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The Relationship Between Indecisiveness and Eye Movement Patterns in a Decision Making Informational Search Task

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ABSTRACT

Indecisiveness is a trait-related general tendency to experience decision difficulties across a variety of situations, leading to decision delay, worry, and regret. Indecisiveness is proposed (Rassin, 2007) to be associated with an increase in desire for information acquisition and reliance on compensatory strategies—as evidenced by alternative-based information search—during decision making. However existing studies provide conflicting findings. We conducted an information board study of indecisiveness, using eye tracking methodology, to test the hypotheses that the relationship between indecisiveness and choice strategy depends on being in the early stage of the decision making process, and that it depends on being in the presence of an opportunity to delay choice. We found strong evidence for the first hypothesis in that indecisive individuals changed shift behavior from the first to the second half of the task, consistent with a move from greater to lesser compensatory processing, while the shift behavior of decisive individuals suggested lesser compensatory processing over the whole task. Indecisiveness was also related to time spent viewing attributes of the selected course, and to time spent looking *away* from decision information. These findings resolve past discrepancies, suggest an interesting account of how the decision process unfolds for indecisive versus decisive individuals, and contribute to a better understanding of this tendency. Copyright © 2009 John Wiley & Sons, Ltd.

KEY WORDS indecisiveness; decision strategy; eye movements; process tracing; individual differences

INTRODUCTION

Almost everyone has had difficulty making a decision on occasion. However, some individuals experience chronic difficulty in making decisions across a wide range of domains and contexts. Decision difficulty for these individuals can be thought of as a trait, and the general tendency to experience decision difficulties is often referred to as *indecisiveness* (Germeijs & DeBoeck, 2002). Definitional components of indecisiveness include choice difficulty, taking a long time to decide, delay in initiating decision making, changing one's

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mind frequently, worry about decisions, and post-decisional regret (Crites, 1969; Germeijs & DeBoeck, 2002). While the concept of indecisiveness is widespread in popular culture, very little research has been devoted to its empirical study (Rassin, 2007) beyond basic construct validation. Yet the systematic study of this individual difference has the potential to illuminate important differences in people's decision behaviors, to help understand *why* these differences arise, and to aid individuals, when needed, in improving the health and other consequences of their decision styles. The goal of the present work is to explore indecisiveness-related differences in information search strategies during decision making that might give rise to outcome behaviors.

PAST RESEARCH ON INDECISIVENESS

Indecisiveness, which is typically measured using an established scale such as Frost and Shows' (1993) indecisiveness scale or Mann's (1982) decisional procrastination scale, has been found to predict a variety of behaviors associated with the construct. Indecisive individuals, relative to more decisive ones, take longer to make simple decisions (Frost & Shows, 1993), seek more information before deciding (Rassin, Muris, Franken, Smit, & Wong, 2007), report greater choice difficulty (Veinott, 2002), more often choose "I don't know" as a preferred alternative (Rassin & Muris, 2005), and are less sensitive to the risk of loss of alternatives over time in deciding when to decide (Patalano & Wengrovitz, 2007). In naturalistic contexts, indecisive individuals have greater difficulty choosing college majors (Gayton, Clavin, Clavin, & Broida, 1994), choosing careers (Gati, Krausz, & Osipow, 1996), and making other major life decisions (Germeijs & DeBoeck, 2002). They also report having a greater number of negative health consequences resulting from this decision style (Ferrari, Johnson, & McCown, 1995; Frost & Shows, 1993). These studies illustrate that indecisiveness is of critical relevance for understanding and explaining important variations in human choice behavior.

Basic approaches have identified reliable and valid scale measures of indecisiveness and have demonstrated that these scales predict a variety of decision behaviors directly related to choice difficulty and delay in both laboratory and naturalistic contexts. What they have not done is provide an account of the cognitive strategies that might mediate indecisive versus decisive choice outcomes. For example, do decisive and indecisive individuals consider different amounts of information during decision making? Do they have more or less difficulty assessing their decision-related values? Do they use different decision strategies to integrate information toward arriving at a preferred alternative? This research approach has the potential to identify differences in the decision making process that give rise to differences in choice behaviors, potentially providing a proximal explanation—one that might later be linked to underlying trait explanations—for why indecisive and decisive individuals differ in perceived choice difficulty and decisional delay. The purpose of the present work is to explore the decision strategies employed during the decision making process as a function of indecisiveness.

BEHAVIORAL PROCESS APPROACH TO INDECISIVENESS

Behavioral process studies of decision making have largely relied on an *information board paradigm* (Payne, 1976) for collecting process data about how individuals attend to and integrate decision information toward arriving at a choice. In this approach, choice alternatives and attribute dimensions are presented as row and column headings respectively on a visually displayed grid. For a college course selection task (see Figure 1), the course names would be listed down the left side of the display while the course dimensions such as "meeting time" and "instructor quality" would be listed across the top. The contents of the cells of the grid, which are not readily visible, contain attribute information for each alternative. For example, a cell might contain "most highly rated" as the instructor quality for Course A. Participants have the opportunity to

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	Meeting Time	Instructor Quality	Relevance to Goals	Amount of Work	Interest in Topic
Course A	Acceptable	Poor	Preferred	Fair	High
Course B	Preferred	Good	Preferred	Poor	Low
Course C	Acceptable	Fair	Burdensome	Fair	Moderate
Course D	Undesirable	Good	Burdensome	Fair	High
Course E	Undesirable	Fair	Acceptable	Good	Low

Figure 1. The information display presented to participants. The gridlines themselves were not in the display but are shown here to illustrate how the board was divided into regions of interest for data analyses involving eye fixations

inspect as many attributes as they wish, either by turning over cards or by clicking on cells of a computerized grid, depending on implementation, before making a final choice. Typical dependent measures include response time to make a choice, number of attributes viewed, percentage of *attribute-based shifts* (moves within a dimension from one alternative to another), percentage of *alternative-based shifts* (a move within an alternative from one dimension to another), and percentage of attributes viewed about the selected alternative.[1] Attribute-based shift and alternative-based shift percentages are often computed by dividing by the total number of these shifts, rather than by all shifts, because other types of shifts (e.g., jumps between noncontiguous pieces of information) are more difficult to interpret.

