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Reducing the Framing Effect in Older and Younger Adults by Encouraging Analytic Processing

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Objectives. The present study explored whether the framing effect could be reduced in older and younger adults using techniques that influenced the accessibility of information relevant to the decision-making processing. Accessibility was manipulated indirectly in Experiment 1 by having participants engage in concurrent tasks, and directly in Experiment 2, through an instructions manipulation that required participants to maintain a goal of analytic processing throughout the experimental trial.

Methods. We tested 120 older and 120 younger adults in Experiment 1. Participants completed 28 decision trials while concurrently either performing a probability calculation task or a memory task. In Experiment 2, we tested 136 older and 136 younger adults. Participants completed 48 decision trials after either having been instructed to "think like a scientist" or base decisions on "gut reactions."

Results. Results demonstrated that the framing effect was reduced in older and younger adults in the probability calculation task in Experiment 1 and under the "think like a scientist" instructions manipulation in Experiment 2.

Discussion. These results suggest that when information relevant to unbiased decision making was made more accessible, both older and younger adults were able to reduce susceptibility to the framing effect.

Key Words: Aging—Cognitive resources—Decision making—Framing effect.

In today's society, older adults are often called upon to make risky decisions under conditions of uncertainty. Whether at work, planning personal finances, or examining health care options, older adults must make many complicated choices that have consequences for their financial and medical well-being. As such, it is important that research elucidates the processes that underlie older adult decision making and develop techniques that improve decision-making abilities. In the present study, we examined older adult decision making within the context of the framing effect. Two important reasons influenced our choice in investigating the framing effect in older adults. First, the bias that results from framing has been shown to be one of the most robust biases in human decision making (Kahneman & Tversky, 2000). Second, research suggests that the framing effect may result from a reliance on specific cognitive processes (cf. Kahneman, 2003). Those cognitive processes may be primed by accessible information in any given problem. When analytical processing is primed, "unbiased" decision making should result. When less demanding processes are primed, through the presentation of salient but unimportant information to the decision task, "biased" decision making often results. The present study examined whether susceptibility to the framing effect may be reduced through techniques designed to prime specific cognitive processes.

The present research examined whether two techniques designed to increase the accessibility of analytical processing would reduce the framing effect in both older and younger adults. The seminal example of the framing effect comes from Tversky and Kahneman (1981), in which participants were presented with the "Asian disease problem." When presented with this problem, Tversky and Kahneman found that choices between a risky and a riskless option of equal expected value depended on whether the options were described in positive terms (i.e., lives saved) or in negative terms (i.e., lives lost). Specifically, younger participants overwhelmingly preferred a sure option of saving 200 of 600 people threatened by the outbreak of a disease versus a risky option of taking a one-third chance of saving all 600 people. When options were described in terms of lives lost, participants preferred the risky choice. In this case, expected value of choices was relevant to unbiased decisions; however, information regarding gains and losses may have been more accessible, biasing decision making. According to Kahneman (2003), the way in which a problem is described will affect the saliency, or accessibility, of information within the problem and decisions may be inappropriately shaped by these salient features.

Basing judgments on accessible features of a problem is consistent with several theoretical models that have been proposed to account for the framing effect. For example, prospect theory proposes that the framing effect is a result of reference dependence. People value certain gains more than they do a probable gain of equal or greater expected value; the opposite is true for losses (Kahneman, 2003; Rönnlund, Karlsson, Laggnäs, Larsson, & Lindström, 2005). The reference frame may be a more accessible feature.

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Researchers have also proposed that the framing effect may arise when individuals rely more on automatic or less effortful processes as opposed to controlled, analytic processes. In support of this hypothesis, Smith and Levin (1996) found smaller framing biases in individuals who had high scores on the "need for cognition" scale. Similarly, LeBoeuf and Shafir (2003) showed that more thoughtful individuals demonstrated greater consistency when they encountered both versions (gains and losses) of a given problem. The availability of cognitive resources has been shown to directly influence responding based on accessibility (Jacoby, 1999; Thomas & Bulevich, 2006).

The present study investigated whether the framing effect could be eliminated in older and younger adults through techniques designed to increase the accessibility of information useful in making unbiased decisions. We compared older and younger adults for two reasons.

First, age differences in the framing effect have not consistently been demonstrated (Mayhorn, Fisk, & Whittle, 2002; Rönnlund et al., 2005; Weller, Levin, & Denburg, 2011). In one recent study, when a monetary gambling task was used, researchers found that whereas younger adults were risk seeking when presented with loss frame trials, older adults were not (Mikels & Reed, 2009). However, in a recent study in which a "fatal disease" problem was used, Kim, Goldstein, Hasher, and Zacks (2006) found greater framing effects for older relative to younger adults.

Second, research suggests that older adults may have fewer cognitive resources available as compared with younger adults (Park, 1999; Salthouse, 1996; Salthouse & Babcock, 1991; Schaie, 1994). This reduction in resources may result in older adults relying on less effortful cognitive processes and being more prone to basing decisions on highly accessible information that may not be useful for unbiased decision making.

