Eliminating Risk Biases in Elderly Decision-Making

An honors thesis for the Department of Psychology

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Abstract

Research in the decision-making behaviors of older adult indicates a heightened preference for decision aids and heuristics in making choices. This preference may be a result of cognitive decline, motivational shifts, or enhanced valence salience in old age. Two experiments used modified versions of the Tversky and Kahneman (1981) framing-effect paradigm to compare both older and younger participants' reliance on gain/loss framing as a potential heuristic. Experiment 1 included alternating secondary tasks that were either calculation-based or memory-based. These tasks were intended to prime motivational states, respectively, toward goals of mathematical analysis, which would enhance awareness of misleading frames, or verbal memory, which would provide no advantage in making a framed choice. Experiment 2 included instructional manipulations to complete the task using either critical reasoning or intuition. Analysis of the data revealed that manipulations that primed analytical processing (i.e. the probabilistic task in Experiment 1 and reasoning instructions in Experiment 2) reduced the effect of risk framing in older adults, but demonstrated no change in effect in younger adults. These findings suggest that older adults may be able to overcome reliance on decision aids under conditions that reinforce advantageous motivation states.

Eliminating Risk Biases in Elderly Decision-Making

In today's society, older adults are often called upon to make risky decisions under uncertain conditions. Whether in working beyond retirement age, planning personal finances or healthcare options, or even watching a commercial, older adults must make many complicated choices that have consequences for their financial and medical well-being. Gain and loss framing often plays a crucial role in these decisions, as the literature has demonstrated a susceptibility among older adults to misleading valence cues (Kim, Goldstein, Hasher, & Zacks, 2006). The present research examines motivational conditions that may alleviate the persuasive bias of valence framing — presenting choice options as gains or losses — in older adults as compared to their younger counterparts.

Risk framing as a concept of cognitive decision-making was first studied by Tversky and Kahneman in their seminal investigation of the framing effect (1981). Their experiment found that phrasing a decision prompt in terms of either gains or losses was a successful influence upon participants' preferences for making risky decisions. Tversky and Kahneman demonstrated this influence by issuing participants one of two forced-choice, two-alternative decision prompts: one in which two logically equivalent options were presented in terms of potential gains, or another one presented in terms of losses. Under both frames, the two options included one risky choice, which had an uncertain outcome, and one safe choice, which had a certain outcome. Expected utility theory, a mathematical model of rational decision-making, would predict that in each question both the risky and safe choices should be equally preferable, as their expected values are equivalent. Contrary to this prediction, Tversky and Kahneman found that the differently phrased decision prompts produced a seemingly irrational pattern in choice preference. When choices were phrased in terms of potential gains, participants were more likely to select the safe option, but when choices were presented in terms of losses, participants tended to select the risky option. Tversky and Kahneman identified this phrasing-induced pattern of decision reversal as the "framing effect."

Since the original experiment, numerous studies have replicated the framing effect. These studies have found framing to be effective across a wide range of scenarios, including judgments of monetary values, personal property, and even dietary fat content (for reviews see Kühberger, 1998; Levin, Schneider, & Gaeth, 1998; Kühberger, Schulte-Mecklenbeck, & Perner, 1999). All these examples of the framing effect are thought to operate on the same basic decision-making principle. According to Prospect Theory, the decision-making process consists of two stages: comprehension and computation (Kahneman & Tversky, 1979). In the comprehension phase, a subjective reference point is established against which to weigh the possible outcomes during the computation phase. This initial reference point, however, is not constant, as it is subject to warping by irrational perceptions of risk. Framing influences a decision by shifting the vantage point from which the decider weighs the available options, before making any direct comparison of values (Kahneman & Tversky, 1979). Cognitive models of the effect treat it as a sort of decision heuristic, as it simplifies the decision-making process and allows the decision-maker to minimize cognitive effort (Reyna & Brainerd, 1991). Theoretically, basing a decision upon a surface feature of positive- vs. negative- valence would require less cognitive resources than performing an in-depth probabilistic analysis. This notion has been supported by fMRI evidence that shows that, compared to decisions made in opposition to framing cues, decisions in line with the framing heuristic engage less activation of the prefrontal cortex, an area often associated with working memory capacity (Gonzalez, Dana, Koshino, & Just, 2005). To summarize, risk framing allows a decision maker to follow the cognitive path of least resistance. This pattern produces a functional bias in choice behaviors, as subjective preferences for risk shift according to valence phrasing.

In discussing decision heuristics, older adults are a particularly important population. Although the specific processes, timeline, and influences are widely open to debate, it is generally agreeable that aging brings about a gradual decline in cognitive functioning, particularly in the area of available cognitive resources (Schaie, 1994; Levy, 1994). Decision-making resources, as it seems, are not exempt from this deterioration. As these resources become further limited, decision-making strategies must shift to require less cognitive effort. Johnson (1990) found that, in an experiment of car selection, older adults spent less time comparing options and reviewed less of the available information than did younger adults. These findings indicated that, when presented with the same external resources, older adults will perform less logical analysis and expend less effort than younger adults will in their decision-making. The age-related difference in decision-making strategy was further exemplified in research with the Iowa Gambling Task, 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). 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 gain and loss valences, and displayed no indication of monitoring card patterns. Together, these studies paint a picture of how decision-making strategies change with age. As the cognitive declines of aging begin to limit analytical decision-making resources, heuristic decision-making becomes the favored method of problem comprehension.

