “ambient stress” (Yates, 1990, p. 376). Task stress originates in the nature of the task a person is seeking to perform, e.g., whether that task requires good memory or good vision. The first three studies sought to assess influences of task stress on coherence shifting behavior. In contrast, ambient stress is inherent to the situation in which the task is attempted and is the same regardless of the specifics of the requisite task, e.g., stress due to fatigue or extreme temperatures. These types of stress map onto integral (task-relevant) and

incidental (task-irrelevant) emotion, and there is evidence that task and ambient stress often have different effects (see, for example, Preston, Buchanan, Stansfield, & Bechara, 2007). This therefore inspires questions about connections and distinctions between the emotional discomfort generated by attribute conflict in decision problems, a kind of task stress, and potential ambient stressors that might be present in a decision situation. Identifying such connections and distinctions would be informative about the details of how coherence shifting proceeds in the service of emotion regulation.

Imagine that a decision maker is presented with a decision problem entailing significant attribute conflict, which engenders substantial emotional discomfort. According to the present analysis, we might expect that decision maker to use coherence shifting to manage that discomfort. Is that expectation more likely or less likely to be realized depending on whether pre-existing ambient stress is intense, mild, or entirely absent? Suppose that coherence-shifting processes are initiated and carried out solely upon the recognition of attribute conflict whenever it occurs (perhaps even automatically, as in the case of Gestalt-like constraint satisfaction, Glöckner et al., 2010, and Simon et al., 2004). Then we should observe the same amount of coherence shifting regardless of the ambient stress in the situation. But suppose that coherence shifting is just one in a kit of purpose-built self-regulation tools available for helping the decision maker maintain an even keel emotionally. Previous research has shown that the execution of emotion regulation activities often draws so heavily on executive control resources that meeting subsequent emotion regulation and cognitive control challenges suffers accordingly (e.g., Hobson et al., 2014; Ochsner et al., 2004; Saunders et al., 2015; Schmeichel, 2007). Resource depletion effects are in fact frequently elicited by presenting individuals with one difficult, frustrating task and observing performance decrements on a subsequent difficult, frustrating task

(Baumeister et al., 1998). Similarly, if a decision maker is already frustrated before the attribute-conflicted decision problem presents itself, it is plausible that this frustration will lead to resource depletion that will diminish coherence shifting, much like other cognitive control and emotion regulation processes. After all, many of the necessary resources will have been preempted by the demands of that prior frustration.

Method

Participants

One hundred and thirteen undergraduates were recruited from the University of Michigan to participate in a 30-minute experiment in exchange for course credit.

Procedure and Materials

We sought to induce resource depletion through the manipulation of ambient emotional discomfort—a kind of “incidental affect”—at varying levels. This was achieved via anagrams rated on their difficulty and solvability as determined by prior research (Mayzner & Tresselt, 1962; 1966). Eighteen anagrams at different challenge levels (i.e., six easy, six medium, and six difficult) were selected. Each participant was randomly assigned to a high depletion ($N = 38$), low depletion ($N = 37$), or baseline control ($N = 39$) condition. The manipulation instructions were modeled after prior research using anagrams to induce feelings of discomfort (Mogg, Matthews, Bird, & Macgregor-Morris, 1990). Participants in the high depletion condition were instructed as follows: “Many people find this task to be easy, so you will likely not have trouble completing the task in the time allotted.” This procedure induced feelings of discomfort because participants actually struggled with the fairly difficult task that they believed others found to be

easy.¹ Participants in the low depletion condition were told: “Many people find this task to be difficult, so you will likely have trouble completing the task in the time allotted.” Participants in the baseline condition did not complete an anagram task (or any other task) before beginning the decision task. The required decision was identical to that in the job offer procedure described in Study 1.

Post-decision, all participants completed individual difference measures examining how and to what extent they tend to regulate emotions in their daily lives, including the Emotion Regulation Questionnaire (ERQ; Gross, 1998) and the Berkeley Expressivity Questionnaire (BEQ; Gross & John, 1997). Upon completion of the study, participants were debriefed about the anagram task involving deception and were awarded course credit.

Results and Discussion

Manipulation Check

A manipulation check was given at the end of the study to determine whether each participant could recall whether the anagram task was described as easy or difficult. Participants who selected the incorrect answer were excluded for failing the manipulation check ($N = 5$ and $N = 3$ in the high and low depletion conditions, respectively). This left 106 cases for analysis. The degree of coherence shifting was calculated using the same procedures described for Study 1.

Relationship Between Resource Depletion and Coherence Shifting

¹ A pretest was conducted to test whether the anagram task actually induced emotional discomfort. Twenty-nine undergraduates (mean age = 18.5) were randomly assigned to either the low discomfort or the high discomfort anagram condition and rated their discomfort on a scale ranging from 1-7. Results indicated that participants in the high discomfort condition ($M = 4.72$, $SD = 1.09$) self-reported more emotional discomfort than those in the low discomfort condition ($M = 3.78$, $SD = 1.25$), $t(27) = 2.16$, $p = .038$, $d = .8$.

From left to right, Figure 1.3 displays the mean values of the three measures of coherence shifting described previously: for desirability ratings ($NACS_{Des}$), for importance weights ($NACS_{Imp}$), and overall ($NACS_{Overall}$). The pattern was similar for all three measures, with coherence shifting being greatest for the baseline condition and least for the high discomfort-induced depletion condition.

With respect to coherence shifting on desirability ratings, participants in the high depletion condition shifted less ($M = -.99$, $SD = 1.98$) than those in the low depletion ($M = .30$, $SD = 2.53$) or baseline ($M = .58$, $SD = 3.26$) conditions, $F(2,103) = 3.41$, $p = .037$, $\eta^2 = .062$. There were no statistically reliable effects of depletion on coherence shifting on dimension importance weights, $F(2,103) = .731$, $p = .484$. An ANOVA indicated that there was only a marginally significant influence of depletion on composite, overall coherence shifting, $F(2,103) = 2.918$, $p = .058$, $\eta^2 = .053$. In sum, there was some evidence of an effect of depletion on coherence shifting, mainly localized to desirability ratings. What is most important, though, is the pattern. It is consistent with the assumption that coherence shifting functions like certain previously documented self- and emotion- regulation tools. In particular, the data suggest that the use of coherence shifting in a decision task is diminished when a person is faced with incidentally experienced negative emotions that presumably must first be managed or otherwise addressed. This procedure, like many other resource depletion tasks, leaves the individual depleted of the resources necessary for the decision problem, and thus disrupts the coherence shifting process.

Associations Between Coherence Shifting and General Emotion Regulation Tendencies

To test whether the predicted associations existed between coherence shifting and general emotion regulation tendencies, a series of correlations were computed. Replicating the findings

from Study 3, there was again no correlation between coherence shifting and cognitive reappraisal. Results indicated that greater overall coherence shifting across conditions was significantly positively associated with greater emotional suppression, $r(102) = .197, p = .047$, but not cognitive reappraisal, $r(102) = -.116, p = .246$. In addition, the more participants coherence shifted, the less they reported expressing their emotions in daily life: For negative emotional expressivity, $r(100) = -.254, p = .011$; for strength of emotional expressivity, $r(100) = -.239, p = .016$; and for the overall tendency to express emotions, $r(100) = -.229, p = .022$. However, a significant association was not found between overall coherence shifting and the tendency to express positive emotions in this study, $r(100) = -.058, p = .570$. This is not unreasonable given the assumption, per Study 2, that the attribute conflict manifested in the kinds of difficult decision situations under discussion generally produces feelings of unpleasantness, even stress. These results lend support to the proposed self-treatment model and suggest that individuals may use coherence shifting to manage negative affect and that high distress can impede one's ability to do that adaptively.

To further pursue these proposals, we repeated the main analysis testing the effect of the depletion manipulation on coherence shifting and added participants' emotional suppression scores as a covariate in the model. This was intended to evaluate the hypothesis that individuals in the high depletion condition who self-reported a trait tendency towards emotion suppression would coherence shift more, as occurs in the self-treatment proposal.

As hypothesized, adding emotional suppression as a covariate in the model eliminated the inverse relationship between induced depletion and coherence shifting on the composite overall coherence shifting measure, $F(2,102) = .274, p = .602$, and also on the desirability rating measure of coherence shifting, $F(2,102) = 2.810, p = .09$. These results further support the

conclusion that a tendency toward using emotional suppression significantly contributed to observed differences in coherence shifting across depletion conditions, and this effect was particularly prominent for shifting on desirability ratings, as opposed to importance weights.

Recall that the self-treatment model proposes that coherence shifting aids individuals in the regulation of currently experienced discomfort. The results of Study 3 suggested that our resource depletion procedure seems to reliably reduce the strength of coherence shifting, with respect to attribute desirability although not attribute dimension importance. On the other hand, self-reported emotional suppression was positively associated with coherence shifting regardless of any resource depletion experienced by the decision maker. An important task for future studies is to evaluate the reliability of the differential impact of resource depletion and ambient discomfort on coherence shifting for attribute desirability and importance.

Note that although emotional suppression was significantly correlated with coherence shifting, cognitive reappraisal was not. This result suggests that the proposed self-treatment process may provide a better explanation for coherence shifting behavior than the preemption mechanism. Perhaps people find it difficult to anticipate the intensity of attribute conflict and thus can only manage it after it arises. The results of Studies 1 and 2 imply that both high and low coherence shifters experience significant discomfort when making decisions, Study 3 suggests that coherence shifters use this strategy consistently across decision contexts, and Study 4 suggests that the high coherence shifters may manage this discomfort through, if not emotional expressivity suppression itself, an associated response-focused, “self-treatment” regulation strategy. It is unclear how low coherence shifters, as in Study 1, meet that challenge. Perhaps they do not meet it at all and are instead preoccupied and buffeted by the existing emotions, as were the high-depletion participants faced with high ambient discomfort in Study 4. It may also

not be unreasonable to speculate that moderate coherence shifters use preemptive emotion regulation strategies in order to achieve and maintain minimal discomfort across the decision episode, and this proposition should be further explored in future research.

Study 5: Decision Speed—Further Evidence of Discomfort from Attribute Conflict

One key feature of our thesis is that attribute conflict is unpleasant. A corollary is that this discomfort encourages the decision maker to attempt to reduce that experience. Study 2 provided self-report indications of the aversiveness of attribute conflict. The coherence shifting observed in Studies 1, 3, and 4, coupled with the emotion regulation tendency self-reports of Studies 3 and 4, suggest that this unpleasantness is sufficient to induce decision makers to undertake psychological activities that alleviate their experiences of attribute conflict. This leaves open the question of whether the discomfort created by attribute conflict is strong enough to manifest itself in other actions taken by the decision maker during the decision process. If found to be the case, then this would provide evidence that decision makers pursue available strategies beyond just coherence shifting that aid them in reducing attribute conflict. This was the focus of Study 5.

There were two competing hypotheses. The first was that attribute conflict would induce the decision maker to speed up the decision process in order to escape the conflict sooner and that, the greater the conflict, the faster the decision maker would decide. The opposing hypothesis was that the decision maker would interpret significant attribute conflict as an indication that the decision problem at hand is complicated and therefore deserves special attention, which would require *more* time rather than less (cf. Tversky & Shafir, 1992). Of

course, both forces might be in play, which then raises the question as to which is stronger and under what conditions.

Method

Participants

One hundred forty seven University of Michigan students and staff members participated in the study, with an average age of 20.9 years. Each participant was paid \$5.

Procedure and Materials

The basic decision task was the same as that in Study 1. That is, in a fictional job-choice scenario, the participant was asked to choose between the marketing job offers at the Splendor and Bonnie's Best department store chains. In this study, however, the instructions, which were presented via computer in a Qualtrics program, emphasized to the participant: "Take as much time as you feel you need on every page." On two separate screens, the program described the attributes of each job offer, at Splendor and at Bonnie's Best. After that, the program displayed the offers (in a decision matrix) "side by side," and the participant was asked: "Taking as much or as little time as you wish, you should then re-examine the job offers and select the bubble corresponding to the offer you prefer." The dependent measure recorded by the computer was the amount of time the participant used in arriving at his or her decision, from the time the participant viewed the first job offer description until the participant recorded his or her choice.

The independent variable was the intensity of the attribute conflict in the job offer choice problem that the participant faced. Each participant was randomly assigned to one of three conditions: "Base," "Minus 2," and "Plus 2," as these terms were defined in Study 2 (Table 1.3). In the Base condition (N = 49), the attributes of the Splendor and Bonnie's Best job offers that participants faced were identical to those specified in the Base condition of Study 2, implying an

intermediate intensity of attribute conflict. The versions of the job offers in the Minus 2 condition ($N = 50$) of the present study were the same as those in the corresponding Minus 2 condition of Study 2, entailing weaker conflict. Similarly, the offers in the Plus 2 condition ($N = 48$) here were identical to those in the Plus 2 condition of Study 2, i.e., involving distinctly more intense conflict than in the Minus 2 condition. Our “conflict escape” hypothesis predicted that participants would make their decisions significantly faster in the Plus 2 condition than in the Minus 2 condition. The competing “special attention” hypothesis predicted the opposite.

Results and Discussion

Figure 1.4 displays the mean times to decision for participants in the respective attribute conflict conditions, with standard errors. Consistent with the conflict escape idea, participants were fastest at reaching their decisions in the Plus 2 condition, where attribute feature conflict was strongest. In contrast, participants were slowest in the Minus 2 condition, where conflict was weakest. To test for the reliability of these indications, as is customary with latencies, in order to stabilize variances and reduce skew, decision times were transformed via $X_T = \log(X + 1)$, and analyses were performed on the transformed data (note that the conclusions were the same regardless of whether analyses were performed on the original or transformed times). Consistent with the escape proposal, the planned contrast between decision times in the Plus 2 and Minus 2 conditions were statistically significant, $t(144) = 2.148$, $p = .033$, $d = .408$.

A core idea in the present research is that attribute conflict induces emotional discomfort in decision makers and that they are motivated to reduce that discomfort. The previous studies were consistent with coherence shifting being one means of achieving that goal. The present results suggest that the discomfort created by attribute conflict is strong enough to manifest itself in other actions taken by the decision maker, including simply deciding faster.

One may wonder why intense attribute conflict induced participants to decide rapidly in this study but more slowly in other studies, such as those of Tversky and Shafir (1992). Our hunch is that the main reason concerns the opportunities available to participants. Through various means, Tversky and Shafir's participants had the option to "defer," to decide later, after searching for other alternatives or to learn more about the options already available to them. That was not the case here, where it was apparent that there was nothing the decision maker could do other than to confront the attribute conflict presented to them. High conflict intensity induced them to simply be done with the ordeal.

General Discussion

Many, and probably most, important decisions in life involve attribute conflict. Jobs that pay well often also bring high stress and long commutes. Apartments close to the beach or to popular shops and restaurants are often small, expensive, and do not have parking or walk-in closets. We usually cannot, as it were, "have our cake and eat it too." Decision problems such as these, which entail significant attribute conflict, require flexible, adaptive decision processes. Myriad psychological phenomena have been identified that appear to help people feel comfortable about such decisions, including post-hoc rationalizing, dissonance reduction, and capitalization (Reis et al., 2010) as well as bolstering (Janis & Mann, 1977). Most of these phenomena occur after a decision is made. However, several investigators, such as Russo and his colleagues (e.g., Russo et al., 1996), Simon and his collaborators (e.g., Simon et al., 2004), Glöckner et al. (2010), and Montgomery and Svenson (1976), have shown that similar effects occur during the decision process itself, in the form of coherence shifting. They have also argued

compellingly that plausible contributors to those effects include mechanisms that emphasize cognitive efficiency, perhaps even automaticity.

In this chapter, we have presented what we believe to be the first evidence that coherence shifting, and people's ability to use it in the adaptive service of unconflicted choice, is significantly related to their trait tendencies to regulate their emotions in particular ways generally. Across five studies, using psychophysiology, an attribute conflict induction, a repeated-task design, and a discomfort-induced resource depletion manipulation, we demonstrated that individuals who tend to express their emotions openly, and seldom actively regulate feelings by suppressing their overt expression, also tend to coherence shift minimally. In contrast, those who do self-report suppressing their emotions also coherence shift more. Such coherence shifting, in turn, appears to reduce or avoid altogether the emotional discomfort generated by the attribute conflict integral to so many real-world decision situations.

Study 1 provided physiological evidence consistent with such an account, as moderate and high coherence shifters perceived their decisions to be less difficult and were less aroused than low coherence shifters, at least by the end of the decision process. Meanwhile, low coherence shifters remained aroused throughout their decision episodes. They also reported a trait tendency for frantic "hypervigilance" (cf. Mann et al., 1997, p. 2). Study 2 revealed that manipulating attribute conflict increased emotions associated with aversive states like stress and anxiety. Study 3 confirmed that people's use of coherence shifting seems to be a trait-like tendency in that individuals showed similar levels of shifting across decision problems involving markedly different content. In addition, those who did coherence shift reported greater use of emotional suppression to manage their emotions in their everyday lives. Study 4 suggested a disruptive, depleting influence of high negative incidental affect on coherence shifting, as those

induced to feel distress from an unrelated source also coherence shifted less, in terms of desirability ratings. Such shifting was again associated with the extent to which individuals reported using emotional suppression as a means of managing unpleasant affect.

Despite the demonstration of connections between coherence shifting and emotion regulation across these studies, several significant challenges remain. Perhaps the most enticing is embodied in what many would probably see as a rather surprising result: Shown in Study 3 and then replicated in Study 4, reliance on coherence shifting was positively correlated with self-reported emotional suppression tendencies, but not cognitive reappraisal. This is surprising because, on their face, the changes that occur during coherence shifting—modifications in how the decision maker appraises the desirability and importance of various attributes of choice alternatives—seem to fit the specifications of the cognitive reappraisal idea almost exactly (e.g., “construing a potentially emotion-eliciting situation in a way that alters its emotional impact,” Gross & John, 2003, p. 349). Such modifications seem at least one step removed from how emotional suppression is commonly characterized (e.g., “inhibiting on-going emotion-expressive behavior,” Gross & John, 2003, p. 349). In this latter view, it is as if the decision maker’s focus is on getting rid of the bad feeling that attribute conflict has generated, not on the reality of working through the actual conflict that is driving that bad feeling. Thus, the following research challenge has emerged: Why *is* coherence shifting reliably associated with emotional suppression but not cognitive reappraisal tendencies?

