AGE DIFFERENCES IN PROCESSING STRATEGIES OF EMOTIONALLY DIFFICULT TRADE-OFF DECISIONS

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ABSTRACT

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The present study explored age differences in emotionally difficult trade-off decisions and the underlying mechanism of the age-related effects. Forty younger adults and 40 older adults finished two decision tasks (i.e., purchasing a car vs. choosing a physician). They were randomly assigned to either the high trade-off difficulty condition or the low trade-off difficulty condition for both decision tasks. MouselabWEB software was used to trace participants’ decision making process.

Results showed that older adults were more likely to use attribute-based processing strategies compared with younger adults in the high trade-off difficulty condition for both tasks. On the other hand, younger adults were more likely to use alternative-based processing strategies compared with older adults in the high trade-off difficulty condition. In the car decision task, the retrospective negative emotion instead of cognitive ability mediated the age-related effects in processing strategies in the high trade-off difficulty condition.
I dedicate this dissertation to my parents who always have faith in me.
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CHAPTER I: INTRODUCTION

The ability of making choices among alternative courses of action lies at the heart of the decision making process (Payne, Bettman, & Johnson, 1993). In the process of decision making, trade-offs among alternative choices may be the most important aspect. Decision makers must accept less of one choice in order to achieve more of another. More specifically, if there is no trade-offs to resolve, such as there is only one option or there is one option dominating the others, decision making process would be very easy.

Nowadays, decisions involving more than one choice and requiring trade-offs among those choices are becoming more and more common. For example, in 2005 forty-three million older adults already enrolled in Medicare were given the opportunity under the emerging Medicare Part D program to choose a prescription drug plan from dozens of alternatives (Reed, Mikels, & Simon, 2008, p.671). In 2006, those options increased to 42 and reached 55 in 2007 (Simon, 2007). Choosing from 55 alternative prescription drug plans, explicit trade-offs among the alternative choices need to be considered to make an accurate decision. Previous research (e.g., Billings & Marcus, 1983; Payne, 1976) showed that when younger adults facing multi-alternative decision tasks, they prefer using processing strategies without explicit trade-offs, such as only focusing on one attribute and choosing the alternative that has the best value on that attribute.

However, research that examined the processing strategies in trade-off decisions for older adults has been limited (e.g., Johnson, 1990). In our society, older adults are making many challenging decisions (e.g., medical decisions and financial decisions) on their own. It is important to gain more understanding of the processing strategies in making trade-off decisions in older population. The purpose of the present study was to
examine age differences in processing strategies of emotionally difficult trade-off decisions.

*Processing Strategies, Emotional Difficulty, and Trade-off Decisions*

When making trade-off decisions individuals have to accept losses on certain attributes in order to gain on other attributes. These types of decision tasks are often presented in the form of a matrix with different alternatives that have specified attributes. For example, the decision task of purchasing a car, which is illustrated in table 1, has three attributes (i.e., price, safety, and sound system), three alternatives (i.e., car A, car B, and car C), and seven attribute values (i.e., best, very good, good, average, poor, very poor, worst).

The processing strategies used during the decision making process in these types of decision tasks could be summed into two major categories: alternative-based vs. attribute-based processing strategies. Alternative-based processing strategy suggests that when making a decision, multiple attributes of a single alternative are considered before information about another alternative is processed. For example, a person considering which car he or she should purchase might mainly engage in alternative-based processing strategy by examining all the attribute values for car A first, then move to car B or car C.

Attribute-based processing strategy suggests that when making a decision, the values of a single attribute across several alternatives are processed before information about another attribute is processed. For example, a person might primarily engage in attribute-based processing by examining price values of all three cars before moving to another attribute.
In order to solve conflicts between valued goals, such as monetary saving and personal safety in purchasing a car, using the alternative-based strategy that processes all relevant information and explicitly considers trade-offs between attributes is a major processing strategy for accurate decision making. However, people often avoid making trade-offs, especially for those they find difficult. For example, Payne (1976) found that either with increased number of alternatives or increased number of attributes, younger adults shifted from alternative-based strategy, which explicitly considered trade-offs, to attribute-based strategy, which avoided trade-offs. Payne, Bettman and Luce (1996) also indicated that when faced with time pressure, participants processed less information, and used more attribute-based processing strategy.

Further, the negative emotion that is evoked by the process of trading off one attribute in order to gain more in another could potentially make the decisions difficult (e.g., Luce, Bettman, & Payne, 1997). For instance, Luce et al. (1997) developed a methodology to manipulate the extent of the task elicited negative emotion. Using this methodology, they found that younger adults shifted their processing strategies from alternative-based to attribute-based with the increased task elicited negative emotion. Along the same line, Luce (1998) found that decisions with higher negative emotion were associated with more avoidant choices (e.g., the option to maintain the status quo).

Luce and her colleagues’ studies (1997, 1998, 1999) used two major aspects to manipulate task elicited negative emotions: attribute conflict and attribute identity. Attribute conflict is defined as the degree to which losses on one attribute must be accepted for gains on another attribute being achieved (Luce et al., 1997). In our previous car example, the values of price and safety are always in conflict; however, the
values of price and sound system are positively correlated. Therefore, if one’s decision only involves price and sound system, car A would be the dominant alternative, and no trade-offs are required. If one’s decision involves price and safety, it is difficult to achieve the two goals simultaneously (i.e., save money vs. safety). One has to accept an unsatisfied value on one attribute in order to achieve a satisfied value on the other attribute. Hence, an explicit trade-off needs to be made to resolve the conflict between the attribute values, which can potentially elicit negative emotion.

Previous research suggested that choice conflict may generate threat and negative emotion (Hogarth, 1987; Tversky & Shafir, 1992; Chatterjee & Heath, 1996). For instance, Tversky et al. (1992) presented the participants with pairs of options, such as bets varying in probability and payoff or student apartments varying in rent and distance from campus. For each pair, participants were asked to choose one option or request an additional option at some cost. They found that when the choice conflict was high between attribute values in each trial, decision makers were more likely to request an additional option to cope with the unpleasant feeling elicited from attributes conflicts. Chatterjee et al. (1996) revealed that when participants made larger trade-offs, the decision difficulty was rated higher. Thus, choice conflict was generally considered unpleasant and aversive.

The other key aspect to elicit potential negative emotion is attribute identities, which are types of attributes presented in the decision task. For instance, in the previous car purchasing example, attribute identities are price, safety, and sound system. According to Lazarus (1991), negative emotion is heightened when a decision task is appraised as likely to threaten more important goals, especially when options for coping
are limited. Beattie (1988; Beattie & Barlas, 2001) categorized decision options as noncommodities (e.g., health, happiness, promotion), commodities (e.g., car, book, clothes), and currencies (e.g., money, coupon, time). Beattie et al. (2001) quantified the trade-off difficulty at the alternative level, and they found that decisions among noncommodities were the most difficult. One possible explanation is that decisions among noncommodities are related to more important goals.

Furthermore, prospect theory (Kahneman & Tversky, 1979) suggests that people tend to strongly prefer avoiding losses to achieving gains. Previous studies have proven this tendency in many different attributes domains (e.g., Kunreuther, Easterling, Desvousges, & Slovic, 1990; Irwin, 1994). For example, decision makers are often reluctant to accept losses in domains like codes for moral behaviors (Baron, 1986), public safety risks for nuclear plant siting (Kunreuther et al., 1990), and noncommodities (Beattie, 1988; Beattie & Barlas, 2001). As losses need to be accepted for trade-off decisions, attributes associated with higher loss aversion could potentially be more difficult to trade off. Payne, Bettman, and Johnson (1988) further suggested that variations in attribute importance can affect how much effort participants take to make decisions and their processing strategies. Based on prospect theory and the previous findings (e.g., Payne et al., 1988), Luce et al. (1997) quantified the trade-off difficulty at the attribute level.