Although heuristic decision cues are generally more influential in older adults than in younger adults, positive and negative valences seem to have a particular importance in the cognition of aging decision-makers. As previously mentioned, older adults have been shown to exhibit a preference for decision strategies based on reactions to game-based gains and losses, as opposed to deliberative strategy (Wood et. al., 2005). Other research has found similar preferences in decisions regarding healthcare plans. Lockenhoff and Carstensen (2007) presented older and younger participants with HMO comparison spreadsheets that incorporated emotionally positive and negative information with neutral statistical information. The results determined that older adults were more sensitive to emotionally relevant information than were younger adults, particularly in information that was positively valenced. This preference was demonstrated in the comparison of study times, search strategies, and post-choice recall of valenced information. However, in a second condition that instructionally enforced an "information-gathering" motivation, these age differences disappeared. Older adults were capable of conducting the same thorough analyses comparisons that younger adults were, but unless externally motivated to do so, older adults relied on the more available cue of emotional valence. This shift in decision strategy may demonstrate age-dependent heuristic reliance, but it might also be explained by another line of reasoning. In their discussion, Lockenhoff and Carstensen (2007) relate their findings to socioemotional selectivity theory. From this perspective, the age-related differences in decision strategy represent a bias in information processing, rather than a decline cognitive functioning. According to the socioemotional selectivity theory, as individuals age they exhibit a shift in internalized goal states brought on by accumulated life experiences and an enhanced awareness of one's own mortality. As a result, older adults, in relation to younger adults, are typically less motivated to seek growth and more motivated to regulate and maintain (Carstensen, Isaacowitz, and Charles, 1999). This goal shift overlaps with other age-related changes in decision-making, including cognitive decline and bounded rationality (Hanoch, Wood, and Rice, 2007). It is important to note that motivation manipulation is successful in eliminating age effects as demonstrated by Lockenhoff and Carstensen (2007), indicating that older adults' decision patterns might not be solely the result of irreversible cognitive decline.

Another topic of note in discussing framing influences in older adults' decision-making is the overall perception of gains and losses in aging populations. One line of research has investigated age-related changes in activation of the striatum, an area often implicated in reward and punishment processing. Functional MRI data for younger and older adults anticipating monetary rewards and punishments has shown similar amounts of striatal activation in older and younger adults, suggesting that this valence-based activation is more or less preserved through aging (Cox, Aizenstein, & Fiez, 2008). However, this preserved reactivity of the striatum has also been shown to be highly differential. Compared to younger adults, who typically demonstrate similar striatal activation to gains and losses, older adults have been shown to exhibit a decrease in early punishment response (Samanez-Larkin, Gibbs, Khanna, Nielsen, Carstensen, & Knutson, 2007). Taken together, these studies would suggest that striatal processing of outcome valence is preserved across aging, but the differences in positive and negative reactivity are enhanced with age. With regard to the risk heuristic involved in the framing effect paradigm, it could be that older adults might perceive gain and loss valences as a more salient, more influential decision cue in comparison with other aspects of a decision prompt that are attended with less specificity.

Given the available research discussed above it would seem reasonable to predict an increased susceptibility to the framing bias in older, as compared to younger, adults. Research with framing effects in older adults is limited to a handful of studies and these reports offer mixed results. Two studies failed to demonstrate age-related difference in choice behavior in completing risk-framing tasks (Mayhorn, Fisk, and Whittle, 2002; Rönnlund, Karlsson, Laggnäs, Larsson, & Lindström, 2005). The reliability of these studies, however, has been taken into question. The Mayhorn et. al. study (2002) included only three pairs of decision prompts that had corresponding gain-framed and loss-framed counterparts. This design made within-subject comparison of frame effects possible for only 6 of their 16 test items. Also, the Rönnlund et. al. paper (2005) has been criticized for interpreting results from a relatively small sample size (Peters, Hess, Västfjäll, and Auman, 2007). Another study by Mikels and Reed (2009), found age-related differences in choice behavior in participants completing a series of 64 gambling-based framing tasks, but this difference was in the direction opposite to that predicted by the literature. Younger adults demonstrated a significant framing effect, while older adults were consistently risk-averse, independent of frame condition. These findings, however, might be explained by a point of their methodology. Each framing prompt contained a pie chart that visualized potential outcomes. This inclusion, in effect, exposed participants to gain and loss information in all trials, which might have affected comprehension of the information. It is important to note here that reliance upon framing as a heuristic is based on perceptions of pure losses or pure gains, so mixed-valence cues might confound the resulting effects.

The final available study of age-dependent framing effects adds further complication to the literature. Kim, Goldstein, Hasher, and Zacks (2006) administered two risk-framed vignettes to older and younger adult groups with an additional manipulation of choice rationalization.

Half the participants simply provided their choice preference while the rest provided a verbal justification in addition their preference. In the unjustified control condition, older adults demonstrated more pronounced framing effects than younger adults. However, of even greater interest, this age difference disappeared in the justification condition. This finding is important to the above-mentioned literature in that it demonstrates that age differences in framing may be variable and dependent on motivation states. When interpreted from a cognitive perspective, the Kim et. al. (2006) results provide convincing evidence for the role of heuristic dependence in the framing effect. Without adequate cues or instructions to engage in more effortful processing, older adults will rely on the "risk heuristic" that offers a faster, simpler method for arriving at a decision. Only when external manipulations provide directive cues will older adults undergo the same objective analysis of decision cues that younger adults perform.

This paper will attempt to resolve some of the inconsistencies among the age-related framing effect literature. Two experiments will test older and younger adults in their performance on a modified risk-framing task. In addition, the motivational conditions that influence the framing effect will be explored. Each experiment will introduce an experimental manipulation aimed at adjusting participants' motivation states: parallel task priming will be manipulated in the first experiment and pre-test instructions will be manipulated in the second. These manipulations differ from those used previously in that they manipulate motivation states implicitly, without direct reference to the framing task itself. This difference is crucial for any claim regarding the efficiency of motivational states in alleviating heuristic reliance. Previous manipulations in older adults (Kim et. al., 2006; Lockenhoff & Carstensen, 2007) may have been successful in reducing age-dependent heuristic reliance only as direct cues to expend cognitive effort. In both the Kim et. al. and Lockenhoff and Carstensen studies, control conditions did not match experimental conditions in difficulty or required effort. This leaves the door open to the possibility that their respective manipulations were only successful in that they elicited more effort than the control conditions. If motivational state is in fact an influential factor in age-dependent heuristic reliance, then manipulations should elicit a difference in performance even when both conditions require equal cognitive effort. To paraphrase, motivational states should influence heuristic reliance not only in the amount of effort put into a problem, but in the focus of that effort – either toward advantageous or non-advantageous qualities of the problem at hand. This experiment aims to demonstrate such an effect by administering motivational manipulations that are matched for required effort. It is predicted that these implicit manipulations of motivational states, like their more explicit counterparts, will successfully shift older adults' risk-taking behaviors to nullify the framing effect bias.