An initial plausible hypothesis is that for the typical decision maker, our proposed self-treatment coherence shifting mechanism is simply more common than the preemption alternative. That is, most people do not (cannot?) anticipate unpleasant attribute conflict before it actually occurs. Instead, they find themselves caught off guard by that conflict, feel compelled to

reduce the discomfort unexpectedly imposed on them, and then seek such relief through coherence shifting. The decision maker remains vaguely aware that the attribute conflict that caused her discomfort still exists. However, the coherence shifts she has created have effectively obscured—perhaps even suppressed—that conflict. Out of sight, out of mind.

These speculations bring to the fore a second major challenge for future studies concerning the time course of broader coherence shifting events. The arousal data of Study 1, along with the consistency results of Study 3, agree with the possibility that low, moderate, and high coherence shifters represent fairly stable categories of decision makers whose existence needs to be tested:

(a) *Low coherence shifters*: As suggested by Figure 1.1, low coherence shifters seldom invoke coherence shifting as a means of addressing the discomfort instigated by attribute conflict, and they perhaps literally suffer for it because their discomfort never diminishes during their decision episodes. It remains to be determined why they behave in this way. It is conceivable that the idea of using coherence shifting as an emotion regulation tool simply never occurs to them. It is also possible that they try to coherence shift but are unable to succeed in doing so. Consistent with the results of Study 4, this might be because they are preoccupied with more general incidental distress (cf. Preston et al., 2007). Low coherence shifters might also fall prey to the hypervigilance discussed by Janis and Mann (1977) and Mann et al. (1997) while engaged futilely in self-treatment efforts to cope with their conflict-induced distress.

(b) *Moderate coherence shifters*: Moderate coherence shifters might be the most skilled at managing the negative affect arising from attribute conflict, often perhaps via the proposed preemption route. Notice in Figure 1.1 that moderate coherence shifters appeared to reduce their arousal levels very early in the decision process and maintained those levels until the end.

(c) *High coherence shifters*: In comparison, high coherence shifters do not succeed in reducing their discomfort until late in the decision process. It is not out of the question that they do not achieve such reductions until after the decision is actually made, via post-choice processes such as dissonance reduction and other justification processes.

A final significant challenge for further research is to understand the biology underlying coherence shifting. Consider again the surprising notion, consistent with our data, that coherence shifting is more strongly associated with emotional suppression than cognitive reappraisal. In recent years, numerous studies using imaging techniques have examined the neural structures involved when participants are engaged in standard cognitive reappraisal and expressive suppression tasks. The patterns and timing of structure involvement tend to differ reliably for reappraisal and suppression (Ochsner & Gross, 2008). This suggests that a sensible place to begin the search for the neural foundations of coherence shifting would entail examining the relationship between the neural activation that occurs during shifting and the neural patterns typically observed during long-recognized emotion regulation tasks. The picture that eventually emerges is likely to be more complicated (and interesting) than one might expect. Consider, for instance, that although some studies (see Gross, 2013, and Gross & Thompson, 2007, p. 15) have indicated that suppression does not tend to reduce the neural activity normally associated with negative experience, other studies, using different methods, do (e.g., Moser, Hajcak, Bukay, & Simons, 2006).

In addition to the present basic scientific challenges, it is important to address the formidable practical issues implicit in coherence shifting and the emotion factors revealed in these studies. As suggested earlier, the existence of coherence shifting is problematic for the very “logic” of multiattribute decision analysis practices (cf. Brown, Kahr, & Peterson, 1974;

Fishburn, 1967; Hammond, Keeney, & Raiffa, 1999), which is predicated on such notions as fixed, “true” degrees of attribute importance. The emotion regulation functions of coherence shifting, implicated in the present findings, suggest that decision makers’ emotional discomfort can and almost certainly does affect their choices in consequential ways. It is hard to imagine that the effects are always in the interests of those the decisions are intended to serve, e.g., an organization’s owners who hope that the managers they hire will “objectively” choose in ways that are best for those owners. Our research thus poses an important question for future development efforts; namely, how should decision routines be refined to accommodate such realities?

Table 1.1a *Decision Matrix for Hypothetical Job Offers, Study 1*

Attribute Dimension	Job Offer	
	1—Splendor	2—Bonnie’s Best (B)
	<i>Attribute</i>	<i>Attribute</i>
Office	Private	Cubicle
Commute	18 minutes	40 minutes
Salary	\$39,400 (below \$40,000 industry standard)	\$40,800 (above \$40,000 industry standard)
Vacation	Minimal time off	Superior package

Note. Adapted from Simon et al. (2004).

Table 1.1b *Hypothetical Time 1 → Time 2 Coherence Shifts for Decision Maker with Initial Leaning Toward Job Offer 1—Splendor, Study 1*

Attribute Dimension		Job Offer			
		1—Splendor		2—Bonnie’s Best (B)	
	<i>Weight</i> ^a	<i>Attribute</i>	<i>Appraisal</i> ^b	<i>Attribute</i>	<i>Appraisal</i>
Office	4 → 5	Private	+3 → +4	Cubicle	-2 → -3
Commute	2 → 3	18 minutes	-1 → 0	40 minutes	-2 → -4
Salary	3 → 2	\$39,400 (below \$40,000 industry standard)	-2 → -1	\$40,800 (above \$40,000 industry standard)	+2 → +1
Vacation	2 → 1	Minimal time off	-1 → 0	Superior package	+2 → +1
Overall Score		+2 → +18		-2 → -23	

Note. Adapted from Simon et al. (2004).

^aAttribute dimension importance weight scale: 0 (no weight) ... 8 (maximum weight)

^bAttribute appraisal rating scale: -5 (highly undesirable) ... +5 (highly desirable)

Table 1.2 *Study 1 Procedure Sequence and Materials*

Time Point	Stage	Activity
	1	Skin conductance response (SCR) apparatus set up, palm of non-dominant hand (Biopac MP150, Biopac Systems, Goleta, CA)
	2	Baseline SCR assessment during handwriting judgment exercise
	3	Assignment to condition: Standard vs. justification expectation
	4	Generic job search scenario
1	5	Time 1 decision tasks—generic situation (E-prime Version 2.0 (Psychology Software Tools, Inc., Pittsburgh, PA): (a) -5 — +5 desirability ratings (attribute appraisals), (b) 0 — 8 importance ratings (dimension importance weights)
	6	Distraction Task A: General knowledge questions
	7	Choice postponement scenario—potential company buyout and rescinding of Splendor or Bonnie’s Best offer
2	8	Time 2 decision tasks—Splendor vs. Bonnie’s Best situation: (a) desirability ratings (attribute appraisals), (b) importance ratings (dimension importance weights), (c) current choice leaning, (d) choice confidence, (e) preference strength
	9	Distraction Task B: Preference for how to receive health decision information
3	10	Time 3 decision tasks—Splendor vs. Bonnie’s Best situation-no buyout: (a) final choice, (b) choice confidence, (c) preference strength, (d) desirability ratings, (e) importance ratings
	11	SCR apparatus removed
	12	Final choice difficulty rating: 1—“Very Easy” → 7—“Very Difficult”
	13	Individual difference measures: (a) Melbourne Decision Making Scale (MDM; decisiveness; Mann et al., 1997), (b) Spielberger Trait Anxiety Scale (STAI-T; Spielberger, 1983), (c) Maximization Scale (Max; Schwartz et al., 2002), (d) Obsessive-Compulsive Inventory (OCI; Foa et al., 2002).

Note. Basic procedure and measures from Simon et al. (2004).

Table 1.3 *Decision Matrices Varying in Attribute Conflict Intensity, Study 2*

		Condition/Attribute Conflict Intensity									
		Minus 2		Minus 1		Base		Plus 1		Plus 2	
Attribute Dimension	Splendor Adv: 4 min		Splendor Adv: 14 min		Splendor Adv: 22 min.		Splendor Adv: 30 min.		Splendor Adv: 38 min.		
	Vs.		Vs.		Vs.		Vs.		Vs.		
		Bonnie's Best Adv: \$400		Bonnie's Best Adv: \$600		Bonnie's Best Adv: \$1400		Bonnie's Best Adv: \$2200		Bonnie's Best Adv: \$3000	
		N = 51		N = 49		N = 49		N = 48		N = 50	
		Splendor	Bonnie's Best	Splendor	Bonnie's Best	Splendor	Bonnie's Best	Splendor	Bonnie's Best	Splendor	Bonnie's Best
Office	Private	Cubicle	Private	Cubicle	Private	Cubicle	Private	Cubicle	Private	Cubicle	
Commute	27 min	31 min	22 min	36 min	18 min	40 min	14 min	44 min	10 min	40 min	
Salary	\$39,900	\$40,300	\$39,800	\$40,400	\$39,400	\$40,800	\$39,000	\$41,200	\$38,600	\$41,600	
	(< \$4K Std)	(> \$4K Std)	(< \$4K Std)	(> \$4K Std)	(< \$4K Std)	(> \$4K Std)	(< \$4K Std)	(> \$4K Std)	(< \$4K Std)	(> \$4K Std)	
Vacation	Minimal	Superior	Minimal	Superior	Minimal	Superior	Minimal	Superior	Minimal	Superior	

Table 1.4 *Correlations of emotion regulation scale scores with overall normalized absolute coherence shifting measures, Study 3*

Scale	<i>R</i>	<i>P</i>
Cognitive Reappraisal ^a		
Job Offers	.182	.320
Apartments	.128	.485
Expressive Suppression ^a		
Job Offers	.401	.023
Apartments	.477	.006
Negative Expressivity ^b		
Job Offers	-.395	.038
Apartments	-.435	.021
Positive Expressivity ^b		
Job Offers	-.321	.096
Apartments	-.487	.009

Note. N = 33

^aEmotion Regulation Questionnaire (Gross & John, 2003)

^bBerkeley Expressivity Questionnaire (Gross & John, 1997)

Figure 1.1 Mean skin conductance response (SCR), in μS , by coherence shifting (low, moderate, high) at 2000 ms, Study 1. Time 1 and Time 2 are “pre-choice” rating periods, while Time 3 is “post-choice.” (Bars represent standard errors of the mean.)

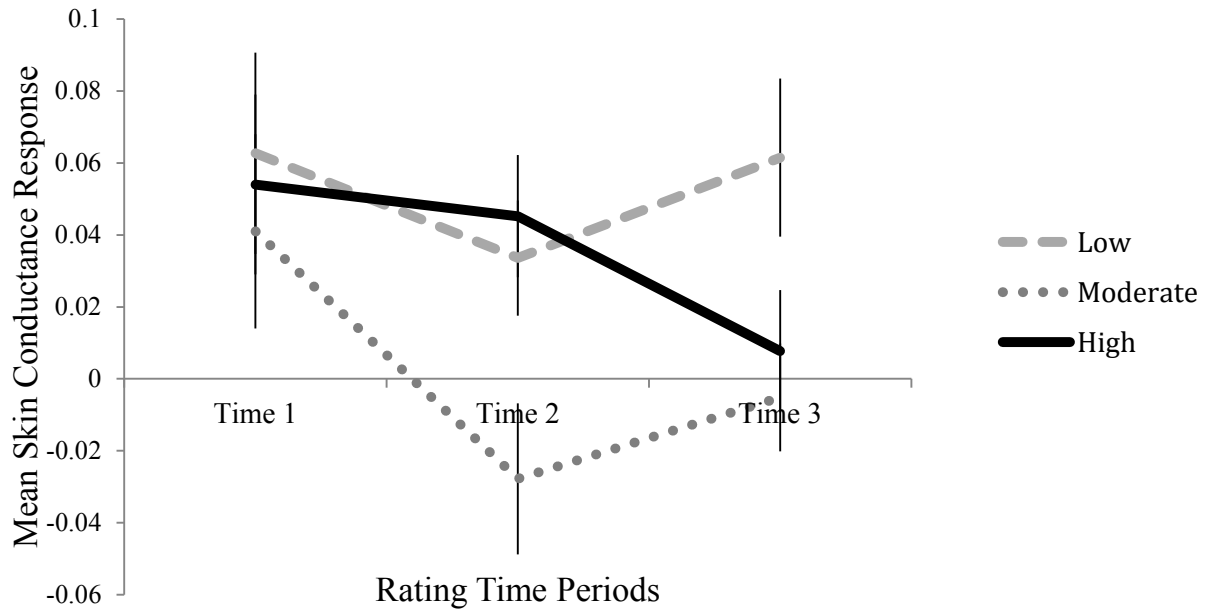


Figure 1.2 Mean aversiveness index values by attribute conflict intensity (with standard errors), Study 2. Note: 1 = "Not at All," ... 9 = "Extremely."

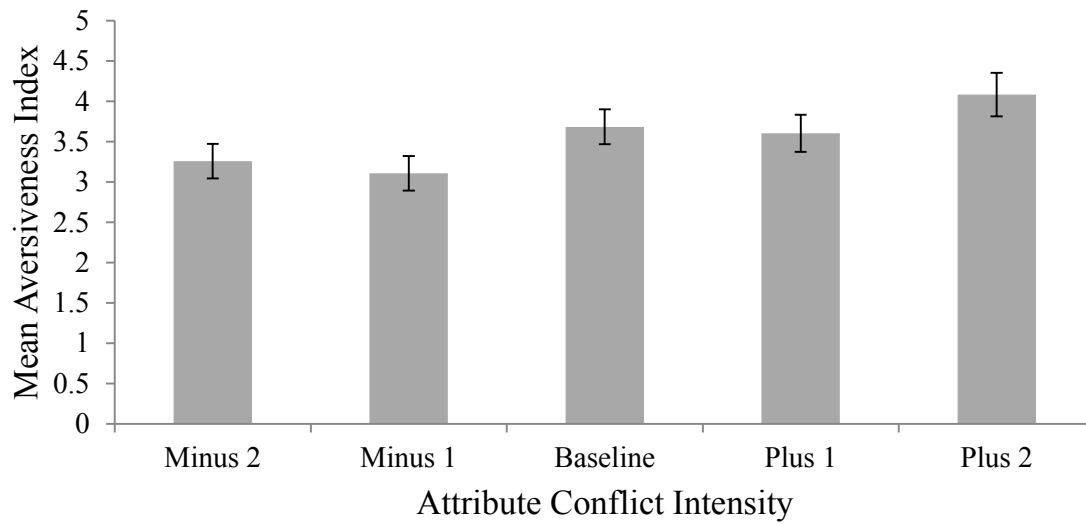


Figure 1.3 Mean coherence shifting scores for desirability ratings, dimension importance weights, and overall (combined), per manipulated resource depletion via ambient discomfort level—high, low, and baseline (with standard errors), Study 4.

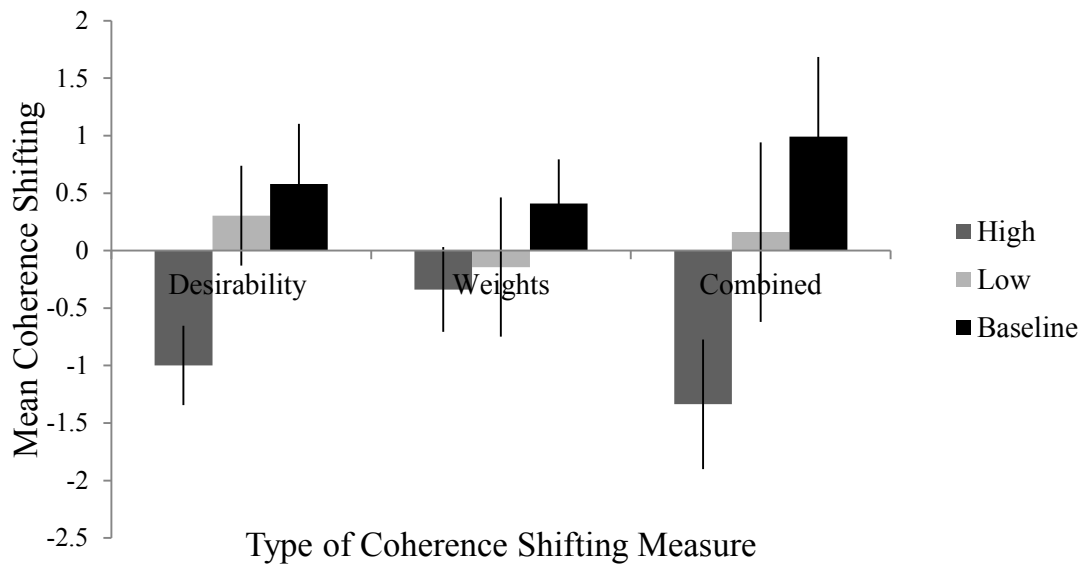
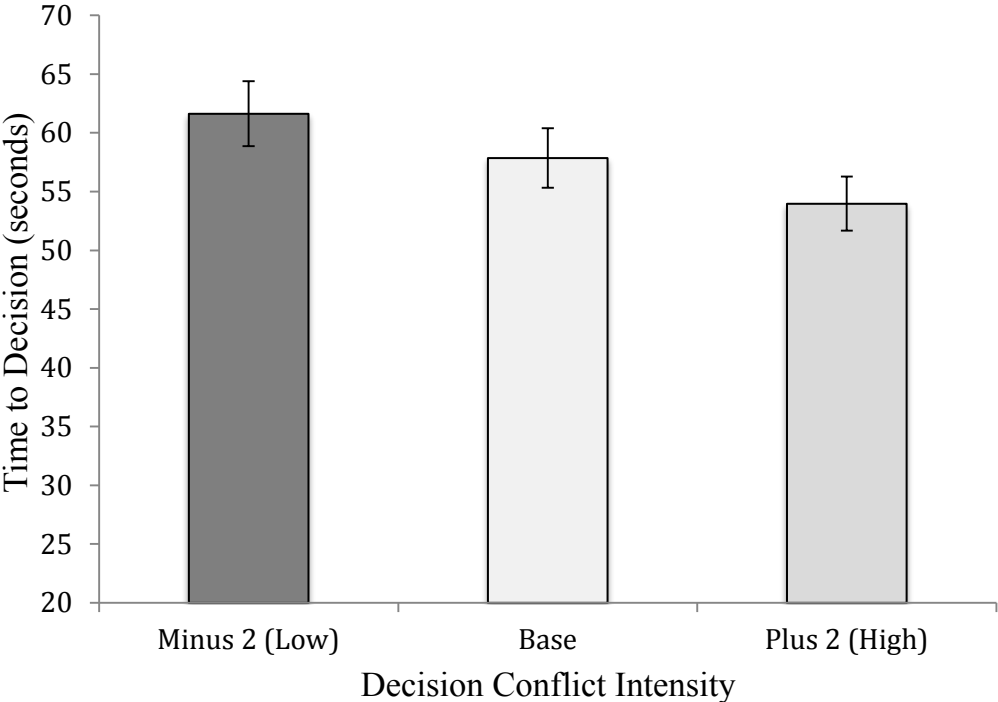


Figure 1.4 Mean decision times (with standard errors) by attribute conflict intensity, Study 5.