Following this line of reasoning, as cognitive resources change, decision-making strategies may shift such that individuals are more likely to rely on processes that require less cognitive effort. To support this hypothesis, Johnson (1990) found that, in an experiment examining car selection, older adults spent less time comparing options and reviewed less of the available information than did younger adults. Similarly, Mata, Schooler, and Rieskamp (2007) found that older adults looked up less information and engaged in less cognitively demanding strategies when making decisions as compared with younger adults. Further, reasoning abilities related to variance in strategy selection. That is, individuals who demonstrated deficits in reasoning were more likely to choose the less cognitively demanding strategy. Age-related differences in decision-making strategy selection have also been demonstrated using the Iowa Gambling Task (IGT). The IGT is a card-drawing paradigm designed to isolate two components of the decision-making process: long-term strategic planning and short-term reactivity to salient outcomes. In completing the IGT, younger and older adults employed different choice behaviors (Wood, Busemeyer, Koling, Cox, & Davis, 2005; Zamarian et al., 2008). Younger adults adjusted their choices based on patterns they noticed in the card decks, a strategy that required substantial attentional and working memory resources. In comparison, older adults based their choices on immediate reactions to gains and losses. They displayed no indication of monitoring card patterns.

Older adults have also been found to make health decisions more quickly than young adults (Leventhal, Leventhal, Schaefer, & Easterling, 1993). Further, they sought less medical information when making these treatment decisions as compared with younger adults (Meyer, Russo, & Talbot, 1995; Petrisek, Laliberte, Allen, & Mor, 1997; Pierce, 1993). These quick decisions often resulted in the acceptance of an immediate treatment plan. Individuals who have been shown to maintain a greater amount of cognitive resources tended to delay treatment decisions and gathered more information before making decisions (Meyer, Talbot, & Ranalli, 2007). Together, these studies paint a picture of how decision-making strategies may change with age and reductions in cognitive resources. Older adults may use different and perhaps less cognitively demanding strategies when making decisions as compared with younger adults.

Unlike the previously discussed decision making findings, research has demonstrated that both older and younger adults are susceptible to the framing effect. That is, studies have demonstrated age invariance in the framing effect (see Rönnlund et al., 2005). Similar to other decision-making findings, to demonstrate effective decision making abilities, both older and younger adults are required to carefully analyze relevant information. For example, when older adults examined more information relevant to the decision, they made more effective decisions (Kim et al., 2006; Löckenhoff & Carstensen, 2007). The present study has not been designed to necessarily demonstrate an age difference in the framing effect. Rather, we were interested in examining whether older and younger adults would benefit from the same techniques designed to reduce the framing effect. In the present study, we used a monetary gambling task similar to Mikels and Reed (2009). In two experiments, we encouraged analytical, or computational, processes to determine whether older and younger adults would show unbiased decision making even when presented with problems framed as gains or losses.

The cognitive processes that individuals rely on are determined by both the properties of the object of judgment as well as characteristics of the observer. As it relates to object properties, Ferreira et al. (2006) influenced the accessibility of analytical processing by priming participants with Graduate Record Exam (GRE)-like questions. Specifically, when participants were primed with formal problems (derived from GRE problems) before they responded to the base-rate problems, they were more likely to rely on analytic processing

(Ferreira et al., 2006). Ferreira et al. concluded that priming of formal thought could induce general abstract rule application. Thomas and Sommers (2005) influenced the accessibility of relational processing of list items by presented lists of words grouped by semantic relationship. Making relational processing more accessible led to errors in memory. Those memory errors were reduced in older adults when relational processing was made less accessible.

As it relates to the characteristics of the observer, research has demonstrated that as we age, different aspects of the object of judgment change on some dimension of accessibility. For example, empirical work has demonstrated that aging is associated with increased attention to emotional content. Carstensen and Turk-Charles (1994) found that older adults recalled relatively more emotional material as opposed to neutral material. This difference was not found in younger adults. A shift in how specific kinds of information are processed may in part result from changes in overall cognitive resources (Levy, 1994; Park, 1999; Salthouse, 1996; Salthouse & Babcock, 1991; Schaie, 1994). Changes in cognitive resources have been proposed to account for declines in executive functioning tasks that rely on planning, organization, judgment, and problem solving (Mittenberg, Seidenberg, O'Leary, & DiGiulio, 1989; West, Murphy, Armilio, Craik, & Stuss, 2002), as well as poorer performance on measures of memory that utilize executive or controlled functions such as prospective memory (Einstein, Smith, McDaniel, & Shaw, 1997) and the Stroop task (Salthouse & Meinz, 1995). Similarly, older adults often demonstrate a pattern of increased susceptibility to memory distortion in a variety of paradigms (Bulevich & Thomas, n.d.; Thomas & Bulevich, 2006; Thomas & Sommers, 2005). This increased susceptibility has been attributed to processing information that is highly accessible but not necessarily useful to specific judgments. Thomas and Sommers (2005) demonstrated that older adults could reduce specific memory errors, but only when relational information was made less accessible. Alternatively, younger adults were able to benefit from strategies that enhanced the accessibility of information the differentiated studied items, without reducing the accessibility of biasing information.