EXPERIMENT 1

The first experiment consisted of an adapted framing-effect paradigm that included alternating secondary tasks. The purpose of each secondary task was to direct participants' attention either toward probabilistic qualities of the framing prompts or toward nominal surface qualities of the prompts. This design was based on the findings of Kim et. al. (2003) in that parallel task completion may provide cues with which decision-makers recontextualize comprehension of the decision task. However, unlike the Kim study, which included an experimental manipulation in which participants provide a rationale for their choice, this secondary task had no surface relevance to the framing choices. Instead, the task provided probabilistic cues implicitly. Additionally, unlike the Kim et. al. manipulation, the control condition matched the experimental condition in terms of required cognitive effort. This design was meant to emphasize the importance of information specificity in motivational priming.

Experiment 1 predicted that older adults would generally display a more robust framing effect than younger adults, but that framing effects in both groups would be significant. Additionally, older adults primed with a calculation task would be less influenced by frame valences in their choices than those primed with a memory task, as the probabilistic nature of the calculation task would produce a motivation state more suitable for carefully analyzing framed prompts. The memory task, in comparison, would prime attention for surface features of the prompts, providing no advantage in eliminating the frame bias.

Method

Participants.

Experiment 1 tested participants in two age groups: older adults and younger adults. Sixty older adults (45 female), defined as those aged 60 and over, participated. Older adults were recruited from a local participant pool maintained by the Department of Psychology at Tufts University. Previously conducted interviews screened older adults for symptoms of dementia. Only those reporting no symptoms were contacted to participate. The average age for older adults was 74.3. All reported completing at least 12 years of formal education, with the average being 15.2 years.

Additionally, 60 younger adults (38 female), ranging from age 18 to 26 were tested (M = 20.7). These participants were recruited through online postings offering compensation either as cash payment or course credit. All younger adults were enrolled as Tufts undergraduate or graduate students with the exception of one Syracuse University student who was a local resident. All had completed at least 12 years of formal education, with the average being 14.8 years.

Both older and younger adults were tested for vocabulary level prior to completing the experiment. On a 20-word synonym-matching task, older adults averaged 15.5 words correct and younger adults averaged 14.9. An independent samples t-test reported no significant difference in vocabulary accuracy between the two age groups, $t(78) = -1.546$, $p > 0.05$. All participants received either hourly cash payment or course credit for participating.

Design and procedure

All participants, both older and younger adults, followed the same experimental procedures. Upon entering the lab, participants signed certificates of informed consent, then completed the vocabulary test mentioned above. Afterward, participants were instructed to complete a hypothetical gambling simulator on a desktop P.C. In completing the simulation, participants alternated between two semi-related tasks at fixed intervals.

Primary Task - Framed Choice Prompts

The primary task was derived from the Tversky and Kahneman risk-framing paradigm (1981). It included 24 monetary decision prompts. 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, while a risky bet had two possible outcomes: either (1) a gain or loss of greater value than that of the certain bet or (2) no change from the initial award. Probabilities for each of the two gamble outcomes were presented as both percentages and fractions. Prompts were written so that the expected utilities – a measure equal to the product of an event's payoff and its probability – of certain bets and risky bets were always identical, e.g. a certain bet for gaining $50 (100% x $50 = $50) was paired with a risky bet for a 50% chance of gaining $100 (50% x $100 = $50).

In total, primary task prompts included 12 gain-framed and 12 loss-framed scenarios. Gain-framed prompts worded each choice as money to be added to the initial dollar award, while loss-framed prompts worded each choice as money to be subtracted from the award. Prompts were paired to match expected values across frames, i.e. 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 12 nearly identical scenario pairs, with each pair only differing in gain/loss framing.

Presentation of the decision prompts was counter-balanced to control for frame ordering and to prevent any prompt from being presented in succession with its opposite-frame counterpart. Following each prompt, participants made ratings from one to seven of comfort with their selections. Following each cycle of four prompts and four comfort ratings, participants completed a condition-specific secondary task.

Secondary Task - Calculation or Memory

Prior to the start of the test, participants had been randomly assigned to one of two conditions: the calculation task (CT) condition or the control, or memory task (MT), condition. These conditions designated the nature of the secondary task to be completed in alternation with the primary decision prompt task.

Participants in the CT condition solved fractional multiplication problems as their secondary task. One cycle of the CT secondary task consisted of four multiplication problems, each one multiplying an integer by a ratio (presented as both a fraction and a percentage). These integers and ratios each corresponded to values in the primary task prompts. The intent of this design was to prime a motivational state of probabilistic analysis. Completion of the calculation task was meant to aid participants in recognizing numerical values referenced in the primary choice task as factors in the expected utility formula. This, in turn, might make participants more aware of the misleading statistics at play in the framing paradigm.

Participants in the MT condition completed a free-recall test as their secondary task. Prior to the start of the experiment, MT participants had been instructed to remember the initial dollar awards of each decision prompt in the primary task. During the secondary task phases, MT participants recalled the award values for the four preceding primary task prompts. This task matched the CT task in cognitive effort, while emphasizing attention to a different quality of the primary task. Whereas the CT task referenced the probabilistic nature of the choice options, the MT task focused attention to the initial dollar award, a surface feature of the primary task that was relatively inconsequential to risk framing.

Altogether, 24 decision prompts were presented in alternation with six cycles of the secondary task. The program recorded participants' input for choices in the primary task prompts, comfort ratings, responses to secondary tasks, and response latencies. The main dependent variable was the percentage of risky bets selected by each participant in gain- or loss-framed primary task prompts.

Results

Secondary task manipulation was predicted to have a significant effect in older adults, but not in younger adults, so risk-taking behaviors were analyzed independently in each age group. Since Experiment 1 presented participants each decision prompt twice – once framed in gains and once framed in losses – a repeated-measures ANOVA was conducted for each age group, testing percentages of risky choices made by each participant. A 2 (condition: calculation, memory) X 2 (frame: gain, loss) mixed subjects design was employed, with condition as a between-subjects factor and frame as a within-subjects factor. All results are reported with a 95% confidence interval. For older adults, the main effect of frame was significant, $F(1, 58) = 4.34$, $p < 0.05$. Older adults made more risky choices under loss frames (M = 0.40) than under gain frames (M = 0.33). Crucially, the ANOVA also revealed a significant interaction between frame and task condition, $F(1, 58) = 3.73$, $p < 0.05$ (See Figure 1). Older adults appeared to demonstrate a strong framing effect in the memory condition (Loss mean = 0.45, Gain mean = 0.32), but not in the calculation condition (Loss mean = 0.34, Gain mean = 0.36).

