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Decisional strategy determines whether frame influences treatment preferences for medical decisions

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Decisional strategy determines whether frame influences treatment preferences for medical decisions

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Abstract

Decision makers are influenced by the frame of information such that preferences vary depending on whether survival or mortality data are presented. Research is inconsistent as to whether and how age impacts framing effects. This paper presents two studies that used qualitative analyses of think-aloud protocols to understand how the type of information used in the decision making process varies by frame and age. In Study 1, 40 older adults, age 65 to 89, and 40 younger adults, age 18 to 24, responded to a hypothetical lung cancer scenario in a within-subject design. Participants received both a survival and mortality frame. Qualitative analyses revealed that two main decisional strategies were used by all participants: one strategy reflected a data-driven decisional process whereas the other reflected an experience-driven process. Age predicted decisional strategy, with older adults less likely to use a data-driven strategy. Frame interacted with strategy to predict treatment choice; only those using a data-driven strategy demonstrated framing effects. In Study 2, 61 older adults, age 65 to 98, and 63 younger adults, age 18 to 30, responded to the same scenarios as in Study 1 in a between-subject design. The results of Study 1 were replicated, with age significantly predicting decisional strategy and frame interacting with strategy to predict treatment choice. Findings suggest that framing effects may be more related to decisional strategy than to age.

Keywords: Medical decision making, heuristics, framing effects

Word Count: 7328

Decisional strategy determines whether frame influences treatment preferences for medical decisions

The manner in which treatment options are presented to patients can have a substantial impact on how those options are evaluated. Evidence suggests that patients find a treatment less attractive when treatment outcomes are framed in terms of mortality rates as compared to survival rates (e.g., Moxey, O'Connell, McGettigan, & Henry, 2003; Wilson, Kaplan, & Schneiderman, 1987). The framing of treatment options also appears to impact the trade-offs that patients are willing to make between short-term risks and long-term benefits (e.g., Kim, Goldstein, Hasher, & Zacks, 2005; McNeil, Pauker, Sox, & Tversky, 1982; O'Connor et al., 1985). For example, some studies suggest that presenting treatment outcome data in terms of survival rates, as opposed to mortality rates, leads to an increased willingness to trade short-term risks for long-term benefits (e.g., McNeil et al., 1982; O'Connor et al., 1985). Older adults are often presented with complex medical decisions with options that vary in terms of long and short-term risk, yet we know little about how these decisions are influenced by age. In addition, we have little information about why frame might shift preferences for long or short-term risk options. The current paper focuses on the question of how the frame of information influences older adults' decisional process in the context of medical decisions that vary in terms of short versus long-term risks.

Studies examining framing effects among older adults have produced mixed results (Bruine de Bruin, Parker, & Fischhoff, 2007; Mayhorn, Fisk, & Whittle, 2002; Mikels & Reed, 2009; Rönnlund, Karlsson, Laggnäs, Larsson, & Lindström, 2005). Mikels and Reed (2009), Rönnlund et al. (2005), and Mayhorn, Fisk, and Whittle (2002) found minimal age differences in framing effects. These studies, using a variety of scenarios and framing manipulations (c.f.,

Levin, Schneider, & Gaeth, 1998), concluded that older and younger adults were equally susceptible to framing biases in decision making. Other research suggests that older adults are more susceptible to framing biases. Bruine de Bruin et al. (2007) used several types of framing problems to measure resistance to framing effects, including the same health scenario used by Mayhorn et al. (2002). Results indicated that older adults were less resistant to framing effects than younger adults. Kim et al. (2005), using a hypothetical lung cancer decision making task, also found that older adults were more susceptible to framing effects than younger adults, though only marginally. It is unclear why some studies have found age differences in framing effects while others have not. One problem is that it is difficult to draw conclusions across studies with widely varying methodologies (e.g., different decision scenarios).

The above studies used decision scenarios that focused on a variety of decision making domains (e.g., financial decision making, evaluation of treatment options for hypothetical patients, and public health decisions), but did not examine the types of information participants consider when they are presented with decisions involving trade-offs between short and long-term risks. Decisions involving trade-offs between long and short-term risk are distinct from more commonly studied decision domains (e.g., financial decision making, public health decisions) in which the options are more clearly defined as risk-seeking versus risk-averse All of the options in complex medical decisions usually involve some risk. Trade offs between short and long-term risk are an inherent component of medical decision making (c.f., Hunink et al., 2001). Because older adults are more likely than younger adults to face decisions about medical treatments that vary in long and short-term outcomes, it is important to understand whether and how age influences these complex medical decisions (c.f., Finucane, Mertz, Slovic, & Schmidt, 2005).

To our knowledge, only one study has included a separate group of older adults and examined framing effects in hypothetical medical decisions involving treatment options varying in short and long-term risk (Kim et al., 2005). This study presented participants with two treatment options: one with higher short-term risk but lower long-term risk, and the other with lower short-term risk but higher long-term risk. Outcomes were framed in terms of survival or mortality. Kim et al. (2005) found that older adults, but not younger adults, showed a preference for the option with higher short-term risk in the survival condition. The Kim et al. (2005) study was based on a study by McNeil et al. (1982), which found that participants were more likely to select the option with higher short-term risk (surgery) when outcomes were framed in terms of survival rates, though this study did not include a separate group of older adults. These studies suggest that the frame in which information is presented may potentially have a powerful influence on how patients decide between treatment options with very different risk outcomes, and that this effect may become more powerful with age. A better understanding of the factors influencing medical decisions that require a trade-off between short and long-term harm and benefit is critical to promotion of patient-centered care and informed medical decision making.