Two widely known classes of decision strategies associated with distinct information search patterns are compensatory and noncompensatory strategies. Use of compensatory strategies is generally indicated by search behavior in the form of alternative-based shifts across decision information (Payne, 1976; Payne, Bettman, & Johnson, 1988). Compensatory strategies are resource intensive approaches in which all relevant dimensions are considered and for which a low value on one dimension can be offset by a high value on another. With a weighted additive rule, for example, the overall attractiveness of each alternative is determined by summing together the value of the alternative on each dimension weighted by the importance of that dimension to the individual. While computationally expensive, this strategy is often considered optimal under conditions of unlimited time in that all information gets utilized. Use of noncompensatory strategies, in contrast, is generally indicated by search behavior in the form of attribute-based shifts across decision information (Payne, 1976; Payne et al., 1988). Noncompensatory strategies are less resource intensive in that dimensions are considered sequentially and alternatives are eliminated that do not meet the dimension's criterion, until a single choice remains (e.g., elimination by aspects; Tversky, 1972). They are also associated with satisficing, that is, with achieving a ''good enough'' solution within the bounds of available cognitive resources (Anderson, 2003; Schwartz et al., 2002; Simon, 1955).[2]

An initial model of indecisiveness recently proposed by Rassin (2007), and heavily informed by Germeijs and DeBoeck (2003), posits two contributors to indecisiveness related to decision strategy. These contributors are a desire to acquire as much information as possible about the choice alternatives and a bias toward use of compensatory strategies, possibly to ensure full utilization of this information in identifying a choice preference. Motivation for these contributors comes both from the strong associations between

[1]These are also often referred to as intradimensional and interdimensional shifts, respectively.
[2]While alternative- and attribute-based search patterns are typically associated with compensatory and noncompensatory choice strategies, respectively, the mapping is not a necessary one. For example, in theory, one could search for information by dimension but then integrate the information using a compensatory strategy.

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indecisiveness and perfectionism (Frost & Shows, 1993; Gayton et al., 1994) and from the results of past experiments that have manipulated compensatory strategy use. For example, it has been found that promotion of compensatory strategy use leads decision makers to perceive alternatives as more similar in attractiveness, to perceive choice as more difficult, to be more likely to defer choice (Dhar, 1996, 1997), and to feel greater regret over unobtained attributes (Anderson, 2003). In short, promotion of compensatory strategy use increases indecisive behavior.

Existing studies provide mixed findings regarding the relationship between information search patterns and indecisiveness. Consistent with a relationship between compensatory strategy use and indecisiveness, studies conducted by Patalano and Wengrovitz (2007; see also Ferrari & Dovidio, 2001, Cond. 1) found that indecisive individuals, relative to more decisive ones, made a greater percentage of alternative-based shifts on an information board task. However, the studies were not typical in that participants were able to delay choice to seek further alternatives and in that the search pattern data were recorded only before the delay. The majority of process studies of indecisiveness have actually found a different pattern: that indecisive individuals make more attribute-based shifts, *inconsistent* with greater compensatory strategy use among indecisive individuals (Ferrari & Dovidio, 2000, 2001, Conds. 2 & 3; Rassin, Muris, Booster, & Kolsloot, 2008, Exp. 3). These studies have typically involved more difficult decision tasks, such as through introduction of similarly attractive choice alternatives (Rassin et al., 2008) or a high dual working memory load (Ferrari & Dovidio, 2001, Conds. 2 & 3). Many studies have also found that indecisive individuals, relative to decisive ones, select more information about the chosen alternative, but not more information overall (Ferrari & Dovidio, 2000; Rassin et al., 2008). Rassin et al. refers to this as ''tunnel vision'' in that indecisive individuals seem to focus on confirming the overall attractiveness of the eventually selected alternative.

INTRODUCTION TO STUDY

Little attempt has been made to explain these differences in findings or to incorporate them into a theory of indecisiveness. Only Rassin et al. (2008) have suggested the possibility that indecisive individuals, while predisposed toward use of compensatory strategies, desire *so* much information that they must quickly move to a strategy that can reduce an otherwise intractable decision problem. But, at this point, there is no evidence that speaks to an indecisiveness-related shift in strategy over time. The contribution of the present work is that it compares two accounts of how indecisive and decisive individuals use different choice strategies over the course of decision making—one of which builds on Rassin et al.'s proposal—that can explain past findings and that are consistent with Rassin's (2007) model. The broad purpose is to resolve past discrepancies, to suggest an interesting account of how the decision process unfolds for indecisive versus decisive individuals, and to contribute to the development of a richer understanding of the nature of indecisiveness.

Our first account, a *time course account* builds on Rassin et al.'s (2008) explanation. We propose that indecisiveness is associated with a predisposition toward use of compensatory strategies, but that this bias might guide strategy use only in the early stages of decision making. Over the course of decision making, individuals move toward whatever strategy will allow them to adequately manage information in the given decision context. This account can explain past mixed findings in that summary measures collapsed over an entire task will take on different patterns depending on how far into the task a strategy change occurred. Collapsing results over the entire task might often mask early group differences. The account can also provide a concrete understanding of why it is sensible to posit a predisposition that has thus far not been revealed by data. It leads to the prediction that indecisive individuals should be more likely than decisive individuals to change their pattern of information search over the course of decision making, and that they should move from use of compensatory to noncompensatory strategies—and thus show increases in attribute-based shifts—over time.

Our second account, which we call a *delay context account*, draws on the fact that the most compelling use of alternative-based search by indecisive individuals has thus far been found when individuals believe that they have the opportunity to delay choice (Patalano & Wengrovitz, 2007). We propose that while

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indecisiveness is associated with a predisposition toward use of compensatory strategies, this bias might be expressed *only* when the decision maker believes that he or she has no immediate choice deadline. In other words, when it is clear that an immediate decision need be made, most individuals might quickly adopt noncompensatory choice strategies because one requirement of the decision problem is to achieve an efficient resolution. However, when it is clear that such efficiency is not required, individuals might feel less constrained by context and more inclined to use their naturally preferred strategies, including ones that might lengthen deliberation time or lead to a desire to search for additional alternatives. This proposal is consistent with the fact that choice deadlines are known to increase use of noncompensatory choice strategies (Payne et al., 1988; Reiskamp & Hoffrage, 2008) and that a contextual bias might reasonably override individual tendencies. This account leads to the prediction that indecisive and decisive individuals should exhibit different search patterns only when the opportunity to delay choice is available. In particular, indecisive individuals should exhibit fewer attribute-based shifts than decisive individuals in this context.