To further investigate this interaction, two paired-samples t-tests compared the percentages of risky choices older adults made under gain frames to those made under loss frames for each of the two task conditions. A significant effect of frame was found in older adults in the memory task condition, $t(29) = -2.17$, $p = 0.04$. In this condition, older adults made more risky choices under loss frames (M = 0.45) than under gain frames (M = 0.32). Older adults in the calculation task condition, however, did not exhibit this effect significantly, $t(29) = -0.35$, $p = 0.73$.

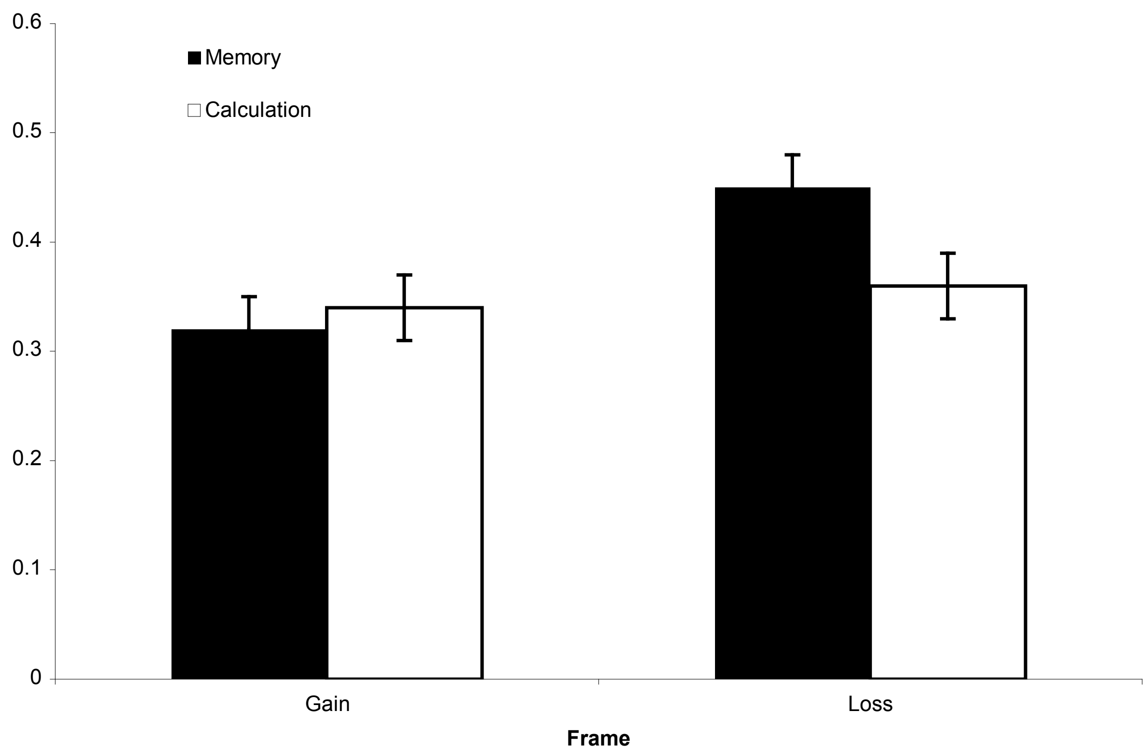

Figure 1.

A repeated-measures ANOVA of the parameters described above analyzed the proportions of risky choices made by younger adults. In contrast to the results obtained in the older adult sample, no significant effects were found in younger adults. There was no significant main effect of frame, $F(1, 58) – 0.13$, $p > 0.70$. Younger adults were no more likely to make risky choices under loss frames (M = 0.44) than they were under gain frames (M = 0.45). The interaction of frame and task condition was also insignificant, $F(1, 58) = 0.75$, $p = 0.40$ (See Figure 2). Two paired-samples t-tests gain-framed to loss-framed risky choices in each task condition. These tests found no significant effect of framing in either the memory task condition, $t(29) = 1.02$, $p = 0.32$, or the calculation task condition, $t(29) = -0.32$, $p = 0.75$.