Specifically, Luce et al. (1997) designed the high vs. low trade-off difficulty experiments about employment (i.e., experiment 3) based on attribute importance, attribute loss aversion, and the average inter-attribute conflict correlation. In the pretest session, they collected the data on importance measure (e.g., how important is each
attribute to you), and loss aversion measure (e.g., how reluctant are you to give up a best value for a worst value for each attribute) of 15 attributes related to employment (e.g., cost of living in general geographical area of job, expected pay increases). Then they designed the experiment based on the pretest results for each participant. By definition, trade-off requires loss to be accepted in at least one of the attributes being traded off. Thus, the attributes importance level for low vs. high trade-off difficulty conditions was held constant; whereas, attributes that were chosen for the high trade-off difficulty condition were associated with higher degree of loss aversion compared with the attributes chosen for the low trade-off difficulty condition.

In addition, the average inter-attribute conflict correlation was .14 for the low trade-off difficulty condition and -.31 for the high trade-off difficulty condition. The negative correlation direction in the high trade-off difficulty condition indicated a tendency of alternatives favored by one attribute and not favored by other attributes. Results showed that participants reported more negative emotion under high trade-off difficulty condition. Applying the same methodology, Luce (1998) successfully manipulated the task elicited negative emotion in purchasing an automobile decision task.

Luce et al. (1997) found that younger adults took longer time to process the information, opened more attribute value boxes, and applied more attribute-based processing strategies in high trade-off difficulty conditions. One possible explanation is that participants use attribute-based processing strategy to avoid the unpleasant emotions elicited from explicit trade-offs between attributes. Consistent with this explanation, Luce (1998) indicated that decision makers who chose an avoidant option (e.g., status
quo), which did not require explicit trade-offs, reported less retrospective negative emotion.

Previous research indicated the important role of emotion in decision making process (e.g., Zajonc, 1980; Damasio, 1994; Eptein, 1994; Loewenstein, Weber, Hsee, & Welch, 2001). For instance, Loewenstein et al. (2001) proposed the risk-as-feelings hypothesis, which suggests that emotional influences, including feelings such as worry, fear, and anxiety, could have a direct impact on the responses to risky situations (including decision making). However, with the importance of emotional influences on decision making, the research of the impact of emotion on decision processing by older adults has been very limited. The main purpose of the present study was to examine age differences in processing strategies of emotionally difficult trade-off decisions and the underlying mechanism.

Age Differences in Decision Strategies

The general declining trend of cognitive functions (e.g., working memory, processing speed) from young to older adulthood has been well documented (e.g., Salthouse, 1982, 1991). Previous studies have examined the influences of cognitive abilities on decision making processes (e.g., Zwahr, Park, & Shifen, 1999; Mata, Schooler, & Rieskamp, 2007). For example, Zwahr et al. (1999) investigated the decision making processes involving estrogen replacement therapy for both younger and older women. Compared with younger women, older women spent more time to make decisions, exhibited more restricted working memory, and evaluated fewer treatment options.
Chen & Sun (2003) found that older adults tended to use less information intensive strategies when making a monetary decision, perhaps to compensate for their reduced working memory capacities. In addition, Mather, Knight, and McCaffrey (2005) found that older adults with high frontal lobe function performance (e.g., the ability to switch strategies, working memory capacities) displayed more attributed-based processing patterns. However, younger adults with high frontal lobe function performance showed more alternative-based searching patterns.

Mata et al. (2007) found that compared to younger adults, older adults tended to look up less information, take longer time to process, and also use simpler and less cognitively demanding strategies in solving the task of deciding which diamond of a pair was more expensive based on cues like size, clarity, and cut. In addition, they found that cognitive measures, such as forward digit span and digit symbol coding, could explain the age differences in information searches and processing strategies. Lower cognitive abilities were associated with simpler processing strategies.

In Johnson’s (1990) study, participants were asked to choose a car from six cars that varied in nine aspects, such as fuel economy, interior roominess, and safety record. Johnson (1990) found that older adults used less information and also spent more time viewing the information when making decisions. Older adults tended to examine all the information corresponding to a particular attribute (i.e., attribute-based processing strategy) across the alternative choices before switching to another attribute. In contrast, younger adults tended to examine all the attributes information of a car (i.e., alternative-based processing strategy) before switching to another car. However, the cognitive ability measures (i.e., vocabulary) could not explain age differences in processing
strategies. It is possible that other underlying mechanisms, instead of cognitive capacities, could explain the age effects.

*Alternative Mechanism Underlying Age Differences in Decision Strategies*

Compared with cognitive development, emotion development in adulthood followed a different pattern (e.g., Carstensen et al., 2005; Carstensen, Mikels, & Mather, 2006). For example, socioemotional selectivity theory proposed by Carstensen (1993, 1995) posits that with the perception of limited time, older adults place increasingly more value on emotionally meaningful goals, because the motivation to pursue knowledge or make new social contacts shifts to pursue emotion satisfaction.

Thus, relative to younger adults, older adults may be more motivated to pursue positive emotion and avoid negative emotion in judgment and decision making processes. For instance, Chen and Ma (2009) found that in an academic scenario, the positive emotions (e.g., happiness) elicited from anticipating good outcomes from risk taking (i.e., if one takes the risk and the outcome turns out to be good) contributed to older adults’ risk taking decisions. However, the negative emotion (e.g., regret) produced from anticipating good outcomes from risk averse (i.e., one does not take the risk and the outcome turns out to be good) contributed to younger adults’ risky decisions.

Further, Löckenhoff and Carstensen (2007) conducted a study about older and younger adults’ decision making processes in the domain of health plan. They found that older adults looked at more positive information, whereas younger adults focused on more negative information. Results further revealed that the age differences in review strategies were eliminated under the information manipulation (i.e., as you review the information, please focus on the specific facts and details). Further, when time
perspective was controlled, the age effects were eliminated as well. This study supported
socioemotional selectivity theory (Carstensen, 1993, 1995) that with the limited time
perception, older adults are more motivated to pursue the goal of emotion satisfaction.
Interestingly, for the information-focused condition, no age differences of the review
strategies were found, which suggested that environmental structures could influence
older adults’ selection of processing strategies. It also suggests that processing strategies
are not necessarily a function of cognitive decline, but rather a function of emotion
regulation.

A more recent study by Chen, Ma, and Pethel (2010) found that compared to
younger adults, older adults preferred using choice deferral (i.e., do not purchase any cars
for now and keep on searching for other alternatives) in purchasing a car decision task
across the two emotion conditions (high vs. low). Results indicated that younger adults
were more likely to use choice deferral in the high emotion condition than in the low
emotion condition. However, older adults used choice deferral despite the emotion
conditions. In addition, older adults who used choice deferral reported less retrospective
negative emotion compared to younger adults who used choice deferral. It is reasonable
to assume that older adults use choice deferral as their coping strategies to regulate the
task elicited negative emotion.

The Present Study

The purpose of the present study is to test cognitive and emotion mechanisms
underlying age differences in processing strategies of emotionally difficult trade-off
decisions. Older and younger participants were asked to finish two decision tasks
(choosing a physician vs. purchasing a car) on the computer screen using the
MouselabWEB software, which can track successive steps of information acquisition and record processing time.

For each decision task, there were two conditions: low trade-off difficulty condition and high trade-off difficulty condition. This study was a 2 (age group: younger vs. older adults) X 2 (task condition: high trade-off difficulty vs. low trade-off difficulty) between subjects design.

Because of the goal shifting from information gathering to emotion satisfaction with age, older adults may be disproportionally more susceptible to high trade-off difficulty decisions than younger adults. Older adults may be more likely to use attribute-based processing strategies to avoid the negative emotion elicited by explicit trade-offs between attributes. However, younger adults may be more likely to use alternative-based searching strategies to view more information in order to make more accurate decisions. The following was a summary of the hypotheses for the present study.