References

- Baumeister, R. F., Bratslavsky, E., Muraven, M., & Tice, D. M. (1998). Ego depletion: Is the active self a limited resource? *Journal of Personality and Social Psychology, 75*, 1252-1265.
- Brown, R. V., Kahr, A. S., & Peterson, C. (1974). *Decision analysis for the manager*. New York: Holt, Rinehart and Winston.
- Chaplin, J. E. (Ed.). (2012). *Benjamin Franklin's Autobiography*. New York: Norton.
- Cooper, J. (2007). *Cognitive dissonance: Fifty years of classic theory*. London: Sage.
- Croyle, R. T., & Cooper, J. (1983). Dissonance arousal: Physiological evidence. *Journal of Personality and Social Psychology, 45*, 782-791.
- Figner, B., & Murphy, R. O. (2010). Using skin conductance in judgment and decision making research. In M. Schulte-Mecklenbeck, A. Kuehberger, & R. Ranyard (Eds.), *A handbook of process tracing methods for decision research*. New York: Psychology Press.
- Fishburn, P. C. (1967). Methods of estimating additive utilities. *Management Science, 13*(7), 435-453.
- Foa, E. B., et al. (2002). The obsessive-compulsive inventory: Development and validation of a short version. *Psychological Assessment, 12*, 485-495.
- Gigerenzer, G. & Goldstein, D. G. (1999). Betting on one good reason: The take the best heuristic. In Gigerenzer, G., Todd, P. M. & the ABC Research Group, *Simple Heuristics That Make Us Smart* (pp. 75-95). New York: Oxford University Press.
- Glöckner, A., Betsch, T., & Schindler, N. (2010). Coherence shifts in probabilistic inference tasks. *Journal of Behavioral Decision Making, 23*, 439-462.
- Gross, J. J. (1998). Antecedent – and – response focused emotion regulation: Divergent consequences for experience, expression, and physiology. *Journal of Personality and Social Psychology, 74*, 224-237.
- Gross, J. J. (2013). Emotion regulation: Taking stock and moving forward. *Emotion, 13*(3), 359-365.
- Gross, J. J., & John, O. P. (1997). Revealing feelings: Facets of emotional expressivity in self-reports, peer ratings, and behavior. *Journal of Personality and Social Psychology, 72*(2), 435-448.
- Gross, J. J., & John, O. P. (2003). Individual differences in two emotion regulation processes: Implications for affect, relationships, and well-being. *Journal of Personality and Social Psychology, 85*(2), 348-362.
- Gross, J. J., & Thompson, R. A. (2007). Emotion regulation: Conceptual foundations. In J. J. Gross (Ed.), *Handbook of emotion regulation* (pp. 3-24). New York: Guilford Press.
- Gyurak, A., Gross, J. J., & Etkin, A. (2011). Explicit and implicit emotion regulation: A dual-process framework. *Cognition and Emotion, 25*(3), 400-412.
- Hammond, J. S., Keeney, R. L., & Raiffa, H. (1999). *Smart choices*. Boston: Harvard Business School Press.
- Hobson, N. M., Saunders, B., Al-Khindi, T., & Inzlicht, M. (2014). Emotion down-regulation diminishes cognitive control: A neurophysiological investigation. *Emotion, 14*, 1014-1026.
- Hogarth, R. M., & Einhorn, H. J. (1992). Order effects in belief updating: The belief-adjustment model. *Cognitive Psychology, 24*(1), 1-55.
- Janis, I. L., & Mann, L. (1977). *Decision making*. New York: Free Press.

- Kiesler, C. A., & Pallak, M. S. (1976). Arousal properties of dissonance manipulations. *Psychological Bulletin*, 83(6), 1014-1025.
- Lerner, J. S., & Tetlock, P. E. (1999). Accounting for the effects of accountability. *Psychological Bulletin*, 125, 255-275.
- Mann, L., Burnett, P., Radford, M., & Ford, S. (1997). The Melbourne decision making questionnaire: An instrument for measuring patterns for coping with decisional conflict. *Journal of Behavioral Decision Making*, 10, 1-19.
- Mayzner, M. S., & Tresselt, M. E. (1962). Anagram solution times: A function of word transition probabilities. *Journal of Experimental Psychology*, 63(5), 510-513.
- Mayzner, M. S., & Tresselt, M. E. (1966). Anagram solution times: A function of multi-solution anagrams. *Journal of Experimental Psychology*, 71(1), 66-73.
- Mogg, K., Matthews, A., Bird, C., & Macgregor-Morris, R. (1990). Effects of stress and anxiety on the processing of threat stimuli. *Journal of Personality and Social Psychology*, 59(6), 1230-1237.
- Montgomery, H., & Svenson, O. (1976). On decision rules and information processing for choices among multiattribute alternatives. *Scandinavian Journal of Psychology*, 17, 283-291.
- Moser, J. S., Hajcak, G., Bukay, E., & Simons, R. F. (2006). Intentional modulation of emotional responding to unpleasant pictures: An ERP study. *Psychophysiology*, 43, 292-296.
- Ochsner, K. N., & Gross, J. J. (2008). Cognitive emotion regulation: Insights from social cognitive and affective neuroscience. *Current Directions in Psychological Science*, 17(2), 153-158.
- Ochsner, K. N., Ray, R. D., Cooper, J. C., Robertson, E. R., Chopra, S., Gabrieli, J. D. E., & Gross, J. J. (2004). For better or for worse: Neural systems supporting the cognitive down- and up-regulation of negative emotion. *NeuroImage*, 23, 483-499.
- Preston, S.D., Buchanan, T.W., Stansfield, R.B., & Bechara, A. (2007). Effects of anticipatory stress on decision making in a gambling task. *Behavioral Neuroscience*, 121, 257-263.
- Reis, H. T., Smith, S. M., Carmichael, C. L., Caprariello, P. A., Tsai, F. F., Rodrigues, A., & Maniaci, M. R. (2010). Are you happy for me? How sharing positive events with others provides personal and interpersonal benefits. *Journal of Personality and Social Psychology*, 99, 311-329.
- Russo, J. E., Carlson, K. A., Meloy, M. G., & Yong, K. (2008). The goal of consistency as a cause of information distortion. *Journal of Experimental Psychology*, 137(3), 456-470.
- Russo, E. J., Medvec, V. H., & Meloy, M. G. (1996). The distortion of information during decisions. *Organizational Behavior and Human Decision Processes*, 66, 102-110.
- Russo, E. J., Meloy, M. G., & Medvec, V. H. (1998). Pre-decisional distortion of product information. *Journal of Marketing Research*, 35(4), 438-452.
- Russo, J. E., Meloy, M. G., & Wilks, T. J. (2000). Predecisional distortion of information by auditors and salespersons. *Management Science*, 46(1), 13-27.
- Saunders, B., Milyavskaya, M., & Inzlicht, M. (2015). Variation in cognitive control as emotion regulation. *Psychological Inquiry*, 26, 1-8.
- Schmeichel, B. J. (2007). Attention control, memory updating, and emotion regulation temporarily reduce the capacity for executive control. *Journal of Experimental Psychology: General*, 136(2), 241-255.
- Schwartz, B., Ward, A., Monterosso, J., Lyubomirsky, S., White, K., & Lehman, D. R. (2002).

- Maximizing versus satisficing: Happiness is a matter of choice. *Journal of Personality and Social Psychology*, 83, 1178-1197.
- Sheppes, G., Sheibe, S., Suri, G., & Gross, J. J. (2011). Emotion-regulation choice. *Psychological Science*, 22, 1391-1396.
- Simon, D., Krawczyk, D. C., & Hoyoak, K. J. (2004). Construction of preferences by constraint satisfaction. *Psychological Science*, 15(5), 331-336.
- Spielberger, C. D. (1983). *Manual for the State-Trait Anxiety Inventory*. Palo Alto, CA: Consulting Psychologists Press.
- Tversky, A., & Shafir, E. (1992). Choice under conflict: The dynamics of deferred decision. *Psychological Science*, 3(6), 358-361.
- Yates, J. F. (1990). *Judgment and decision making*. Englewood Cliffs, NJ: Prentice-Hall.
- Yates, J. F., Veinott, E. S., & Patalano, A. L. (2003). Hard decisions, bad decisions: On decision quality and decision aiding. In S. L. Schneider & J. C. Shanteau (Eds.), *Emerging perspectives on judgment and decision research* (pp. 13-63). New York: Cambridge University Press.

CHAPTER II

Constructing Value from “Irrelevant” Experience: Activating Previous Tradeoffs

Involving Time Dynamically Shifts Future, Unrelated Decisions

Many real-life decision problems require the decider to make difficult choices involving tradeoffs. Such tradeoffs entail that the negative qualities of the selected option be accepted and the positive qualities of the rejected option be foregone. For example, imagine that you are choosing between two restaurants for lunch. Restaurant A is a fast food chain with quick service, but Restaurant B is a local bistro with high-quality food. Suppose that you choose Restaurant A and therefore enjoy its faster service but painfully forego Restaurant B's higher quality food. Making this choice suggests that you place a higher value on speed than on quality. However, imagine that later that day when you are deciding what to eat for dinner you are faced with a similar tradeoff between quickly microwaving a frozen meal or cooking an elaborate dinner that will take much longer but be higher in quality. It is intuitive to assume that you would make this tradeoff in the same way that you made the first tradeoff, valuing speed over quality. However, it is also easy to imagine doing the opposite, now taking the time to satisfy your desire for a higher quality meal at the expense of time. This line of research investigates how people make these kinds of tradeoffs across contexts.

One important question in decision theory is how we construct value (i.e., the extent to which a given decision outcome is desired) in difficult choice tradeoff situations. Traditional (e.g., microeconomic) views have presumed that the values or utilities people attach to various

entities are fixed (Fishburn, 1970; Friedman & Savage, 1948). From this perspective, making a good decision requires a valid process for determining what those values are, which may be thought of as equivalent to “looking up” fixed utility measures in a registry. More recent behavioral decision research has largely displaced that presumption with one maintaining that valuation is a labile process. In particular, studies have demonstrated that value assessments depend on the conditions that happen to be present at the time of elicitation (e.g., framing and the nature of the required decision, Fischhoff, Slovic, & Lichtenstein, 1980; Hsee, 1996; Slovic, 1995). The resulting consensus has been that values are constructed on the spot, per existing conditions and demands.

There has been prior research on multiple tradeoffs that has remained in only one decision domain (e.g., health, environmentalism, morality, etc.). For example, moral licensing research has shown that when people do something moral they then give themselves license to do something less moral later on (Mazar & Zhong, 2010; Monin & Miller, 2001; Sachdeva, Iliev, & Medin, 2009). Similar effects have been observed in research on goals (Chartrand, Huber, Shiv, & Tanner, 2008; Shah, 2005; McCulloch, Fitzsimons, Chua, & Albarracin, 2011), where going to the gym one day makes it easier to avoid going to the gym the next day. This research, however, has remained in the same decision domains across choice contexts, moral choices and health behaviors. These findings leave open the question of how general tradeoff carryover is across contexts. The present question we address is whether a tradeoff in one domain (e.g., food choices) can influence decisions in another domain (e.g., travel).

There is reason to believe that such carryover can occur if one of the attributes is sufficiently general to influence tradeoffs in both domains. We focus specifically on the temporal dimension because it occurs often across multiple domains (e.g., service, products, finances,

travel, etc.) and it tends to be an important factor in people's choices (Berns, Laibson, & Loewenstein, 2007; Soman, 2001).

The present research introduces a phenomenon we describe as *complementary value carryover* and examines the proposition that recollections of prior tradeoffs influence people's values in current, unrelated choices. We argue that the value we assign to time-related outcomes changes across contexts and domains, such that the processing of prior tradeoffs through recalling those experiences can "spill over" onto seemingly unrelated decisions. Consider, for example, the following experimental paradigm:

Phase 1: The participant is asked to recall a previous Decision Situation X (e.g., lunch restaurant choice), where she was confronted with Options I (e.g., Fast Service Restaurant), and II (e.g., High Quality Restaurant).

Option I was superior to Option II with respect to a temporal dimension, say, speed of service, but was inferior on another dimension, for example, product quality. The participant recalls which of the alternatives she chose, either I or II.

Phase 2: The same participant is now put into new Decision Situation Y (e.g., train choice), where she must choose between Option I* (e.g., Fast Speed Train) and Option II* (e.g., Clean, Luxury Train).

Option I* is better than Option II* on a *different* temporal dimension, say, how fast a train travels between locations, but is worse on an arbitrary second dimension, for instance, cleanliness.

The phenomenon we call complementary value carryover implies the following: If the participant chose Option I in Phase 1, then in Phase 2, she is relatively more likely to choose Option II*. In contrast, if she picked Option II in Phase 1, she is more prone to selecting Option

I* in Phase 2. This is equivalent to saying that the relative value she attaches to time changed from Phase 1 to Phase 2. When the participant picks Option I in Phase 1, she is sacrificing strength on the second feature dimension in order to gain strength on the temporal dimension; she places a high value on time. Then, when she finds herself in Phase 2, the participant places a higher value on a different dimension (e.g., cleanliness) and chooses Option II*.

In the present research, we sought to establish whether complementary value carryover reliably occurs (Study 1). We also sought to understand why it happens, e.g., what factors moderate it (Studies 2-5). We hypothesized and found evidence across five studies and a meta-analysis that when faced with a subsequent choice involving time, recalling a previous tradeoff involving time motivated the decision maker to choose options superior on the complementary value dimension.

Study 1: Recall of Past Tradeoffs Involving Time Leads to Value Carryover

The purpose of Study 1 was to demonstrate tradeoff value carryover in the real-world financial domain of investing in a stock or a bond. We hypothesized that recalling a prior product purchase with a temporal attribute would carry over onto a later, unrelated choice in the financial domain that also included a temporal dimension.

Method

Participants

One hundred and thirty five participants in the United States (US) were recruited online through Amazon's Mechanical Turk (cf. Goodman, Cryder, & Cheema, 2012). Two subjects were removed for inactivity during the choice task, and another forty-two were excluded from analysis for indicating that they were unlikely or very unlikely to invest in either stocks or bonds,

on a scale ranging from 1 (very unlikely) to 7 (very likely). We used these criteria for exclusion to elicit meaningful choices that would not be irrelevant to our sample. This left a total of 91 subjects for analysis. The sample size for this study was deemed sufficient based on prior work on preference construction (cf. Hsee, 1996). The subsequent studies also followed this general guideline.

Procedure and Materials

Each subject was assigned randomly to one of three conditions to activate a frustrated value. We define “frustrated value” as a value that has been foregone in a tradeoff decision. The subject recalled and wrote about a past tradeoff choice when s/he purchased: (1) an *expensive* product that was purchased *right away, during that shopping trip*; (2) an *inexpensive product* that was purchased *thoughtfully, over multiple shopping trips*; or (3) any occasion when they had purchased a product (i.e., control condition). These are referred to as the superior speed, inferior speed, and control conditions, respectively. These recalled attributes were intended to reflect a tradeoff between *speed* and *monetary cost* of the product. Following this manipulation, in an ostensibly unrelated study, participants made a hypothetical purchase decision between two financial investment opportunities (Table 2.1). One investment opportunity was superior on a low-monetary risk acquisition attribute dimension (bond), but was inferior on the time attribute (long wait time to acquire). The other investment option was superior on the time attribute (short wait time to acquire), but inferior on the higher-monetary risk attribute (stock). A third attribute about one’s individual share in the personal investment package was held constant between the investment options.

Results and Discussion

A logistic regression analysis was conducted for all choice data, with choices for the superior speed option coded as one and choices for the inferior speed option coded as zero. The recall condition was always included as a between-subjects variable. Since this analysis is consistent across studies, only additional covariates are discussed later.

In Study 1, choices for the low-monetary risk, long wait time investment were dummy coded as 0 and choices for the high-monetary risk, short wait time investment were coded as 1 such that higher probabilities reflect a higher probability of choosing the superior speed option. Overall, there was a main effect of recall group, $\chi^2(2) = 7.37, p = .025$. Subjects in the superior speed recall condition chose the inferior speed investment significantly more than the control condition, odds ratio (OR) = 3.90, $\beta = 1.36$, 95% CI = (0.33, 2.39), $p = .009$, and marginally more than the inferior speed condition, $OR = 2.67, \beta = 0.98$, 95% CI = (-0.12, 2.08), $p = .079$. There was no difference between the control and inferior speed recall condition, $OR = 0.68, \beta = -0.38$, 95% CI = (-1.48, 0.71), $p = .496$ (Figure 2.1).