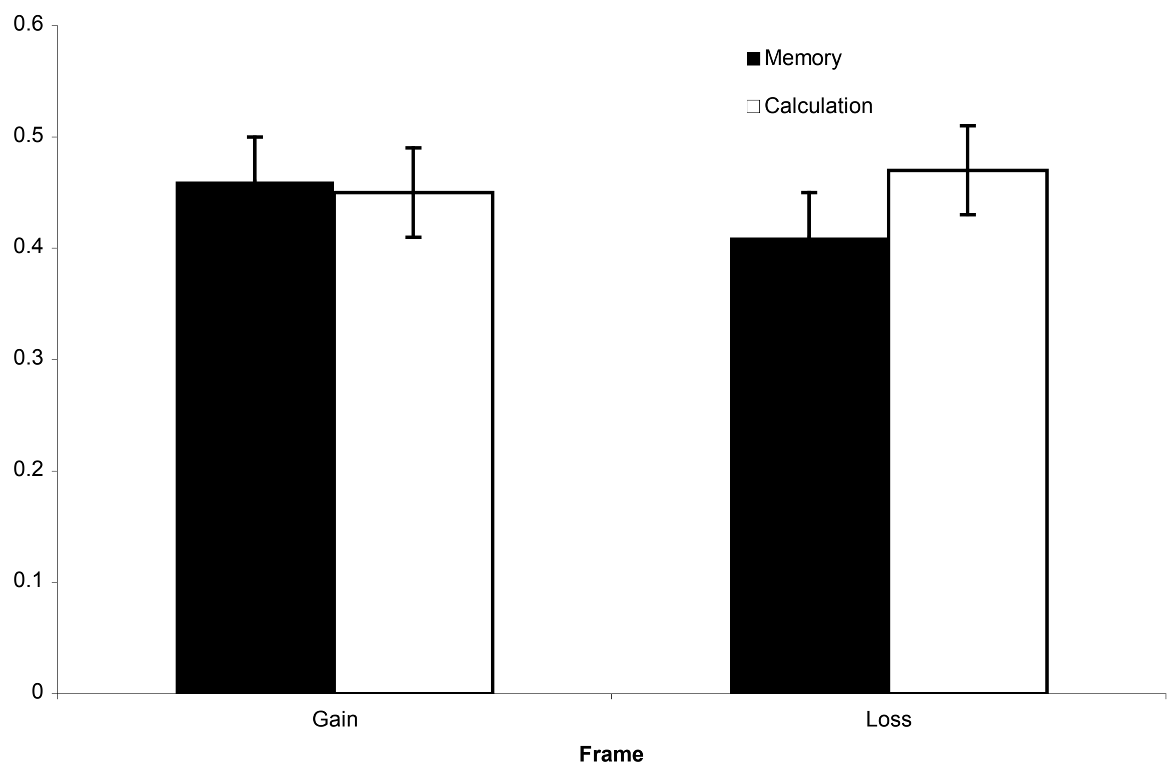

Figure 2.

Discussion

Experiment 1 examined if implicit parallel-task priming manipulations could influence observable risk-framing effects in older and younger adults. In completing a set of gain- and loss- framed monetary gambling scenarios older adults demonstrated a frame bias when primed with a memory task, but not when primed with a calculation task. This finding confirmed the hypothesis that internal motivational manipulations would be successful in influencing frame bias.

This finding is in line with a number of available studies (Kim et. al., 2006, Lockenhoff & Carstensen, 2007; etc.) in that it demonstrated that the decision heuristic reliance of older adults may be overcome with proper effort and motivation. According to the current model, older adults' dependence upon decision heuristics arises through an interaction of cognitive decline, shifts in goal preferences, and in the case of risk-framing, differential salience of positive and negative valences (Hanoch et. al., 2007). This heuristic dependence may only be overcome when older adults experience a shift in motivational state. Other studies have demonstrated successful motivational shifts by instructing participants to rationalize their choices (Kim et. al., 2006) and by instituting an information-gathering goal state (Lockenhoff & Carstensen, 2007). This experiment contributes to the available research by highlighting parallel task priming an equally successful manipulation. Compared to the previously mentioned designs, this paradigm directed motivational states more implicitly and without an increase in cognitive demand.

One limitation of this claim is the repetitive nature of the priming tasks used in Experiment 1. Although the secondary tasks manipulated motivation state implicitly, without direct reference to the primary framing task, the priming tasks appeared six times during the procedure, following each subset of four decision prompts. Such a persistent manipulation might not be truly representative of underlying motivational states as its success depended on frequent reminders. Instead, the demonstrated effect might be the result of training or conditioning. More importantly, the frequency of the prime tasks might have enhanced participants' awareness of the experimental manipulation, potentially confounding the results. The claims of this experiment would be enhanced if demonstrated using a method that induced motivational states only once, rather than constantly redirecting participants' attention. This possibility would be later addressed in Experiment 2.

Before Experiment 2 went underway, however, another issue had to be addressed. Although the hypotheses accurately predicted choice behavior of older adults, they failed to predict the behavior of the younger age group. Younger adults did not demonstrate a significant framing effect in any condition. This finding was rather surprising as a wealth of findings have confirmed the consistent robustness of the framing effect across all adult age groups (for reviews see Kühberger, 1998; Levin, Schneider, & Gaeth, 1998; Kühberger, Schulte-Mecklenbeck, & Perner, 1999). To explore possible faults or variations in the framing materials used, a brief investigation studied younger adults' decision behaviors in an unprimed version of the Experiment 1 task.

EXPERIMENT 1B

A repeated-measures ANOVA of risky choice made across all ages and conditions in Experiment 1 revealed an insignificant main effect of frame, $F(1, 116) = 1.13$, $p = 0.30$. Overall, participants were no more likely to make risky choices under loss frames (M = 0.40) than under gain frames (M = 0.42). Only one group, older adults primed with a memory task, demonstrated a significant framing effect in the typical direction. Given the volume and strength of evidence in support of general risk-framing effects, this lack of a finding was surprising.

Experiment 1B administered the same framed decision prompts used in Experiment 1 without the inclusion of any priming secondary tasks in an attempt to replicate the expected framing effect as demonstrated by Tversky and Kahneman (1981), with participants making more risky choices under losses than under gains. If such an effect was again not significant, then the framed prompt set would be examined to find possible variations in effect size among the prompts. The prompt set would then be adjusted, removing any low-effect prompts and including additional prompts with traits in common with the high-effect prompts, before continuing with any further experiments.

Method

Experiment 1B tested 39 younger adults (26 female). Participants had a mean age of 18.8 and had completed an average of 12.6 years of formal education. After signing an informed consent agreement, participants completed a simplified version of the Experiment 1 paradigm. This method included only decision prompts from Experiment 1's primary task. These prompts were completed consecutively on a desktop P.C. with no intervening secondary task. All original prompts were presented in counter-balanced order so that prompts were not presented in succession with their opposite-framed counterparts. Again, the program recorded each participant's decision, comfort rating, and response latency for each prompt. After completing the task, participants received compensation as either cash payment or course credit.

Results and Discussion

A paired-samples t-test compared risky choices made under gain and loss frames. More risky choices were taken under gain frames ($M = 0.57$) than under loss frames ($M = 0.48$), but this difference was not significant, $t(38) = 1.66$, $p > 0.10$. This finding, again, was contrary to typical findings using similar prompts.

One possible reason for this lack of an effect might be internal variations of effect sizes among framing effect prompts. Certain types of frame prompts have been shown to be more effective than others in eliciting the frame bias. These differences may stem from a number of variations, such as objects at risk (i.e. saving lives vs. gambling money) or mathematical qualities of a prompt's design (i.e. high risk vs. low risk). To examine variation in effect size of the Experiment 1B prompts, five distribution graphs were plotted. These graphs displayed percentages of risky choices made along five variables of the framing prompts. These variables included (1) initial award value, (2) final or expected value, (3) percentage value of risk, (4) proportion of initial value put at risk, and (5) difference between initial and final value. These graphs indicated that framing effect biases were more common in prompts of high proportion of initial value risked and high final-initial difference. To supplement to prompt pool, 36 additional prompts, each high in one of the two aforementioned traits, were crafted.