The results of Thomas and Sommers (2005) demonstrate two important points. First, memory performance can be influenced by processing specific kinds of information. Second, older and younger adults may automatically rely on different cognitive processes. The present research examined whether older and younger adults would show similar changes in framing effect susceptibility as a result of manipulations that encouraged specific cognitive processes. We were guided by findings from the episodic memory literature, which have demonstrated reductions in memory errors when older adults were explicitly encouraged to engage in controlled processes. For example, Bulevich and Thomas (n.d.) demonstrated that when older adults were explicitly instructed to inspect various contextual cues associated with retrieved memories, memory accuracy and metamemorial monitoring improved. Within the context of decision making, Löckenhoff and Carstensen (2007) found that when older adults were encouraged to engage in an "information gathering" procedure, age differences in decision making were eliminated. Similarly, the framing effect was reduced when older adults were explicitly directed to provide a rationale for their choices before making the decision (Kim et al., 2006). These results suggest that older adults, like younger adults, were capable of unbiased decision making; however, unlike younger adults, they required explicit direction.

In the present study, we extend this research by investigating whether the framing effect could be reduced if older and younger adults were encouraged to engage in analytical processing. In two experiments, younger and older adults were compared in their judgments of a series of monetary decisions framed in terms of gains or losses. In Experiment 1, we primed different cognitive processes in the decision task by having participants perform either a memory or a probability calculation orienting task concurrently with the decision task. Specifically, participants were asked to recall elements (initial endowments) from previous decision trials or compute outcomes from previous decision trails (expected value). In Experiment 2, we examined whether older adults could remember to engage in analytic processing if given instructions at the beginning of an experimental session. Specifically, in Experiment 2, participants were either instructed to "think like of scientist" or base decisions on "gut reactions."

Experiment 1

Experiment 1 examined whether biases in decision making that result from the way problems are framed could be eliminated if participants were primed to analyze expected values. We primed participants by having them perform either a probability calculation task or a memory task between decision blocks. This manipulation is conceptually similar to that used by Ferreira et al. (2006, Experiment 4) in which participants solved problems designed to promote analytic thinking prior to solving base-rate problems. We hypothesized that the probability calculation task would prime participants to carefully evaluate the values within each decision prompt. Alternatively, the memory task did not direct participants to process information relevant for unbiased decision making. Rather, participants were instructed to remember the initial endowments in each decision trial. Neither the probability calculation task nor the memory task directly referenced the framing choices. We predicted that the framing effect would be eliminated in both older and younger adults in the probability calculation condition. Further, we expected to see a framing effect in both age groups in the memory task condition.

Method

Participants

We tested 120 older adults (*M* age = 74.3 years) and 120 younger adults (*M* age = 19.4 years) in Experiment 1. Older participants were recruited from the older adult participant pool maintained by the Department of Psychology at Tufts University. Older adult participants were prescreened for cognitive impairment (Mini Mental State Exam, Folstein, Folstein, & McHugh, 1975) and answered a questionnaire regarding general health and medication. Older participants were those that presented as cognitively healthy, not suffering from mood disorders, and not presently taking medication that might interfere with cognitive functioning. Younger participants were recruited through an internet posting. All younger adults were enrolled as Tufts undergraduate students. The older adults did not differ on level of education or vocabulary score (Salthouse, 1993) from the younger adults. Participants received either course credit (younger adults) or $10/h (older adults) for participating.

Materials

Decision task.—Twenty-eight monetary decision prompts were developed for Experiment 1. Decision prompts used in Experiments 1 and 2 are presented in the Appendix. Each prompt presented an initial dollar award, ranging from $150 to $800, followed by a forced choice between a certain and a risky bet. A certain bet was a fixed gain or loss of a particular dollar value, whereas a risky bet had two possible outcomes: either (a) a gain or loss of greater value than that of the certain bet or (b) no change from the initial award. For example, a participant may have been presented with the following: "You are awarded a sum of $150. You now have the choice between: a. A sure gain of $270; b. A 90% chance of gaining $300 or a 10% chance of gain $0." Similarly, a participant may have been presented with: "You have been awarded a sum of $450. You now have the choice between: a. A sure loss of $30; b. A 10% chance of losing $300 or a 90% chance of losing nothing." Prompts were written so that the expected values, a measure equal to the product of an event's payoff and its probability, of certain bets and risky bets were always identical.

In total, decision trials included 14 gain-framed and 14 loss-framed scenarios. For gain-framed prompts, each choice was worded as money to be added to the initial dollar award, whereas for loss-framed prompts each choice was worded as money to be subtracted from the award. Prompts were developed such that the 14 gain-framed prompted had the same expected values as the 14 loss-framed prompts. That is, for every loss-framed prompt, there was a gain-framed prompt of corresponding level of risk and expected outcome. This resulted in a pool of 14 scenario pairs, with each pair only differing in gain/loss framing. The decision prompts were presented in a fixed random order to control for frame ordering and to prevent any prompt from being presented in succession with its opposite-frame counterpart.

Processing tasks.—Participants in the probability task condition solved fractional multiplication problems after the presentation of four decision trials. In this task, participants completed four multiplication problems, each one multiplying an integer by a ratio (i.e., $200 × 20% or 1/5 =). Integers and ratios from each problem corresponded to values in the decision trial prompts; however the decision task was not directly referenced. Participants in the memory task condition recalled initial dollar awards for each decision made on the previous four decision trials. The two processing tasks did not differ in average completion time, $t < 1$. Further, both younger and older adults performed at ceiling on these tasks.