These results are consistent with the value carryover proposed in this line of work. We observed the value carryover acting on the time dimension such that individuals who recalled a high price, short time purchase decision chose the lower-monetary risk (bond), long wait time investment. Those who recalled the low price, long time-to-purchase tradeoff decision also chose the higher risk (stock), short wait time investment directionally more than the other value shifting condition, but not more than the control condition. This is presumably because the stock option, which could potentially lead to a greater monetary gain, was objectively somewhat more attractive than the bond option. We also showed that the act of making a choice in a previous tradeoff experience did not disrupt the value carryover. This is important because it reveals that frustrated values can be activated and carry over even post-choice when one might expect

cognitive dissonance (cf. Festinger, 1962) justification processes to have resolved the conflict between one's choice and any foregone values.

Study 2: Self-Perceived Domain Knowledge Influences Value Carryover

The purpose of Study 2 was to conceptually replicate the value carryover demonstrated in Study 1 and to begin investigating the mechanisms underlying these value carryover effects. One possibility is that value carryover effects are enhanced by a degree of knowledge with a specific domain. This is plausible because having knowledge of a domain may cause one to really understand what value s/he is foregoing, leaving that value to be especially sensitive to activation in a later tradeoff context. We thus predicted that greater domain (e.g., camera) knowledge would increase value carryover.

Method

Participants

Sixty-seven US subjects (mean age = 32.0, 35 females) participated online through Amazon's Mechanical Turk. The sample size collection rule for this study was again deemed sufficient based on the samples used in prior work on preference construction (cf. Hsee, 1996). Six participants were excluded for failing an item assessing whether or not they were reading the survey questions, leaving 61 total cases for analysis.

Procedure and Materials

Each subject was assigned randomly to one of three conditions to activate frustrated values. The subject recalled and wrote about a tradeoff experience when s/he had: (1) a *fast*, but *low-quality*, restaurant experience; (2) a *slow*, but *high-quality*, restaurant experience; or (3) any

restaurant experience (control condition). These conditions are referred to as the superior speed, inferior speed, and control conditions, respectively.

Following this manipulation, in an ostensibly unrelated study, each participant made a hypothetical purchase decision between two cameras (Table 2.2). One camera was superior on an attribute dimension conceptually associated with *speed* (shutter speed), and the other was superior on an attribute commonly recognized as reflective of *quality* (megapixels and lens). Participants then completed a measure assessing their self-perceived camera knowledge as compared to the average US consumer of their age, ranging from 1 = much less knowledge to 7 = much more knowledge, as well as demographic information.

Results and Discussion

In the analysis, we included subjective camera knowledge rating as a continuous predictor², and we controlled for the amount of time that subjects spent on the recall task to account for any differences in effort between subjects. Continuous covariates across studies were mean-centered per statistical conventions because it allows for clearer interpretation of main effects when higher-level interactions exist. While results revealed no overall effect of recall experience, $\chi^2(2) = 0.65, p = .724$, there was a trending effect of camera knowledge, $OR = 0.27, \beta = -1.29, 95\% CI = (-2.80, 0.21), z = -1.69, p = .092$, which was moderated by an interaction between group and camera knowledge, $\chi^2(2) = 6.31, p = .043$. Closer analysis of the results using the inferior speed recall group as the reference shows that their camera knowledge slope differed significantly from that of the fast-low quality group, $OR = 5.26, \beta = 1.66, 95\% CI = (0.05, 3.27), z = 2.02, p = .044$, but not from the slope of the control group, $OR = 3.22, \beta = 1.17, 95\% CI = (-0.46, 2.80), z = 1.41, p = .160$. Analysis on subjects half a standard deviation from (above and

² Using only group as a predictor revealed no main effect, $\chi^2(2) = 0.32, p = .852$, so only the knowledge covariate model is reported here.

below) the mean of camera knowledge indicated that the effect of prior recall on current tradeoffs influenced individuals with high subjective camera knowledge, $\chi^2(2) = 9.16, p = .010$, but not those with low subjective camera knowledge, $\chi^2(2) = 0.76, p = .683$ (Figure 2.2). This may suggest that a person needs to be able to recognize and understand the significance of a value in order for the value to be taken into account and importantly carry over to influence subsequent choices.

Results were consistent with our prediction that recalling a prior tradeoff experience would activate frustrated values from their dormant states, thereby affecting decisions in current contexts that are irrelevant to the original tradeoff situations. We also found that our effect was obtained only for participants who self-reported high camera knowledge, suggesting that camera knowledge was necessary for the predicted carryover. Our effect was also most pronounced in the slow-high quality recall condition, indicating that frustration of the time value was critical to motivating this carryover process.

Previous research on tradeoff processing has linked greater choice and attribute processing with greater perceived difficulty of the choice (Luce, Bettman, & Payne, 1997). Tradeoff dilemmas are considered to be difficult because the decision maker is forced to sacrifice a desirable attribute, regardless of the choice made (Yates, 2003). In our study, it is plausible that having high subjective knowledge about the camera attributes highlighted the tradeoff and the pain experienced when realizing that the desirable attribute of the rejected alternative will be sacrificed, increasing choice tradeoff processing. This, in turn, activates a need to satisfy the frustrated value and leads to the carryover of that value onto an unrelated choice. Alternatively, if there is little choice/tradeoff processing, then the tradeoff sacrifice will not be recognized and any pain associated with foregoing the rejected alternative will be absent. In this case, we would

not expect that the value frustrated in a prior tradeoff experience would carry over onto the subsequent choice, as observed in Study 1.

One limitation of Study 2 was that the recall manipulation prompted participants to recall a time involving either a fast or a slow service restaurant experience. One could argue that a fast service restaurant experience may not always be positive (cf. being rushed by the wait-staff during a meal), and likewise a slow restaurant experience may not necessarily be negative (cf. enjoying a relaxed meal at a gourmet establishment). Additionally, Study 2 lacked direct evidence that increased tradeoff processing in our high knowledge group caused the effect. To overcome these limitations, Study 3 used a different recall paradigm and directly manipulated attribute tradeoff processing.

Study 3: Increased Tradeoff Processing Enhances Value Carryover

To investigate the mechanisms underlying why the observed value shift occurs, we increased choice difficulty to produce greater choice and attribute tradeoff processing (see Bettman, Luce, & Payne, 1998, for a review). Previous research indicates that perceived choice difficulty is affected by the ease with which an individual can process choice information (i.e., preference fluency; Novemsky, Dhar, Schwarz, & Simonson, 2007). In other words, information that is difficult to process (i.e., disfluent information) produces a feeling of greater task difficulty. To increase tradeoff processing while controlling option attributes, we used a standard fluency manipulation (Song & Schwarz, 2008).

We hypothesized that increased tradeoff processing, manipulated through disfluent option presentation, would lead a participant to become more sensitive to the value of forgone time attributes in prior situations because the necessary increased tradeoff processing would highlight

what had been foregone in the prior tradeoff context. This should, in turn, cause the decision maker to seek ways to satisfy the frustrated values. We thus predicted that this greater tradeoff processing would increase the desirability, or value, of options with superior attributes on the frustrated time dimension.

Method

Participants

Two hundred and sixty six (mean age = 22.8, 95 females) US participants were recruited online through both Amazon's Mechanical Turk as well as the undergraduate psychology subject pool at the University of Michigan. No significant differences on any of the measures between subject pools emerged, $ps > .38$, so data from both samples were collapsed. Two participants from the Amazon Mechanical Turk subject pool with recall times greater than 50 minutes (inattention to task) were removed, leaving 264 cases for analysis.

Procedure and Materials

Each subject was assigned randomly to one of three conditions to activate a frustrated value. The subject recalled and wrote about a past tradeoff experience when s/he had: (1) a *fast*, but *low-quality*, doctor's office experience; (2) a *slow*, but *high-quality*, doctor's office experience; or (3) any doctor's office experience (i.e., control condition). These are referred to as the superior speed, inferior speed, and control recall conditions, respectively. Following this manipulation, in an ostensibly unrelated study, participants made a hypothetical purchase decision between two trains traveling between cities (Table 2.3). One train was superior on attribute dimensions reflective of train *quality* (cleanliness, food service), and the other was superior in *speed* (travel time). We manipulated depth of tradeoff processing in the train decision using a paradigm intended to induce high and low fluency (Song & Schwarz, 2008). Participants

were randomly assigned to view the train options in either (1) *Arial*, an easy-to-read, high fluency font, or (2) *Mistral*, a difficult-to-read, low fluency font. As a manipulation check, after making the train choices, all participants answered the question, “How easy or difficult did you find the task where you made the decision about trains?” on a scale from 1 = Very difficult to 7 = Very easy.

Results and Discussion

Manipulation check. A two-sample *t*-test applied to train choice difficulty ratings confirmed that the train choice was more difficult for the *Mistral* than the *Arial* group, $t(262) = 3.74$, $M_{\text{diff}} = 0.58$, 95% CI = (0.27, 0.88), $p < .001$, *Arial* mean (SD) = 5.99 (1.16), *Mistral* mean (SD) = 5.41 (1.34).

Choice results. Recall time was entered as a covariate to control for differences in effort between subjects and the slow-high quality group served as the reference level. Consistent with our hypothesis, train choices were only influenced by group when the decision task was more difficult; group-by-difficulty interaction, $\chi^2(2) = 6.76$, $p = .034$. There was no main effect of group or difficulty; group: $\chi^2(2) = 1.81$, $p = .403$, difficulty: $\chi^2(1) = 0.04$, $p = .840$. Follow-up analyses on the difficult choice group (*Mistral* font) and the easy choice group (*Arial* font) separately revealed an effect of group for the difficult choices, $\chi^2(2) = 7.07$, $p = .029$, but not the easy choices, $\chi^2(2) = 1.91$, $p = .384$. The slow-high quality recall participants in the difficult choice condition were more likely to choose the train that was superior on the frustrated value dimension, speed, than the fast-low quality participants, $OR = 3.27$, $\beta = 1.19$, 95% CI = (0.28, 2.09), $z = 2.55$, $p = .011$, and chose the fast train directionally more than the control participants, $OR = 2.25$, $\beta = 0.81$, 95% CI = (-0.08, 1.71), $z = 1.79$, $p = .074$ (Figure 2.3).

Study 3 demonstrated that value carryover occurred for participants in the difficult choice condition, and this value carryover was especially prominent when the frustrated value was time-related. This indicates that increasing tradeoff processing is sufficient for previously frustrated time values to carry over onto a subsequent decision. Also as predicted, the easy choice condition did not show the value carryover, further supporting our proposal that greater tradeoff processing leads to the use of frustrated values. In all prior studies, the carryover of frustrated values occurred more for the time attribute than any other. The purpose of Study 4 was thus to determine if the time attribute is indeed especially sensitive to the value carryover process.

Study 4: The Carryover of Value is Reduced when Time is not Included in the Tradeoff

In the first three studies we established conditions under which value carryover occurs. In each case, we found that value carryover happened when one of the attributes in question was related to time. In Study 4, we sought to determine whether we would observe carryover when the time attribute was not involved in the later choice task. We hypothesized that when no tradeoff was made on the time dimension, the value carryover effect would disappear. This would plausibly occur because time is a resource that individuals are able to mentally account for and quantify as limited (i.e., there are 24 hours in a day, 60 minutes in an hour, 60 seconds in a minute, etc.) and can thus trade off more easily in later choices.

Method

Participants

One hundred and forty five undergraduate business school students participated in a laboratory experiment where they completed a computerized task for course credit. Twenty-five people were excluded for failing an attention check, leaving a total of 120 subjects for analyses.

Procedure and Materials

Each subject was assigned randomly to one of three conditions to activate a frustrated value. The subject recalled and wrote about a past tradeoff experience when s/he had: (1) a *fast*, but *unfriendly*, doctor's office experience; (2) a *slow*, but *friendly*, doctor's office experience; or (3) any doctor's office experience (i.e., control condition). These are referred to as the unfriendly, friendly, and control recall conditions, respectively. Following this manipulation, in an ostensibly unrelated study, participants made a hypothetical decision between one of two job choices (Table 2.4) that did not differ on a temporal dimension. One job was superior on an attribute dimension reflective of coworker *friendliness* (corporate culture), and the other attribute was reflective of job *amenities* (office size). A third attribute reflective of *speed* (commute time) was held constant between offers. Time was held constant in this study to help us determine whether a tradeoff on the attribute dimension of time was necessary for the carryover of value to occur.

After making their choices, participants then rated how similar they found the recall and choice tradeoff tasks to be on a scale ranging from 1 to 7. We included this question about the perceived similarity of tradeoff attributes across the recall and choice tasks to observe how perceived similarity might influence our carryover effect. We predicted that perceived similarity would be important because if participants viewed the attributes of the recall and choice tradeoffs as highly similar, this might lead them to use one valued attribute from the recall task more in the later tradeoff choice context. This is presumably because participants would be more likely to find the later tradeoff context to be an opportunity to satisfy the value that was foregone during the recall task. This is not to say that participants would necessarily think that the recall and

choice tasks were the same, but rather they could recognize similarities in the attributes of the options.

Results and Discussion

We began by coding job choices for the friendly job as 1 and job choices for the unfriendly job as 0. There was a marginal effect of recall group on job choices, $\chi^2(2) = 4.89, p = .087$. The people who recalled the friendly doctor's office visit chose the friendly job 61% of the time, which was more often than the control condition subjects, $OR = 2.47, 95\% CI = (1.06, 5.77), \beta = 0.91, 95\% CI = (0.06, 1.75), z = 2.09, p = .037$, who only chose the friendly job 39% of the time. Subjects who recalled the unfriendly job chose the friendly job 43% of the time, which did not differ significantly from either the control condition, $OR = 1.19, \beta = 0.17, 95\% CI = (-0.76, 1.11), z = 0.36, p = .716$, or the friendly recall condition, $OR = 2.08, \beta = 0.73, 95\% CI = (-0.21, 1.57), z = 1.52, p = .129$. These findings suggest more of a priming effect (cf. Bargh et al., 2012), whereby recalling a friendly doctor's office visit likely activated friendliness as an important value and thus led to a subsequent choice of the option superior on friendliness.

As before, we mean-centered subjects' ratings of similarity between the doctor's office visit and the job choice task and ran a logistic regression predicting job choice with recall group similarity, and the interaction between these variables. Overall, subjects chose the friendly job more often as the tasks seemed more similar, $\chi^2(1) = 4.94, p = .026$. Additionally, when controlling for perceived tradeoff similarity, there was no recall group effect, $\chi^2(2) = 2.14, p = .344$, nor any interaction between recall group and similarity, $\chi^2(2) = 2.26, p = .323$.

These results indicate that when there was no tradeoff on the time attribute, regardless of how similar the recall and choice tasks were perceived to be, no carryover effect occurred. The primary effect that emerged was more akin to a priming effect, whereby those who recalled a

friendly doctor's office experience were more likely to select the friendly job. We consider this to be closer to a traditional priming effect because consistent with literature on priming (see Bargh et al., 2012, for a review), when friendliness was activated, this led individuals to focus on the friendliness dimension and choose the option superior on friendliness regardless of whether friendliness was gained in the recall task. This provides at least initial evidence that tradeoffs involving time are particularly sensitive to our observed carryover effects. One plausible explanation is that time is a resource that individuals are able to mentally account for and quantify as limited (i.e., there are 24 hours in a day, 60 minutes in an hour, 60 seconds in a minute, etc.) and these types of quantifiable values can be traded off more easily in later choices.

One important component of our proposition is that the carryover occurs at least partly due to the desire to satisfy a frustrated value. The very notion of a frustrated value implies that the decision maker is deprived of the foregone attribute, and this deprivation underlies the frustration mechanism. It is also plausible, however, that both a deprivation mechanism and a satiation mechanism are at play, such that sometimes the deprived value becomes activated and carries over, and on other occasions the satiated value becomes deactivated and allows for other values to be prioritized. This latter possibility is in line with a balance framework, whereby an individual seeks to maintain a balance among valued attributes as much as possible. This balance hypothesis would allow for the possibility that both deprivation and satiation can plausibly occur and influence subsequent value carryover onto seemingly unrelated choice contexts. Our next goal was thus to investigate these two potential balance mechanisms for the carryover of temporal value: satiation and deprivation.

Study 5: Time Carryover and Satiation or Deprivation Mechanisms

Given that tradeoff processing influences the carryover of frustrated value, especially for time, it was important to determine whether value carryover is explained either by the satiation of a value one satisfied in a prior value situation, the deprivation of a value that was frustrated in a prior value situation, or some combination of the two. The prior studies that demonstrated temporal value carryover (i.e., Studies 1-3) confounded deprivation and satiation because the choices were always perfectly symmetrical tradeoffs (e.g., one option always had A+, B- and the other option always had A-, B+), making it impossible to disentangle these two mechanisms. We also wanted to generalize our time carryover effects to choices that are of greater importance than cameras or trains; namely choices between job offers.

In order to un-confound the satiation and deprivation mechanisms, Study 5 aimed to test both mechanisms separately. To clarify the procedure for testing both satiation and deprivation as a mechanism in complementary value carryover, imagine a decision problem where attribute A = speed, attribute B = friendliness, and attribute C = office size, where (+) indicates attribute superiority, and (-) attribute inferiority. Because the time value was found to be important to the carry over process in Study 4, time is used here as the focal value to test the satiation and deprivation mechanisms.

Satiation. To illustrate the procedure required to test the satiation mechanism, imagine a two stage paradigm where:

(Stage I) Recall tradeoff: A+ (superior speed), B- (inferior friendliness)

(Stage II) Choice options:

Option 1: A- (inferior speed), C+ (superior office)

Option 2: A+ (superior speed), C- (inferior office)

Given that a person recalls a tradeoff in Stage I with superior speed but inferior friendliness attributes, we would hypothesize the satiation mechanism is at play if that person chooses Option 1 in Stage II, where the speed attribute is inferior, but the office attribute is superior. The logic here is that when the value for speed is satiated (i.e., satisfied) in the tradeoff recall, then other attributes (i.e., office size) can be prioritized in the subsequent, unrelated choice context.