In an item analysis of the original prompt pool, 24 paired samples t-tests compared risky choices taken under gain frames to those taken under loss frames for each individual decision prompt. Twelve prompts exhibited moderate ($p < 0.20$) to high ($p < 0.05$) effects of frame. These prompts were selected inclusion in the revised prompts pool, while the other twelve were discarded. The final prompt pool to be used in Experiment 2 included 48 decision prompts, featuring 12 prompts from the original pool and 36 new prompts.

EXPERIMENT 2

Experiment 1 demonstrated that an analytical priming task was successful in reducing risk heuristic reliance in an older adult sample. This priming task, however, appeared frequently and prominently in the experimental procedure. As a result the calculation and memory task conditions might have functioned more as behavioral conditioning manipulations rather than manipulations of internal motivation state. Experiment 2 attempted to address this possibly confounding factor. In a new design, motivational state was manipulated using pre-task instructions. These instructions, unlike the secondary tasks of Experiment 1, occurred only once at the beginning of the experiment and provided no reinforcement later on in the procedure. Similar instructional manipulations have been shown to be successful in reducing reliance on other decision heuristics, such as the availability heuristic. Ferreira, Garcia-Marques, Sherman, and Sherman (2006) instructed participants to either use either "intuition and sensitivity" or "rational and reflective thinking" in completing several base-rate estimation tasks. They found that instructional manipulations to use rational analysis were successful in reducing heuristic influence in decision-making.

Experiment 2 predicted that older adults' reliance on the risk frame heuristic under instructional manipulations would resemble the findings of Ferreira et. al. (2006). Older adults should demonstrate a more prominent framing effect under conditions that introduce the study as a test of intuition than under those that introduce a test of critical thinking. Additionally, following the adjustments made to the framing prompt pool in Experiment 1B, Experiment 2 predicted a more prominent framing effect in older adults than in younger adults, but frame effects should also be significant in both age groups.

Method

Participants

Experiment 2 tested 46 older adults (34 female) and 68 younger adults (46 female) from the same recruitment sources utilized in Experiment 1. Older adults averaged 73.3 years of age, with 61 being the minimum. Younger adults averaged 19.2 years of age, with 21 being the maximum. All participants reported completing at least 12 years of formal education. Older adults reported an average of 15.0 years of schooling completed, while younger adults reported an average of 12.6 years. The same 20-point vocabulary test used in Experiment 1 was administered to all participants. Older adults scored an average of 14.98 words correct and younger adults averaged 14.40. A t-test reported no significant difference in vocabulary accuracy between the two groups, $t(112) = 1.62$, $p > 0.10$.

Design

Older and younger adults followed identical experimental procedures. As in Experiment 1, upon entering the lab, participants signed certificates of informed consent, then completed the previously mentioned vocabulary test. Afterward, participants were instructed to complete a hypothetical gambling simulator on a desktop P.C.

Before beginning the main task, participants received one of two distinct instruction sets, as pre-determined by random assignment. Instructions for participants in the first condition introduced the study as a test of critical thinking skills. Text prompts and verbal scripts instructed participants to complete the experiment by "thinking like a scientist" and using "reasoning, logic, and statistical analysis." These instructions also specified that the experiment would not record response times and that there would be no time limits, emphasizing the importance of thinking carefully before each response. Instructions for participants in the second condition introduced the study as a test of human intuition. In contrast to those of the first condition, these text prompts and verbal scripts instructed participants to complete the experiment by "thinking like a gambler" and using "initial reactions and gut feelings." The instructions also specified that the experiment record would record response times and that speed would be a factor in calculating overall performance.

Following instructions, participants in both conditions completed the same risk-framing decision task. As in the primary task of Experiment 1, participants responded to a series of decision prompts presented on the P.C. Each prompt presented an initial dollar award followed by a forced choice between a certain and a risky bet. Again, in all cases the expected utilities of a certain bet and a risky bet were identical. The prompts included in this task resembled the primary task prompts of Experiment 1 except for three crucial differences. First, the task was not paired with a secondary task. Decision prompts appeared in a continuous series until completion of the experiment. Second, the task included twice as many decision prompts as did Experiment 1, presenting a total of 48 prompts. Third, prompt inclusion was tailored so that only high-effect prompts were included in the presentation list. Based on the results of Experiment 1B, only prompt pairs that demonstrated a reliable framing effect were selected for use in Experiment 2. New prompt pairs were written with features associated with reliable effect results, i.e. high proportion of gambled amount to initial value and high difference between final and initial values. In total, 12 already-used prompts from Experiment 1 and 36 new prompts were included in the decision prompt pool for Experiment 2.

Presentation of the decision prompts was counter-balanced to control for frame ordering and to prevent any prompt from being presented in succession with its opposite-frame counterpart. Following each prompt, participants made ratings from one to seven of choice comfort. The program recorded choices made, comfort ratings, and response latencies for each participant. The main dependent variable was, again, the percentage of risky bets selected in gain- or loss- framed decision prompts.

Results

As Experiment 2 followed a factorial design similar to Experiment 1, analysis of the data used the same tests. First, two repeated-measures ANOVA were conducted – one for each age group – testing percentages of risky choices made by each participant. A 2 (frame: gain, loss; within) X 2 (condition: calculation, memory; between) mixed subjects design was used again. All results are reported with a 95% confidence interval. For older adults, the main effect of frame was not significant, $F(1, 44) < 0.01$, $p > 0.90$. Overall, older adults were no more likely to make risky choices under loss frames (M = 0.42) than under gain frames (M = 0.42). However, the ANOVA crucially revealed a significant interaction between frame and task condition, $F(1, 44) = 9.06$, $p < 0.01$ (See Figure 3). Older adults demonstrated a strong framing effect in the intuition condition (Loss mean = 0.37, Gain mean = 0.48), but not in the reasoning condition (Loss mean = 0.47, Gain mean = 0.36).