The current studies use a mixed-method design to explore how frame impacts older and younger adults' hypothetical medical decisions about options that vary in long and short-term risk. We used the scenarios from McNeil et al. (1982) and Kim et al. (2005) which simulate one type of complex trade-off that patients are often asked to make in medical decisions. Use of these scenarios provides an opportunity to replicate the results of McNeil et al (1982) and Kim et al. (2005). In the qualitative component of the studies, we ask participants to report the type of information they consider to be most relevant to their decisions. An understanding of how participants incorporate information into their decision making process will lead to a more

comprehensive understanding of why and how age interacts with frame in medical decision making.

Study 1

In the first study, we used a within-subjects design with the scenarios from McNeil et al. (1982) and Kim et al. (2005) to investigate whether treatment preferences for a hypothetical lung cancer treatment varied by frame. We hypothesized that we would replicate the results of Kim et al. (2005) and McNeil et al. (1982). That is, we expected that there would be a preference for the option with higher short-term risk in the survival condition. We explored the type of information used by participants in their decision making by having them think-aloud while making their decision. The main goal of the study was to determine whether and how information use varied by age and frame. No a priori hypotheses were formulated about the types of information that would be used by participants and whether the information would vary by frame or age. We used an inductive approach to analysis of the qualitative data, such that a coding scheme was developed based on themes that emerged from participants' protocols rather than from a priori hypotheses.

Method

Participants

Younger and older adults were recruited for participation in the current study. The first group of participants consisted of 40 younger adults (25 women and 15 men) recruited from undergraduate psychology classes, who had a mean age of 19.8 years (range 18-24; *SD* = 1.5). The second group of participants consisted of 40 older adults (21 women and 19 men), recruited from local senior centers, who had a mean age of 77.4 years (range 65-89; *SD* = 5.9). Additional demographic information is presented in Table 1. As compared to the older adult sample, the

younger adult sample had significantly more years of education and rated their health as significantly better (see Table 1).

The protocol for the current study was approved by the Institutional Review Board at West Virginia University. Some of the undergraduate participants participated in the project for class credit. All participants had the opportunity to enter their names to win one of four $75 cash prize drawings.

Equipment & Materials

Equipment. Think-aloud protocols were recorded using a standard audio recorder. The participants were asked to wear lapel microphones while they worked through the think-aloud technique. All interviews were transcribed following the session.

Demographic. All participants completed a demographic questionnaire. The questionnaire asked the participants to provide basic information such as age, gender, years of education, marital status, ethnicity, and current health status. Participants were also asked a series of questions on vicarious (second-hand) experience with cancer and knowledge of cancer-related facts and statistics.

Practice Think-Aloud Problems and Instructions. Participants were provided with detailed instructions on how to complete the think-aloud portion of the study. Prior to asking the participant to practice thinking aloud, the first author modeled the think-aloud technique using a simple arithmetic problem. Participants were then asked to practice two think-aloud problems. These problems, taken from Ericsson and Simon (1984), focused on getting the participants to verbalize their thought process while engaging in the task.

Participant Instructions. The participant instructions were adapted from McNeil et al. (1982) and provided participants with background information on the two cancer treatment

options, surgery and radiation. The instructions also provided information on how most patients feel six weeks after receiving either treatment. The six week comparison was used to allow participants to compare information on the duration of treatments and the length of recovery. The instructions provided to participants are presented in the Appendix.

Stimulus Materials. The two hypothetical lung cancer scenarios used in the current study were taken from McNeil et al. (1982). The scenarios presented outcome data in a cumulative probability format with outcomes framed either in terms of survival rates or in terms of mortality rates. Based on the description of the treatments, radiation offered better short-term survival rates (post-treatment and after one year) and worse long-term survival rates (after five years) whereas surgery offered worse short-term survival rates (post-treatment and after one year) and better long-term survival rates (after five years). Because long-term survival was higher for the surgery option, surgery had a greater net benefit. The scenarios are presented in Table 2, with the treatment options arranged to highlight the differences in outcome between the two treatments. All participants received both frames (survival and mortality) in a within-subject design, with order of frame counter-balanced across participants.

Treatment Choice Questionnaire. Directly following presentation of each scenario (survival and mortality frames), participants were asked to circle their preferred treatment choice.

Study Procedure

All participants completed the study in a one-on-one interview format. The first author administered all the materials. After participants gave consent, the first author read the instructions for the think-aloud procedure, then modeled a think-aloud problem. Participants were then asked to complete two think-aloud practice problems. The practice problems were repeated until the participant could talk out loud continuously with no more than a five second

break. Following this practice session, participants were instructed to read the medical scenarios and think-aloud while they made their decisions. Participants were asked to engage in the think-aloud procedure before circling their preferred treatment choice. During the think-aloud procedure, the participant was prompted to verbalize his or her thoughts if there was more than five seconds of silence. The medical scenarios were counter-balanced across participants such that 40 participants received the survival frame first and 40 received the mortality frame first. In between presentation of the two frames, participants completed a related decisional scenario that was not analyzed as part of this study. Participants completed the demographic questionnaire following completion of the think-aloud and decision making components of the study.