Deprivation. We also wanted to test the deprivation mechanism. Imagine now a two-stage paradigm with the following features:

(Stage I): Recall tradeoff: A- (inferior speed), B+ (superior friendliness)

(Stage II): Choice options:

Option 1: A- (inferior speed), C+ (superior office)

Option 2: A+ (superior speed), C- (inferior office)

Given that the tradeoff in Stage I has inferior speed but superior friendliness attributes, we hypothesized that the deprivation mechanism is at play if a person in this recall condition chooses Option 2 in Stage II, where the speed attribute is superior, but the office attribute is inferior. The logic here is that the value for speed is deprived (i.e., foregone) in the tradeoff recall, and thus becomes activated and seeks to be satisfied in the subsequent, unrelated choice context.

If both mechanisms are at play, then we would predict the carryover from the recall task to the choice task to occur in both the satiation and the deprivation conditions, relative to the control, as a way to balance value across different tradeoff contexts.

Method

Participants

One hundred and forty six participants were recruited online through Amazon's Mechanical Turk. Thirty-one people were excluded for failing an attention check, leaving a total of one hundred and fifteen subjects for analyses.

Procedure and Materials

Each subject was assigned randomly to one of three conditions to activate a frustrated value. The subject recalled and wrote about a past tradeoff experience when s/he had: (1) a *fast*, but *unfriendly*, doctor's office experience; (2) a *slow*, but *friendly*, doctor's office experience; or (3) any doctor's office experience (i.e., control condition). These are referred to as the superior speed, inferior speed, and control conditions, respectively. Following this manipulation, in an ostensibly unrelated study, participants made a hypothetical decision between one of two jobs (Table 2.5). One job was superior on attribute dimensions reflective of job *amenities* (office size), and the other was superior in *speed* (commute time to work). A third attribute reflective of each job's corporate culture (related to friendliness) was held constant between offers.

As in Study 4, we again included a question about the perceived similarity of tradeoff attributes across the recall and choice tasks. Since we found that perceived similarity increased the carryover of the friendliness value in Study 4, we expected that perceived similarity would also be important when the temporal attribute was present. Specifically, if participants rate the recall and choice tradeoffs as similar, they may also view the choice as an opportunity to make a balanced tradeoff. It is also plausible that the high choice tradeoff participants from Study 3 made greater connections between the past and future tradeoffs, and therefore found them to be more similar. Thus, after making their choice, each participant was asked to rate how similar they found the tradeoffs in the recall and choice tasks to be, on a scale ranging from 1 to 7.

Results and Discussion

Overall, there was no effect of recall group on job choices when the choice options had speed attributes associated with them, $\chi^2(2) = 0.90, p = .637$. The subjects who recalled the inferior speed doctor's office visit chose the superior commute job about 61% of the time, which was very similar to what occurred in the superior speed recall group (60%) and the control condition (51%).

We then ran the same analysis including similarity to test whether perceived similarity between the recall and choice tasks would enhance complementary value carryover. There was no effect of similarity, $\chi^2(1) = .136, p = .713$, or recall group, $\chi^2(2) = 0.87, p = .647$, but there was an interaction between similarity and recall group, $\chi^2(2) = 9.92, p = .007$. The slope of similarity for the group who recalled the superior speed doctor's visit was significantly more positive than the slope of similarity for both the control condition, $OR = 3.76, \beta = 1.33, 95\% CI = (0.19, 2.46), z = 2.28, p = .022$, and the inferior speed recall condition, $OR = 4.09, \beta = 1.41, 95\% CI = (0.31, 2.51), z = 2.50, p = .012$. That is, subjects in the superior speed recall condition who thought the recall task and later job choices were similar showed a value carryover effect while those who thought that they were dissimilar did not show the value carryover (Figure 2.4). This indicates that the superior speed recall group (used to test satiation) was especially sensitive to perceived similarity between the recall and choice tasks.

Based on a median split of perceived similarity, subjects in the superior speed recall condition who thought the decisions were similar chose the inferior commute job more than those in the inferior speed condition, $\chi^2(2) = 6.45, p = .040$; pairwise $OR = 7.88, \beta = 2.06, 95\% CI = (0.30, 3.83), z = 2.30, p = .022$, providing evidence for a satiation effect. In other words, recalling a superior speed tradeoff led those individuals who perceived the recall and choice

tasks to be similar to choose the inferior commute job in the subsequent, unrelated choice context. This occurred presumably because the value for speed was satiated in the recalled tradeoff and allowed prioritization of the office space attribute in the subsequent choice. There was no difference between the control and the superior speed recall, $OR = 0.22$, $\beta = -1.50$, 95% CI = (-3.48, 0.47), $z = -1.50$, $p = .135$, and inferior speed recall conditions, $OR = 1.75$, $\beta = 0.60$, 95% CI = (-0.95, 2.07), $z = 0.73$, $p = .469$.

For subjects who thought that the recall and job choices were dissimilar, there was a marginal effect of recall group, $\chi^2(2) = 5.92$, $p = .052$. The superior speed recall condition chose the superior commute job more frequently than did the control condition, $OR = 4.98$, $\beta = 1.61$, 95% CI = (0.17, 3.04), $z = 2.20$, $p = .028$, and marginally more often than the inferior speed condition, $OR = 3.81$, $\beta = 1.34$, 95% CI = (-0.14, 2.81), $z = 1.78$, $p = .076$. There was no difference in which choice was made between the control and inferior speed recall conditions for subjects who thought that the choices were dissimilar, $OR = 0.77$, $\beta = -0.27$, 95% CI = (-1.36, 0.82), $z = -0.48$, $p = .630$. In other words, participants who found the recall task and subsequent choice task to be dissimilar showed more of a priming effect, whereby recalling superior speed led the speed attribute to be prioritized again in the subsequent choice task.

These results are supportive of value satiation as another mechanism underlying time value carryover, particularly among individuals who view the recall and choice tradeoff tasks as similar. In this study, the option favoring the value that had been satisfied in the recall task was less likely to be selected in the choice tradeoff task, relative to the control and deprivation conditions. This indicates that once a value becomes satisfied in one choice context, other values can be prioritized in subsequent, unrelated choice contexts, particularly when the tradeoff contexts are perceived to be similar. Although we did not find evidence in support of a

deprivation mechanism in this study, this may be explained by a few factors. First of all, in this study the satiation mechanism was more sensitive to perceived similarity between the tradeoff and choice tasks than the deprivation mechanism, and thus we only observed complementary value carryover in the superior speed recall (satiation) condition. Additionally, collapsing across perceived similarity, participants in all recall conditions chose the superior speed job option more than the inferior speed job option. This may indicate that the default for this choice context was the superior speed job option, and thus it was more difficult to detect differences across recall conditions. These possibilities suggest that a balance story, where in some cases satiation is the stronger mechanism, and in other cases deprivation is the stronger mechanism, cannot be ruled out based on this study alone. To better understand how the value carryover effects are playing out across tradeoffs, we next ran a meta-analysis on the four studies that included time as a carryover value.

Study 6: Meta-Analysis of Prior Time-Related Study Results

In order to investigate the robustness of our carryover results from prior studies, we ran a fixed-effects meta-analysis on both the omnibus and individual contrasts from all studies except Study 4, which did not include a temporal value carryover effect.

Method

Procedure

Omnibus and contrast tests between groups were included in separate data files for a meta-analysis. All chi-squared values from omnibus tests were converted for Cramer's V , and all ORs from individual contrasts were converted to Cohen's d . We then ran fixed-effects meta-analyses on effect sizes, weighted by the sample size for each test (overall and contrast

comparisons; Wilson, 2005). Effects from Study 4 were omitted because they did not test the effects of recalling speed on subsequent decisions.

Results and Discussion

Omnibus effects. In line with all prior results, we found a significant omnibus effect of recall condition on subsequent choices, mean effect size = 0.22, 95% CI = [0.10, 0.33], $Z = 3.67$, $p = .0002$ (Table 2.6).

Group contrasts. Contrasts from recall groups in each study were re-coded to compare (1) control vs. inferior speed recall, (2) superior speed recall vs. control, and (3) inferior speed recall vs. superior speed recall. Concerning effects across studies, the inferior speed recall group was more likely to choose superior speed options compared to the control group, mean effect size = -0.34, 95% CI = [-0.46, -0.22], $Z = -5.58$, $p < .0001$. Additionally, the superior speed recall group was less likely to choose superior speed options than the control group, mean effect size = 0.45, 95% CI = [0.33, 0.56], $Z = 7.35$, $p < .0001$, and the inferior speed recall group was more likely to choose superior speed options than the superior speed recall group, mean effect size = 0.37, 95% CI = [0.26, 0.49], $Z = 6.50$, $p < .0001$ (Table 2.7).

In other words, we find that the information recalled by subjects influenced their subsequent choices, and that all group contrasts were robust across studies. Recalling a situation with an inferior speed option made subjects more likely to choose superior speed options than either recalling anything (control condition) or recalling a situation with a superior speed option. Additionally, recalling a situation with a superior speed option led subjects to choose inferior speed options more often than subjects in the control condition who were not instructed to recall a specific tradeoff. The results of this meta-analysis thus strongly support a balance mechanism, whereby we observe that both the deprivation (frustration) mechanism and the satiation

mechanism are at play. This is especially important given that the satiation mechanism was more strongly supported in Study 5 than the deprivation mechanism. Our findings across the four time-related studies suggest that balancing value across tradeoff contexts is an important process underlying complementary value carryover.

General Discussion

The findings across five studies and a meta-analysis support the idea introduced in this new line of research, whereby the construction of value for time is subject to the systematic influences of prior value experiences in contexts that are removed from the current decision situation, in both time and domain. In decision situations involving tradeoffs, frustrated values do not simply go away, e.g., dissipate instantly. Instead, they remain active and seek to be satisfied. Subsequent, superficially distinct decision situations represent opportunities to satisfy these values. Once the activated values become satisfied (i.e., satiated), then other values can be prioritized in subsequent, unrelated decision contexts.

In this series of studies, we found that the carryover of value occurred exclusively when one of the attributes was time related. The next goal for this research program will be to extend the study of value carryover effects into other domains not involving time. On the one hand, it could be that there is something very special about the construct of time. For instance, mental accounts are not usually applied to time management in the same way they are applied to money management, but instructing individuals to make accounts for time leads to many of the same irrationalities often observed for decisions involving money (Soman, 2001).

On the other hand, something about the way in which we think about or perceive time may be leading to the value carryover observed in these studies. It is, for example, plausible that

value activation and carryover occurs most frequently when the attribute domain in question is a limited resource that can be in some way mentally accounted for, e.g., time. Other, more abstract attributes, e.g., quality or friendliness, may not have a maximal limit that is easily calculable (e.g., 24 hours in a day) and therefore may be more difficult for people to make up for or balance with future choices. This possibility warrants further investigation.

The dynamic nature of value demonstrated here reveals how influential difficult tradeoff experiences, both past and present, are in shaping how we make decisions. Our findings are also critical in their contribution of a more comprehensive understanding of value construction that extends beyond the immediate context in which a choice is embedded. Future research should be directed toward the elaboration of further forces that affect value carryover and the dynamic nature of value generally.

Table 2.1 *Investment options in Study 1. Investment B was superior on an attribute associated with speed, time to implement the investment, while Investment A was superior on an attribute associated with a high probability of making money.*

	Investment A	Investment B
Type	Bond, where there is a high probability that you will make a small amount of money.	Stock, where there is a small probability that you will make a large amount of money.
Implementation	Unavailable through your broker. Pages of paperwork necessary.	Available through your broker. Immediate, easy purchase.
Share in Personal Investment Package	15%	15%

Table 2.2 *Digital camera options in Study 2. Digital Camera 1 was superior on an attribute associated with speed, shutter speed, while Digital Camera 2 was superior on attributes associated with quality, lens and number of megapixels.*

	Digital Camera 1	Digital Camera 2
Shutter Speed	Hummingbird Shutter 1/1000 second max.	Williamson Shutter 1/250 second max.
Lens/Megapixel	Traditional Lens/ 5 megapixels	Crystal View Lens / 12 megapixels
Price	\$130	\$140
LCD Size	3 inches	3 inches

Table 2.3 *Train options as presented to subjects in Study 3. Train A was superior on speed, while Train B was superior on attributes associated with quality, cleanliness and food service.*

	Train A	Train B
Speed	4 hours from Ann Arbor to Chicago	5 hours from Ann Arbor to Chicago
Amenities	Sanitation average: Cleaned every 4 trips No food available	Sanitation excellent: Cleaned every trip 3.5 star dining car
Wifi	Works 96% of the time	Works 96% of the time

Table 2.4 *Job choice options in Study 4. Job Offer 1 was superior on an attribute associated with corporate culture, friendliness of co-workers, while Job Offer 2 was superior on attributes associated with job amenities, specifically office space.*

	Job Offer 1	Job Offer 2
Corporate Culture	Friendly, close relationships with co-workers	Unfriendly, distant relationships with co-workers
Office	Small, noisy cubicles without windows	Private offices with window to courtyard
Commute	Moderate commute time	Moderate commute time

Table 2.5 *Job choice options in Study 5. Job Offer 1 was superior on an attribute associated with speed, commute time, while Job Offer 2 was superior on an attribute associated with job amenities, specifically office space.*

	Job Offer 1	Job Offer 2
Commute	Short commute time, with light, fast flowing traffic	Long commute time with heavy, bumper-to-bumper traffic
Office	Small noisy cubicles without windows	Private offices with window to courtyard
Corporate Culture	Professional relationships with co-workers	Professional relationships with co-workers

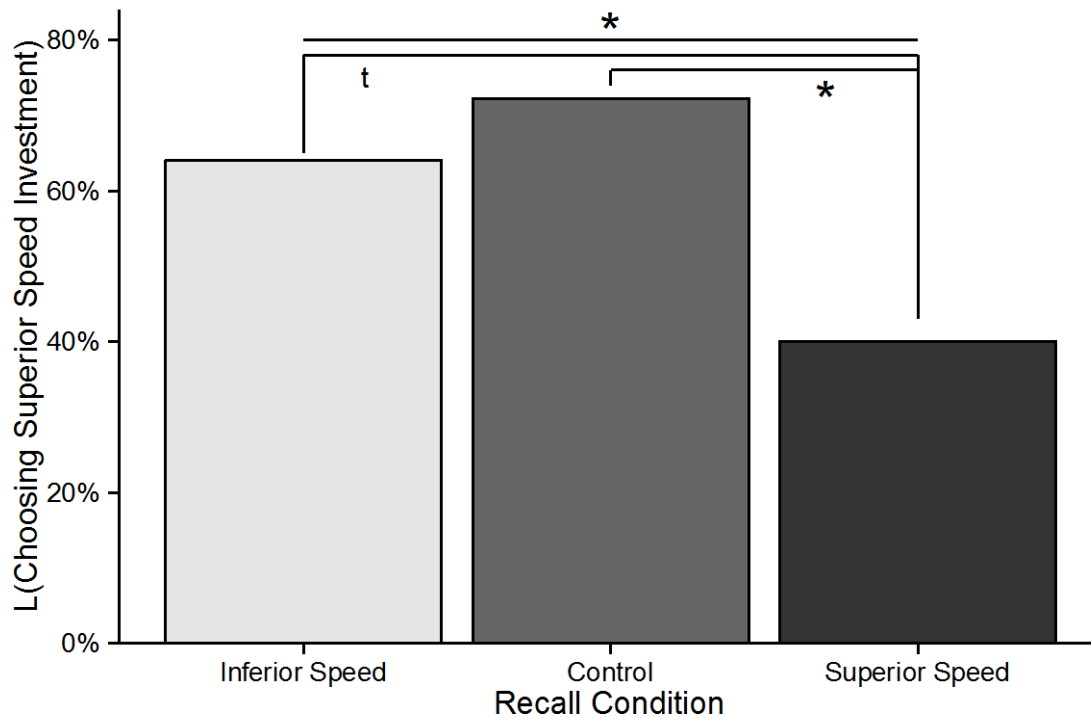
Table 2.6 *Omnibus effects tested in meta-analysis, Study 6.*

Study	Total <i>n</i>	Test <i>n</i>	Effect	$\chi^2(3)$	Cramer's <i>V</i>
1	91	91	Group effect	7.37	0.201
2	62	27	Group effect, high knowledge	9.16	0.412
3	264	132	Group effect, Mistral group	7.07	0.164
4	120	N/A	N/A. Does not test time effect.		
5	115	43	Group effect, similarity > mean	6.45	0.274

Table 2.7 *Group contrast effects tested in meta-analysis, Study 6.*

Study #	Test n	Test Effect	Reference Group	Comparison Group	OR	Cohen's D
2	35	Slope of camera Effect	Control	Inferior Speed	0.311	-0.645
3	85	Difficult Choice	Control	Inferior Speed	0.444	-0.447
5	32	High Similarity	Control	Inferior Speed	0.571	-0.309
1	61	Recall	Control	Inferior Speed	0.680	-0.213
2	46	Slope of Camera Effect	Superior Speed	Control	0.614	-0.269
3	92	Difficult Choice	Superior Speed	Control	3.226	0.646
5	21	High Similarity	Superior Speed	Control	0.220	-0.835
1	66	Recall	Superior Speed	Control	3.900	0.750
2	43	Slope of Camera Effect	Inferior Speed	Superior Speed	5.250	0.914
3	87	Difficult Choice	Inferior Speed	Superior Speed	3.190	0.640
5	33	High Similarity	Inferior Speed	Superior Speed	0.263	-0.738
1	55	Recall	Inferior Speed	Superior Speed	0.375	0.541

Figure 2.1 Likelihood of choosing the superior speed investment (short paperwork, high risk) split by the recall group, Study 1.