Design and Procedure

A 2 (processing: probability, memory) × 2 (frame: gain, loss) × 2 (age: older, younger) mixed-design analysis of variance (ANOVA) was used with processing and age serving as between-subjects variables and frame serving as a within-subjects variable. The main dependent variable was the percentage of risky bets selected. Specifically, for each of the 24 experimental decision prompts, participants chose between a sure bet or a gamble. Participants were not paid according to their choices. The task was hypothetical. The proportion of risky choices made within each of the frame conditions (gains or losses) was calculated for each participant and served as the primary dependent variable. We also measured response time for judgments made.

Upon entering the lab, participants signed an informed consent form and then completed a brief vocabulary test. Participants then were presented with 28 decision trials on a Dell Optiplex GX520 computer using E-Prime Software Version 1.1. To indirectly encourage specific cognitive processes, after participants completed four decision trials, they performed either the memory task or the probability calculation task. The first 4 decision trials and first prompt for the accompanying processing task served as a practice block. We analyzed data from the 24 decision trials that occurred after the practice block.

Results

A 2 × 2 × 2 (Age [older, younger] × Frame [gain, loss] x Processing [probability calculation, memory]) mixed ANOVA was performed on average risky choices. A main effect of frame was found, $F(1, 236) = 27.44$, $p < .001$. More risky choices were made when decisions were framed in terms of losses ($M = 0.49$) as compared with gains ($M = 0.38$). In addition, the interaction between frame and age was significant, $F(1, 236) = 5.10$, $p < .05$. Older adults were more likely to select the risky choice when decisions were framed in terms of losses as compared with younger adults.

Table 1. Average Proportions of Risky Choices Made as a Function of Frame, Age, and Processing Manipulation in Experiment 1

	Gains, *M* (*SD*)	Losses, *M* (*SD*)
Younger		
Memory	0.33 (0.24)	0.43 (0.19)
Probability	0.45 (0.22)	0.47 (0.23)
Older		
Memory	0.32 (0.23)	0.62 (0.30)
Probability	0.43 (0.27)	0.46 (0.27)

Finally, the interaction among age, frame, and processing was significant, $F(1, 236) = 4.81$, $p < .05$. As Table 1 illustrates, older adults in the memory condition were more susceptible to the framing effect, demonstrating greater risk seeking behavior when presented with loss trials, as compared with younger adults in that same condition. However, this age difference was eliminated when participants completed probability calculations in conjunction with the decision trials.

A 2 × 2 × 2 (Age [older, younger] × Frame [gain, loss] × Processing [probability calculation, memory]) mixed ANOVA was also performed on average response times in association with judgments. For each participant, response times that were greater than 2.5 *SD*s away from average responding were removed, before performing the final analysis. Importantly, we found a main effect of processing, $F(1, 236) = 5.48$, $p < .05$. Participants took longer to make decisions in the probability calculation condition ($M = 23$ s) as compared with the memory condition ($M = 20$ s). In addition, we found main effects of age and frame, $F(1, 236) = 54.34$, $p < .001$; $F(1, 236) = 55.32$, $p < .001$. Older adults ($M = 26$ s) were slower to make decisions as compared with younger adults ($M = 17$ s). Participants also took longer to make decisions in loss frame trials ($M = 23$ s) as compared with gain frame trials ($M = 20$ s). No other effects were significant, Fs < 1.

Experiment 1 examined whether encouraging, or priming, specific cognitive processes would reduce the framing effect in both older and younger adults. In the memory condition, where participants were required to recall initial endowments, the framing effect was present in both older and younger adults. In addition, in the memory condition, the framing effect was greater in older adults as compared with younger adults. These results suggest that both age groups based decisions on information that was not useful for unbiased decision making. The framing effect was eliminated in both age groups when participants were asked to complete probability calculations between blocks of decision trials. We hypothesized that the probability calculation task indirectly encouraged analytical processing by directing attention to expected values, which resulted in the elimination of the framing effect. This finding is consistent with previous research that demonstrated that older adult susceptibility to the framing effect was reduced when they were directly encouraged to use analytic processes (Kim et al., 2006). The present experiment expands on previous research by demonstrating that older adults were able to reduce susceptibility to the framing effect without explicit direction to engage in analytic processing.

Experiment 2

The goal of Experiment 2 was to examine whether older adults could consistently produce unbiased decisions within a given testing session if given instructions to use analytic processing only once at the beginning of the testing session. In Experiment 2, participants were directly instructed to engage specific cognitive processes. That is, older and younger participants were instructed to either "think like a scientist" or "think like a gambler." Similar instructional manipulations have been shown to be successful in reducing reliance on other decision heuristics, such as the availability heuristic and the representativeness heuristic, in younger adults. For example, Ferreira et al. (2006) instructed participants to use either "intuition and sensitivity" or "rational and reflective thinking" when completing several base-rate estimation tasks. They found that instructions to use rational analysis were successful in reducing heuristic influence in decision making. We hypothesized that older and younger participants would maintain a goal state based on the instructions given. When instructed to think like a gambler, the framing effect in both older and younger adults would result. In addition, we predicted that the framing effect would be eliminated in both groups after encouragement to think like a scientist.

