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The Effect of Presented Outcome Order on Patients' Decisions Concerning

Abdominal Aortic Aneurysm Repair

A Thesis Submitted to the
Yale University School of Medicine
in Partial Fulfillment of the Requirements for the
Degree of Doctor of Medicine

by

Joseph Cousin

2006

Abstract

Background: As the field of medicine is often described as one that combines science and art, it must be noted that data are only considered influential if understood by the person or persons deciding whether or not to use such data. Thus, psychological principles that govern the use of data play almost as equal a role as the medical development of that data. This study applies the psychologically-derived concepts of framing effects to the field of medicine, in an attempt to determine whether risk order should be considered as a framing effect. Specifically, this study used a randomized double-blinded controlled study to determine whether the presented order of risks involved with an abdominal aortic aneurysm surgical repair significantly affected patients' decisions as to whether or not they would hypothetically undergo the surgery.

Methods: Participants (n = 90) were shown a video interaction between a doctor and a patient whereby the doctor explained to the patient that he had an abdominal aortic aneurysm, and then detailed the surgical repair option along with the possible risks of the surgery. Participants were randomized to three different experimental conditions (A, B, and C) that differed solely on the order that participants saw the risks being outlined to the patient by the doctor. Participants in condition A (n = 30) saw the risks presented in a most grave to least grave order, participants in condition C (n = 30) saw the risks presented in a least grave to most grave order, and participants in condition B (n = 30) saw the risks presented in crescendo-decrescendo order of gravity. This study predicts that the more salient the grave risk(s), the less likely that participants would indicate that they would theoretically decide to undergo the surgery.

Results: In comparing the data from participants' responses as to whether they would undergo the surgery if they were in the patient's position, the results showed a statistically significant difference (p-value of 0.015) between three experimental conditions, with results according to the predicted direction (surgery selection rate of B > surgery selection rate of C > surgery selection rate of A). Additionally, participants were asked to rank how dangerous they believed the surgery to be on a 0 (least dangerous) to 10 (most dangerous) scale. The data showed a statistically significant difference among the three conditions (p-value of < 0.001), with the direction of association again consistent with the predicted results (i.e. mean danger scorings of condition A > mean danger scorings of condition C > mean danger scorings of condition B).

Conclusion: This study presents strong evidence for including the order of presented risks for a particular medical or surgical treatment as a subset of framing effects. The author believes this finding to necessitate that presentation order be included in the discussion of ethics governing how doctors communicate with their patients about treatment options.

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Introduction

"The fear of death is the most unjustified of all fears, for there's no risk of accident for someone who's dead." – Albert Einstein (Calaprice, 2000)

This statement, one of many clever musings of the great Albert Einstein, speaks to the physicist's understanding of the role that risk plays in the human psyche. Rationally attempting to explain away arguably the human mind's largest fear, Einstein, it could be argued, needs to appeal to the relief and cessation of fear associated with the passing of human life. Implicit in his statement, however, is that by nature of being alive, the human mind is forced to struggle with risks and accidents and more broadly speaking, one may add, decisions. These decisions may indeed be heavily based upon risks and possible negative outcomes, as Einstein implies.

Making decisions based on risk seems to be a perpetually-present occurrence in our daily lives. On a small-scale, we make decisions everyday that take into account the risk of various future outcomes. For instance, our food selection may depend on our known qualities about our bodies; most of us would be less inclined to eat food that will harm or injure our bodies. On a larger-scale, we may follow what we were taught as children and 'look both ways before crossing the street.' The risk associated with not following this advice may indeed be grave, jeopardizing our health or even our life. Risk as excitement, in and of itself, has even been popularized by the human mind by the

inventions of gambling (e.g., horse racing, the stock market), shows and games (e.g., The Price is Right, Monopoly), and thrill-seeking activities (e.g., sky-diving, full-contact martial arts). So many factors play into the human mind when engaging in such activities, from the investments to the risks to the payoffs, that entire fields of study (economic game theory, social evolutionary studies, statistics, probability, and psychology of choice) are devoted to understanding the decisions made by our human minds.

I can think of few realms of decision-making whereby the future risk or risks of a decision is taken into account more so than that of the realm of medical decision-making. From weighing the adverse-effects of a medication to composing an end-of-life advanced directive to deciding whether or not to undergo a surgery, the world of medicine prides itself on presenting patients with evidence-based medicine that attempts to quantify the risks and various outcomes of medical and surgical treatments. The human mind, however, cannot incorporate and synthesize all given information in a logical and rational way, say for example, as a computer does. Rather, as implied by Einstein's quote, our minds are influenced by our humanness, our emotional states, whether rational or not. It would seem wise also to include external perceptions, inter-personal dynamics, and internal motivations (both conscious and subconscious) along with our emotional states, as factors that influence how the human mind, in reality, makes decisions.