The present study uses a course selection decision task (as used in, e.g., Ferrari & Dovidio, 2000) and Frost and Shows' (1993) indecisiveness scale (as used in, e.g., Rassin et al., 2008), similar to past work. However, rather than using a manual information board, this study uses eye tracking methodology to capture informational search behavior. We believe this to be the first use of eye tracking methodology to study indecisiveness. This method involves recording eye fixation locations and durations as individuals look at units of decision information on a visible grid. Decision information obtained through eye movements is, not surprisingly, more quickly and easily acquired by decision makers than that obtained by moving one's eyes to some location *plus* having to then manually reveal the information. As a result, this method has been shown to capture more flexible and natural search of information (Lohse & Johnson, 1996). Use of this method to investigate information search with regard to individual differences in indecisiveness has the potential to provide a finer grained analysis of behavior that is more directly tied to active thought processes. The results of studies using this methodology are also more readily generalizable to everyday search situations (e.g., comparisons of consumer products, health plans, or stock portfolios), and can provide descriptive information about potentially important differences in how people search in these types of situations.

In this study, we consider three major dependent measures. The central variable of interest is *percentage of attribute-based shifts*. This measure is critical for evaluating the predictions derived from our proposed accounts of the relationship between decision strategy and indecisiveness and, as such, is the focus of our data analyses. We do not separately look at *percentage of alternative-based shifts* because this is simply equal to 100% minus the percentage of attribute-based shifts assuming the convention of not including other types of shifts in the denominator. The second variable is *percentage of time on selected alternative*. This variable is important because indecisive individuals have previously been found to look more at the selected alternative than decisive individuals (Ferrari & Dovidio, 2000, 2001; Rassin et al., 2008). A finer grained analysis of this attention to the selected alternative might also be revealing of how the final choice is made. The third variable is *percentage of time on noninformation*. Because there are empty rows in the grid between rows of decision information (see Figure 1), it is possible to explore time spent *not* looking at actual information but instead looking at cells with no information. This last analysis is purely exploratory but gives us the chance to consider whether choice delay associated with indecisiveness could also be occurring at the ''micro-'' level of avoiding information selection. We use fixation time in computing the latter two measures rather than number of fixations (e.g., time spent on selected alternative rather than number of fixations on the alternative) but the choice is arbitrary in that these are nearly perfectly correlated ($r = .96$ in the present data).

In addition to *indecisiveness group* (Indecisive vs. Decisive) [3], the design includes a between subjects *delay manipulation* (No-Delay vs. Delay), and a repeated measures *half-of-task variable* (first half vs. second

[3]While it is more accurate to refer to these groups as ''High Indecisiveness'' and ''Low Indecisiveness'', we use the categorical terms ''Indecisive'' and ''Decisive'' for consistency with past work and to minimize mental effort for the reader.

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half). In the delay manipulation, half of the participants are instructed at the outset of the task that, after they have explored an initial set of alternatives, they will have an opportunity to delay choice to seek further alternatives. Because they are later informed that no new alternatives are actually available, the manipulation sets up the perception that delay is possible without actually changing the choice set. This manipulation is important for assessing predictions associated with our delay context account of strategy differences. For the repeated measures half-of-task variable, the data for each individual are grouped into the first half of eye fixations versus the second half of eye fixations, and values for the dependent measures are computed for each half of the data. This variable is important for assessing predictions associated with our time course account of strategy differences.

We make the following predictions. First, to the extent that *delay context* influences the relationship between indecisiveness and strategy use, we should see an interaction between indecisiveness group and delay condition on percentage of attribute-based shifts. Specifically, when there is a perceived opportunity for delay, indecisive individuals should make a lower percentage of attributed-based shifts than decisive individuals; when there is no perceived opportunity for delay, no group difference should emerge. Second, to the extent that the *time course* of decision making is related to the relationship between indecisiveness and strategy use, we should see an interaction between indecisiveness group and half of task. In particular, in the first half of the task, indecisive individuals should make a lower percentage of attribute-based shifts than decisive individuals; in the second half of the task, no group difference should emerge. In addition to these shift pattern hypotheses, we consider group differences in percentage of time spent on selected course information and percentage of time on noninformation cells. For the latter two variables, we foreshadow some surprising results. Namely, while indecisive individuals relative to decisive ones did not ultimately spend more time on the chosen alternative, they *did* allocate that time differently over the attributes. Additionally, indecisive individuals relative to decisive ones spent a greater percentage of task time looking at noninformation cells.

METHOD

Participants

Fifty-four Wesleyan University students (28 female, 24 male, and 2 unidentified) participated in exchange for monetary compensation or credit in an introductory psychology course. All had normal or corrected to normal vision and were native English speakers. They were divided approximately equally between no-delay (13 female, 15 male) and delay (15 female, 9 male, 2 unidentified) conditions. A median split on an indecisiveness scale administered at the end of the study was used to later also divide individuals into indecisive and decisive groups. Participants were run individually in approximately 45 minutes sessions.

Apparatus

An EyeLink 1000 (SR Research, LTD) eye tracker was used to record participants' eye movements. Eye movements were measured from the right eye but viewing was binocular. The eye tracker sampled eye position every 1 ms and was interfaced with a personal computer. Participants' eyes were positioned 83 cm from a computer screen (a 20-inch ViewSonic CRT monitor) where the decision information grid was displayed. At this distance, approximately 3.6 characters subtended 1 degree of visual angle. Gaze position accuracy was good—the average error after calibration for all participants was 0.38°. A chin rest and a head rest were used to stabilize head movements.

Decision materials

A decision situation was created in which the goal was to make a choice from among five course alternatives that differed on five dimensions. The five courses, labeled Course A through E, differed in value on the

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dimensions of *Meeting Time*, *Instructor Quality*, *Amount of Work*, *Usefulness for Goals*, and *Interest in Topic*. There were three possible attribute values for each dimension (e.g., for Meeting Time, they were *undesirable*, *acceptable*, and *preferred*) that ranged along a spectrum of desirability. We used relative rather than absolute values (e.g., *undesirable* instead of *8:30 a.m.*) to ensure that the desirability of each value was approximately the same for all participants. To create a challenging decision task, the attributes for each course were chosen so that the courses were similar in overall quality assuming equal weighting of all dimensions. A course decision task (see Figure 1) was created by displaying the information in a grid format where the rows were course names, columns were course dimensions, and grid cells contained the attributes for each course.