*Age Differences in Processing Strategies:*

**Hypothesis 1:** For both decision task, in high trade-off difficulty condition, older adults would use more attribute-based processing strategies and younger adults would use more alternative-based processing strategies.

**Hypothesis 2:** Across the two conditions, older adults would open fewer cells and take longer time to make decisions than younger adults would.

**Hypothesis 3:** Both older and younger adults would open more cells and spend more time to make decisions in the high trade-off difficulty condition compared with the low trade-off difficulty condition.
Assessing Cognitive and Emotion Mechanisms underlying Age Differences in Processing Strategies:

**Hypothesis 4:** Retrospective negative emotion instead of cognitive abilities would mediate the age differences in processing strategies in the high trade-off difficulty condition.
CHAPTER II: METHOD

Participants

The younger adults group consisted of 40 undergraduate students, ranging from 18 to 25 years old ($M = 19.68$, $SD = 1.56$, 18 male). Fifty percent of younger adults were Caucasians, and 27.5% were African-Americans. They were recruited from undergraduate psychology classes at a large northwestern university in exchange for extra credits. Forty older adults participated in the current study, ranging from 60 to 88 years old ($M = 71.03$, $SD = 8.17$, 14 male). They were recruited from the local senior centers and each participant was paid $10 for his or her participation. Eighty three percent of older adults were Caucasians. Older adults reported more years of education than younger adults did (Older: $M = 15.42$, $SD = 3.73$; Younger: $M = 14.04$, $SD = 1.22$; $F(1, 71) = 4.9$, $p < .05$). No age differences were found for the self-reported health status (1 = poor, 2 = fair, 3 = good, 4 = excellent; Older: $M = 2.98$, $SD = .83$; Younger: $M = 3.2$, $SD = .61$; $F(1, 78) = 1.91$, $p = .17$).

Decision Tasks and Emotion Manipulation

A pilot study conducted by Chen, Ma, and Pethtel (2009) investigated the types of attributes that would generate higher negative emotions for both younger and older adults in choosing a physician and purchasing a car tasks. Sixty undergraduate students between 17 and 27 years old ($M = 20.55$, $SD = 1.68$), and thirty older adults between 62 to 84 years old ($M = 70.13$, $SD = 5.37$) participated in this study. Older adults reported fewer years of education than younger adults did (Older: $M = 13.39$, $SD = 2.31$; Younger: $M = 14.61$, $SD = 2.16$; $t(88) = 2.41$, $p < 0.01$). For the self-rated health (1 = poor, 4 =
excellent), older adults reported lower score compared with younger adults (Older: $M = 2.53$, $SD = .78$; Younger: $M = 3.27$, $SD = .55$; $t(88) = 4.67$, $p < .0001$).

The present study used both attribute identity and attribute value manipulations to control the level of trade-off difficulty. Trade-off requires accepting losses in at least one of the attributes being traded off. Some attributes, such as safety and cost, could be rated as the same extent of importance, but safety was rated with higher loss aversion than cost did (Tversky & Kahneman, 1991). Therefore, in Chen et al.’s (2009) study, the importance measures and the loss aversion measures were used for the two tasks to decide which attributes would generate more trade-off negative emotion.

Fifteen attributes were chosen from Consumer Report magazine and other similar sources for the car (e.g., occupant survival, routine handling, and interior roominess) and the physician (e.g., malpractice record, office location, and interpersonal skills) tasks. Each attribute value ranged from worst to best (7-point Likert scale, 1 is the worst, 7 is the best), with worst as the least desirable value of the attribute, and best as the most desirable value of the attribute.

The importance measures asked the participants how important those 15 attributes were for their decisions when purchasing a new car and choosing a new physician. The scale of the important rating measures was from 1 (not important at all) to 7 (very important). For the loss aversion measures, participants were first informed that they had the best value for each attribute, and then they were asked to rate how reluctant they were to give up a best value for a worst value for each attribute. The scale of this measure was from 1 (not reluctant at all) to 7 (very reluctant).
In order to select attributes for the low vs. high trade-off difficulty conditions for both younger and older adults, three criteria were satisfied. First, no age differences were presented in the importance measures and reluctance measures for all the attributes used in the decision tasks. Second, the importance measures for each pair of attributes were constant across the low vs. high trade-off difficulty conditions. Third, for each pair of attribute, one attribute in the high trade-off difficulty condition displayed higher loss aversion scores than the other one in the low trade-off difficulty condition. Therefore, attributes in each pair had the same importance level; whereas, the attributes in the high trade-off difficulty condition had higher loss aversion level than the attributes in the low trade-off difficulty condition.

Multivariate tests were performed to test age differences in attributes of the car and physician tasks. Results showed that across the 2 measures (importance measure vs. loss aversion measure) except sound system, style, and domestic content ($F_{s} > 2.30$, $p < .05$), the other 27 attributes did not show any age differences.

Based on paired-t tests, two pairs of attributes in each decision task were selected according to the three criteria. For car: occupant survival vs. routine handling and pollution caused vs. recycling potential. For physician: malpractice vs. patient confidentiality and hospital connection vs. office location. Results indicated that the first attributes in each pair had the same attribute importance level with the second attributes. At the same time, the first attributes had higher scores in loss aversion measure than the second attributes. It is more difficult to make trade-offs among higher loss aversion attributes. Thus, in the current study, the first attributes in each pair were used in the high trade-off difficulty condition, and the second attributes in each pair were used in the low
trade-off difficulty condition. Also, in order to increase the complexity of the two
decision tasks, two attributes were added in both conditions of each decision task: For the
car task was price and interior roominess and for the physician task was cost and
interpersonal skills. Thus, each decision task had 4 alternatives and 4 attributes; the
matrix dimension is 4 x 4.

Further, the average inter-attribute correlation in the low trade-off difficulty
condition was -.17, and the average inter-attribute correlation in the high trade-off
difficulty condition was -.27. Thus, the high trade-off difficulty condition had a higher
attribute conflict than the low trade-off difficulty condition, which made the trade-offs in
high trade-off difficulty condition even more difficult. The descriptions of the decision
tasks and the meaning of each attribute were presented before each decision task (See
Appendix A.). The two decision tasks were both presented in the form of a matrix, with
rows being alternative choices, and columns being attributes (See Appendix B.).

Attribute Importance Rating Scale

Participants also finished the attribute importance scale. They were asked how
important each attribute was to their decisions (1 = not important at all, 5 = extremely
important). This measure was used to explore the quality of participants’ decisions. The
total utility value of each alternative was calculated. Each attribute value was multiplied
by the corresponding attribute importance rating, and then these multiplied values were
summed up across each alternative. The alternative that had the maximum value among
the four alternatives were chosen.

The MouselabWeb Computer Program
Information processing patterns were monitored by the MouselabWEB software designed by Willemse and Johnson (2006). MouselabWEB presents information in a matrix form, with rows being attributes and columns being alternatives. All the attributes values are hidden. Participants can use the computer mouse to uncover the hidden information. As soon as the mouse is moved over an attribute value cell, the content is displayed; after moving the mouse out of the cell, the content is hidden again. MouselabWEB can record the order of the cells being opened, the processing time, and the number of cells being opened.

*Emotion Measures*

In order to measure the task elicited emotions, an adjective checklist *(See Appendix C.)*, similar to PANAS (Positive and Negative Schedule; Watson, Clark, & Tellegen, 1988; Watson & Tellegen, 1985), was given immediately following each decision task. Participants were asked to indicate how well each adjective described the way they had felt while making their decisions, with 1 being not well at all and 5 being extremely well. Although the primary interest of the present study was the negative emotion, the positive emotion terms (e.g., happy, peaceful) were on the checklist as well in order to hide the purpose of the current study from the participants.