Note. * $p < .05$, t = marginal

Figure 2.2 *Logistic regression curves showing the fitted probability of choosing the superior speed camera as a function of self-perceived camera knowledge and recall condition, Study 2.*

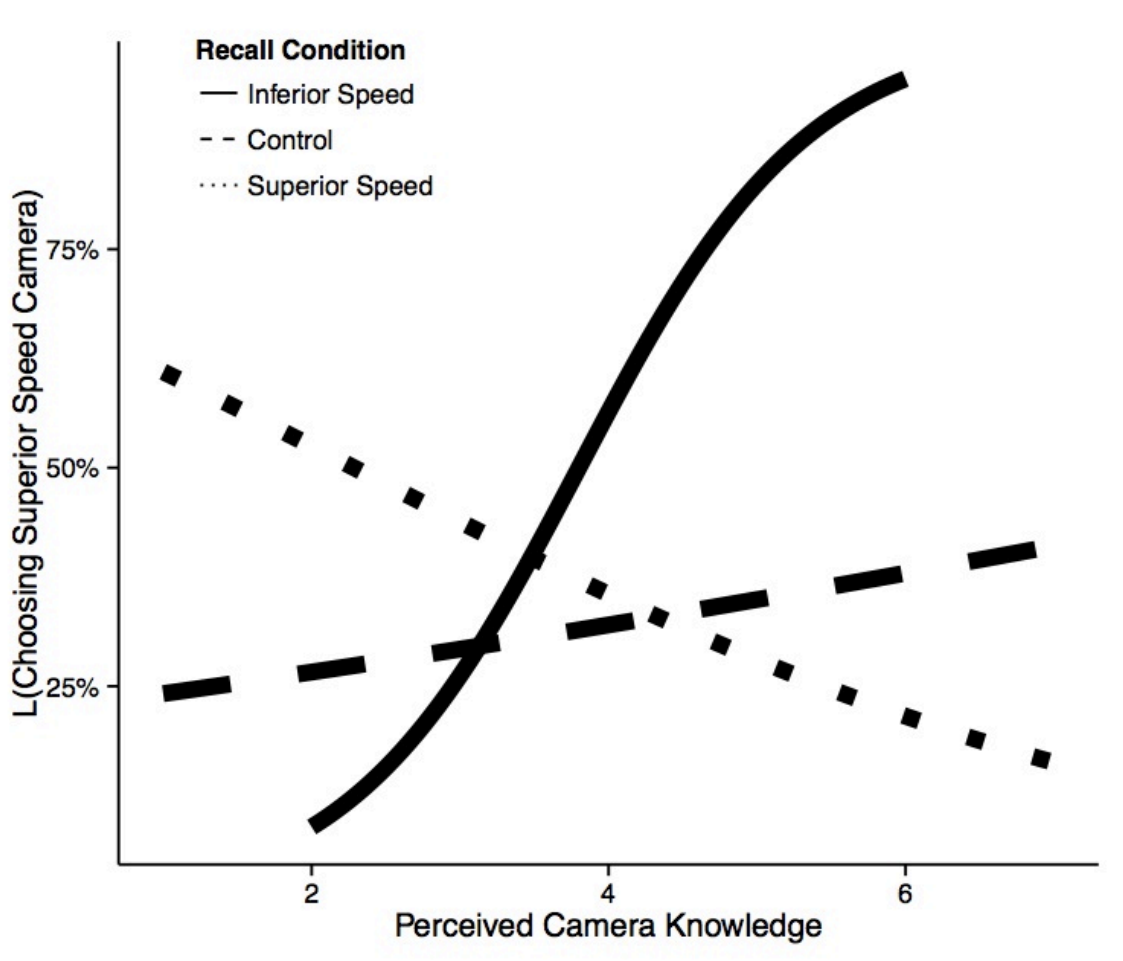
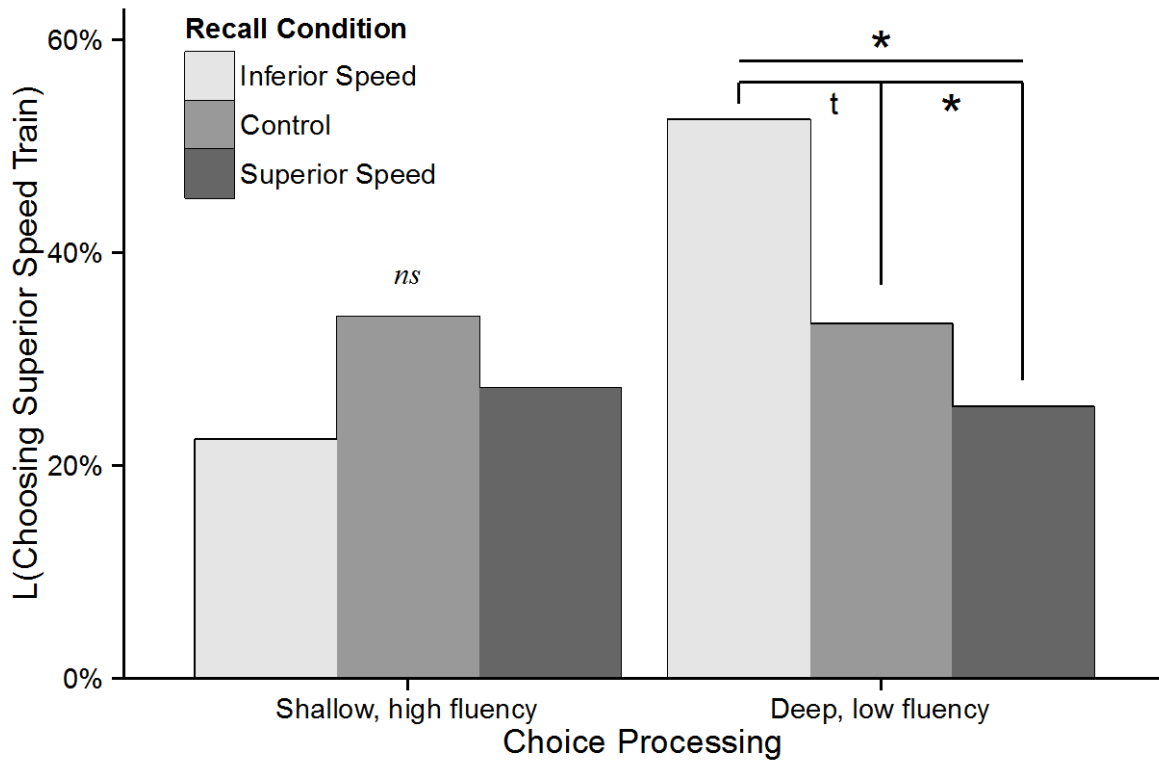
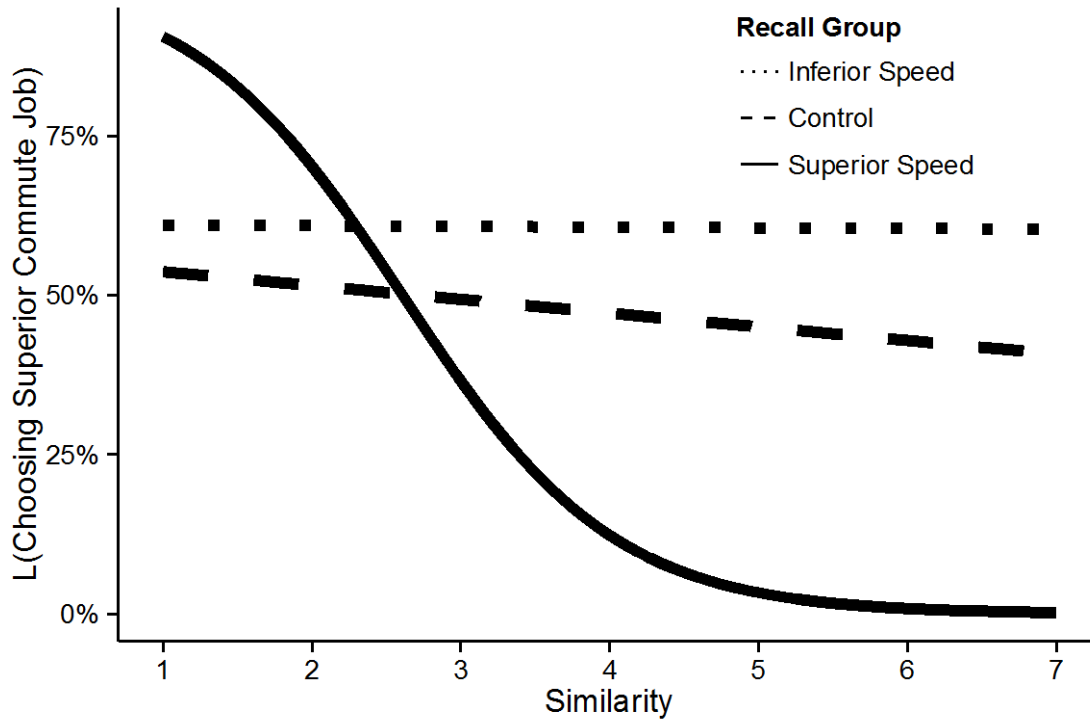


Figure 2.3 Likelihood of choosing the superior speed train, Study 3. Bars are grouped by level of choice processing (fluency) on the x-axis, and shaded by recall condition.



Note. * $p < .05$, t = marginal

Figure 2.4 *Logistic regression curves showing the fitted probability of choosing the superior commute job as a function of perceived task similarity and recall group, Study 5.*



References

- Bargh, J. A., Schwader, K. L., Hailey, S. E., Dyer, R. L., & Boothby, E. J. (2012). Automaticity in social-cognitive processes. *Trends in Cognitive Sciences*, *16*, 593-605.
- Berns, G. S., Laibson, D., & Loewenstein, G. (2007). Intertemporal choice—toward an integrative framework. *Trends in Cognitive Sciences*, *11*, 482-488.
- Bettman, J. R., Luce, M. F., & Payne, J. W. (1998). Constructive consumer choice processes. *Journal of Consumer Research*, *25*, 187-217.
- Chartrand, T. L., Huber, J., Shiv, B., & Tanner, R. J. (2008). Nonconscious goals and consumer choice. *Journal of Consumer Research*, *35*, 189-201.
- Goodman, J. K., Cryder, C. E., & Cheema, A. (2012). Data collection in a flat world: The strengths and weaknesses of Mechanical Turk samples. *Journal of Behavioral Decision Making*, DOI 10.1002/bdm.1753.
- Festinger, L. (1962). Cognitive dissonance. *Scientific American*, *207*, 83-107.
- Fischhoff, B., Slovic, P., & Lichtenstein, S. (1980). Knowing what you want: Measuring labile values. In T. S. Wallstein (Ed.), *Cognitive processes in choice and decision behavior* (pp. 117-141). Hillsdale, NJ: Erlbaum.
- Fishburn, P. C. (1970). *Utility theory for decision making*, New York: Wiley.
- Friedman, M., & Savage, L. J. (1948). The utility analysis of choices involving risks. *Journal of Political Economy*, *56*, 279-304.
- Higgins, E. T., Bargh, J. A., & Lombardi, W. (1985). Nature of priming effects on categorization. *Journal of Experimental Psychology: Learning, Memory and Cognition*, *11*, 59-69.
- Hsee, C. K. (1996). The evaluability hypothesis: An explanation for preference reversals between joint and separate evaluations of alternatives. *Organizational Behavioral and Human Decision Processes*, *67*, 247-257.
- Luce, M. F., Bettman, J. R., & Payne, J. W. (1997). Choice processing in emotionally difficult decisions. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *23*, 384-405.
- Mazar, N., & Zhong, C. B. (2010). Do green products make us better people? *Psychological Science*, *21*, 494-498.
- McCulloch, K. C., Fitzsimons, G. M., Chua, S. N., & Albarracín, D. (2011). Vicarious goal satiation. *Journal of Experimental Social Psychology*, *47*, 685-688.
- Monin, B., & Miller, D. T. (2001). Moral credentials and the expression of prejudice. *Journal of Personality and Social Psychology*, *81*, 33.
- Novemsky, N., Dhar, R., Schwarz, N., & Simonson, I. (2007). Preference fluency in choice. *Journal of Marketing Research*, *44*(3), 347-356.
- Sachdeva, S., Iliev, R., & Medin, D. L. (2009). Sinning saints and saintly sinners: The paradox of moral self-regulation. *Psychological Science*, *20*, 523-528.
- Shah, J. Y. (2005). The automatic pursuit and management of goals. *Current Directions in Psychological Science*, *14*, 10-13.
- Slovic, P. (1995). The construction of preference. *American Psychologist*, *50*, 364-371.
- Soman, D. (2001). The mental accounting of sunk time costs: Why time is not like money. *Journal of Behavioral Decision Making*, *14*, 169-185.
- Song, H., & Schwarz, N. (2008). If it's hard to read, it's hard to do. *Psychological*

- Science*, 19, 986-988.
- Wilson, D.B. (2005, May 23). Meta-analysis macros for SAS, SPSS, and STATA. Retrieved August 10, 2014 from <http://mason.gmu.edu/~dwilsonb/ma.html>
- Yates, J. F. (2003). *Decision management*. San Francisco: Jossey-Bass.

CHAPTER III

Creativity and Aging: Positive Consequences of Diminished Inhibitory Control

Creativity is a fundamental skill that fosters success across many life domains, ranging from how we manage our careers to the way we decorate our homes. Creativity often plays out in seemingly mundane settings, such as at the grocery store when a consumer is deciding which food items to choose for future meals. Decision makers of all ages make choices about products and services in complex and busy consumption environments, like the grocery store. In such contexts, individuals must inhibit a vast amount of distracting information in order to make more effective and satisfying choices. The ability to inhibit this distracting information, however, may be limited by the availability of processing resources (Hasher, Zacks, and May, 1999). Reduced processing resources make people especially vulnerable to distracting information and may interfere with people's ability to stay focused on the task at hand.

One theory of information processing suggests that as people age, they become more vulnerable to the effects of distracting information due to normal age-related declines in inhibitory control (Hasher, Zacks, & May, 2011). These inhibitory control decrements are thought to occur gradually over the life course and to contribute to declines in a variety of cognitive processes, including working memory, selective attention, speed of processing, and reasoning (Kim, Hasher, & Zacks, 2007; Salthouse, 1996).

Whereas declines in inhibitory control have typically been described as a negative consequence of normal cognitive aging, the current research seeks to investigate whether

positive outcomes may also be associated with a vulnerability to distraction. In particular, we propose that reduced inhibitory processing resources that increase one's vulnerability to distracting information may actually lead people of all ages to make more creative decisions.

Creativity is often described as a process that involves a combination of the experience based "convergent" thinking, and the more disinhibited "divergent" thinking that allows one to integrate distracting information into a creative process (Kasoff, 1995). It is thought that a successful integration of both types of thinking produces creative outcomes that are both unique and practical enough to be successfully executed.

Past research suggests that distracting information can prime older adults with concepts that improve performance on the Remote Associates Task (RAT; Kim et al., 2007). In the RAT, participants view a triad of words (e.g., falling, actor, dust) and are asked to find a new word that can be paired with each word in the triad (e.g., star). Better performance on the RAT is thought to be associated with cognitive flexibility and convergent thinking. In addition, attention to distracting (and often seemingly irrelevant) information is associated with enhanced divergent thinking in situations where the goal is complex, such as with a creative or artistic goal (Kasoff, 1995).

The present line of research seeks to investigate the potential benefits of a vulnerability to distraction by investigating how older individuals with diminished inhibitory control and younger adults under conditions of diminished inhibitory control exhibit greater creativity when making construction decisions. We operationalize creativity in the decision making process as different or unusual combinations of construction choices that are made throughout the development of a given product outcome (e.g., a successful recipe). For example, consumers, before going to a grocery store, often decide on what ingredients to purchase so that they may

use these ingredients in a variety of possible recipes. However, they do not necessarily have specific recipes in mind when they are grocery shopping, and the question arises as to what factors in the pre-decisional process may lead them to purchase ingredients for a more creative recipe (e.g., ratatouille) as opposed to a relatively uncreative dish (e.g., spaghetti with marinara sauce). Beyond decisions involving grocery shopping, creativity comes into play in a variety of choice domains including those involving self-made accessories, pottery, gift packages, computers, smart phones, vehicles, “Build-A-Bear” styled stuffed animals, home decorations, and vacation packages, to name a few.

Four studies sought to integrate the separate literatures on inhibitory processing and creativity to investigate how greater inhibition of seemingly distracting information can serve to enhance pre-decisional performance on subsequent tasks requiring divergent thinking. We reasoned that a difficult inhibition task would cause features of the distracting information to become activated and carry over to enhance performance on an unrelated creativity task. This carry over effect may be especially useful in the recipe generation domain, where people of all ages tend to have at least some experience. Capitalizing on the activation of distracting information within a domain in which most people have experience maps generally onto the divergent and convergent thinking inherent in a successful creative process.

We theorized that reduced inhibitory control would enhance one’s vulnerability to distracting information, and this vulnerability would allow distracting information to become activated and carry over to a greater extent onto a subsequent task. If this subsequent task would be likely to benefit from distracting information, which is often the case with creative tasks, then we would expect that vulnerability to this distracting information would increase performance on a creativity task. In line with our theoretical framework, we hypothesized that when distracting

information is present and difficult to inhibit, this will increase creativity in the recipe generation construction decisions made by both younger and older adults.

Study 1: Testing the Effects of Disinhibition on Creativity in Younger Adults

In the first study, we sought to test our initial hypothesis that participants induced to have an increased vulnerability to distracting information would generate more creative recipes on a subsequent recipe generation task than those in a control condition. We included two different distraction conditions because it is plausible that trying to not read distracting information (e.g., suppressing) may activate a different process than actively ignoring the distracting information. If this is the case, then it is possible that one type of distraction may produce greater creativity than the other. The idea here is that by being explicitly told to not read the distracting information, the subject may become more distracted by that information. This kind of effect would be in line with other work on thought suppression showing that trying to suppress information can lead to distraction and lowered performance on unrelated tasks (Wegner, Schneider, Carter, & White, 1987).

Method

Participants

One hundred and fifty six (mean age = 20.7; 68 females) undergraduates from the University of Michigan Ross School of Business subject pool were recruited to participate in a laboratory study on reading comprehension. Subjects were compensated with course credit for their participation.