Coding Procedure

We examined participant responses to the think-aloud procedure to determine what information participants used in making their treatment decisions. All think-aloud responses were transcribed and imported into NVivo qualitative analysis software (QSR International Pty Ltd. Version 6, 2002). Each participant provided two responses, one for each frame. The first and second authors read through all the responses to identify systematic patterns in the types of information used by participants in their responses. The transcribed responses were generated from a report in NVivo which produced aggregated responses across age and condition. Therefore, the authors were blind to age and condition when reading participant responses and developing the coding scheme. We coded any information mentioned in participant responses. However, our analysis focused on the piece of information on which participants based their final treatment choice. After the coding system was developed, the first author and a research assistant independently coded all responses, again in aggregate form and blind to age and

condition. Disagreements were resolved through discussion. Interrater reliability for coding of the main decisional strategy (experience or data) was 0.91.

Results

Qualitative Results

Responses to the think-aloud procedure were relatively short, with an average word count of 118 words for the survival frame and 126 words for the mortality frame. Word count was not significantly different across age groups.

Participants used two distinct types of information to inform their decisions. Either participants used the data provided in the scenario or they used information gleaned from their personal experience or beliefs about the treatment. Comments coded as data-driven were ones in which the participant cited or elaborated on the data provided by the experimenter in the scenario. The following are examples of comments that were coded as data-driven:

> The surgical procedure…more than 12 patients live longer than 5 years, as opposed to the radiation… So, in one I chose radiation and one I chose surgery, so that don't make sense either. But, each one is different. (older adult participant)
>
> I think I'd take that second one [surgery]. 90 patients live through treatment, 68 live for more than one year, and 34 more than five years. Yeah, 34 live more than five years, that's more than the first one. And that first one, all of them lived through the treatment, but then 77 lived through just more than a year. I'd take that second treatment [surgery]. (older adult participant)
>
> I would probably pick radiation therapy, just based on the numbers because it says here that none died during the treatment and for the surgery 10 died during the treatment… the first thing that comes to mind is family, and any loved ones it would be hard to just go in

> there knowing that you might not come out. But during radiation they don't really worry about that. (younger adult participant)

Comments coded as data-driven were broken down into those in which participants made their decision based upon the short-term data (post-treatment and one-year outcomes), those in which participants based their decision upon the long-term data (five-year outcomes), and those in which the participant misread or misquoted either the long or short-term data. In the following quotation, the participant makes the decision based upon short-term data:

> For this one radiation therapy sounds better because none of the patients died during treatment, as compared to surgery where 10 individuals died. All the statistics after that as far as living or dying within five years doesn't seem to be that much different. So for this one I would definitely do radiation therapy. Just to eliminate the possibility of not making it through surgery. (younger adult participant)

In this quotation, the participant makes the decision based upon long-term data:

> Now, see I would have the surgery on this one because you live longer. See, 34 patients live more than 5 years and only 22 patients lived [with the radiation]. (older adult participant)

In the following quotation, which was coded as misreading the data, the participant discusses how radiation has better long-term outcomes when it is actually surgery that has better long-term outcomes:

> …I'd rather go with the second one [radiation]. Because of the fact that you live better longer, you know, then they have time away from that longer, that'd be okay. In other words, they'd be improving the length of their life once they get done with the radiation. I'd go for that one… where you would have good days at the end. (older adult participant)

Some participants did not use the data provided in the scenarios to inform their decisions but instead used information from their own personal experience or that of friends and family members, or their knowledge and beliefs about the process of treatment. We coded these responses as "experience-driven." The following are examples of comments that were coded as experience-driven:

> My husband died in six months and he had his lung removed… they didn't give him any radiation, I think they just thought it was too late…I would choose the radiation and try that because of the experience I had [with my husband]. (older adult participant)
>
> My dad went through radiation and cancer; he had a better survival rate but we never considered surgery. So I'd probably have to go with radiation only because I know more about it... it's more about my own experience. (younger adult participant)
>
> Well, again, it's the thing of the surgery… to remove a lung. It seems to me it was very stressful and I don't know whether I could handle that or not. It'd be too much stress on me and my body. (older adult participant)

Although our analyses included only the information used by participants to inform their final choice, we also coded whether participants ever mentioned the other type of information. That is, we noted whether people who ultimately made their decision based on their own knowledge or experience ever mentioned the data presented in the scenarios and vice versa. For example, one older adult participant responded to the survival frame by stating:

> Nothing here is persuading me, but they live more than one year, and 22 patients live for more than five, and I'm looking forward to more than five. I had enough of surgeries, I don't need no more. I got an artificial leg, for one thing. I had a triple bypass, so I think I'd try the radiation.

For this response, the main decisional strategy was coded as experience-driven, though the participant also referenced the data. For those responses that used experience as the main strategy but also incorporated data, there was a tendency to dismiss the data as unimportant, as illustrated in the previous quotation.