*Digit Symbol Coding*

The digit symbol coding subtest of Wechsler Adult Intelligence Skill (WAIS)-III was used to measure participants’ processing speed capacities. Participants needed to follow a scheme relating a set of symbols to digits by writing as many symbols as possible corresponding to the digits within 1 minute. The reliability coefficient of digit symbol coding test is .84.
Dependent Variables: Assessing Processing Strategies

The information recorded by MouselabWEB was used to create the major dependent variables. Processing strategies was determined on the basis of the order of the information box being opened. If participants checked one information box, there were three possibilities for their next acquisition. First, when the participants moved the mouse along the horizontal line, they were presented with the same alternative but different attribute (alternative-based transition). Second, when the participants moved the mouse along the vertical line, they were presented with the same attribute but different alternative (attribute-based transition). Third, when the participants moved the mouse along the diagonal line, they were presented with different alternative and different attribute (mixed transition). Only the first two transitions were considered because we could not describe the third case as either attribute or alternative-based searching pattern. Luce et al.’s (1997) study indicated that the third case was relatively infrequent. The mean percentage across all their three experiments of this type of searching pattern was only 8%.

The relative amount of alternative- vs. attribute-based processing, addressed as processing pattern, was calculated by subtracting the number of attribute-based transitions from the number of alternative-based transitions and divided by the total number of attribute-based and alternative-based transitions. Therefore, the dependent variable processing pattern ranged from -1 to 1, with the negative values associated with more attribute-based processing and positive values associated with more alternative-based processing.

Task Procedure
First, participants finished two demo tasks (See Appendix D.) to become familiar with using the mouse to uncover the hidden box content. Then, younger and older adults were randomly assigned to either the low trade-off difficulty condition tasks or the high trade-off difficulty condition tasks. The order of the two tasks was counterbalanced. Immediately after participants finished the first task, the emotion measure and the attribute importance scale followed. The same procedure applied to the second task. Finally, participants finished the paper and pencil digit symbol coding measure and demographic questionnaire (See Appendix E.).
CHAPTER III: RESULTS

Preliminary Analysis and Manipulation Check

Eleven adjective words were used to measure retrospective negative emotion elicited by each decision task. The Cronbach’s alpha of negative emotion was .89 for the car decision task and .94 for the physician task. A one-way ANOVA was performed using averaged negative emotion (adding up scores of the 11 items and divided by 11) as dependent variable and trade-off difficulty condition (low vs. high) as the independent variable in each decision task. Results showed that in both decision tasks, participants reported higher retrospective negative emotion in the high trade-off difficulty condition than in the low trade-off difficulty condition (Car: Low: $M = 1.67$, $SD = .52$, High: $M = 2.03$, $SD = .66$, $F(1, 61) = 6.23, p < .05$; Physician: Low: $M = 1.71$, $SD = .69$, High: $M = 2.1$, $SD = .93$, $F(1, 61) = 12.6, p < .05$). Hence, our emotion manipulation was effective.

More negative emotion was elicited in the high trade-off difficulty condition than in the low trade-off difficulty condition.

Age Differences in Processing Strategies

In the car decision task, a significant age group effect was revealed in the high trade-off difficulty condition of processing patterns, with older adults tended to use more attribute-based processing strategies and younger adults tended to use more alternative-based processing strategies (Older: $M = -.07$, $SD = .30$; Younger: $M = .12$, $SD = .25$; $F(1, 39) = 4.47, p < .05$, see Figure 1). The same age effect was found in the high trade-off difficulty condition of the physician decision task (Older: $M = -.02$, $SD = .26$; Younger: $M = .16$, $SD = .24$; $F(1, 39) = 5.43, p < .05$, see Figure 1). Thus, hypothesis 1 was supported. For both decision tasks, in the high trade-off difficulty condition, older adults
used more attribute-based searching strategies and younger adults used more alternative-based searching strategies.

On the other hand, in the low trade-off difficulty condition of both decision tasks, no age differences of processing strategies were found (Car: Older: $M = .10, SD = .39$; Younger: $M = .06, SD = .30; F(1, 37) = .14, p = .71$; Physician: Older: $M = .04, SD = .29$; Younger: $M = .04, SD = .37; F(1, 37) = 0, p = .99$, see Figure 2).

In addition to record mouse movements, the MouselabWEB software also recorded how many cells in total (counting the reopened cells) participants viewed before submitting their final decisions and how much time (in millisecond unit, 1000 millisecond = 1 second) they spent to make their decisions. The natural log transformation was applied to processing time to correct the skewness of the data. For further analysis, the natural log of processing time was used.

Across the two trade-off difficulty conditions, older adults took more time to make decisions than younger adults did in both tasks (Car: Older: $M = 11.17, SD = .50$; Younger: $M = 10.52, SD = .51, F(1, 78) = 33.84, p < .0001$; Physician: Older: $M = 11.32, SD = .84$; Younger: $M = 10.48, SD = .51, F(1, 78) = 30.02, p < .0001$). Older adults opened marginally more cells than younger adults did in the car task (Older: $M = 39.73, SD = 15.96$; Younger: $M = 33.42, SD = 14.43, F(1, 69) = 3.06, p < .1$). However, older adults viewed the same amount of information as younger adults did in the physician task (Physician: Older: $M = 36.7, SD = 17.39$; Younger: $M = 32.05, SD = 14.78, F(1, 69) = 1.48, p = .23$).

Thus hypothesis 2 was partly supported with older adults took longer time to decide than younger adults did in both decision tasks. However, instead of viewing less
information as predicted, older adults viewed more information in the car decision task than younger adults did and viewed the same amount of information in the physician task as younger adults.

Furthermore, series of one-way multivariate ANOVA were performed within each age group using the total cells opened and the natural log of processing time in each decision task as dependent variables and trade-off difficulty conditions as independent variable. Table 2 presented the means and standard deviations of these two variables by each age group.

Within the younger adults group, in both decision tasks, younger adults opened more cells (Car: $F(1, 36) = 4.79, p < .05$; Physician: $F(1, 36) = 7.35, p < .05$) and took longer time to process (Car: $F(1, 38) = 10.61, p < .01$; Physician: $F(1, 38) = 6.45, p < .05$) in the high trade-off difficulty condition than in the low trade-off difficulty condition.

However, within the older adults group, no trade-off difficulty condition effects were found for the amount of cells opened (Car: $F(1, 31) = 1.18, p = .29$; Physician: $F(1, 31) = 1.64, p = .21$). Older adults spent marginally significant more time in the car task (Car: $F(1, 38) = 3.09, p < .1$) and significantly more time in the physician task (Physician: $F(1, 38) = 7.39, p < .05$) in high compared to low trade-off difficulty condition. Hence, hypothesis 3 was supported in the younger adults group; whereas, hypothesis 3 was only partially supported in the older adults group.

**Assessing Emotion Mechanism Underlying the Age Differences in Processing Strategies**

Within each age group, both younger and older adults reported higher retrospective negative emotion in the high trade-off difficulty condition than in the low...
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trade-off difficulty condition for the physician scenario (Younger: Low: $M = 1.78$, $SD = .65$, High: $M = 2.66$, $SD = 1.05$, $F(1.33) = 8.73$, $p < .01$; Older: Low: $M = 1.64$, $SD = .75$, High: $M = 2.27$, $SD = .89$, $F(1.28) = 4.4$, $p < .05$). The condition effects in the car scenario for both age groups were marginally significant (Younger: Low: $M = 1.87$, $SD = .49$, High: $M = 2.2$, $SD = .64$, $F(1.33) = 3$, $p < .1$; Older: Low: $M = 1.42$, $SD = .47$, High: $M = 1.84$, $SD = .8$, $F(1.28) = 3.15$, $p < .1$).