For instance, in the psychological realm, the way in which choices are presented by one person to another can significantly influence peoples' decision-making. Such variations in the presentation of the identical data have been called 'effects of framing.' For example, Tversky and Kahneman (1981) show that accenting different features of the same information can affect participants' choices: when presented with a positive frame,

participants choose certainty over risk-taking but when presented with a negative frame, participants choose risk-taking over certainty. In the first of two seminal studies, when participants were asked to choose either:

(a) a drug that would save 200 out of 600 lives

or

(b) a drug that would have a 1/3rd chance of saving all 600 lives and a 2/3rd chance of saving 0 lives,

participants choose option (a). Thus, when presented with the positive frame, participants choose certainty over risk. When asked, however, to choose either:

(a) a drug that would kill 400 out of 600 lives

or

(b) a drug that would have a 2/3rd chance of killing all 600 lives and a 1/3rd chance of killing 0 lives,

participants choose option (b). Thus, when presented with the negative frame, participants choose risk over certainty.

Another example is as follows. Participants, when asked to choose either:

(a) a sure gain of \$240

or

(b) a 25% chance of gaining \$1000 and a 75% chance of gaining \$0,

participants chose option (a). Again, when presented with the positive frame, participants were risk-averse, choosing the option of certainty over the risky option that would net equal (or even greater) expected monetary value. When asked, however, to choose either:

(a) a sure loss of \$750

or

(b) a 75% chance of losing \$1000 and a 25% chance of losing \$0,

participants chose option (b). Thus, when presented with the negative frame, participants were risk-taking, choosing the risky option over the option of certainty of equal expected monetary value. Such early work led to the development and acceptance of prospect theory (Tversky and Kahneman, 1981), which takes into account the frame with which information is presented, over the previously dominant rational choice theory (J. Von Neumann and O. Morgenstern, 1947).

Thus, it is absolutely the case that identical information, framed differently, can significantly affect how the receiver interprets that factual information and, correspondingly, affects any decisions based on that information. Tversky and Kahneman (1981) recognized the ethical implications of their work, concluding their seminal paper with “when framing influences the experience of consequences, the adoption of a decision frame is an ethically significant act.”

In the medical realm, almost all of the research on framing effects has concentrated on inherent bias associated with accenting positive or negative aspects of a given decision (Fishburn & Kochenberger, 1979). For instance, a medical or surgical option stated as being associated with a 60% chance of survival was shown to be more likely selected than the exact same option but stated to be associated with a 40% chance of mortality. Unfortunately, other important issues have often been ignored, such as risk order presentation. For instance, does the order, in and of itself, in which medical or surgical risks are presented to patients affect those patients' perceptions of the risks involved with that treatment and therefore affect the likelihood of their treatment selection?

The primacy and recency effects have been well documented in psychological studies of memory and attention (Murdock, 1962). These effects demonstrate participants' increased ability for recall of words or ideas presented at the start (primacy) and end (recency) of a list, relative to words or ideas presented in the middle. More specifically, with their study of memory recall as a function of serial position, Murdock showed that the recency effect is even more robust than the primacy effect, though both effects do indeed exist. But to what extent do the primacy or recency effects play a role in patients' understanding of risks of a possible medical or surgical treatment?

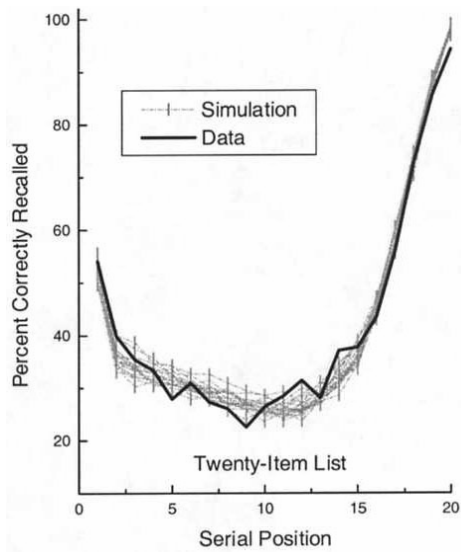


Figure 1: Percent of Items Correctly

Recalled Versus Serial Position: Data demonstrating the primacy and recency effects proposed by Murdock (from Dimopoulos & Li, 2002).

Other studies (Shields, 2005) have shown that patients may actually be stunned or shocked upon hearing bad news, such as a diagnosis of cancer. Allowing patients time to ingest such unfortunate news is essential to their emotional well-being, both current and future, as well as to their understanding of their disease. If a buzzword such as “cancer” is used and information regarding prognosis and treatments is relayed immediately after the shock of the diagnosis from the patient’s perspective, then it is likely that such a patient will not be in a suitable emotional or cognitive state to receive such subsequent information (Shields, 2005).

This study combines the findings of memory salience documented in the psychological literature with the emotional valence inherent to the realm of medical choice theory. The effort is to demonstrate that the presented order of various risks associated with a surgical treatment affects the salience of each particular risk, and

therefore affects the decision-making associated with the surgery. Specifically, this study investigated whether the order of presented risks of abdominal aortic aneurysm surgical repair affected patients' hypothetical decisions as to whether or not to undergo the surgery. Do the primacy and recency effects exist in the realm of medical decision making? Does the shock value principle exist? If so, what is its relationship to the aforementioned primacy and recency effects?