Procedure and Materials

Participants completed all tasks individually on a laboratory computer and were randomly assigned into one of two distraction conditions, or a control condition. All participants read a mundane passage about a person going on a regular trip to the grocery store. Participants in the control condition read the passage in italicized font without any distracting information; XXXX's replaced the embedded words from the two distraction conditions (Appendix A). Participants in the first distraction (suppress) condition were asked to read the italicized passage with distracting food-related words (e.g., avocado, chicken) periodically embedded in upright font. Their task was to "read only the italicized words" in the passage (Appendix B). This task instruction prompted them to read only the italicized words without explicit instructions for them to ignore the non-italicized words. In the second distraction (ignore) condition, participants were asked to read the same italicized passage with food-related words periodically embedded in upright font, but explicitly told to "ignore all of the upright words" (Appendix C). The latter "ignore" condition instructions were adapted from a pre-existing distraction paradigm (Kim et al., 2007).

After completing the reading task, participants answered a few short comprehension questions, and then completed an ostensibly unrelated creativity task. In the creativity task, they were given three ingredients – corn, carrots, and tomatoes – and were instructed that they had five minutes to generate and type out as many food recipes as possible that included at least one of those three ingredients. Following the recipe generation task, participants completed demographics and were debriefed.

In a procedure adapted from Cheng, Burks, and Lee (2008), recipes were scored by two judges that self-identified as "cooking connoisseurs" and were blind to hypotheses and conditions. Each recipe was judged on 3 items—dish creativity, deliciousness, and potential

popularity—on a 5-point scale ranging from 1 (not at all) to 5 (very high). The internal reliability of the three items was .89. Recipe creativity is analogous to a measure of “divergent” thinking, whereas “deliciousness” and “popularity” are analogous to measures of convergent thinking. These three items were averaged together to create an “originality composite” score, which was used as the main dependent variable in our analyses. The interrater reliability between the coders was high ($r = .77, p < .001$), and all coding discrepancies were resolved by the first author, who was blind to condition.

Results and Discussion

A one-way analysis of variance assessing the influence of distraction condition on recipe originality indicated that participants in the ignore ($M = 4.06, SD = .64$) and suppress ($M = 3.95, SD = .79$) distraction conditions generated significantly more original recipes than those in the control (no distraction) condition ($M = 3.70, SD = .59$), $F(2,153) = 3.748, p = .026, \eta^2 = .046$ (Figure 3.1). Planned contrasts revealed that participants in the ignore distraction condition produced significantly more original recipes than those in the no-distraction control condition, $t(153) = 2.672, p = .008, d = .58$, and there were no differences in recipe originality between the ignore and suppress distraction conditions, $t(153) = .797, p = .427, d = .153$.

These findings indicate that both the ignore and suppress distraction conditions produced more original recipes than did the no-distraction control condition. This provides initial evidence that information activated in conditions where participants are vulnerable to distracting information leads to the generation of more original recipes on a subsequent, unrelated creativity task. Our next step was to extend these initial findings into an older adult population to determine if distracting information would also increase originality in a population that is considered to be particularly vulnerable to distracting information.

Study 2: Testing the Effects of Disinhibition on Creativity in Older Adults

In Study 2, we sought to replicate the results of Study 1 in an older adult sample. Older adults are a population with declining inhibitory control, which is generally viewed as having negative consequences for attention and memory. If, however, we find that a vulnerability to distraction enhances older adults' performance on a creative recipe task that requires both divergent and convergent thinking, this would provide further support for the idea that reduced inhibitory control can enhance performance on tasks requiring creativity.

Method

Participants

Sixty-four community-dwelling older adults (mean age = 73.76; 37 females) were recruited to participate in a laboratory study on reading comprehension and were compensated \$25 for participation and \$2 for transportation costs. The data from two participants were removed for failures to complete the recipe generation creativity task.

Procedure and Materials

The procedure in this study was identical to that described in Study 1. Also identical to Study 1, the recipes were scored by two judges that self-identified as “cooking connoisseurs” and were blind to hypotheses and conditions. Coders rated each recipe on 3 items—dish creativity, deliciousness, and potential popularity—on a 5-point scale ranging from 1 (not at all) to 5 (very high). The internal reliability for the three items was .73. These three items were again averaged together to create an “originality composite” score. The interrater reliability was high ($r = .89, p < .001$), and all coding discrepancies were resolved by the first author, who was blind to condition.

Results and Discussion

Results of a one-way ANOVA assessing the influence of distraction condition on recipe originality replicated the results of Study 1; older adult participants in the ignore ($M = 3.66$, $SD = .97$) and suppress ($M = 3.16$, $SD = .77$) distraction conditions generated significantly more original recipes than those in the control (no distraction) condition ($M = 2.96$, $SD = .85$), $F(2,59) = 4.403$, $p = .017$, $\eta^2 = .13$ (Figure 3.2). Planned contrasts revealed that as in the younger adult sample from Study 1, older adult participants in the ignore distraction condition generated significantly more original recipes than those in the no-distraction control condition, $t(59) = 2.780$, $p = .005$, $d = .76$, and there were no differences in recipe originality between the ignore and suppress distraction conditions, $t(59) = .467$, $p = .642$, $d = .57$.

Study 2 replicates the findings that the ignore and suppress distraction conditions increase recipe originality, relative to a control condition, but in an older adult sample. These findings also provide additional support for our theory that reduced inhibitory control can have positive consequences for creativity on tasks that require both convergent and divergent thinking. Importantly, our findings suggest that these facilitative effects occur for both younger and older adults. In contrast to the well-documented detrimental effects of diminished inhibitory control on cognitive processing, our findings suggest positive consequences of decreased inhibitory control.

However, a remaining question is whether the observed creativity effects are the result of activating congruent (e.g., food-related) information under conditions of low inhibitory control (as we propose), or if any depleting activity will lead to greater creativity. This is especially important given that similar reading comprehension tasks have been used in studies as a method for inducing resource depletion (cf. Hagger, Wood, Stiff, & Chatzinsarantis, 2010). Our next study aimed to investigate this possibility.

Study 3: Is the Observed Creativity Driven by Information Activation or Depletion?

The purpose of Study 3 was to establish that our effects were due to the carry over of activated information in our distraction conditions, and not just to depletion effects increasing creativity. If our carryover findings were simply due to depletion, then we would expect increased recipe originality regardless of whether the distracting information was a food word or a non-food word. However, if our effects rely on the activation of information that can carry over and be meaningfully used in a subsequent, unrelated recipe originality task, then our observed creativity effects cannot be attributed solely to depletion. Thus, we hypothesized that under conditions of vulnerability to distracting information, food word distractors would increase creativity on a recipe generation task relative to when non-food word distractors were provided.

Method

Participants

One hundred and six undergraduates at the University of Michigan Ross School of Business subject pool (mean age = 19.23, 47 females) were recruited to participate in a study on reading comprehension. Participants received course credit as compensation for their participation. The data from four participants were removed for failing to complete the recipe generation creativity task.

Procedure and Materials

The procedure for this study was identical to Study 1 and Study 2, with the exception that we now had a control (no prime) condition, an “ignore” inhibitory condition where participants were directly instructed to ignore the distracting food words (as in Study 1 and Study 2), and a new distraction condition where participants were instructed to “ignore” distracting non-food

words (Appendix D). The “suppress” condition was excluded from this study because it did not produce originality scores that differed from the “ignore” condition in the previous two studies.

Each recipe was again rated by two judges that self-identified as “cooking connoisseurs” and were blind to hypotheses and conditions. 3 items—dish creativity, deliciousness, and potential popularity—were rated on a 5-point scale ranging from 1 (not at all) to 5 (very high). The internal reliability of the three items was .63. These items were again averaged to create an “originality composite” score. The interrater reliability was high ($r = .81, p < .001$), and all coding discrepancies were resolved by the first author, who was blind to condition.

Results and Discussion

A one-way analysis of variance indicated that participants in the relevant food word distraction condition ($M = 3.88, SD = .43$) generated significantly more original recipes than those in the non-food word distraction condition ($M = 3.59, SD = .48$) or in the control (no word) condition ($M = 3.62, SD = .50$), $F(2,99) = 4.26, p = .017, \eta^2 = .08$ (Figure 3.3). Planned contrasts confirmed that participants in the food word distraction condition produced significantly more original recipes than those in the no-distraction control condition, $t(99) = 2.49, p = .014, d = .56$, as well as those in the non-food distraction condition, $t(99) = 2.48, p = .015, d = .64$.

This supports our proposal that priming distracting information when subjects are engaged in inhibitory control tasks increases originality only when the creative task is in the same domain as the distracting information. Thus, these enhancements in creativity cannot be attributed only to depletion effects, but rely on the activation of relevant information during times of reduced inhibitory control. Our next and final step was to directly compare how an induced vulnerability to distracting information influences younger and older adults.

Study 4: Comparing the Creativity of Younger and Older Adults

This study seeks to replicate the findings from Study 1 and Study 2, and to also directly compare younger and older adults' creativity. We predicted that older adults in the distraction condition would have preserved, and perhaps even enhanced, originality relative to the younger adult participants. Our reasoning for this prediction was that older adults' increased vulnerability to distracting information would allow more of the distracting information to become activated in their minds and thus to carry over to the subsequent recipe generation creativity task to a greater extent than for the younger adults.

Method

Participants

Eighty-five undergraduates were recruited from a University of Michigan Business School subject pool (mean age = 21.8, 55 females). In addition, fifty-three community dwelling older adults were recruited from senior centers in cities located in the Midwest and New England (mean age = 73.2, 33 females). All subjects were told that the study was about reading comprehension. Younger adults received course credit as compensation for their participation, and older adults received \$25 dollars for participation and \$2 for transportation costs. The data from one younger adult participant was removed for failing to complete the recipe generation creativity task, and from five older adult participants who encountered computer technical difficulties and were unable to complete the task.

Procedure and Materials

The procedure in this study was identical to that described in Study 1 and Study 2, except we only used the "ignore" distraction condition. As differences were not detected between the ignore and suppress distraction conditions in the first two studies, we did not include the

“suppress” condition in this study. Also identical to all prior studies, the recipes were scored by two judges that self-identified as “cooking connoisseurs” and were blind to hypotheses and conditions. The raters coded each recipe on 3 items—dish creativity, deliciousness, and potential popularity—on a 5-point scale ranging from 1 (not at all) to 5 (very high). The internal reliability of the three items was .85. The three items were again averaged to create an “originality composite” score. The interrater reliability was high ($r = .74, p < .001$), and coding discrepancies were resolved by the first author, who was blind to condition.

Results and Discussion

A 2 (age: older, younger) x 2 (distraction: ignore, control) analysis of variance revealed a significant main effect of distraction condition, whereby participants in the ignore ($M = 3.34, SD = .49$) distraction condition generated significantly more original recipes than those in the control (no distraction) condition ($M = 2.98, SD = .54$), $F(1,128) = 16.02, p < .01, \eta^2 = .12$ (Figure 3.4). Results also revealed a marginal main effect of age group, with older adults ($M = 3.28, SD = .67$) generating marginally more original recipes than younger adults ($M = 3.08, SD = .46$), $F(1,128) = 3.63, p = .059, \eta^2 = .03$. This trending age difference can be better visualized in Figure 3.4, where one can observe that older adults in the ignore condition generated more original recipes ($M = 3.50, SD = .59$) than younger adults in the ignore condition ($M = 3.24, SD = .40$), or older ($M = 3.05, SD = .67$) and younger ($M = 2.95, SD = .46$) adults in the no-distraction control conditions. The age group x distraction condition interaction, however, was not significant, $F(1,128) = .781, p = .378$.

Replicating the previous studies, Study 4 indicated that the ignore distraction condition increased originality scores for both younger and older adults, relative to a non-distraction control condition. Study 4 also revealed a trend of older adults generating marginally more

original recipes than younger adults. This suggests that a vulnerability to distracting information increases originality on recipe generation tasks in both younger and older adults. It also provides evidence that the decreases in inhibitory control that lead to a vulnerability to distracting information among older adults preserve, and may even bolster, performance on tasks that require creativity.

General Discussion

Across four studies, we find evidence in support of the proposition that a vulnerability to distracting information increases performance on tasks that require creativity in both younger and older adults. Results from Study 4 also suggest that the vulnerability to distracting information often observed in older adults preserves, and perhaps even enhances, performance on creativity tasks that require both divergent and convergent thinking. Future research should seek to replicate these findings with other populations and should extend these ideas into creativity domains other than recipe generation tasks. It is plausible that our enhanced originality effects will disappear in domains where individuals have little experience (e.g., artistic domains, unfamiliar disciplines).

One limitation to the current work is that the older adult samples in Study 2 and Study 4 are smaller than the younger adult samples. These sampling differences reflect recruitment and subject testing difficulties that were encountered when bringing older adult subjects into the laboratory to complete a computerized study. However, given that we replicated our older adult effects across both Study 2 and Study 4, we feel confident that our findings reflect real and meaningful differences.

It should also be noted that much extant research on cognitive functioning would not predict that reduced inhibitory control, which increases the vulnerability to distracting information, could have positive consequences. For example, research on cognitive depletion argues that low inhibitory control decreases self-regulation and increases unhealthy choices and behaviors (cf. Baumeister, 2014). Selective attention, which is hindered by low inhibitory control (Kim, Hasher, & Zacks, 2007), is also an important component of executive functioning ability, and the Attention Restoration Theory (ART) suggests that directed-attention abilities are improved by taking a walk in nature, or even by viewing photographs of nature scenes (Berman, Jonides, & Kaplan, 2008). The explanation given for these findings is that nature scenes invoke involuntary attention; thus, replenishing more directed attention and improving performance.

At first blush, these findings suggest that having full inhibitory control may be universally beneficial. However, our theoretical framework and results indicate that in contexts where it is necessary to integrate divergent and convergent information, creative outcomes may actually benefit from lowered inhibitory control. Future research should seek to further decompose the relationship between inhibitory mechanisms and creative processing, and to more specifically examine how changes in inhibitory control influence decision making and general well-being.

The research described here also has the potential to generate insights that meaningfully enhance well-being as people age. Extant research on creativity suggests that consumers rate products they creatively design more positively (Dahl & Moreau, 2008). It is thus plausible that enhanced creativity resulting from reduced inhibitory control will enhance the well-documented positivity bias associated with aging (Charles & Carstensen, 2010), such that both older and younger participants will feel more positive toward and satisfied with their creative products.

Specifically, we propose that when individuals are faced with tasks that draw on creative processes (e.g., choosing recipe ingredients at a supermarket, putting together gift ideas, designing custom made handbags or toys), those with low inhibitory control who generate a more creative product will feel especially satisfied with the final outcome. This is not only because putting effort into creation of the product enhances liking (i.e., “The Ikea Effect”; Norton, Mochon, & Ariely, 2012), but also because taking an interactive role in the creative development and making choices during the product generation process is likely to induce positive feelings of pride, interest, and contentment.

In conclusion, our findings importantly suggest that cognitive declines associated with normal aging are not always negative, and can boost creative outcomes during the decision process and potentially contribute to positive feelings and experiences. Future research will be directed toward the elaboration of further forces that affect inhibitory control, creativity, and satisfaction, and the benefits this may have for supporting a healthy lifestyle across the adult lifespan.

Figure 3.1 *Depicts recipe originality score by distraction condition (control, ignore, suppress) for younger adults, Study 1.*

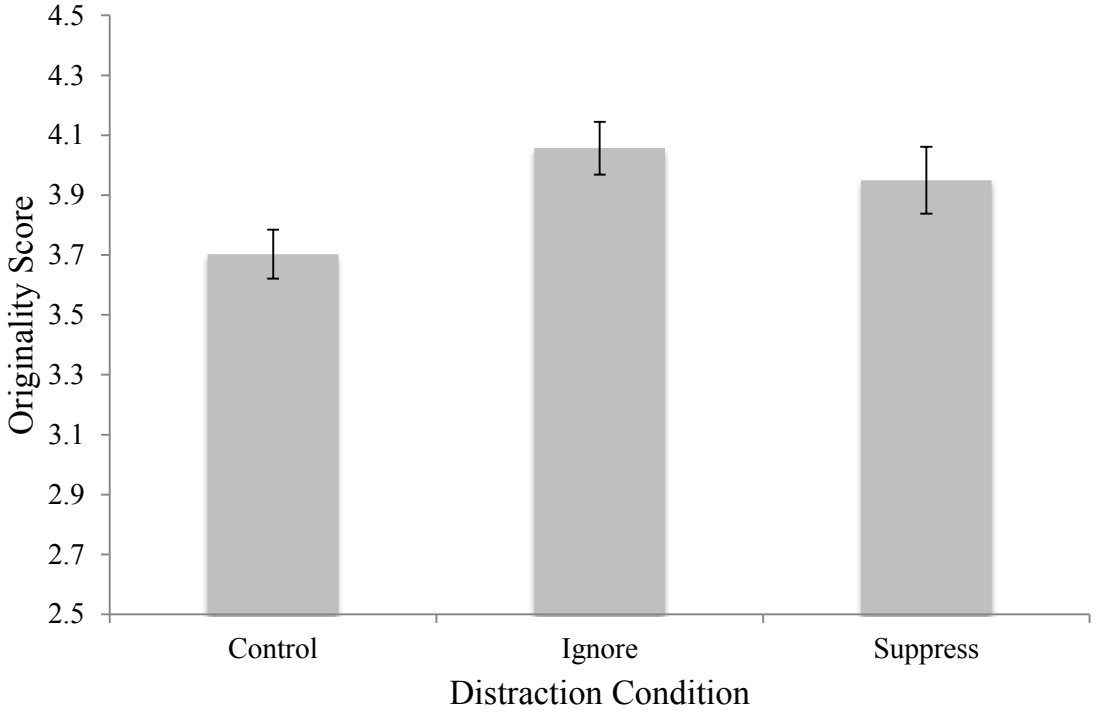


Figure 3.2 *Depicts recipe originality score by distraction condition (control, ignore, suppress) for older adults, Study 2.*