Across all responses (160 total; 80 responses per age group), 73.1 percent of responses were based on scenario data and 26.9 percent of responses were based on experiential information. A majority of participants (83.8%) referenced the same type of information (either experience or data) across both frames (younger adults: 90%; older adults: 77.5%). We calculated the percent of total participant responses which fell into each of four categories: responses which referred to presented data only, responses which referred to experiential information only, responses which referred to both types of information with final decision based on the data, and responses which referred to both types of information with final decision based on experience. We calculated percents based on responses rather than participants because each participant contributed two responses. For younger adults, 71.2 percent of responses referenced only data and none focused exclusively on experience. Ten percent of responses referenced both data and experience and based the final decision on experience and 18.8 percent of responses referenced both and based the final decision on data. For older adults, 40.0 percent of responses referenced only data and 30.0 percent referenced only experience. Percent of responses referencing both types of information and basing the final decision on experience was 13.7 percent, whereas percent of responses referencing both types of information and basing the final decision on the data was 16.3 percent.

Predicting Decisional Strategy

Logistic regression analysis was used to predict the main decisional strategy used in the think-aloud responses. Main decisional strategy (experience or data) was used as the dependent variable; the independent variables were age (continuous variable), frame (0 = survival, 1 = mortality), treatment choice (0 = radiation, 1 = surgery), years of education (continuous variable), and order (survival first vs. mortality first). In forward (Wald) entry, age was the only significant predictor (O.R. = 0.97, $p < 0.001$). Increased age was associated with decreased use of the data strategy (Table 3).

Predicting Treatment Choice

Logistic regression was used to predict treatment choice (surgery or radiation). Independent variables were age, years of education, order, frame (survival [coded as 0] or mortality [coded as 1]), and decisional strategy (experience [coded as 0] or data [coded as 1]). Three interaction terms were also included: age by frame, frame by strategy, and order by frame by age. The age by frame interaction was included to examine age differences in framing effects. The frame by strategy interaction was included to test whether framing effects vary by decisional strategy. The interaction with order, frame, and age was included to examine the impact of receiving the survival or mortality framed scenario first.

Using forward (Wald) entry for the independent variables, strategy (O.R. = 2.60, $p < 0.05$) and the frame by strategy interaction (O.R. = 0.19, $p < 0.001$) were the only significant predictors (Table 4). An examination of the interaction term revealed that, among those using the experience strategy there was no effect of frame (surgery was chosen 40 percent of the time in the survival frame, and 50 percent of the time in the mortality frame), whereas among those using the data strategy there was a framing effect. Specifically, among those who based their decision on scenario data, surgery was chosen 67.3 percent of the time in the survival frame and 27.4 percent

of the time in the mortality frame. In sum, framing effects were observed only among those participants using the data strategy.

Each treatment choice included both short and long-term outcome data, so participants using a data strategy could focus on either short or long-term data to make their final decision. Across frames, participants were equally likely to focus on long and short-term outcome data (47.9 percent of responses were indicative of a short-term time focus). We also examined whether frame was associated with a differential focus on short vs. long-term outcome data. In a logistic regression analysis with time focus as the dependent variable and frame as the independent variable, frame significantly predicted time focus (O.R. = 0.23, $p < 0.001$). In the mortality frame participants were more likely to focus on short-term data (Table 5).

Among older adults' responses reflecting a data-driven strategy, 22.2 percent (10 responses) reflected a misread or misquote of the data. Among younger adults' responses reflecting a data-driven strategy, 18.1 percent (13 responses) reflected a misread or misquote of the data. Age was unrelated to likelihood of misreading the data, $\chi 2$ (1, N = 117) = 0.30, p = 0.58. There was also no significant relationship between education and misreading the data, $\chi 2$ (2, N = 117) = 5.10, p = 0.07, or between frame and misreading the data, $\chi 2$ (1, N = 117) = 3.16, p = 0.07.

Discussion

Study 1 showed that older adults were less likely than younger adults to use scenario data to make their final treatment choice. The type of information used by participants determined whether frame influenced treatment choice. When participants used scenario data to inform their decisions, their treatment choice was influenced by the frame of the information. When participants relied on personally-generated information (i.e., their own experience) to inform

their decision, their final treatment choice was not impacted by the frame of the information. Among those using a data strategy, frame appeared to influence treatment choice by shifting the weight assigned to long versus short-term outcomes. Specifically, in the mortality frame, participants appeared to focus more on short-term outcomes. The framing effect demonstrated by participants using the data strategy replicated the findings of McNeil et al. (1982) and Kim et al. (2005), in that participants preferred surgery in the survival frame. Whereas Kim et al. (2005) found that the framing effect was stronger in older adults, we found no main effect of age on treatment choice and age did not interact with frame to predict treatment choice. Instead, our findings showed that decisional strategy predicted susceptibility to framing effects and age did not play a direct role.

There are three factors that limit our ability to interpret the findings from Study 1. First, presenting all participants with both frames may have led some participants to question the data, thus promoting a higher degree of reliance on experiential information to inform decisions. To address this issue, we use a between-subjects design for the framing condition in Study 2. Second, it is possible that the lower level of education among older adults resulted in a greater reliance on experiential information. Study 2 addresses this issue by including a sample of younger and older adults who have roughly equivalent levels of education. Additionally, use of a think-aloud procedure with a within-subject design in Study 1 may have made it more likely that participants were aware of their responses and tried to act in a consistent manner. To address this concern, Study 2 asked participants to write their responses to only one frame (survival or mortality).