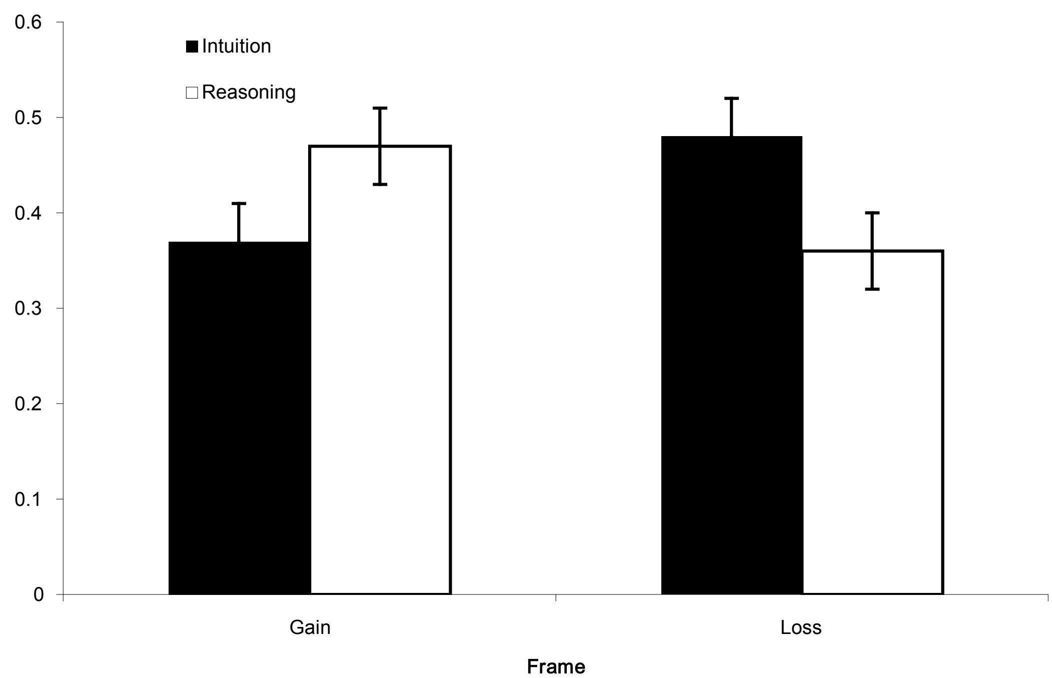

Figure 3.

To further investigate this interaction, two paired-samples t-tests compared the percentages of risky choices older adults made under gain frames to those made under loss frames for each of the two instructional conditions. A significant effect of frame was found in older adults in the intuition task condition, $t(22) = -2.14$, $p = 0.04$. Older adults who received intuition instructions made more risky choices in loss-framed questions (M = 0.48) than in gain-framed questions (M = 0.37). In contrast, older adults in the reasoning condition demonstrated a significant effect in the reverse direction, $t(22) = 2.37$, $p = 0.03$. These participants made more risky choices under gain frames (M = 0.47) than they did under loss frames (M = 0.36).

A repeated-measures ANOVA of the parameters described above analyzed the proportions of risky choices made by younger adults. In contrast to the results obtained in the older adult sample, only a significant main effect of frame was found in younger adults $F(1, 66) = 8.19$, $p < 0.01$. However, the direction of this effect was opposite to that expected for a typical framing effect. Younger adults were more likely to make risky choices under gain frames (M = 0.58) than under loss frames (M = 0.46). The interaction of frame and task condition, however, was not significant, $F(1, 66) = 0.07$, $p > 0.75$ (See Figure 4).

To clarify these findings, two paired-samples t-tests – one for each sub-group of younger adults – compared percentages of gain-framed risky choices against percentages of loss-framed risky choices. These tests revealed that younger adults demonstrated significant reversed-direction framing effects in both the intuition, $t(33) = 2.03$, $p = 0.05$, and reasoning conditions, $t(33) = 2.03$, $p = 0.05$. Younger adults consistently took more risky bets in gain-framed choices than they did in loss-framed choices

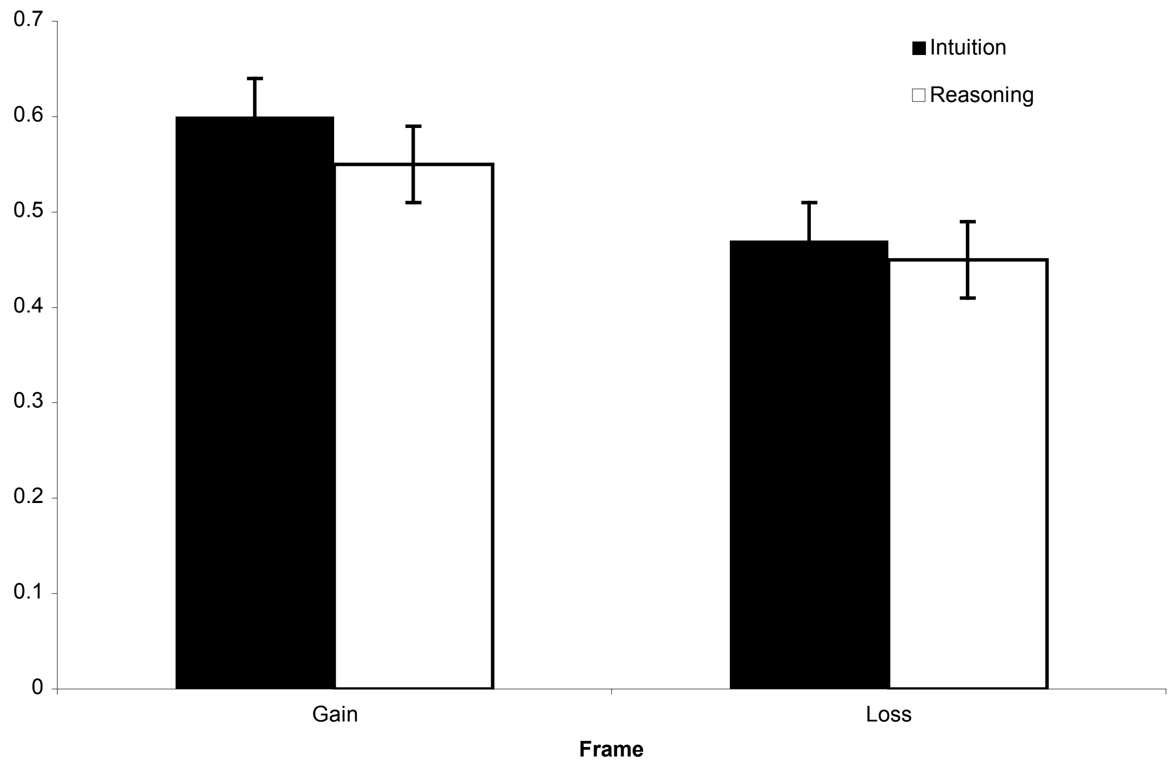

Figure 4.