In order to assessing the mediation effects of negative emotion underlying age differences in processing strategies in the high trade-off difficulty condition, three steps were followed (Baron & Kenny, 1986). First, the initial variable (age group) was correlated with the outcome (processing strategies). A regression equation was applied using the processing strategies as the outcome variable and age group as the predictor. Age group significantly predicted processing strategies in both decision tasks: car task, $\beta = -.32$, $t(38) = -2.11$, $p < .05$; physician task, $\beta = -.35$, $t(38) = -2.33$, $p < .05$. The first criterion was satisfied because age group was significantly correlated with processing strategies. Second, the initial variable (age group) was correlated with the mediator (retrospective negative emotion). The averaged retrospective negative emotion was used as the dependent variable and age group was used as the predictor. In the car task, age group marginally predicted negative emotion, $\beta = -.29$, $t(33) = -1.77$, $p < .1$. However, age group did not significantly predict negative emotion in the physician task, $\beta = -.16$, $t(35) = -.97$, $p = .34$. The second criterion was only supported in the car decision task. Third, the mediator (retrospective negative emotion) affected the outcome variable (processing strategies). A regression equation was fitted using the processing strategies as the dependent variable, age group and the retrospective negative emotion as the
independent variables. For the car task, controlling negative retrospective emotion, the age group effect was eliminated, $\beta = -.19, t(32) = -1.09, p = .29$. For the physician task, controlling negative emotion, the age group effect was still significant, $\beta = -.36, t(34) = -2.24, p < .05$. Hence, for the car decision task, retrospective negative emotion mediated the age effect on processing strategies in the high trade-off difficulty condition. However, for the physician decision task, retrospective negative emotion did not mediate the age effect on processing strategies.

Assessing Cognitive Mechanism Underlying the Age Differences in Processing Strategies

Processing speed (digit symbol coding test) was used to measure participants’ cognitive ability. Younger adults displayed higher processing speed compared with older adults (Younger: $M = 42.33, SD = 6.73$, Older: $M = 28.16, SD = 7.01$, $F(1,74) = 80.81, p < .001$). Across the two age groups, processing speed was negatively correlated with processing time in both car and physician tasks (Car: $r(74) = -.41, p < .001$; Physician: $r(74) = -.45, p < .001$).

The same three steps were followed to test the competing cognitive mechanism underlying the age effect in processing strategies in the high trade-off difficulty condition. First, the initial variable (age group) was correlated with the outcome (processing strategies). A regression equation was applied using the processing strategies as the outcome variable and age group as the predictor. Age group significantly predicted processing strategies in both decision tasks: car task, $\beta = -.32, t(38) = -2.11, p < .05$, physician task, $\beta = -.35, t(38) = -2.33, p < .05$. The first criterion was satisfied because age group was significantly correlated with processing strategies. Second, the initial variable (age group) was correlated with the mediator (processing speed). The score of
digit symbol coding was used as the dependent variable and age group was used as the predictor. Results indicated that age group significantly predicted processing speed, $\beta = -.68, t(35) = -5.56, p < .001$. Third, the mediator (processing speed) affected the outcome variable (processing strategies). A regression equation was fitted using the processing strategies as the dependent variable, age group and processing speed as the independent variables. For both decision tasks, controlling processing speed, the age group effects were still significant (Car: $\beta = -.54, t(34) = -2.57, p < .05$; Physician: $\beta = -.44, t(34) = -2.05, p < .05$). Thus, cognitive abilities did not mediate the age effect in processing strategies in the high trade-off difficulty condition for both decision tasks.

The mediation analysis provided evidence that the retrospective negative emotion instead of cognitive ability mediated the age effect in processing strategies in the car decision task. However, for the physician task, the age effect in processing strategies in the high trade-off difficulty condition was not mediated by either retrospective negative emotion or cognitive ability. Thus, hypothesis 4 was only supported in the car decision task.

**Attribute Importance and Decision Qualities**

Keeney and Raiffa (1976) suggested that the weighted additive decision strategy is considered to be the classic model of normative decision making. Weighted additive decision strategy is defined as participants viewing each alternative sequentially (i.e., alternative-based processing), multiplying each attribute value by its importance weight and then summing across all these weighted values for each alternative. The choice with the highest overall value will be chosen. This strategy identifies the choice with the maximum utility and involves thorough and compensatory (i.e., explicitly consider trade-
offs) decision processing. The choice made from this strategy is usually considered to be accurate (Keeney & Raiffa, 1976).

In the current study, for each decision task, participants were asked how important each attribute was to their decision, with 1 as not important at all and 5 as extremely important. This importance rating score of each attribute was multiplied by the corresponding attribute value (worst = 1, best = 7). Then, the weighted values were summed up across each alternative choice. The alternative with the highest score was chosen and this was the choice with the maximum utility.

Participants, who selected the choice with the maximum utility, were coded as 1. Participants, who did not select the choice with the maximum utility, were coded as 0 (see Tables 3, 4, 5, 6). Logistic regression was performed in both decision tasks using binary variable select or not select as dependent variable, age group and trade-off difficulty condition as independent variables.

For both decision tasks, only trade-off difficulty condition effects were significant (Car: $\chi^2(1, N = 79) = 14.3, p < .0001$; Physician: $\chi^2(1, N = 78) = 3.87, p < .05$). Participants were more likely to select the choice with the maximum utility in the low trade-off difficulty condition than in the high trade-off difficulty condition. In the car decision task, participants in the low trade-off difficulty condition were 2.63 times more likely to select the choice with the maximum utility compared with participants in the high trade-off difficulty condition. In the physician decision task, participants in the low trade-off difficulty condition were 1.59 times more likely to select the choice with the maximum utility compared with participants in the high trade-off difficulty condition.
CHAPTER IV: DISCUSSION

Summary of Results

The present study examined the age differences in processing strategies in emotionally difficult trade-off decisions. In the high trade-off difficulty condition, older adults tended to use more attribute-based processing strategies and younger adults tended to use more alternative-based processing strategies. No age effects in processing strategies were revealed in the low trade-off difficulty condition.

Older adults spent more time making decisions than younger adults did across the two decision tasks. Further, older adults viewed more cells in the car task compared with younger adults. Younger adults opened more cells and took more time in the high trade-off difficulty condition than in the low trade-off difficulty condition in both decision tasks. However, for both decision tasks, older adults viewed the same amount of information in the two trade-off difficulty conditions, while spent more time making decisions in the high trade-off difficulty condition than in the low trade-off difficulty condition.

Both younger and older adults reported higher retrospective negative emotion in the high trade-off difficulty condition than in the low trade-off difficulty condition in both decision tasks. In the car decision task, the retrospective negative emotion while not the cognitive capacity mediated the age effect in processing strategies in the high trade-off difficulty condition. However, in the physician decision task, neither the retrospective negative emotion nor the cognitive capacity mediated the age effect in processing strategies in the high trade-off difficulty condition.

Relations to Previous Findings
As predicted, the current research found that older adults used more attribute-based processing strategies compared with younger adults in the high trade-off difficulty condition. This finding not only replicated Johnson’s (1990) study in purchasing a car decision task, but also extended to a different decision domain (i.e., choosing a physician) and examined the underlying cognitive and emotion mechanisms. In Johnson’s (1990) study, cognitive abilities (i.e., vocabulary scores) could not explain the age difference in processing strategies. Further, research conducted by Johnson (1993) and Hartley (1990) could not replicate Johnson’s (1990) finding that older adults tended to organize their information searches by attributes and younger adults tended to organize their information searches by alternatives.

The present study presented an alternative explanation for the mixed findings from previous research. The selection of processing strategies may not necessarily be a function of cognitive abilities, it could also stem from the goal of minimizing task elicited negative emotion. In the low trade-off difficulty condition, no age differences were found in processing strategies. However, in the high trade-off difficulty condition, older adults switched to more attribute-based processing strategies compared with younger adults. The retrospective negative emotion mediated this age effect in the car decision task.