Study 2

In Study 2 each participant only saw one frame of information (survival vs. mortality). In addition to the difference in design, the younger and older adults who participated in the second study did not differ significantly in years of education, which allowed us to observe the effect of age independent of education. For the second study, participants were asked to describe, in writing, the piece of information that was most important to their decision[1]. Our main goal for the second study was to confirm the findings from Study 1.

Participants

Two groups, younger and older adults, were recruited for participation in the current study (Table 1). The first group consisted of 63 younger adults (38 women and 25 men) recruited from Introduction to Psychology classes, who had a mean age of 18.6 years (range 18-30; *SD* = 1.9). The second group of participants consisted of 61 older adults (41 women and 20 men) who had a mean age of 76.8 years (range 65-98, *SD* = 7.1). The older adult participants were recruited from community-based senior centers. Younger and older adults had 12.7 and 13.4 years of education, respectively. This difference was not statistically significant. There was a statistically significant difference in self-reported health with younger adults rating their health as significantly better than older adults.

Materials

Demographic. The demographic questionnaire used in the current study asked the

[1] Study 2 included a manipulation to reduce framing effects in which half of the participants were asked to describe the advantages and disadvantages of surgery and radiation. The remaining half of the participants answered four questions about health behavior change (as a control for time and effort). All participants were asked to indicate which information was most important in their decision. The latter response was analyzed for this study. Because the manipulation described above did not impact decisional strategy, treatment choice, or the interaction of frame with treatment choice, we will not discuss it further.

participant to complete basic information such as age, gender, years of education, marital status, and ethnicity. The demographic questionnaire also included questions on the participants' health background and vicarious experience of cancer (see Table 1).

Participant Instructions. The participant instructions were the same as used in Study 1.

Medical Scenarios. A set of two medical scenarios containing information about treatments for lung cancer, taken from McNeil et al. (1982) served as the stimulus materials (see Appendix). The scenarios were the same as used in Study 1.

Treatment Choice Questionnaire. This form asked the participants to circle whether they would choose surgery or radiation for the scenario they just read.

Procedure

After completing the written consent form and completing the demographic questionnaire, the participants read the participant instructions and then read the scenario. After reading the scenario, the participants were either asked questions about the advantages/disadvantages of each treatment (see previous footnote) or were asked questions about willingness to make health behavior changes. All participants were asked to identify the piece of information most important to their decision, either before making their treatment decision (debias group) or directly after making their decision (control group).

Data were collected in a group format, with approximately five to ten participants per group administration. Upon study completion, participants were asked not to discuss the experiment with peers. Younger adult participants were awarded extra credit for their participation. Older adult participants entered their names into a drawing for an opportunity to win $100. The protocol for this study was approved by the Institutional Review Board at West Virginia University.

Coding Procedure

Participant responses identifying the information most important to their decision were coded according to the coding scheme developed in Study 1. Responses were typically only one or two sentences. The responses were coded as referring to scenario data or to information gleaned from personal experience. Similar to Study 1, we coded any information mentioned in participant responses. However, our analysis focused on the piece of information on which participants based their final treatment choice. As in Study 1, responses referring to scenario data were further coded into those referring to short-term data, those referring to long-term data, and those reflecting a misread or misunderstanding of scenario data. As noted previously, half of the participants responded to additional questions about the advantages and disadvantages of each treatment. These responses were also coded according to the above coding strategy, though were not included in analyses[2]. The first author and a research assistant coded all responses according to the above coding strategy. Interrater reliability for coding the main decisional strategy (experience or data) was 0.96.

Results

Qualitative Results

An example of a response referring to scenario data is as follows: "The death rate during the procedure is the most important because living through treatments is as important as time after surgery." This response was from a younger adult participant in the survival frame condition who chose radiation. An example of a response coded as an experience strategy is as follows:

[2] Participants who were asked to describe the advantages and disadvantages of each treatment option tended to cite both experience and data. However, in order to test our results from Study 1, we focused our analysis on responses from the 'most important piece of information' question. Many participants in the advantages/disadvantages group did not answer all five questions, suggesting a possible effect of fatigue and increasing our rate of missing data (1 younger adult and 11 older adults did not provide an answer regarding the most important piece of information).

"Because my mother had surgery and it spread more." This response was from an older adult participant who chose radiation with the mortality frame.

As can be seen, responses obtained in Study 2 were significantly shorter than responses obtained in Study 1 and often focused on one piece of information, potentially due to the fact that participants were asked to answer more questions in Study 2. Across all participants who provided responses to the open-ended question about most important piece of information (112 total; 62 younger adults, 50 older adults), 58.9 percent of participants used a data strategy and 41.1 percent of participants used an experience strategy.

Predicting Decisional Strategy

Logistic regression analysis was used to predict the main decisional strategy used by participants. Main decisional strategy (experience or data) was the dependent variable and the independent variables were age (continuous variable), frame (0 = survival, 1 = mortality), treatment choice (0 = radiation, 1 = survival), and years of education (continuous variable). In forward (Wald) entry, age was the only significant predictor (O.R. = 0.96, $p < 0.001$). Similar to Study 1, increased age was associated with decreased use of the data strategy (Table 3).