Questionnaire items

Questionnaire items including sex, year in school, Frost and Shows' (1993) 15-item Indecisiveness Scale (e.g., *I have trouble making decisions, I regret a lot of my decisions*), and four other personality scales unrelated to the present work were put in a single booklet. Likert responses to the questionnaire items were elicited on a scale ranging from 1 (very strong disagreement) to 7 (very strong agreement). This single scale was used for consistency across the questionnaire (as in Patalano & Wengrovitz, 2006, 2007) even though the indecisiveness scale was originally administered with a 1–5 Likert range. The indecisiveness scale was the second scale administered (following a holism scale; Choi, Dalal, Kim-Prieto, & Park, 2003). While we administered the scales *after* the task here, past work in our lab has found strong correlation (> 0.70) between pre- (2 months prior) and post- (immediately after task) indecisiveness scores and a typical change in indecisiveness group of fewer than 5% of individuals. Thus, the results would likely have changed little with a different test administration.

Procedure

The experimenter instructed participants that their task was to choose one course to complete their college course schedule for a fictitious semester. Participants were told to look at as much or as little course information as they wished before making a decision. In the no-delay condition, participants had to choose a course after looking at the course grid. In the delay condition, participants were told that they had the additional option of instead choosing to delay their choice in order to access the course database a final time. They were informed that if they opted to delay choice, some new courses could become available while some existing ones could become full. They would then have to make a course choice from the updated course list.

A 9-point calibration was conducted over the entire computer screen. This was followed by a validation procedure which provided information on the accuracy of the calibration. If the calibration was deemed inaccurate, a new calibration routine was initiated. After calibration of participants' eyes was conducted, the course information grid was displayed on the screen and the course selection task was performed. Upon identifying a preferred course (or opting to delay when this option was available), participants pressed a button on a handheld game controller to end the assessment. They then verbally reported a decision to the experimenter. For participants who opted to delay, they were informed that the database was consulted but that no changes to the course list emerged. These participants were able to look at the information grid again before pressing the button and reporting a final choice. After completing the decision task, participants rated the importance of each of the five course dimensions on a scale from 1 (not at all important) to 7 (extremely important), and completed the questionnaire booklet.

RESULTS

Unless otherwise noted, results with major dependent measures are presented first as $2 \times 2 \times 2$ ANOVAs with delay condition and indecisiveness group as independent measures and first versus second half of fixations as

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a repeated measure. Identified effects are followed up with correlational analyses using the continuous indecisiveness scale measure. Unreported main effects and interactions for ANOVAs should be assumed to not be statistically reliable. All differences not statistically reliable can be assumed to have $p > .100$. Other dependent measures (e.g., the course chosen) are presented to illustrate dimensions on which there were *no* group differences as evidence that these variables were not driving the results.

Questionnaire results

Indecisiveness scores were obtained by averaging scores of scale items, after appropriate reverse coding.[4] Scores close to 1 reflect decisiveness and to 7 indecisiveness. Scores ranged from 1.3 to 6.1 with a mean of 3.60 ($SD = 0.91$). No gender differences or condition differences in indecisiveness were found. A median split ($Mdn = 3.63$) on indecisiveness yielded 27 indecisive individuals ($M = 4.30$; $SD = 0.54$) and 27 decisive ones ($M = 2.93$; $SD = 0.65$).

Regions of interest cells

Eye fixations that produced tracking errors were thrown out ($M = 6\%$ per individual; ranging from 5–58%). Tracking errors are output by eye tracker software and reflect a momentary inability to compute coordinates of gaze on the computer screen, often because the participant blinked or looked away from the computer screen. Remaining fixations that were on the border of two coordinates were moved to the closest coordinate ($M = 29\%$ per individual; ranging from 5–60%). Each fixation was then labeled by the grid cell (the ''region of interest'') in which its coordinates fell (see Figure 1 for all grid cells) for use in data analyses.

Choice results

Indecisive and decisive individuals in each condition performed similarly in a number of basic ways. First, there were no group or condition differences in the number of times each course was chosen. The two most popular courses—Course A and Course E—were together chosen 74% of the time (31% and 43%, respectively); the remaining courses were each chosen about 8% of the time.[5] Second, there were no group or condition differences in the ratings of the importance of each dimension. On average, they were rated from most to least important: Interest in Topic, Instructor Quality, Usefulness for Goals, Amount of Work, and Meeting Time. Third, in the delay condition, there were no group differences in the number of people opting to delay choice: only three indecisive and four decisive individuals delayed choice. Any differences found in the process data, therefore, cannot be attributed to differences in choice preferences, weightings of dimension importance, or delay behavior. Note that while we conducted all future analyses both with and without inclusion of post-delay eye movements—both because our goal was to look at pre-delay behavior and because only 6 participants made post-delay eye movements—we do not include post-delay eye movements in our analyses. When we refer to ''all data,'' we mean all pre-delay data.

Process dependent measures

Our major dependent measures were: percentage of attribute-based shifts, percentage of time on selected course, and percentage of time on noninformation. As in past work (e.g., Patalano & Wengrovitz, 2007), an

[4]Items were averaged rather than summed, the latter being more conventional, for consistency with our own past work (Patalano & Wengrovitz, 2007) and because we used a 7 rather than a 5-item Likert scale (summing is based on a 5-item scale).
[5]The chosen course of 1 indecisive participant in the delay condition was accidentally not recorded; this participant is excluded from analyses involving course selection.

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attribute-based shift was defined as any movement from one information cell to another within the same attribute dimension and the percentage of attribute-based shifts was calculated as *number of attribute-based shifts / (number of attribute-based shifts + number of alternative-based shifts)*. Intermediate shifts to noninformation cells were ignored in this computation (e.g., a shift from Course A's meeting time to a noninformation cell to Course B's meeting time counted as one attribute-based shift). Percentage of time spent on the selected course was defined as the sum of all time spent fixating on any attribute of the selected course divided by total time. The percentage of time spent on noninformation was defined as the sum of all time spent fixating on noninformation cells divided by total time.