Socioemotional selectivity theory (SST, Carstensen, 1993, 1995) suggests that with the perception of limited time, older adults shift their life goal from information gathering to emotion satisfaction. The present study supported SST that in the high trade-off difficulty tasks, older adults used more attribute-based processing strategies to avoid or minimize the task elicited negative emotion; on the other hand, younger adults
used more alternative-based processing strategies to gather more information in order to make accurate decisions. Similarly, Hanoch, Wood, and Rice (2007) pointed out that older adults are “emotion satisfiers” and younger adults are “cognitive satisfiers”.

Furthermore, the present study showed that younger adults opened more cells and spent more time in the high trade-off difficulty condition compared with the low trade-off difficulty condition, which is consistent with Luce et al.’s findings (1997). This indicated that in the high trade-off difficulty condition, younger adults were actively viewing more information and took more time in order to make an accurate decision. Older adults did spend more time in the high trade-off difficulty condition compared with the low trade-off difficulty condition, but they opened the same amount of cells in the two conditions. Thus, older adults spent more time in each piece of information in the high trade-off difficulty condition. Similarly, Johnson (1990, 1993) found that older adults opened fewer cells and spent the same amount of time to make decisions compared with younger adults, which indicated that older adults spent more time in each cell than younger adults did.

The mediation effect of retrospective negative emotion was only found in the car decision task, whereas not in the physician task. One possible explanation is that older adult maybe more familiar with the task of choosing a physician in real life and more skilled at choosing their own physician than younger adults. Thus, older adults’ familiarity of this particular decision task could contribute to the age effects in processing strategies in the high trade-off difficulty condition. Also, Beattie and her colleague (1988, 2001) found that decisions among noncommodities (e.g., health) were the most difficult to make. It is possible that different task domains could elicit different level of negative
emotion in younger vs. older adults. The physician decision task may elicit a higher valence of negative emotion in older adults than in younger adults even before they started to process the information. This background negative emotion could potentially contribute to the age effect on processing strategy in the high trade-off difficulty condition.

Another explanation could be the retrospective negative emotion measure was not sensitive to capture the true task elicited negative emotion during the decision making process. Immediately after indicating a choice, participants were asked how they felt when they were making their decisions. Fredrickson and Kahneman (1993) indicated that this types of assessments were strongly influenced by the peak emotion felt during the relevant decision making process. Participants should report their peak emotion in their decision making process. However, there were possibilities that some participants reported their end point emotion, which could be mitigated by the coping strategies they used to make decisions. Further, the baseline emotion should be measured for both older and younger adults beforehand. The difference between task elicited retrospective negative emotion and emotion baseline could be a better mediator than the retrospective negative emotion.

**Implications for Decision Qualities**

Frisch and Clemen (1994) pointed out that the degree to which the process is extensive (i.e., view more information) and the degree to which it attempts to resolve trade-offs between attributes (i.e., compensatory) are considered as two important aspects of normatively accurate decision making process. The weighted additive strategy is both extensive and compensatory, which is considered as the classical model of normative
Aging and Emotionally Difficult Trade-off Decisions

decision making (Keeney & Raiffa, 1976). The present study explored whether or not participants selected the choice with the maximum utility value, which was made by using weighted additive strategy, could be predicted by age group and trade-off difficulty condition. Results indicated that participants in the low trade-off difficulty condition were more likely to select the choice with the maximum utility value than in the high trade-off difficulty condition. It was possible that participants in the high trade-off difficulty condition were less likely to explicitly consider trade-offs between attributes compared with participants in the low trade-off difficulty condition.

Interestingly, no age differences were found in selecting the choice with the maximum utility value. Older adults did as well as younger adults across the two trade-off difficulty conditions. Although older adults used simpler and more heuristic decision processing strategies in the high trade-off difficulty condition than did younger adults, the decision outcome was as good as that of younger adults. It is reasonable to assume that with more experience, older adults could still make good decisions just as younger adults.

However, previous studies about aging, processing strategies, and decision quality have yielded mixed results. For example, Chen and Sun (2003) found that older adults selected simpler strategies in a monetary decision task; however, their decisions were as effective as younger adults. Kim and Hasher (2005) revealed that older adults showed consistent choice in two different domains: earning extra credit and grocery shopping. Younger adults only showed consistent choice in the earning extra credit task.

On the other hand, Löckenhoff and Carstensen (2007) found that older adults were more likely to make inconsistent choice than younger adults in a health plan decision task. Further, Chen et al. (2010) indicated that older adults were more likely to
use choice deferral (do not make any decision at the time being, searching for more alternatives) than did younger adults regardless of the emotion conditions in a car purchasing task.

Future studies are needed to examine the association between processing strategies and decision qualities in a variety of decision environment structures. For example, decision domains, task formats, task complexity, and task elicited negative emotion, are all possible variables to explore. The present study provided an initial step in exploring age differences in processing strategies in the high trade-off difficulty decisions and the association between age and decision quality. More studies would benefit us thoroughly understand the aging decision maker and thus aid them to make more accurate decisions.

Limitations and Future Directions

To our knowledge, the current study is the first study that systematically manipulated the task elicited negative emotion and examined the age differences in processing strategies in emotionally difficult trade-off decisions. However, there were a number of limitations to the present study. First, the emotion measure might not be accurate. Luce (1998) measured participants’ negative emotion when they were actually making the decisions by moving a scale bar on the compute screen. Also, she measured participants’ end point emotion by asking participants to predict if they were making a similar decision in the future, how they would feel. Future studies could measure participants’ in process emotion and the end point emotion in order to accurately examine the mediation effects of emotion in age effects in processing strategies. Further, as older
and younger adults might have different emotion baseline, the baseline emotion should also be measured.

Second, the current study was conducted in a laboratory setting. The decision tasks were all well structured. Given our interest in age differences in processing strategies, it was necessary to conduct our experiment in highly controlled laboratory settings. We did find participants reported higher level of negative emotion in the high trade-off difficulty condition compared with the low trade-off difficulty condition. However, even in the high trade-off difficulty condition, the mean of negative emotion was below the midpoint, which indicated that the task elicited negative emotion in a lab setting could be different from the negative emotion elicited from real life situations. Additional studies examining choices across a range of real-life settings are needed to address these concerns.

Third, we examined one measures of decision processing strategies in the present study, which is processing patterns (attribute-based vs. alternative-based). Based on 9 measures of decision processing strategies (e.g., consistent vs. selective, alternative – based vs. attribute – based, compensatory vs. noncompensatory), Riedl, Brandstätter, and Roithmayr (2008) categorized 13 decision strategies (e.g., additive difference strategy, weighted additive strategy, lexicographic strategy). Riedl et al. (2008) also developed an algorithm to identify those 13 decision strategies. Future studies could use this algorithm to identify decision strategies that older and younger adults adopt in different environment structures to understand their decision making processes more in depth.

Fourth, only processing speed was used as the cognitive measure in the current study. Mata et al. (2007) indicated that the measures of fluid intelligence (i.e., processing
speed and working memory) explained age-related differences in processing strategies. Therefore, future studies measuring participants’ working memory capacity should be conducted in order to confirm that cognitive mechanism did not mediate the age-related effects in processing strategies in the high trade-off difficulty condition. Further, Payne et al. (1992) found that people preferred using strategies without trade-offs when decision tasks were more complex. Our present study held the task complexity constant for both conditions. However, it is necessary to explore the joint effects of task complexity and task elicited negative emotion on processing strategies through systematically varying the level of task complexity and the level of task elicited negative emotion.