Predicting Treatment Choice

We used logistic regression to predict treatment choice (surgery or radiation). Independent variables were age, frame (0 = survival, 1 = mortality), years of education, and decisional strategy (0 = experience, 1 = data). Interaction terms for age by frame and frame by strategy were also included. Using forward (Wald) entry for the independent variables, the frame by strategy interaction was the only significant predictor (O.R. = 0.32, $p < 0.05$; Table 4). An examination of the interaction term revealed that, among those using the experience strategy, surgery was chosen 57.1 percent of the time in the survival frame, and 57.1 percent of the time in

the mortality frame. Among those using the data strategy, surgery was chosen 62.9 percent of the time in the survival frame and 29.0 percent of the time in the mortality frame. Therefore, similar to Study 1, framing effects were observed only among those participants using the data strategy.

Among those using a data strategy we examined whether frame was related to time focus (short vs. long-term). In a logistic regression analysis with time focus as the dependent variable and frame as the independent variable, frame significantly predicted time focus (O.R. = 0.23, $p < 0.001$). In the mortality frame participants were more likely to focus on short-term data (Table 5). In Study 2, only seven responses reflected a misread of the data (2 older adults and 5 younger adults). Due to this, additional analyses were not undertaken to examine variables related to misreading the data.

Discussion

Study 2 provided further evidence that framing effects are contingent on the decisional strategy adopted by participants. Study 2 also suggests that older adults are less likely to adopt a data-driven decisional strategy even when their level of education is equivalent to younger adults. One of the concerns about the method used in Study 1 was that use of a think-aloud procedure with a within-subject design may have made it more likely that participants were aware of their responses and tried to act in a consistent manner. Our findings from Study 1 were replicated in Study 2, despite the change in design and new sample.

General Discussion

The main goal of the two studies presented in this paper was to examine how participants incorporate information into their decision making process when making hypothetical lung cancer treatment decisions that vary in short and long-term outcomes. Across studies we found that participants utilized two different types of information to decide between treatment options:

either they used the data about short and long-term outcomes, which was presented in the scenarios, or they used information from their personal experience and beliefs. Older participants were less likely to use scenario data to inform their decisions. Only participants who utilized scenario data were influenced by the frame of the information in the scenarios. For these participants, frame appeared to shift the weight placed on short versus long-term outcomes. When reading the survival framed scenario, participants tended to focus on the long-term benefits of surgery, whereas the mortality frame shifted focus to short-term risks. When participants used personal experience or beliefs to inform their decision they were not influenced by whether the data were presented in terms of mortality or survival. This set of findings was replicated in two different samples using both a within-subject and between-subject design.

The framing effect observed in the current studies among those using a data strategy also replicated the framing effect found by McNeil et al. (1982) and by Kim et al. (2005) in older adults. Across all studies, individuals tended to select the option with higher short-term risk more frequently when outcomes were presented in terms of survival rates than when outcomes were presented in terms of mortality rates. Unlike Kim et al. (2005) we did not find an age difference in framing effects. The age difference in our study was related to decision strategy. It is not clear why our findings regarding age diverge from those of Kim et al. (2005). One possibility is that the older adults in the Kim et al. (2005) study were more likely to show framing effects because they were more likely than the older adults in our study to use the scenario data to inform their decisions. This may have resulted from differences in the sample of older adults (rural vs. urban), or to a difference in the instructions we provided to participants. Our instructions encouraged use of multiple types of information, including personal experiences, during the decision task (see Appendix).

In the current studies, age was not directly related to framing effects or treatment choice. Instead, age differences were seen in selection of a final decisional strategy. Across studies, younger adults primarily used a data-driven decisional strategy. In Study 1, older adults were equally likely to use either strategy and in Study 2 older adults were more likely to use an experience based strategy. One possibility is that older adults used an experience-based strategy more frequently than young adults because they have more experience with cancer and other diseases. Our measure of experience suggested that the younger and older adults in the current studies had relatively equal exposure to cancer via friends and family members. However, a more detailed measure of experience might show that older adults have more experience with illness than younger adults. The age difference in strategy did not appear to be related to education, but it could potentially be related to differences in cognitive status between the two age groups (e.g., Henninger, Madden, & Huettel, 2010).

Individuals who use experience to guide their decision making appear to be less susceptible to surface level differences (e.g., framing effects) in the presentation of information. However, using experience may represent a problematic decisional strategy for high-risk medical decisions. Informed medical decision making involves making trade-offs between risks, benefits, costs, and preferences, taking into account the evidence for each option, and integrating this information with personal values (Hunink et al., 2001). In our studies, older adults' increased reliance on experience to inform decisions is consistent with research by Labouvie-Vief (1991), suggesting that adults' information-processing systems may change with age. Specifically, younger adults may be more focused on the concrete aspects of a decision (e.g., outcomes), whereas older adults appear to integrate more contextual factors into their processing. The emphasis on experience by older adult participants may reflect an improved ability to integrate

contextual factors and personal values into their decision making process, which is a critical component of medical decision making. However, our finding in Study 1 that 30 percent of older adults used experience without referencing the data suggests that some individuals may utilize personal experience and beliefs to the exclusion of relevant data. This strategy may be protective against framing effects, but may also increase the risk of uninformed medical decisions.