Method

Participants

In Experiment 2, we tested 136 older adults (M age = 71.5 years) and 136 younger adults (M age = 20.1 years). The recruitment procedures used in Experiment 1 were employed for Experiment 2. The older adults did not differ on level of education or vocabulary score (Salthouse, 1993) from the younger adults.

Design and Procedure

A 2 × 2 × 2 (Age [older, younger] × Frame [gain, loss] × Instructions [intuition, reasoning]) ANOVA was used with age and instructions serving as between-subjects variables and frame serving as a within-subjects variable. As in Experiment 1, the main dependent variable was the percentage of risky bets selected in gain or loss framed decision prompts as well as response time. Upon entering the laboratory, participants signed informed consent forms and then completed a vocabulary test. Afterward, participants completed a series of decision tasks similar to those used in Experiment 1. Participants were not paid according to their choices. The task was hypothetical. Participants were

Table 2. Average Proportions of Risky Choices Made as a Function of Frame, Age, and Instructional Manipulation in Experiment 2

	Gains, *M* (*SD*)	Losses, *M* (*SD*)
Younger		
Intuition	0.43 (0.30)	0.52 (0.21)
Analytic	0.45 (0.25)	0.45 (0.26)
Older		
Intuition	0.39 (0.24)	0.53 (0.24)
Analytic	0.48 (0.23)	0.47 (0.28)

divided into two groups. One group received instructions that introduced the study as a test of reasoning. These participants were told that the following task would require "thinking like a scientist" and that they should use "critical thinking and logic." Instructions for participants in the second condition introduced the study as a test of human intuition. Participants were instructed to "thinking like a gambler" and use "initial reactions and gut feelings." Following instructions, participants in both conditions completed the 48 decision trials. The prompts included in this task were similar to those used in Experiment 1.

Results and Discussion

A 2 × 2 × 2 (Age [older, younger] × Frame [gain, loss] × Instructions [intuition, reasoning]) ANOVA found a main effect of frame, $F(1, 268) = 6.25$, $p < .05$. As in Experiment 1, participants were more likely to choose the risky option when decision prompts were framed in terms of losses ($M = 0.49$) as opposed to gains ($M = 0.44$). In addition, the interaction between frame and type of instructions was significant, $F(1, 268) = 7.17$, $p < .005$. As can be seen in Table 2, participants were more likely to demonstrate the framing effect in the intuition condition as compared with the reasoning condition. When instructed to think carefully about the decision, the framing effect was eliminated in both older and younger adults. Finally, the age difference demonstrated in Experiment 1 was not found in Experiment 2. As a further test of a possible aging effect, we performed a 2 × 2 (Age [older, younger] × Frame [gain, loss]) ANOVA on proportion of risky choices made only in the intuition condition. Whereas the framing effect was present, $F(1, 134) = 14.02$, $p < .001$, a main effect of age was not found, $F < 1$. When given instructions to base judgments on "initial reactions," younger adults were as likely to be risk seeking when presented with loss frames and risk averse when presented with gain frames as compared with older adults.

As with Experiment 1, we conducted a 2 × 2 × 2 (Age [older, younger] × Frame [gain, loss] × Instructions [intuition, reasoning]) ANOVA on average response times associated with decisions. Main effects of frame, age, and condition were found, $F(1, 268) = 62.96$, $p < .001$; $F(1, 268) = 66.51$, $p < .001$; $F(1, 268) = 11.83$, $p < .001$. People responded more slowly when presented with decision prompts framed as losses ($M = 21$ s) as compared to when prompts were framed as gains ($M = 18$ s). In addition, older adults ($M = 26$ s) responded more slowly as compared with younger adults ($M = 14$ s). Finally, participants responded more slowly in the analytic instructions condition ($M = 22$ s) as compared with the intuition instructions condition ($M = 17$ s). The interaction between frame and age was also significant, $F(1, 268) = 5.59$, $p < .05$, demonstrating that older adults showed a greater increase in response time between gain and loss framed decision prompts as compared with younger adults.

General Discussion

The goal of the present study was to determine whether manipulations designed to influence the accessibility of specific types of cognitive processes would reduce the framing effect in older and younger adults. We found that when participants calculated expected values between decision blocks (indirect) or when participants were instructed to think like a scientist (direct), they were neither risk averse in gain conditions nor risk seeking in loss conditions. Alternatively, when participants were asked to recall information from previous decision prompts, or when they were instructed to base decisions on gut reactions, both older and younger adults demonstrated the framing effect. Our results demonstrate that both older and younger adults are able to reduce the framing effect in decision making and that a reduction results when people are encouraged to use specific types of cognitive processes.