Process results

Across all participants, the mean number of fixations was 200 (ranging from 61–379, $SD = 81$), and the mean task time was 456 seconds (ranging from 136–923; $SD = 182$) until choice (or delay for a few participants). There were no differences in number of fixations or overall time to do the task as a function of delay condition or indecisiveness group so any group effects cannot be attributed to differences in overall time or overall number of fixations on the task. The mean number of diagonal shifts, ones that were neither attribute- nor alternative-based but that instead represented a move between cells that differed on alternative *and* attribute, was 13 (6.5%). There were no differences in number of these shifts as a function of delay condition or indecisiveness group, supporting our focus on attribute- and alternative-based shifts.

Shifts across information cells

Regarding percentage of attribute-based shifts (see Table 1 for means), we found an interaction between indecisiveness and half of task ($F(1,50) = 3.97$, $MSE = .01$, $p = .052$). As shown in Figure 2, *post hoc t*-tests revealed that indecisive individuals made a greater percentage of attribute-based shifts in the second relative to the first half of the task ($t(26) = -2.33$, $SE = .03$, $p = .028$) while decisive individuals showed no difference across halves ($t(26) = 0.67$, $SE = .03$, $p = .508$). Indecisive individuals also made a lesser percentage of attribute-based shifts than did decisive individuals in the first half of the task ($t(52) = -2.14$, $SE = .03$, $p = .037$) while there was no difference in the second half ($t(52) = 0.62$, $SE = .04$, $p = .539$). Relatedly, the correlation between indecisiveness score and percentage of attribute-based shifts is reliable for the first half ($r(52) = -.28$, $p = .038$) but not for the second half ($r(52) = .06$, $p = .653$) (see Figure 3). No main effect of indecisiveness was found ($F(1,50) = .673$, $MSE = .02$, $p = .416$). These results suggest a difference in strategy early in the task with indecisive individuals making more alternative-based shifts than decisive ones, but with indecisive individuals migrating to the overall search pattern of decisive individuals over time. No reliable effects involving delay condition were found.

Table 1. Percentage of attribute-based shifts made by each indecisiveness group in each delay condition for the first versus second half of eye fixations

	Half of decision task	
	First half	Second half
No-delay		
Indecisive	66 (3.0)	73 (3.5)
Decisive	75 (3.0)	72 (3.5)
Delay		
Indecisive	67 (3.1)	73 (3.6)
Decisive	70 (3.1)	68 (3.6)

Note: *SE*'s in parentheses in all data tables.

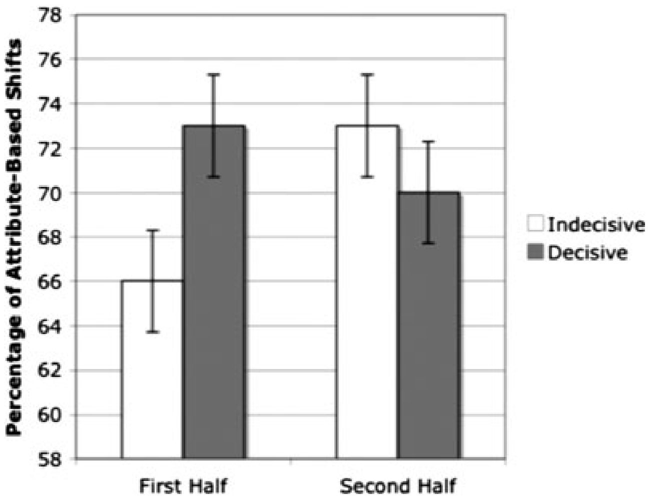

Figure 2. Percentage of attribute-based shifts (relative to attribute-based and alternative-based shifts combined) made by each indecisiveness group for the first versus second half of eye fixations. Error bars represent 1 *SE* unit in each direction

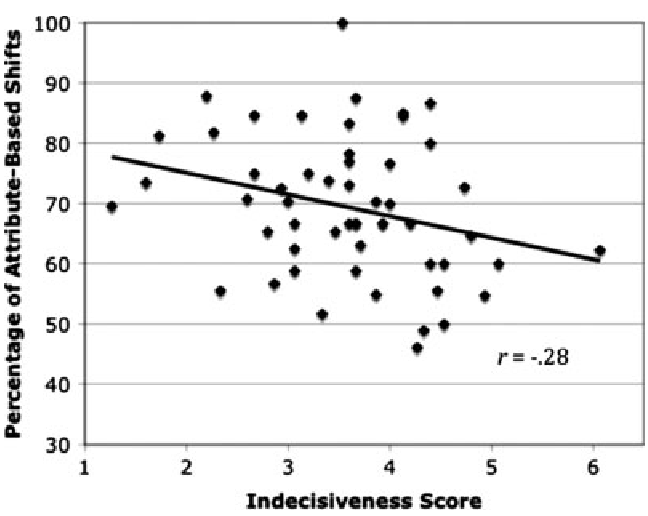

Figure 3. Relationship between indecisiveness score and percentage of attribute-based shifts for the first half of eye fixations

Information about selected alternative

We first considered the percentage of overall time spent on the selected alternative ($M = 14\%$, ranging from 3–34, $SD = 6$) and found no group or condition effects, though, not surprisingly, all individuals look at the selected course less in the first half than in the second half of the task (11% vs. 17% respectively; $F(1,49) = 12.38$, $MSE = .01$, $p = .001$). We then looked more deeply at how individuals distributed their time over the five attributes of the selected alternative. For ease of interpretation, we present these results collapsed over condition and half of task (see Figure 4). Note that the two most often selected course choices had different attributes on the first through third dimensions but not on the fourth and fifth dimensions. This can