It is also possible that use of an experience strategy is related to motivational shifts in decision making across the lifespan in which older adults place more emphasis on emotionally-salient information (e.g., Carstensen & Turk-Charles, 1994; Löckenhoff & Carstensen, 2007). It is possible that use of the experience strategy among older adults in our studies may reflect an age-related increase in attention to emotionally-based information. The use of "gist" in decision making also increases with age and experience (Reyna, 2008), suggesting that medical decisions among older adults may be guided more by stereotyped representations of treatments than by the provided outcome information. This process may also partially explain why we saw increased use of decision making guided by personal experience and beliefs among our older adult participants.

Our study provides evidence that information frame changes treatment choice by shifting participants' focus on short-term versus long-term outcomes of treatment options. When information was presented in terms of survival, participants using the data strategy considered long-term outcomes to be most important. Because surgery had better long-term outcomes, surgery was preferred in the survival frame. In contrast, when information was presented in terms of mortality, participants using a data strategy considered information about short-term risks to be most important. Thus, they preferred radiation in the mortality frame condition. McNeil et al. (1982) speculated that radiation is selected more often in the mortality condition because the

relative reduction in risk of immediate death from 10 percent to zero is more salient than the relative increase in survival from 90 percent to 100 percent. Our findings confirm that participants are focused on short-term outcomes more in the mortality condition. Future research should explore whether this finding is dependent on the particular values of the outcomes presented in the scenarios.

Further, our results imply that individuals may utilize qualitatively different strategies when faced with the same choices. In particular, our findings should serve as a reminder that results of studies with younger adults should not be generalized to older adults who may be using qualitatively different decision strategies. Moreover, our results may help explain the mixed findings with regard to framing effects among older and younger adults. Whether older or younger adults show framing effects may depend, in part, on the type of decisional strategy they apply to the situation. Understanding age differences in framing effects may require a better understanding of the factors that lead older adults to base decisions on experimenter presented data versus their own personal experience.

Limitations

The presented results must be considered in light of some limitations. First, we did not collect extensive data on the cognitive functioning of our participants for either study. A cognitive screening instrument was used in Study 1, though both younger and older adults scored low on the measure, suggesting poor specificity. It is possible that the low scores on our screening instrument were partially due to the measure being completed at the end of the study, thereby increasing the potential effects of fatigue on performance (e.g., Vohs et al., 2008). A more complete cognitive assessment should be included in future studies, as it would help to address the question as to whether cognitive status predicts decisional strategy and framing

effects. It is also possible that the effectiveness of the think-aloud protocol in Study 1 may have been influenced by the educational differences between our younger and older adults. Specifically, younger adults may have been more skilled at verbalizing their thought processes and at summarizing and discussing the presented outcome data, as compared to the older adults. However, word count was collected in Study 1 and there were no significant age differences, suggesting that potential differences were not seen in this aspect of the think-aloud protocols. Also, the fact that we replicated the findings using a written response format in Study 2 suggests that the think aloud protocol did not influence the results.

Our coding strategy reflects the main decisional strategy that was used by participants. It is likely that patients use multiple decisional strategies when faced with complex medical decisions. It is also likely that some individuals consider multiple types of information in their decision making, as we saw in Study 1 among the minority of participants who referenced both experience and data in their decision justification responses. Further studies of patient decision-making should probe decisional strategies in more depth in order to understand the circumstances in which patients use data, experience or a combination of both when making treatment decisions. Additionally, we made an implicit assumption with our scenarios that they would be perceived as valid and personally relevant to our participants. As noted above, it is possible that our results would change with a study of patients faced with information that is tailored to their specific disease and condition.

Another limitation to our study is that we focused on short and long-term risks that were directly comparable because they addressed the same outcome (mortality/survival). Often patients are faced with options in which they must trade off risks that differ along distinct dimensions such as seriousness, familiarity, affect, and convenience, to name a few. Results from

this study may not apply to more complex, albeit common, medical decisions. Also, our results relied on a single decision scenario. Future studies are necessary to determine the range of decision types over which our findings are valid.

Conclusion and Future Directions

The current study was unique in its ability to uncover factors influencing participants' decisions about medical treatments that varied in terms of short and long-term risks and benefits. Our study suggests three major hypotheses. First, the factors influencing medical decisions vary with the decisional strategy employed. Second, age increases the likelihood that a decision maker will use experience rather than data to make decisions. Third, frame only influences decisions of those who consider data, and does so by shifting the perceived importance of long versus short-term outcome data.

Future research should aim to further characterize the decisional strategies used by patients who are facing complex medical decisions. Our findings suggest that experiential factors may play a large role in decision making, particularly among older adult patients. Further studies are necessary to explore whether, and under what conditions older adults adopt an experience-based decisional strategy. If older adults have a general tendency to make decisions based on experience and not consider data, this could have wide-ranging implications. One fruitful line of research suggests that older adult medical decision making may be optimized by focusing attention on the emotional experience of the decision, whereas younger adult decision making may be optimized by focusing attention on the presented information (e.g., Mikels, Löckenhoff, Maglio, Carstensen, Goldstein, & Garber, 2010). Our results provide further evidence that understanding how older adults use experience in their decision making may be important for understanding ways to improve decision making across the lifespan.