Cognitive changes that result from aging may affect the accessibility of specific types of information, as well as specific types of processing. For example, numerous studies have demonstrated that emotional information is more accessible in older adults as compared with younger adults (Charles, Mather, & Carstensen, 2003; Mather & Carstensen, 2003). Similarly, research has demonstrated that relational information is more accessible in older adults than younger adults (Thomas & Sommers, 2005). These changes in accessible information may influence the types of cognitive processes that older adults recruit. For example, having increased access to relational information may result in participants relying on relational processing when performing memory tasks. Similarly, having increased access to how decision prompts are framed (positively or negatively) may result in a heuristic reliance on phrasing rather than a more careful analysis of information useful for unbiased decision making. Our findings demonstrate that simple techniques can be used to encourage the use of cognitive processes that will yield unbiased decision making in the elderly.

The present study found that older adults can successfully be encouraged to inspect expected values as well as rely on analytic processes. When given some direction (even indirectly), they demonstrated a reduced susceptibility to the framing effect. We hypothesized that this direction influenced the use of specific decision making processes.

Similarly, research has demonstrated that older adults can improve episodic memory performance if given some support at retrieval (i.e., Bulevich & Thomas, n.d.; Craik, F. & Byrd, 1982; Naveh-Benjamin, Craik, Guez, & Kreuger, 2005; Thomas & Bulevich, 2006). According to Craik and colleagues, the ability to engage in demanding strategies is compromised by age (Craik, F. & Byrd, 1982; Craik, F. I. M., 1983); however, memory differences in cued recall were reduced when participants were given specific "strategy instructions" that encouraged them to create sentences for cue–target word pairs. Craik and Byrd suggested that older adults experience a reduced capacity for unsupported effortful cognition, but when given instructions or reminders at retrieval, they re-engage that effortful processing (see also, Light & Singh, 1987). More recently, in a study of imagination inflation, Thomas and Bulevich (2006) found that instructional manipulations were successful in attenuating typical age-related deficits in source monitoring. Similarly, Bulevich and Thomas (n.d.) demonstrated that older adults were more likely to withhold incorrect responses when encouraged to evaluate retrieved information carefully. The present study extends the benefits of environmental support to the domain of decision making.

An important contribution of the present study is the finding that both younger and older adults benefit from the same techniques. That is, both groups demonstrated unbiased decision making when indirectly primed to think about expected values and directly instructed to engage in analytic processing. These results suggest that within the context of the framing effect, age differences that have previously been found may not be a result of changes in cognitive resources. Rather, these differences may be a result in accessibility of information that influences the decision or differences in the strategies that each group may employ to make decisions.

Importantly, in Experiment 1 of the present study, older adults demonstrated increased susceptibility to the framing effect as compared to younger adults. This result is puzzling in light of findings presented by Mikels and Reed (2009), who demonstrated age equivalent risk aversion when presented with gain frames, and greater risk seeking tendencies in younger adults than older adults when presented with loss frames. Although the present study used decision prompts similar to those employed by Mikels and Reed, the concurrent memory task may have influenced older adult decision making in unintended ways. This task was designed to reduce the accessibility of expected value information, useful for unbiased decision making; however, it may have captured older participants' attention such that they skipped any further attempt to carefully analyze decision prompts (cf. Jacoby & Rhodes, 2006). Whereas younger adults may still have examined expected values in this condition, older adults may have prematurely halted the analytic process. Alternatively, the memory task may have resulted in a working memory burden. As such, the task may have reduced the cognitive resources required for both older and younger adults to engage in unbiased decision making, which, in turn, may have led to the framing effect.

In Experiment 2, explicit instructions to "use intuition" also resulted in a framing effect; however, an age difference in the effect was not found. That is, older adults did not demonstrate increased risk averse or risk seeking behavior as compared with younger adults. The instructional manipulation in Experiment 2 may have led to the instantiation of similar processes across both age groups. When instructed to think like a scientist, both older and younger adults may have spent time considering all components of the decision prompts. This hypothesized analysis may have resulted in unbiased decision making. Alternatively, when instructed to rely on gut reactions, careful analysis may have been appropriately truncated in both age groups. Participants may have relied on whatever information was most accessible. In this case, our results suggest that participants relied on the valence of the frame. The latency data further support this accessibility explanation. That is, decisions were made more quickly when participants engaged in the memory task or when they were given intuition instructions, as compared with when they engaged in the probability calculation task or when they were given reasoning instructions.

The findings from both experiments are consistent with several models that have been proposed to account for the framing effect (i.e., prospect theory, dual-process models). The present study does not differentiate among these models. Rather, we demonstrate that unbiased decision making can result from both direct and indirect encouragement to use specific cognitive processes. Finally, our results do not clearly indicate age-related susceptibility to the framing effect. The relationship between general cognitive ability and the framing effect may be complicated. Studies may sometimes demonstrate age-related susceptibility when testing older adults who show significant, but within normal range, cognitive deficits. Supporting this conclusion, Henninger, Madden, and Huettel (2010) demonstrated that age-related differences in decision-making performance reflected age-related differences in two underlying cognitive factors. Differences in processing speed and aspects of memory account for the age-differences in the IGT. Alternatively, in some cases, age-related susceptibility due to cognitive deficits may be counteracted by some form of age-related compensatory mechanisms, for example, in the form of added experience. Both of these factors may influence the sometimes found age-invariance in the framing effect.