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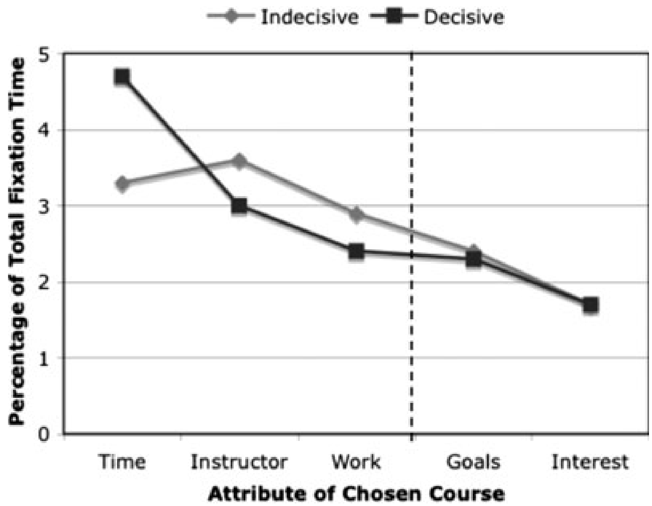

Figure 4. Percentage of total fixation time spent viewing each attribute of the selected course alternative for each indecisiveness group

explain why, for both indecisive and decisive participants, these three attributes were viewed more than the others. An important pattern emerges in that indecisive individuals looked relatively equally at these three attributes, while decisive individuals focused on the first attribute (see Figure 4). The interaction between indecisiveness group and attribute is significant ($F(4,49) = 3.48$, $MSE < .01$, $p = .009$), as is the main effect of attribute ($F(4,49) = 16.29$, $MSE < .01$, $p < .001$). *T*-tests on indecisive versus decisive group differences showed a reliable difference for the first attribute only ($t(51) = 2.40$, $SE > .01$, $p = .020$). The results suggest that decisive individuals might more quickly resolve conflict on the basis of a single dimension while indecisive individuals spend more time deliberating about all dimensions of conflict. There was no difference in the number of attributes of the selected course viewed at least once; most individuals looked at least briefly at all five of these attributes ($M = 4.8$ out of 5, ranging from 4.6–4.9, $SD = 0.65$).

Time spent on noninformation

While individuals in each delay condition by indecisiveness group took the same amount of time to do the task, indecisive and decisive individuals did differ in the percentage of this time spent looking at noninformation cells (see Table 2 for means). In particular, indecisive individuals spent a greater percentage of overall time looking at noninformation cells than did decisive individuals in both conditions and halves of the task, as shown by a main effect of indecisiveness (28% vs. 36% for decisives vs. indecisives; $F(1,50) = 4.36$, $MSE = .04$, $p = .042$; see Figure 5). Relatedly, the correlation between indecisiveness score and percentage of time spent looking at noninformation over the whole task approached significance ($r(52) = .25$, $p = .074$). Additionally, *all* individuals spent a greater percentage of time looking at noninformation in the second half relative to the first half of the task, as shown by a main effect of half of task ($F(1,50) = 8.61$, $MSE = .01$, $p = .005$). The results suggest that indecisive individuals might spend more time delaying the task, deliberating about information not in view, or maintaining two pieces of information in peripheral vision (which can cue individuals to already-read attributes). If one simply counts how many pieces of information each individual viewed at least once, it is 83% of all cells ($SD = 14\%$) with no group or condition differences.

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Table 2. Percentage of total fixation time spent looking at noninformation cells for each indecisiveness group in each delay condition for the first versus second half of eye fixations

	Half of decision task	
	First half	Second half
No-delay		
Indecisive	32 (3.7)	38 (4.2)
Decisive	26 (3.7)	29 (4.2)
Delay		
Indecisive	33 (3.9)	38 (4.4)
Decisive	24 (3.9)	31 (4.4)

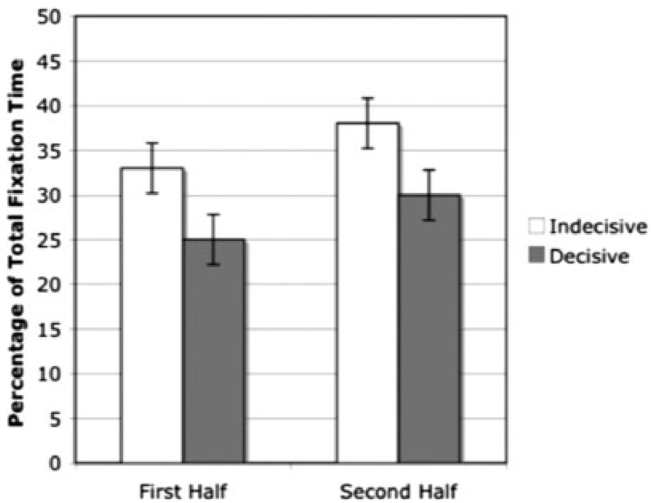

Figure 5. Percentage of total fixation time spent viewing noninformation cells for each indecisiveness group for the first versus second half of eye fixations

DISCUSSION

The first of three major findings is that indecisive and decisive individuals had different shift patterns across the decision task. Indecisive individuals made a lower percentage of attribute-based shifts than did decisive individuals in the first half of the task, and there was no difference between groups for the second half. This pattern resulted from indecisive individuals increasing their use of attribute-based shifts in the second half of the task relative to the first half, while decisive individuals remained consistent in their use of these shifts over the entire task. The second finding is that while both groups spent the same percentage of time viewing information about the selected course, the two groups used that time differently. Decisive individuals spent most of their time on a single dimension while indecisive individuals divided their time equally over the three dimensions on which the two top choice alternatives varied. The third finding is that indecisive individuals, relative to decisive individuals, spent a greater percentage of time viewing noninformation cells. While both groups spent a similar amount of time on the task overall and focused on a similar number of attributes, indecisive individuals spent less of their overall time focusing on these attributes and more time looking at empty cells.

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Indecisiveness and information search

The search strategy results are important in that they support a time course account of differences in information search between indecisive and decisive individuals. According to this account (Rassin et al., 2008), indecisive individuals, while predisposed toward use of compensatory strategies, desire *so* much information that they eventually have to take action to reduce the otherwise intractable decision problem, namely by refocusing on a narrow set of dimensions. While differences in search strategies between indecisive and decisive individuals had been found in past work, the findings were inconsistent and the possibility of a shift in search strategy over time for indecisive individuals had not been explored. The present work captures a shift in strategy that emerges for indecisive individuals as compared to a steady pattern of attribute-based search for decisive individuals. Indecisiveness has previously been shown to be unrelated to intelligence or working memory capacity (Ferrari & Dovidio, 1997), ruling this out as an alternative explanation for the behavioral differences.