Discussion

Experiment 2 investigated whether instructional manipulations could influence observable risk-framing effects in older and younger adults. In completing a set of gain- and loss- framed monetary gambling scenarios older adults demonstrated a frame bias when instructed to complete the study using intuition, but not when instructed to use critical thinking. This finding confirmed the hypothesis that internal motivational manipulations would be successful in influencing frame bias.

This finding is in line with the results of Experiment 1, as well as with much of the available research on the topic of age-related decision heuristics. The results of Experiment 2 make a significant contribution to the interpretations of this preceding research in that its design isolates instructional conditions as a successful manipulation for influencing framing effects.

Unlike that of Experiment 1, the instructional design of Experiment 2 ruled out the possibility that repeated conditioning might be responsible for shifts in choice behaviors. In Experiment 2, task procedures following the instruction phase were identical between the intuition and reasoning groups, so any difference in task performance must stem from participants' original interpretations of the condition-specific instructions. The manipulation used and results obtained in Experiment 2 somewhat resemble those of Lockenhoff and Carstensen (2007). That study, however, examined study times and post-choice recall as independent variables reflecting decision strategies, but made no analysis of patterns in choice behavior. When taken together, the current Experiment 2 and the Lockenhoff and Carstensen (2007) study suggest that instructional manipulations of motivation state may modulate the influence of heuristics in older adults' decision-making by implementing differential comprehension strategies.

Unfortunately, as was the case in Experiment 1, data collected from younger adults did not conform to the hypothesis. Choice patterns for younger adults did not follow a typical framing bias of loss-framed risk seeking and gain-framed risk aversion, but surprisingly, trended significantly in the opposite direction. Such a finding is an anomaly among the available framing effect literature (for reviews see Kühberger, 1998; Levin, Schneider, & Gaeth, 1998; Kühberger, Schulte-Mecklenbeck, & Perner, 1999). One possible explanation is presented below in discussion of both experiments.

General Discussion

In the context of previous literature, we can now use these findings to propose a tentative model of elderly decision-making. This model recognizes that cognitive declines brought on in old age may limit capacity for rational decision-making, but these declines are not absolute. Equally important in the decision-making process are motivational goal states. These internal strategies may be in part responsible for the late-adulthood shift towards heuristic reliance, in that older adults will be typically less inclined to seek gain opportunities, but they may also provide a means to overcome heuristic bias. Unlike age-related cognitive declines, motivational states are temporary. Although older adults' preferred goals may be predisposed to preserving cognitive resources, these two experiments, as well as others (Kim et. al, 2006; Lockenhoff & Carstensen, 2007), have demonstrated that these motivation states may be overcome through simple experimental manipulations.

Such a model would be consistent with another theory put forth by Craik and Byrd (1982). They proposed that older adults experience deficits of "self-initiated processes," or capacities for unsupported effortful cognition. Evidence to support this view comes mainly from research of episodic memory. Experiments looking at self-initiated processes have demonstrated that typical age-related memory deficits, such as free recall accuracy and list-learning abilities, may be nullified in conditions providing contextual support (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 and removing age differences in false memory generation. Although these examples make no indication of the decision-making capacities of older adults, they are relevant to the discussion at hand in that they demonstrate a relative preservation of cognitive resources. Much like the motivational manipulations discusses above, contextual support in studies of self-initiated processing is successful in compensating for age deficits, signifying that, with external support, older adults may perform cognitively demanding tasks at levels equal to their younger counterparts.

Although this study's findings regarding motivational influences upon older adults' decision-making patterns seem fairly convincing, another crucial issue examined in the literature review remains unresolved. This study had sought to settle inconsistencies of age differences in the available research, with some studies finding an enhanced effect of framing in older adults (Kim et. al., 2006), other studies findings a reduced effect (Mikels and Reed, 2009), and still others finding no age differences at all (Mayhorn et. al., 2002; Rönnlund et. al., 2005). Both of the current experiments, based upon previous research and theoretical models, hypothesized age differences in framed choice behavior, predicting that, overall, older adults would be more susceptible to the framing bias than younger adults. However, after analyzing the data, claims to this regard are limited by a failure to find significant framing effects in any of the younger adult samples. In contrast to most studies of framed risk prompts, younger adults tested in this study have consistently demonstrated frame effects that were either not significant or in the direction opposite of typical findings. Because of this anomaly, this study will make no claim of age differences in frame effect susceptibility, but will only submit another possibility to the already contradictory pool of findings.

One possible explanation for this failure stems from the concept of numeracy. Essentially, numeracy is a trait regarding fluency with numbers and performing calculations. Individual differences in numeracy have been demonstrated to create disruptions in typical framing effects, since those of high numeracy may be more likely than their low-numeracy counterparts to recognize misleading information in framed decision tasks (Peters & Levin, 2008). Although basic numeracy is typically not an age-dependent factor, levels of advanced numeracy might be influential in comparing a younger adult sample of college students to a mostly retired older adult sample. Group differences could possibly account for the inconsistent findings in younger adults, as they may be interpreting the decision prompts from a perspective of more advanced numeracy. Unfortunately, no measure of numeracy was taken in these experiments. Future studies might benefit from analyzing numeracy traits in relation to age differences and frame task performance.

Practically speaking, these findings have implications for many day-to-day decisions made by older adults, especially in financial domains. Even if advertisers do not intentionally warp statistical information, simple presentations of monetary gains and losses may be strongly misleading to older adults. This study has demonstrated that simple manipulations of motivation state may help reduce these biases in decision-making with minimal effort. Older adults, as well as the framers of their decisions should take such motivational states into consideration, so that they arrive at more sound, reflective decisions.

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