Conclusions

The present study examined two techniques that can be used to reduce the framing effect in older and younger adults. Both techniques we designed to increase the use of specific kinds of cognitive processes, either through instructions or

by directing attention to information within the decision prompts. We found that when participants thought about expected values or were encouraged to engage in analytic processing, the frame effect was eliminated. When encouraged to "go with one's gut," the framing effect was present in both groups. Our results suggest that the framing effect can be overcome if participants are encouraged to engage in more effortful analytic processes. Further, these results are consistent with previous research that has demonstrated a reduction in the framing effect when older and younger participants "justified" their choices (Kim et al., 2006). Most importantly, our results demonstrate that older adults can use more effortful cognitive processes even when encouragement to do so is minimal. In the present research, and in much of the framing effect literature, the frame effect was eliminated when individuals carefully examined their options. This careful examination can be extremely taxing of cognitive resources. As these resources have been hypothesized to decline with age it is important for researchers to determine the situations in which older adults maintain some ability to engage, ways in which older adults can be encouraged to engage, as well as situations in which these processes may not be necessary for successful decision making.

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Appendix

Decision Prompts Used in Experiments 1 and 2

1. You are awarded a sum of $700. You now have the choice between:
   a. A sure loss of $200.
   b. A 2/3 (66%) chance of losing $300, with a 1/3 (33%) chance of losing $0.
2. You are awarded a sum of $820. You now have the choice between:
   a. A sure loss of $360.
   b. A 3/4 (75%) chance of losing $480, with a 1/4 (25%) chance of losing $0.
3. You are awarded a sum of $250. You now have the choice between:
   a. A sure loss of $50.
   b. A 1/3 (33%) chance of losing $150, with a 2/3 (66%) chance of losing $0.
4. You are awarded a sum of $425. You now have the choice between:
   a. A sure loss of $180.
   b. A 2/3 (66%) chance of losing $270, with a 1/3 (33%) chance of losing $0.
5. You are awarded a sum of $750. You now have the choice between:
   a. A sure loss of $200.
   b. A 4/5 (80%) chance of losing $250, with a 1/5 (20%) chance of losing $0.
6. You are awarded a sum of $720. You now have the choice between:
   a. A sure loss of $180.
   b. A 3/5 (60%) chance of losing $300, with a 2/5 (40%) chance of losing $0.
7. You are awarded a sum of $700. You now have the choice between:
   a. A sure loss of $360.
   b. A 4/5 (80%) chance of losing $450 with a 1/5 (20%) chance of losing $0.
8. You are awarded a sum of $480. You now have the choice between:
   a. A sure loss of $40.
   b. A 1/5 (20%) chance of losing $200, with a 4/5 (80%) chance of losing $0.
9. You are awarded a sum of $650. You now have the choice between:
   a. A sure loss of $210.
   b. A 7/10 (70%) chance of losing $300, with a 3/10 (30%) chance of losing $0.
10. You are awarded a sum of $360. You now have the choice between:
   a. A sure loss of $140.
   b. A 7/10 (70%) chance of losing $200, with a 3/10 (30%) chance of losing $0.
11. You are awarded a sum of $380. You now have the choice between:

a. A sure loss of $150.

b. A 3/4 (75%) chance of losing $200, with a 1/4 (25%) chance of losing $0.

12. You are awarded a sum of $350. You now have the choice between:

a. A sure loss of $225.

b. A 9/10 (90%) chance of losing $250, with a 1/10 (10%) chance of losing $0.

13. You are awarded a sum of $700. You now have the choice between:

a. A sure loss of $200.

b. A 2/3 (66%) chance of losing $300, with a 1/3 (33%) chance of losing $0.

14. You are awarded a sum of $820. You now have the choice between:

a. A sure loss of $360.

b. A 3/4 (75%) chance of losing $480, with a 1/4 (25%) chance of losing $0.

15. You are awarded a sum of $250. You now have the choice between:

a. A sure loss of $50.

b. A 1/3 (33%) chance of losing $150, with a 2/3 (66%) chance of losing $0.

16. You are awarded a sum of $425. You now have the choice between:

a. A sure loss of $180.

b. A 2/3 (66%) chance of losing $270, with a 1/3 (33%) chance of losing $0.

17. You are awarded a sum of $750. You now have the choice between:

a. A sure loss of $200.

b. A 4/5 (80%) chance of losing $250, with a 1/5 (20%) chance of losing $0.

18. You are awarded a sum of $720. You now have the choice between:

a. A sure loss of $180.

b. A 3/5 (60%) chance of losing $300, with a 2/5 (40%) chance of losing $0.

19. You are awarded a sum of $700. You now have the choice between:

a. A sure loss of $360.

b. A 4/5 (80%) chance of losing $450 with a 1/5 (20%) chance of losing $0.

20. You are awarded a sum of $480. You now have the choice between:

a. A sure loss of $40.

b. A 1/5 (20%) chance of losing $200, with a 4/5 (80%) chance of losing $0.

21. You are awarded a sum of $650. You now have the choice between:

a. A sure loss of $210.

b. A 7/10 (70%) chance of losing $300, with a 3/10 (30%) chance of losing $0.