The present work offers an explanation for inconsistencies in past findings. Ferrari and Dovidio's (2001) finding of greater attribute-based search by indecisive individuals under a high working memory load can be explained by the fact that such a load would promote an early switch to an attribute-based strategy for these individuals. Patalano and Wengrovitz's (2007) finding of greater use of alternative-based search by indecisive individuals can be explained by their collection of search data for the first part of the task only. Rassin et al.'s (2008) finding that indecisive individuals engaged in more attribute-based search under low task difficulty can be explained by the fact that the task ease would contribute to a late shift toward an attribute-based search for these individuals. This is not to say that indecisive individuals always engage in early alternative-based search—taxing of cognitive resources might occur even before search begins, such as upon thinking about available dimensions—but the fact that it occurs at least under some conditions can explain past conflicting findings and support a theory of why indecisiveness-related strategy shifts occur.

The finding of no effect of delay opportunities on behavior suggests that any relationship between indecisiveness and use of alternative-based shifts does not depend on the decision maker perceiving that the decision context permits delay. It also means that discrepancies in past findings cannot be accounted for by differing perceptions of delay opportunities. This is important in that it refutes any notion that indecisiveness reflects a context sensitive preference for use of optimal decision strategies. One important limitation of the present study is that few individuals in either indecisiveness group actually chose to delay choice in the delay condition. Technically speaking, this is not a problem in that the goal of the study was to manipulate delay opportunities rather than to assign individuals to conditions based on their delay behavior. However, if the delay manipulation had been successful in changing participants' beliefs about the nature of the task, one would expect more participants to have delayed choice. Possibly, the eye tracking apparatus affected the number of delays, the task was not sufficiently motivating, or the risk of loss of existing options loomed larger than the potential gain of new options (Tversky & Kahneman, 1981). While it is conceivable that a stronger manipulation would have produced different results, based on the present data we are inclined to believe that this is unlikely.

Indecisiveness and selected-choice attributes

The second finding here is that indecisive individuals relative to decisive ones divided their time over a greater number of attributes of the eventually selected alternative. There was no difference in the total amount of time that decisive and indecisive participants spent looking at the selected alternative. Attention was simply allocated differently over the five attributes for each of the groups. Interestingly, the dimensions given the most time for both groups were the three that differed in value between the two most often selected courses. Beyond this, however, indecisive individuals gave approximately equal time to each of the three dimensions while decisive individuals focused on just one of them. It appears that individuals were using the information specifically to decide which course to choose, with indecisive individuals focusing on all

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dimensions of conflict and decisive individuals using one attribute as the basis for selection. It also seems that, for indecisive individuals, the use of a focusing strategy to reduce the set of viable alternatives might have advanced the choice process, but it did prevent the continued influence of a compensatory strategy bias in final choice selection.

Past studies (e.g., Ferrari & Dovidio, 2000; Rassin et al., 2008) found that indecisive individuals relative to decisive ones looked at more information about the eventually selected alternative. This finding is similar to the present one. It has been suggested that such search behavior allows indecisive individuals to limit information acquisition while still confirming the quality of the chosen alternative, exhibiting a type of confirmation bias (e.g., Ferrari & Dovidio, 2000; Rassin et al., 2008; see also Nickerson, 1998). The present research suggests that it might not be that indecisive individuals look at more information about the eventually selected alternative simply to confirm its quality. If indecisive individuals here had been simply verifying the quality of the selected course, increased attention should have been devoted to the most important dimensions (as indicated by later ratings) rather than to ones that differed in value across courses. Rather, indecisive individuals appear to be actively using these dimensions to deliberate about a promising subset of alternatives.

Indecisiveness and time on noninformation

A third major finding is that indecisive individuals relative to decisive ones spent more time viewing noninformation cells. Evidence of delay behavior by indecisive individuals has been previously shown largely through global outcome measures (e.g., overall time to decide; Frost & Shows, 1993). One plausible interpretation of the present finding concerning noninformation cells that is consistent with past delay evidence is that it illustrates delay at a more ‘‘micro’’ level of behavior. In other words, indecisive individuals spent more time delaying the task by looking *away* from information cells throughout the decision process. This interpretation is also consistent with an association between indecisiveness and distractibility (Harriott, Ferrari, & Dovidio, 1996) and between indecisiveness and fatigue of self-regulation (Ferrari & Pychyl, 2007), and is similar to responses to decision making under stress (Janis & Mann, 1977).

Another plausible explanation that cannot be ruled out is that looking at blank cells reflects engagement in deliberation about previously viewed information. The group difference could arise because indecisive individuals find it easier to deliberate while looking at blank cells rather than at informational ones, because they engage in more reflection and deliberation about already viewed information relative to decisive individuals, or because they more often use peripheral vision to try to simultaneously keep in mind two previously viewed attributes. The latter would be possible in the current context assuming the two attributes had already been read and were simply being refreshed peripherally. Use of any of these strategies would be consistent with use of compensatory processes and with the desire for information integration by indecisive individuals. The results reveal an interesting low-level difference between groups that requires further investigation, and they illustrate the beneficial use of eye tracking for capturing micro level behaviors that cannot be captured with manual information board methods.

Integration and conclusions

These results contribute to a developing model of indecisiveness proposed by Rassin (2007), which builds on extensive work of Germeijs and Deboeck (2003). The findings are consistent with the proposal that indecisive individuals are motivated to seek extensive information about choice alternatives and to try to use all of this information toward arriving at a choice, possibly due to a greater desire to make an optimal choice. This is demonstrated here by the relatively greater use of alternative-based search early in the task and by the continued emphasis on examining multiple dimensions in selecting a choice. The present work suggests that the behaviors of information search and focusing associated with the model are related in that the latter might

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provide a strategy for honing in on a subset of alternatives, but that the indecisive individual does not lose sight of the breadth of attribute information in making a final choice. Rassin (2007) made a link between indecisiveness, perfectionism, and maximizing tendencies, where maximizers look for the best solutions to problems, while satisficers look for good enough solutions (Schwartz et al., 2002). For indecisive individuals, a desire for the best solution combined with the difficulty of identifying it in some situations given the limits of cognitive resources might give rise to decision delay, avoidance, and ultimately choice dissatisfaction.