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Table 1

Demographic Characteristics

	Study 1		Study 2	
	Older Adults	Younger Adults	Older Adults	Younger Adults
Education (years)	11.4 (SD = 3.1)	14.4 (SD = 1.6)	12.7 (SD = 2.9)	13.3 (SD = 1.0)
Ethnicity (%)				
Caucasian	97.5	92.5	95.1	79.4
African-American	2.5	2.5	0.0	6.3
Asian/Pacific Islander	0.0	5.0	0.0	4.8
Hispanic	0.0	0.0	0.0	4.8
Self-rated Health (%)				
Excellent	12.5	45.0	9.8	34.9
Good	52.5	40.0	39.3	52.4
Average	7.5	10.0	29.5	9.5
Fair/Poor	27.5	5.0	19.7	1.6
Chronic illness (%)	82.5	10.0	65.6	3.2
Vicarious Experience (%)	95.0	97.5	83.3	75.8

Note. For Study 1, younger adults rated their health as significantly better, $t(78) = -3.57$, $p < 0.001$, and reported significantly more years of education than older adults, $t(78) = -5.36$, $p < 0.001$. For Study 2, younger adults rated their health as significantly better than older adults, $t(120) = 5.57$, $p < 0.001$. The Vicarious Experience question asked participants whether any family or friends had ever been diagnosed with cancer. For Study 2, 31 younger adults and 31

older adults received the survival frame; 32 younger adults and 30 older adults received the mortality frame.

Table 2

Stimulus Materials

Treatment	Survival Frame	Mortality Frame
Radiation Therapy Lower short-term risk Higher long-term risk	Of 100 patients having radiation therapy, all patients live through treatment, 77 patients live for more than one year, and 22 patients live for more than five years.	Of 100 patients having radiation therapy, no patients die during treatment, 23 patients die by one year, and 78 patients die by five years.
Surgery Higher short-term risk Lower long-term risk	Of 100 patients having surgery, 90 patients live through treatment, 68 patients live for more than one year, and 34 patients live for more than five years.	Of 100 patients having surgery, 10 patients die during the treatment, 32 patients die by one year, and 66 patients die by five years.

Table 3

Logistic Regression Predicting Decisional Strategy

Variable	*B*	*SE*	Exp(B)	Wald
Study 1				
Age	-0.03	0.01	0.97	20.83**
Constant	2.88	0.50	17.83	33.04
Study 2				
Age	-0.04	0.01	0.96	21.09**
Constant	2.22	0.46	9.18	23.09

Note. Study 1: Model χ^2 (1) = 25.56, $p < 0.001$; R^2 = 0.15 (Cox & Snell), 0.22 (Nagelkerke).

Study 2: Model χ^2 (1) = 24.46, $p < 0.001$; R^2 = 0.22 (Cox & Snell), 0.30 (Nagelkerke).

** $p < 0.001$

Table 4

Logistic Regression Predicting Treatment Choice

Variable	*B*	*SE*	Exp(B)	Wald
Study 1				
Strategy	0.95	0.42	2.60	5.15*
Frame by Strategy	-1.69	0.41	0.19	17.54**
Constant	-0.23	0.31	0.79	0.58
Study 2				
Frame by Strategy	-1.14	0.47	0.32	5.98*
Constant	0.30	0.25	1.35	1.46

Note. Study 1: Model χ^2 (2) = 19.17, $p < 0.001$; R^2 = 0.11 (Cox & Snell), 0.15 (Nagelkerke).

Study 2: Model χ^2 (1) = 6.37, $p < 0.01$; R^2 = 0.06 (Cox & Snell), 0.08 (Nagelkerke).

* $p < 0.05$; ** $p < 0.001$

Table 5

Logistic Regression Predicting Time Focus (Long vs. Short-term)

Variable	*B*	*SE*	Exp(B)	Wald
Study 1				
Frame	-1.49	0.39	0.23	13.98**
Constant	0.89	0.30	2.43	9.01
Study 2				
Frame	-1.30	0.53	0.27	6.08*
Constant	0.56	0.36	1.75	2.39

Note. Study 1: Model χ^2 (1) = 15.01, $p < 0.001$; R^2 = 0.12 (Cox & Snell), 0.16 (Nagelkerke).

Study 2: Model χ^2 (1) = 6.41, $p < 0.05$; R^2 = 0.10 (Cox & Snell), 0.13 (Nagelkerke).

* $p < 0.05$; ** $p < 0.001$

Appendix

Participant Instructions

The following pages contain specific information about cancer treatments at several Chicago area hospitals. Each hospital has its own doctors and policies regarding patient care, approaches to treatment, and different survival rates for the various types of treatment. For each hospital, please indicate whether you prefer surgery or radiation therapy. Below are general descriptions of the treatments.

Surgery for lung cancer involves an operation on the lungs. Most patients are in the hospital for two to three weeks and have some pain around their incisions; they spend a month or so recuperating at home. After that they generally feel fine.

Radiation therapy for lung cancer involves the use of radiation to kill the tumor and requires coming to the hospital about four times a week for six weeks. Each treatment takes a few minutes, and during the treatment patients lie on a table as if they were having an x-ray. During the course of treatment, some patients develop nausea and vomiting, but by the end of six weeks they generally feel fine.

Thus, after the initial six weeks, patients treated with either surgery or radiation therapy feel about the same.

Please read the scenarios in the order they appear. Please think-aloud about all the information that you would hypothetically consider with a decision of this magnitude, including personal experiences and the presented data for the scenario you are reading.