22. You are awarded a sum of $360. You now have the choice between:

a. A sure loss of $140.

b. A 7/10 (70%) chance of losing $200, with a 3/10 (30%) chance of losing $0.

23. You are awarded a sum of $380. You now have the choice between:

a. A sure loss of $150.

b. A 3/4 (75%) chance of losing $200, with a 1/4 (25%) chance of losing $0.

24. You are awarded a sum of $350. You now have the choice between:

a. A sure loss of $225.

b. A 9/10 (90%) chance of losing $250, with a 1/10 (10%) chance of losing $0.

25. You are awarded a sum of $400. You now have the choice between:

a. A sure gain of $100.

b. A 1/3 (33%) chance of gaining $300, with a 2/3 (66%) chance of gaining $0.

26. You are awarded a sum of $340. You now have the choice between:

a. A sure gain of $120.

b. A 1/4 (25%) chance of gaining $480, with a 3/4 (75%) chance of gaining $0.

27. You are awarded a sum of $100. You now have the choice between:

a. A sure gain of $100.

b. A 2/3 (66%) chance of gaining $150, with a 1/3 (33%) chance of gaining $0.

28. You are awarded a sum of $175. You now have the choice between:

a. A sure gain of $90.

b. A 1/3 (33%) chance of gaining $270, with a 2/3 (66%) chance of gaining $0.

29. You are awarded a sum of $500. You now have the choice between:

a. A sure gain of $50.

b. A 1/5 (20%) chance of gaining $250, with a 4/5 (80%) chance of gaining $0.

30. You are awarded a sum of $420. You now have the choice between:

a. A sure gain of $120.

b. A 2/5 (40%) chance of gaining $300, with a 3/5 (60%) chance of gaining $0.

31. You are awarded a sum of $250. You now have the choice between:

a. A sure gain of $90.

b. A 1/5 (20%) chance of gaining $450, with a 4/5 (80%) chance of gaining $0.

32. You are awarded a sum of $280. You now have the choice between:

a. A sure gain of $160.

b. A 4/5 (80%) chance of gaining $200, with a 1/5 (20%) chance of gaining $0.

33. You are awarded a sum of $350. You now have the choice between:

a. A sure gain of $90.

b. A 3/10 (30%) chance of gaining $300, with a 7/10 (70%) chance of gaining $0.

34. You are awarded a sum of $160. You now have the choice between:

a. A sure gain of $60.

b. A 3/10 (30%) chance of gaining $200, with a 7/10 (70%) chance of gaining $0.

35. You are awarded a sum of $180. You now have the choice between:

a. A sure gain of $50.

b. A 1/4 (25%) chance of gaining $200, with a 3/4 (75%) chance of gaining $0.

36. You are awarded a sum of $100. You now have the choice between:

a. A sure gain of $25.

b. A 1/10 (10%) chance of gaining $250, with a 9/10 (90%) chance of gaining $0.

37. You are awarded a sum of $400. You now have the choice between:

a. A sure gain of $100.

b. A 1/3 (33%) chance of gaining $300, with a 2/3 (66%) chance of gaining $0.

38. You are awarded a sum of $340. You now have the choice between:

a. A sure gain of $120.

b. A 1/4 (25%) chance of gaining $480, with a 3/4 (75%) chance of gaining $0.

39. You are awarded a sum of $100. You now have the choice between:

a. A sure gain of $100.

b. A 2/3 (66%) chance of gaining $150, with a 1/3 (33%) chance of gaining $0.

40. You are awarded a sum of $175. You now have the choice between:

a. A sure gain of $90.

b. A 1/3 (33%) chance of gaining $270, with a 2/3 (66%) chance of gaining $0.

41. You are awarded a sum of $500. You now have the choice between:

a. A sure gain of $50.

b. A 1/5 (20%) chance of gaining $250, with a 4/5 (80%) chance of gaining $0.

42. You are awarded a sum of $420. You now have the choice between:

a. A sure gain of $120.

b. A 2/5 (40%) chance of gaining $300, with a 3/5 (60%) chance of gaining $0.

43. You are awarded a sum of $250. You now have the choice between:

a. A sure gain of $90.

b. A 1/5 (20%) chance of gaining $450, with a 4/5 (80%) chance of gaining $0.

44. You are awarded a sum of $280. You now have the choice between:

a. A sure gain of $160.

b. A 4/5 (80%) chance of gaining $200, with a 1/5 (20%) chance of gaining $0.

45. You are awarded a sum of $350. You now have the choice between:

a. A sure gain of $90.

b. A 3/10 (30%) chance of gaining $300, with a 7/10 (70%) chance of gaining $0.

46. You are awarded a sum of $160. You now have the choice between:

a. A sure gain of $60.

b. A 3/10 (30%) chance of gaining $200, with a 7/10 (70%) chance of gaining $0.

47. You are awarded a sum of $180. You now have the choice between:

a. A sure gain of $50.

b. A 1/4 (25%) chance of gaining $200, with a 3/4 (75%) chance of gaining $0.

48. You are awarded a sum of $100. You now have the choice between:

a. A sure gain of $25.

b. A 1/10 (10%) chance of gaining $250, with a 9/10 (90%) chance of gaining $0.