Indecisiveness is a fascinating phenomenon for the field of decision making but it has been given very little attention by decision researchers (Rassin, 2007). The experience of chronic difficulty making decisions across a wide range of situations has been found to be common in many cultures including the United States and China (Patalano & Wengrovitz, 2006). Along with many situational influences (e.g., Dhar, 1997; Payne, 1988), this individual difference variable is turning out to be predictive of information search behavior and choice strategies, as well as decision difficulty and delay. Research on indecisiveness may be significant for understanding not only decision making in the general population, but also decision making associated with clinical disorders for which indecisiveness is a characteristic (e.g., depression, *DSM-IV*, 1994). Understanding this phenomenon requires approaching it from a number of perspectives including clinical and applied decision contexts, personality traits and scale measures, and use of basic behavioral decision making perspectives.

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REFERENCES

American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders*, (4th ed.). Washington, DC: American Psychiatric Publishing.

Anderson, C. J. (2003). The psychology of doing nothing: Forms of decision avoidance from reason and emotion. *Psychological Bulletin*, *129*, 139–167.

Choi, I., Dalal, R., Kim-Prieto, C., & Park, H. (2003). Culture and judgment of causal relevance. *Journal of Personality and Social Psychology*, *84*, 46–59.

Crites, J. O. (1969). *Vocational psychology: The study of vocational behavior and development*. New York: McGraw-Hill.

Dhar, R. (1996). The effect of decision strategy on deciding to defer choice. *Journal of Behavioral Decision Making*, *9*, 265–281.

Dhar, R. (1997). Consumer preference for a no-option choice. *Journal of Consumer Research*, *24*, 215–231.

Ferrari, J. R., & Dovidio, J. F. (1997). Some experimental assessments of indecisives: Support for a noncognitive failures hypothesis. *Journal of Social Behavior and Personality*, *12*, 527–538.

Ferrari, J. R., & Dovidio, J. F. (2000). Information search processes by indecisives: Individual differences in decisional procrastination. *Journal of Research in Personality*, *34*, 127–137.

Ferrari, J. R., & Dovidio, J. F. (2001). Behavioral information search processes by indecisives. *Personality and Individual Differences*, *30*, 1113–1123.

Ferrari, J. R., & Pychyl, T. A. (2007). Regulating speed, accuracy and judgments by indecisives: Effects of frequent choices on self-regulation depletion. *Personality and Individual Differences*, *42*, 777–787.

Ferrari, J. R., Johnson, J. L., & McCown, W. G. (1995). *Procrastination and task avoidance*. New York: Plenum Press.

Frost, R. O., & Shows, R. L. (1993). The nature and measurement of compulsive indecisiveness. *Behavioral Research and Therapy*, *31*, 683–692.

DOI: 10.1002/bdm

Gati, I., Krausz, M., & Osipow, S. H. (1996). A taxonomy of difficulties in career decision-making. *Journal of Counseling Psychology*, *43*, 510–526.
Gayton, W. F., Clavin, R. H., Clavin, S. L., & Broida, J. (1994). Further validation of the indecisiveness scale. *Psychological Reports*, *75*, 1631–1634.
Germeijs, V., & De Boeck, P. D. (2002). A measurement scale for indecisiveness and its relationship to career indecision and other types of indecision. *European Journal of Psychological Assessment*, *18*, 113–122.
Germeijs, V., & De Boeck, P. D. (2003). Career indecision: Three factors from decision theory. *Journal of Vocational Behavior*, *62*, 11–25.
Harriott, J. S., Ferrari, J. R., & Dovidio, J. F. (1996). Toward an understanding of indecision: Distractibility, daydreaming, and self-critical cognitions as determinants. *Journal of Social Behavior and Personality*, *11*, 337–344.
Janis, I. L., & Mann, L. (1977). *Decision making: A psychological analysis of conflict, choice, and commitment*. New York: Free Press.
Lohse, G. L., & Johnson, E. J. (1996). A comparison of two process tracing methods for choice tasks. *Organizational Behavior and Human Decision Processes*, *68*, 28–43.
Mann, L. (1982). *Decision-making questionnaire*. Unpublished scale. Flinders University of South Australia.
Patalano, A. L., & Wengrovitz, S. M. (2006). Cross-cultural exploration of the indecisiveness scale: A comparison of Chinese and American men and women. *Personality and Individual Differences*, *41*, 813–824.
Patalano, A. L., & Wengrovitz, S. M. (2007). Indecisiveness and response to risk in deciding when to decide. *Journal of Behavioral Decision Making*, *20*, 405–424.
Payne, J. W. (1976). Task complexity and contingent processing in decision making: An information search and protocol analysis. *Organizational Behavior & Human Performance*, *16*, 366–387.
Payne, J. W., Bettman, J. R., & Johnson, E. J. (1988). Adaptive strategy selection in decision- making. *Journal of Experimental Psychology: Learning, Memory and Cognition*, *14*, 534–552.
Rassin, E. (2007). A psychological model of indecisiveness. *The Netherlands Journal of Psychology*, *63*, 2–13.
Rassin, E., & Muris, P. (2005). To be or not to beindecisive: Gender differences, correlations with obsessive-compulsive complaints, and behavioural manifestation. *Personality and Individual Differences*, *38*, 1175–1181.
Rassin, E., Muris, P., Booster, E., & Kolsloot, I. (2008). Indecisiveness and informational tunnel vision. *Personality and Individual Differences*, *45*, 96–102.
Rassin, E., Muris, P., Franken, I., Smit, M., & Wong, M. (2007). Measuring general indecisiveness. *Journal of Psychopathology and Behavioral Assessment*, *29*, 61–68.
Schwartz, B., Ward, A., Monterosso, J., Lybominsky, 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.
Simon, H. A. (1955). A behavioral model of rational choice. *Quarterly Journal of Economics*, *69*, 99–118.
Tversky, A. (1972). Elimination by aspects: A theory of choice. *Psychological Review*, *79*, 281–299.
Tversky, A., & Kahneman, D. (1981). The framing of decisions and the psychology of choice. *Science*, *211*, 453–458.
Veinott, E. S. (2002). *The effect of understanding and anticipated regret on decision readiness*. Unpublished doctoral dissertation, University of Michigan, Ann Arbor.

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