Finally, Chen et al. (2010) found that older adults were more likely to use choice deferral compared with younger adults across the two emotion conditions. Would older adults who use choice deferral adopt different decision strategies compared with younger adults who use choice deferral? What types of processing strategies could lead to higher chance of choice deferral? What about choice satisfaction? Kim, Healey, Goldstein, and Hasher (2008) showed that older adults were more satisfied with their choices than did younger adults in the evaluation condition (i.e., list the pros and cons of the products). Would there be any age differences in choice satisfaction for older and younger adults who choose the same choice but adopt different types of decision strategies? To better understand the relationship between aging and decision making process, these questions are necessary to be addressed in the future studies.

Conclusion

Our research indicated that with increased task elicited negative emotion older adults used more attribute-based processing strategies compared with younger adults. In
the car decision task, the retrospective negative emotion mediated the age-related effects in processing strategies in the high trade-off difficulty condition. Participants in the low trade-off difficulty condition were more likely to select the choice with the maximum utility value compared with the participants in the high trade-off difficulty condition. We believe that these findings represent an important step towards enhancing our understanding of aging and decision making from the perspective of processing strategies. Also, the findings of the impact of task elicited negative emotion on decision making processes and decision making outcomes have further implications for policy making, decision aiding, and marketing practice.
References


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Appendix A

Purchasing a Car (Low Trade-off Difficulty Condition)

Imagine that you need to purchase a new car due to the breakdown of your current car. You looked up the various attributes of a car in the Consumer Reports and went to shop for the car at a number of dealerships in your area. There were five cars that you were interested in and they varied in four attributes: price, routine handling, interior roominess, and recycling potential.

The price is how much a car costs. A value of “average” represents the average cost you can accept on a particular car.

The routine handling refers to how smoothly it is to maneuver the steering wheel, the brake, and the gas pedal of a car. A value of “average” represents a national average index of routine handling on a particular car.

The interior roominess indicates how much room a car has inside. A value of “average” represents a national average roominess a car has inside.

The recycling potential means the degree to which components of a car can be recycled. A value of “average” represents a national average recycling potential of a particular car.

The four attributes are all scaled on a 7-points scale ranging from best, very good, good, average, poor, very poor, and worst. Best indicates the most desirable value for the attribute and worst indicates the least desirable value for the attribute.
Purchasing a Car (High Trade-off Difficulty Condition)

Imagine that you need to purchase a new car due to the breakdown of your current car. You looked up the various attributes of a car in the Consumer Reports and went to shop for the car at a number of dealerships in your area. There were five cars that you were interested in and they varied in four attributes: price, occupant survival, interior roominess, and pollution caused.

The price is how much a car costs. A value of “average” represents the average cost you can accept on a particular car.

The occupant survival refers to the survival rate for the passengers in a car during a crash sequence. A value of “average” represents a national average survival rate on a particular car.

The interior roominess indicates how much room a car has inside. A value of “average” represents a national average roominess a car has inside.

The pollution caused describes how much pollution a car would produce to the environment. A value of “average” represents a national average pollution rate of a particular car.

The four attributes are all scaled on a 7-points scale ranging from best, very good, good, average, poor, very poor, and worst. Best indicates the most desirable value for the attribute and worst indicates the least desirable value for the attribute.
Choosing a Physician (Low Trade-off Difficulty Condition)

Imagine that you need to choose a new physician due to the close of your current physician’s office. You checked the Physician Reports on various attributes describing relevant physicians in your area, who are all board-certified and accept new patients. There were five physicians that you were interested in and they varied in four attributes: cost, patient confidentiality, interpersonal skills, and office location.

The cost is calculated by how much you pay the physician annually. A value of “average” represents the national average cost of a physician.

The patient confidentiality refers to the degree to which medical information of a patient is accessible only to those who are authorized. A value of “average” represents a national average index of patient confidentiality.

The interpersonal skills describe how well a physician communicates and interacts with the patient. A value of “average” represents the national average ratings on interpersonal skills of a particular physician.

The office location describes how close the physician’s office is to the patient. A value of “average” represents a national average distance from the patient’s home to doctor’s offices.

The four attributes are all scaled on a 7-points scale ranging from best, very good, good, average, poor, very poor, and worst. Best indicates the most desirable value for the attribute and worst indicates the least desirable value for the attribute.
Choosing a Physician (High Trade-off Difficulty Condition)

Imagine that you need to choose a new physician due to the close of your current physician’s office. You checked the Physician Reports on various attributes describing relevant physicians in your area, who are all board-certified and accept new patients. There were five physicians that you were interested in and they varied in four attributes: cost, malpractice record, interpersonal skills, and hospital connection.

The cost is calculated by how much you pay the physician annually. A value of “average” represents the national average cost of a physician.

The malpractice record refers to professional negligence by act or omission by a physician in which care provided deviates from accepted standards of practice in the medical community and causes injury to the patient. A value of “average” represents a national average rate of malpractice record of a physician.

The interpersonal skills describe how well a physician communicates and interacts with the patient. A value of “average” represents the national average ratings on interpersonal skills of a particular physician.

The hospital connection describes how well connected a physician is with local hospitals when his or her patients need hospital care. A value of “average” represents a national average index of a physician’s hospital connection.

The four attributes are all scaled on a 7-points scale ranging from best, very good, good, average, poor, very poor, and worst. Best indicates the most desirable value for the attribute and worst indicates the least desirable value for the attribute.
Appendix B

I. Purchasing a car task (Low trade-off difficulty condition)

<table>
<thead>
<tr>
<th>Attributes /Cars</th>
<th>Price</th>
<th>Routine Handling</th>
<th>Interior Roominess</th>
<th>Recycling Potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Car A</td>
<td>Very poor</td>
<td>Very good</td>
<td>Average</td>
<td>Very good</td>
</tr>
<tr>
<td>Car B</td>
<td>Average</td>
<td>Average</td>
<td>Best</td>
<td>Poor</td>
</tr>
<tr>
<td>Car C</td>
<td>Best</td>
<td>Worst</td>
<td>Very Poor</td>
<td>Average</td>
</tr>
<tr>
<td>Car D</td>
<td>Worst</td>
<td>Best</td>
<td>Poor</td>
<td>Worst</td>
</tr>
</tbody>
</table>

Note. Attributes are all scaled on a 7-points scale ranging from best to worst, with best indicating the most desirable value for the attribute and worst indicating the least desirable value for the attribute.

II. Purchasing a car task (High trade-off difficulty condition)

<table>
<thead>
<tr>
<th>Attributes /Cars</th>
<th>Price</th>
<th>Occupant Survival</th>
<th>Interior Roominess</th>
<th>Pollution Caused</th>
</tr>
</thead>
<tbody>
<tr>
<td>Car A</td>
<td>Very poor</td>
<td>Very good</td>
<td>Poor</td>
<td>Average</td>
</tr>
<tr>
<td>Car B</td>
<td>Average</td>
<td>Very poor</td>
<td>Best</td>
<td>Poor</td>
</tr>
<tr>
<td>Car C</td>
<td>Best</td>
<td>Worst</td>
<td>Very Poor</td>
<td>Average</td>
</tr>
<tr>
<td>Car D</td>
<td>Worst</td>
<td>Best</td>
<td>Average</td>
<td>Very Poor</td>
</tr>
</tbody>
</table>

Note. Attributes are all scaled on a 7-points scale ranging from best to worst, with best indicating the most desirable value for the attribute and worst indicating the least desirable value for the attribute.
### III. Choosing a physician task (Low trade-off difficulty condition)

<table>
<thead>
<tr>
<th>Attributes /physicians</th>
<th>Cost</th>
<th>Confidentiality</th>
<th>Interpersonal Skills</th>
<th>Office Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physician A</td>
<td>Best</td>
<td>Worst</td>
<td>Very Poor</td>
<td>Average</td>
</tr>
<tr>
<td>Physician B</td>
<td>Worst</td>
<td>Best</td>
<td>Poor</td>
<td>Worst</td>
</tr>
<tr>
<td>Physician C</td>
<td>Very poor</td>
<td>Very good</td>
<td>Average</td>
<td>Very good</td>
</tr>
<tr>
<td>Physician D</td>
<td>Average</td>
<td>Average</td>
<td>Best</td>
<td>Poor</td>
</tr>
</tbody>
</table>

Note. Attributes are all scaled on a 7-points scale ranging from best to worst, with best indicating the most desirable value for the attribute and worst indicating the least desirable value for the attribute.