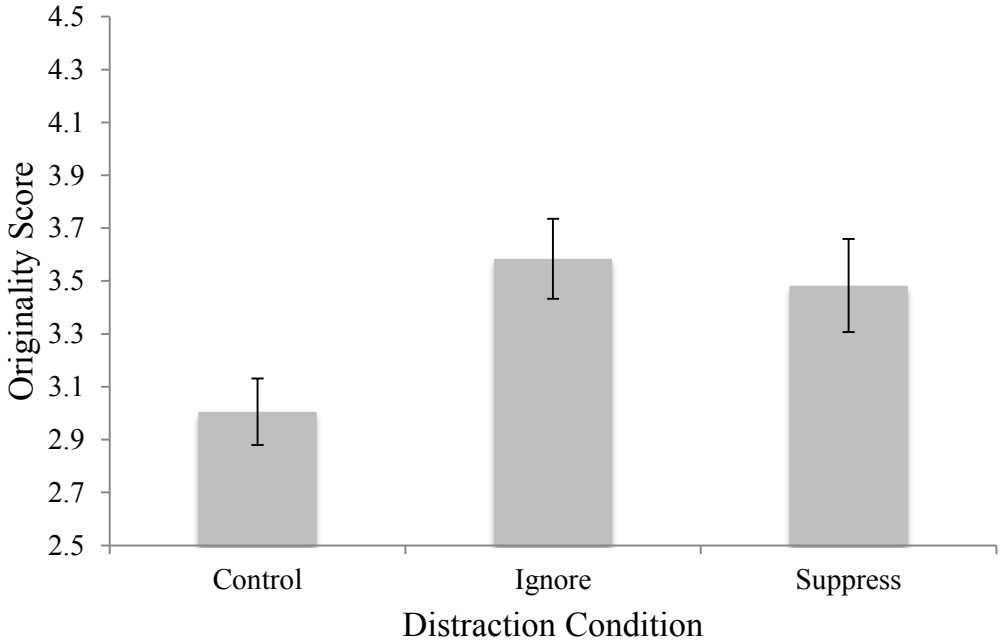


Figure 3.3 *Depicts recipe originality score by word distraction condition (no word control, food word, non-food word), Study 3.*

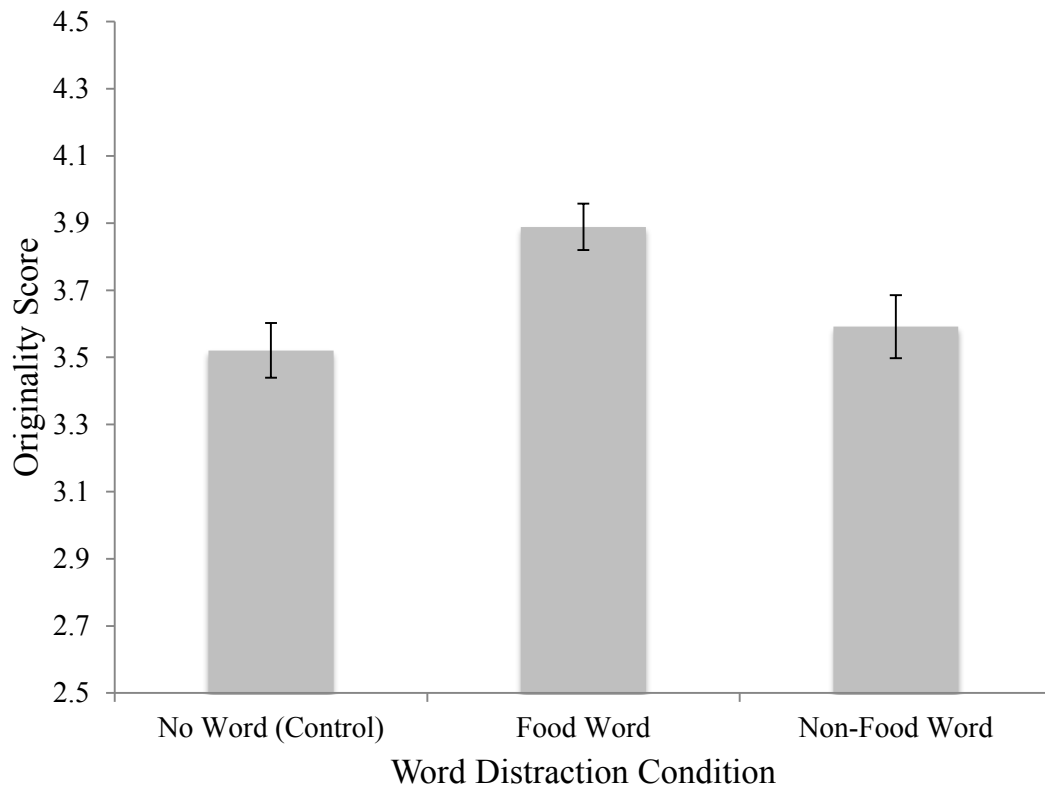
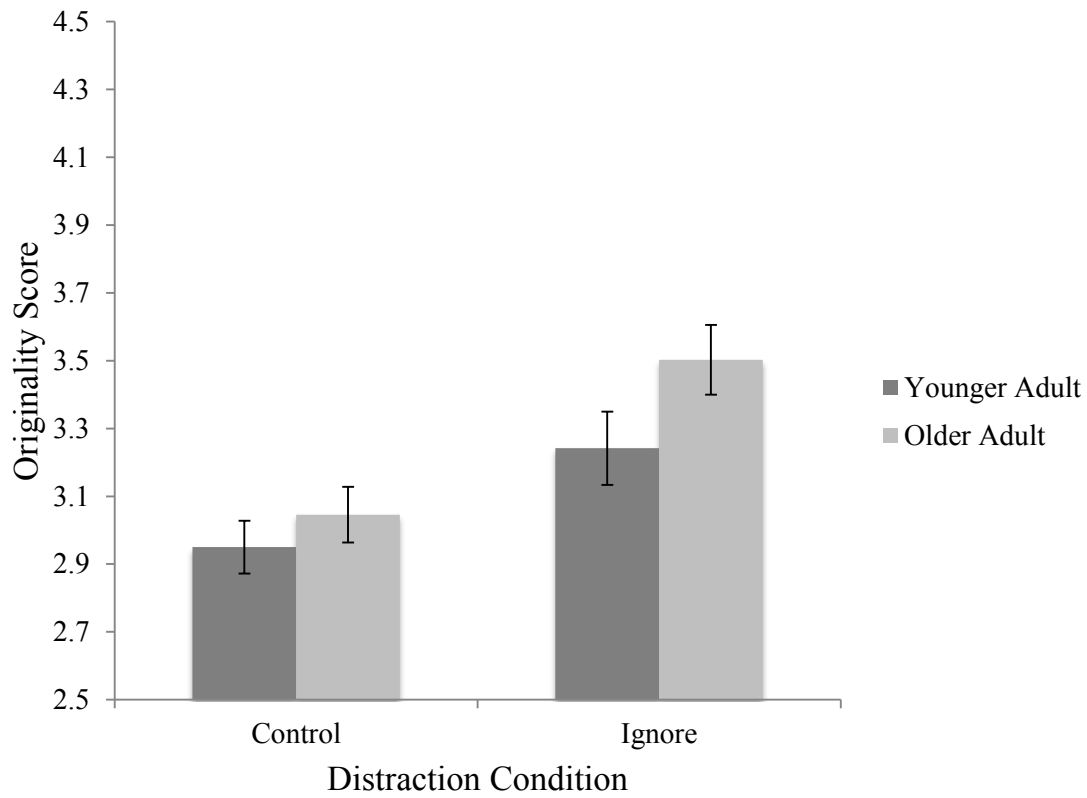


Figure 3.4 *Depicts recipe originality score for age group (younger, older) by distraction condition (control, ignore), Study 4.*



APPENDIX A

No Distraction “Control” Condition Instructions and Task, Study 1-4

Instructions: In this study, we are interested in your reading comprehension. Please read the following passage. While reading, your task is to read only the italicized words and to ignore the xxxxxx words. You will later be asked to answer questions testing your comprehension of the passage based on accurately reading the italicized words.

Sarah Jones xxxxxx xxxxxx was going to xx xxxxxxxx the supermarket on a xxxxxxx xxxxxx Tuesday evening in xxxxxxxx order to purchase groceries. The store xxxxxxx xxxxxx was very xxxxxxxx busy so she had xxxxxxx xxxxxx difficulty finding a xxxxxx xxxxxx space to park xx xxxxxxxx her car. On the xxxxxxxx way into xxxxxxx xxxxxx the grocery xx xxxxxxxx store, she xxxxxx xxxxxx ran into her xxxxxxxx good friend xxxxxx xxxxxx Sam. They xx xxxxxxxx talked for xxxxxxx xxxxxx five minutes and xx xxxxxxxx caught up on xxxxxx xxxxxx recent xxxxxxxx events and xx xxxxxxxx then Sarah proceeded xxxxxx xxxxxx into the store. She selected a xxxxxxx xxxxxx shopping cart xxxxxx xxxxxx and began xx xxxxxxxx walking through xxxxxxxx the store starting xxxxxxx xxxxxx first with the xxxxxxxx produce aisle. She looked xxxxxx xxxxxx specifically for xx xxxxxxxx items that she xxxxxxx xxxxxx had xxxxxxxx indicated on her xx xxxxxxxx shopping list and crossed xxxxxx xxxxxx each item off xxxxxxx xxxxxx her xxxxxxxx list as she xx xxxxxxxx went. Sarah xxxxxxxx was pleased xxxxxxx xxxxxx to xx xxxxxxxx discover xx xxxxxxxx that xxxxxx xxxxxxxx many xxxxxxx xxxxxx items on xxxxxx xxxxxx her list were xxxxxxx xxxxxx discounted in the xxxxxx xxxxxx store, so that xxxxxxxx her final xxxxxx xxxxxx store xxxxxxxx total was xx xxxxxxxx much lower than xxxxxxxx she anticipated. She xxxxxx xxxxxx felt reasonably satisfied xx xxxxxxxx with her xxxxxxxx overall purchase experience at the xxxxxxx xxxxxx grocery store.

APPENDIX B

No Distraction “Suppress” Condition Instructions and Task, Study 1-2

Instructions: In this study, we are interested in your reading comprehension. Please read the following passage. While reading, your task is to read only the italicized words. You will later be asked to answer questions testing your comprehension of the passage based on accurately reading the italicized words.

Sarah Jones fresh basil was going to an avocado the supermarket on a orange juice Tuesday evening in chicken order to purchase groceries. The store orange juice was very chicken busy so she had orange juice difficulty finding a fresh basil space to park an avocado her car. On the chicken way into orange juice the grocery an avocado store, she fresh basil ran into her chicken good friend fresh basil Sam. They an avocado talked for a orange juice few minutes and an avocado caught up on fresh basil recent chicken events and an avocado then Sarah proceeded fresh basil into the store. She selected a orange juice shopping cart fresh basil and began an avocado walking through chicken the store starting orange juice first with the chicken produce aisle. She looked fresh basil specifically for an avocado items that she orange juice had chicken indicated on her an avocado shopping list and crossed fresh basil each item off orange juice her chicken list as she an avocado went. Sarah chicken was pleased orange juice to an avocado discover an avocado that fresh basil many orange juice items on fresh basil her list were orange juice discounted in the fresh basil store, so that chicken her final fresh basil store chicken total was an avocado much lower than chicken she anticipated. She fresh basil felt reasonably satisfied an avocado with her chicken overall purchase experience at the orange juice store.

APPENDIX C

Distraction “Ignore” Condition Instructions and Task, Study 1-4

Instructions: In this study, we are interested in your reading comprehension. Please read the following passage. While reading, your task is to read only the italicized words and to ignore the upright words. You will later be asked to answer questions testing your comprehension of the passage based on accurately reading the italicized words.

Sarah Jones fresh basil was going to an avocado the supermarket on a orange juice Tuesday evening in chicken order to purchase groceries. The store orange juice was very chicken busy so she had orange juice difficulty finding a fresh basil space to park an avocado her car. On the chicken way into orange juice the grocery an avocado store, she fresh basil ran into her chicken good friend fresh basil Sam. They an avocado talked for a orange juice few minutes and an avocado caught up on fresh basil recent chicken events and an avocado then Sarah proceeded fresh basil into the store. She selected a orange juice shopping cart fresh basil and began an avocado walking through chicken the store starting orange juice first with the chicken produce aisle. She looked fresh basil specifically for an avocado items that she orange juice had chicken indicated on her an avocado shopping list and crossed fresh basil each item off orange juice her chicken list as she an avocado went. Sarah chicken was pleased orange juice to an avocado discover an avocado that fresh basil many orange juice items on fresh basil her list were orange juice discounted in the fresh basil store, so that chicken her final fresh basil store chicken total was an avocado much lower than chicken she anticipated. She fresh basil felt reasonably satisfied an avocado with her chicken overall purchase experience at the orange juice store.

APPENDIX D

No Food Item Distraction Condition Instructions and Task, Study 3

Instructions: In this study, we are interested in your reading comprehension. Please read the following passage. While reading, your task is to read only the italicized words and to ignore the upright words. You will later be asked to answer questions testing your comprehension of the passage based on accurately reading the italicized words.

Sarah Jones plastic wrap was going to container the supermarket on a baking sheet Tuesday evening in spatula order to purchase groceries. The store baking sheet was very spatula busy so she had baking sheet difficulty finding a plastic wrap space to park container her car. On the spatula way into baking sheet the grocery container store, she plastic wrap ran into her spatula good friend plastic wrap Sam. They container talked for a baking sheet few minutes and container caught up on plastic wrap recent spatula events and container then Sarah proceeded plastic wrap into the store. She selected a baking sheet shopping cart plastic wrap and began container walking through spatula the store starting baking sheet first with the spatula produce aisle. She looked plastic wrap specifically for container items that she baking sheet had spatula indicated on her container shopping list and crossed plastic wrap each item off baking sheet her spatula list as she container went. Sarah spatula was pleased baking sheet to container discover container that plastic wrap many baking sheet items on plastic wrap her list were baking sheet discounted in the plastic wrap store, so that spatula her final plastic wrap store spatula total was container much lower than spatula she anticipated. She plastic wrap felt reasonably satisfied container with her spatula overall purchase experience at the baking sheet store.

References

- Baumeister, R. F. (2014). Self-regulation, ego depletion, and inhibition. *Neuropsychologia, 65*, 313-319.
- Berman, M. G., Jonides, J., & Kaplan, S. (2008). The cognitive benefits of interacting with nature. *Psychological Science, 19*, 1207-1212.
- Charles, S. T., & Carstensen, L. L. (2009). Social and emotional aging. *The Annual Review of Psychology, 61*, 383-409.
- Cheng, C., Burks, J. S., & Lee, F. (2008). Connecting the dots within: Creative performance and identity integration. *Psychological Science, 19*, 1178-1184.
- Dahl, D. W., & Moreau, C. P. (2008). Thinking inside the box: Why consumers enjoy constrained consumer experiences. *Journal of Marketing Research, 357-369*.
- Hagger, M. S., Wood, C., Stiff, C., & Chatzinsarantis, N. L. D. (2010). Ego depletion and the strength model of self-control: A meta-analysis. *Psychological Bulletin, 136*, 495-525.
- Hasher, L., Zacks, R. T., & May, C. P. (1999). Inhibitory control, circadian arousal, and age. In Gopher, D., & Koriat, A., (Eds.), *Attention and Performance*, 653-675.
- Kasoff, J. (1995). Explaining creativity: An attributional perspective. *Creativity Research Journal, 8*, 311-366.
- Kim, S., Hasher, L., & Zacks, R. T. (2007). Aging and benefit of distractibility. *Psychonomic Bulletin & Review, 14*, 301-305.
- Norton, M. I., Mochon, D., & Ariely, D. (2012). The IDEA effect: When labor leads to love. *Journal of Consumer Psychology, 22*, 453-460.
- Salthouse, T. A. (1996). The processing-speed theory of adult age differences in cognition. *Psychological Review, 103*, 403-428.
- Wegner, D. M., Schneider, D. J., Carter, S. R., & White, T. L. (1987). Paradoxical effects of thought suppression. *Journal of Personality and Social Psychology, 53*, 1-13.

CONCLUSION

Three chapters have demonstrated the importance of previously unexplored contextual and emotional factors that critically and systematically affect the way in which we construct value and generate choice options prior to making a decision. This is important because our decisions are not only influenced by contextual factors present at the moment of making a choice, but also the factors at play before any choice commitment. These chapters have revealed, in particular, that emotions, the recall of prior tradeoffs, and diminished inhibitory control all play an important role during this pre-decision process and consequently influence decision making. Each chapter in this dissertation separately tackled one of these three factors in an effort to provide a more comprehensive and complete understanding of how we construct value and choice options during the pre-decision phase of the decision process.

Chapter I indicated that negative, aversive emotions associated with stress and anxiety are evoked by difficult multi-attribute decisions, which some people regulate by shifting their values prior to making a decision. In Chapter II, recalling a past tradeoff situation led to the activation and carry over of a valued attribute onto a subsequent, unrelated choice. Interestingly, the carryover seemed to occur as a way to balance value that was either satiated or deprived in the tradeoff recall. Specifically, recalling a prior tradeoff context where a valued attribute was satisfied led to a satiation effect whereby other valued attributes became prioritized in the subsequent, unrelated choice, whereas recalling a prior tradeoff where a valued attribute was sacrificed suggested a deprivation effect such that the foregone attribute became prioritized in

subsequent, unrelated decision contexts. Chapter III showed that under conditions of reduced inhibitory control, both younger adult and older adult participants became vulnerable to distracting information. In these circumstances, the distracting information became activated, and was particularly likely to lead to more creative construction decisions when the distracting information was relevant to the construction decision (e.g., when the distracting information was food-related and the construction decision was a creative recipe generation task).

One critical message that should be taken from the work described here is that studying the pre-decisional process matters. It is simple to think about and study decision making in a vacuum; focusing solely on the choice process in the moments a decision is made, or immediately after. Decisions in the real world, however, do not occur as entities separate from their contexts. Factors that occur before we actually arrive at the choice can importantly influence the way we construct value, generate choice options, and determine what option attributes become prioritized in the decision context.

These findings only begin to scratch the surface of investigating how factors that occur in the pre-decisional process importantly influence the way in which we make decisions. Future research will continue to elucidate what factors are important during the decision process, and will further investigate how the pre-decisional phase influences decision outcomes, including post-choice satisfaction and well-being.