### IV. Choosing a physician task (High trade-off difficulty condition)

<table>
<thead>
<tr>
<th>Attributes /physicians</th>
<th>Cost</th>
<th>Malpractice Record</th>
<th>Interpersonal Skills</th>
<th>Hospital Connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physician A</td>
<td>Best</td>
<td>Worst</td>
<td>Very Poor</td>
<td>Average</td>
</tr>
<tr>
<td>Physician B</td>
<td>Worst</td>
<td>Best</td>
<td>Average</td>
<td>Very Poor</td>
</tr>
<tr>
<td>Physician C</td>
<td>Very poor</td>
<td>Very good</td>
<td>Poor</td>
<td>Average</td>
</tr>
<tr>
<td>Physician D</td>
<td>Average</td>
<td>Very Poor</td>
<td>Best</td>
<td>Poor</td>
</tr>
</tbody>
</table>

Note. Attributes are all scaled on a 7-points scale ranging from best to worst, with best indicating the most desirable value for the attribute and worst indicating the least desirable value for the attribute.
This scale consists of a number of words that describe different feelings and emotions. Please rate how well each word described how you had felt this way while making your decision.

<table>
<thead>
<tr>
<th></th>
<th>Very slightly or not at all</th>
<th>A little</th>
<th>Moderately</th>
<th>Quite a bit</th>
<th>Extremely Well</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Happy</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>2. Angry</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>3. Irritable</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>4. Frustrated</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>5. Peaceful</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>6. Confident</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>7. Distressed</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>8. Confused</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>9. Hopeful</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>10. Upset</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>11. Worried</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>12. Interested</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>13. Troubled</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>14. Uneasy</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>15. Regretful</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>16. Concerned</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
Practice Task 1:

Imagine that you are shopping for a digital camera for yourself. You found two models on sale at the same price in a local electronics store. The two models differed in the following features:

<table>
<thead>
<tr>
<th></th>
<th>Optical Zoom</th>
<th>Megapixels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model A</td>
<td>3x</td>
<td>2.1</td>
</tr>
<tr>
<td>Model B</td>
<td>1x</td>
<td>4</td>
</tr>
</tbody>
</table>

Your decision:

1. Not buy any of these brands and search for other stereo systems.
2. Buy Model A.
3. Buy Model B.

Practice Task 2:

Imagine that you are planning to purchase a stereo system for yourself. The local electronics store has three brands on sale at the same price today. You listened to each brand on sale and felt that the three stereo systems varied on the following characteristics:

<table>
<thead>
<tr>
<th></th>
<th>Sound Richness</th>
<th>Sound Power</th>
<th>Sound Clarity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brand A</td>
<td>High</td>
<td>Low</td>
<td>Average</td>
</tr>
<tr>
<td>Brand B</td>
<td>Average</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Brand C</td>
<td>Low</td>
<td>Average</td>
<td>High</td>
</tr>
</tbody>
</table>

Your decision:

1. Not buy any of these brands and search for other stereo systems.
2. Buy Brand A.
3. Buy Brand B.
4. Buy Brand C.
Appendix E

The Background Questionnaire

(Please circle your choice)

1. Gender: Male Female

2. Age: ____

3. Marital Status:

   Single  Married  Divorced  Widowed

4. Ethnic Background:

   African-American  Caucasian  Hispanic

   Native American  Asian  Other (Specify)

5. Is English your first language? Yes  No

6. Years of Education: ____

7. Highest degree:

8. Religion:

   Protestant  Catholic  Jewish

   Other (Specify)

9. How would you rate your overall health at the present time?

   Poor  Fair  Good  Excellent
### Table 1

*A Decision Task Example*

<table>
<thead>
<tr>
<th></th>
<th>Price</th>
<th>Safety</th>
<th>Sound System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Car A</td>
<td>Good</td>
<td>Average</td>
<td>Very Good</td>
</tr>
<tr>
<td>Car B</td>
<td>Average</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Car C</td>
<td>Poor</td>
<td>Best</td>
<td>Poor</td>
</tr>
</tbody>
</table>

Note. Attributes are all scaled on a 7-points scale ranging from best to worst, with best indicating the most desirable value for the attribute and worst indicating the least desirable value for the attribute.
Table 2

Means and Standard Deviations of the Total Cells Opened and the Natural Log of Processing Time for the Car and Physician Decision Tasks within Each Age Group

<table>
<thead>
<tr>
<th>Dependent Measure</th>
<th>Younger Adults</th>
<th></th>
<th>Older Adults</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low (n = 18)</td>
<td>High (n = 22)</td>
<td>Low (n = 21)</td>
<td>High (n = 19)</td>
</tr>
<tr>
<td>Total Cells Opened (Car)</td>
<td>28.28</td>
<td>11.66</td>
<td>42</td>
<td>21.86</td>
</tr>
<tr>
<td>Total Cells Opened (Physician)</td>
<td>25.72</td>
<td>13.08</td>
<td>41.32</td>
<td>17.81</td>
</tr>
<tr>
<td>Processing Time (Car)</td>
<td>10.26</td>
<td>0.42</td>
<td>10.72</td>
<td>0.48</td>
</tr>
<tr>
<td>Processing Time (Physician)</td>
<td>10.26</td>
<td>0.54</td>
<td>10.64</td>
<td>0.41</td>
</tr>
</tbody>
</table>

### Table 3

*Numbers of Younger Adults Who Selected or not Selected the Choice with the Maximum Utility Value in the Car Decision Task*

<table>
<thead>
<tr>
<th></th>
<th>Select</th>
<th>Not Select</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Condition</td>
<td>14</td>
<td>4</td>
</tr>
<tr>
<td>High Condition</td>
<td>5</td>
<td>16</td>
</tr>
</tbody>
</table>
Table 4

*Numbers of Older Adults Who Selected or not Selected the Choice with the Maximum Utility Value in the Car Decision Task*

<table>
<thead>
<tr>
<th>Condition</th>
<th>Select</th>
<th>Not Select</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>16</td>
<td>5</td>
</tr>
<tr>
<td>High</td>
<td>8</td>
<td>11</td>
</tr>
</tbody>
</table>
Table 5

*Numbers of Younger Adults Who Selected or not Selected the Choice with the Maximum Utility Value in the Physician Decision Task*

<table>
<thead>
<tr>
<th>Condition</th>
<th>Select</th>
<th>Not Select</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Condition</td>
<td>10</td>
<td>7</td>
</tr>
<tr>
<td>High Condition</td>
<td>7</td>
<td>14</td>
</tr>
</tbody>
</table>
Table 6

*Numbers of Older Adults Who Selected or not Selected the Choice with the Maximum Utility Value in the Physician Decision Task*

<table>
<thead>
<tr>
<th></th>
<th>Select</th>
<th>Not Select</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Condition</td>
<td>14</td>
<td>7</td>
</tr>
<tr>
<td>High Condition</td>
<td>9</td>
<td>10</td>
</tr>
</tbody>
</table>
Figure 1

*Processing Patterns of Younger and Older Adults in the High Trade-off Difficulty Condition*
Figure 2

*Processing Patterns of Younger and Older Adults in the Low Trade-off Difficulty Condition*