Albert Einstein suffered and eventually died from an abdominal aortic aneurysm. True to his statement regarding the fear of death, Einstein had been presented with the risks and benefits of undergoing surgery and chose to forego the procedure, living his final years with abdominal pain and dying in his sleep at the age of 76. Though tragic for the untimely death of one of the world's greatest thinkers, the decision as to how to present risks of an abdominal aortic aneurysm surgical repair is what has inspired the current study. A positive finding, in the author's opinion, will necessitate that the presented order of risks be an understudied subset of framing effects in the medical literature and as such, should carry great ethical implications, as well as spur future research.

Statement of purpose & hypothesis

The overarching purpose of this study is to examine whether framing effects, shown to be prevalent in physicians' linguistic and statistical presentation of risks, influence patient decision-making. More specifically, when patients are deciding whether

or not to undergo a treatment or test, are they influenced by the order with which the risks of undergoing that treatment or test are presented to them by their physician? When doctors are presenting their patients with a list of the risks involved with the treatment, do the relative locations in this list of the most and the least serious risks influence patient interpretation of the risks involved? If this type of framing effect is shown to be the case, then the presented order of the risks involved in treatment would greatly impact whether or not the patients choose to undergo such a treatment. Thus, ethical significance would be extended to presented risk order, a likely essential subset of framing effects.

The specific aim of this project is to determine whether the order in which a doctor discusses the possible risks of treatment affects (a) how the patient views the treatment and (b) whether or not the patient decides to undergo that treatment? The hypothesis for this study is that when risks for a proposed treatment are presented in a most-to-least order of gravity, fewer participants will decide to undergo that treatment than when the risks are presented in a least-to-most grave order. Furthermore, as compared to either of these two groups, more participants will decide to undergo the treatment when the risks are presented with the most grave one in the middle of the list, with less grave risks both preceding and following it. Specifically, the hypothesis is that the more prominent the grave risk (i.e. relayed first being more prominent than relayed last, itself being more prominent than relayed in the middle of a risk list), the less likely that patients will choose the treatment. Stated differently, the null hypothesis is that the order in which possible risks of a treatment are presented to patients will not significantly affect whether or not patients decide to undergo that treatment.

The specific modality used in this study to investigate the proposed risk-order framing effect subset is the presentation of the risks of an abdominal aortic aneurysm surgical repair. As detailed below in the methods section and Appendix A, participants were shown a video of a doctor-patient interaction, whereby the doctor explains that, based on diagnostic imaging studies performed, the patient may indeed benefit from an abdominal aortic aneurysm surgical repair. In addition to explaining what the surgery would involve, the doctor also presents five risks of the surgery. Participants randomized to one of three conditions (A, B, and C) are shown the exact same video, with the exception that the order with which the risks are presented varies with each of the three conditions. In experimental condition A, participants will watch the video with risks presented in a most grave to least grave order. In experimental condition B, participants will watch the video with risks presented in a randomized crescendo-decrescendo of gravity order. And in experimental condition C, participants will watch the video with risks presented in a least grave to most grave order.

The specific hypothesis for this study, then, is that when the risks for the abdominal aortic aneurysm surgical repair are presented in a most-to-least order of gravity (condition A), statistically fewer participants will decide to undergo the surgery than when the risks are presented in a least-to-most order of gravity (condition C). Furthermore, as compared to either of these two conditions, more participants will decide to undergo the surgery when the risks are presented with the most grave one in the middle of the list, with less grave outcomes both preceding and following it (condition B). Participants will also be asked to rank how dangerous they believe the proposed surgery to be. As risk is assumed to be the underlying factor determining participants decision as

to whether or not they would undergo the surgery, then the hypothesis is that participants in condition A will rank the surgery most dangerous, participants in condition C will rank the surgery less dangerous, and participants in condition B will rank the surgery least dangerous.

These hypotheses are based both on above-mentioned psychological principles of working memory (primacy and recency effects) and on the above-mentioned shock value principle. By comparing all three (A, B, and C) conditions' responses for both deciding theoretically to undergo the surgery and for determining the danger level of the surgery, this design will demonstrate whether presented risk order significantly affects participants' understanding of and therefore, decisions concerning, the surgery. By comparing the responses from conditions A and C directly, this design will also allow for relative determination of the potency of the primacy and recency effects in the medical model. In addition, by comparing responses from one condition to the two others, this design will allow for determination of the existence of the shock value principle, as well as the principle's interaction with that of the primacy and recency effects.

Methods

Participants for this study consisted men and women (n = 90) with the following inclusion criteria:

- must be over the age of 40
- must speak English fluently

- must be coherent and appear to be operating at their full decision-making capacity
- must agree to participate in this study

and with the following exclusion criteria:

- must have never been diagnosed with an abdominal aortic aneurysm.

These criteria were selected as they would afford a participant population that is representative of patients who actually develop abdominal aortic aneurysms, thus making the results of the study most valid and generalizable to the larger targeted population. Patients' names or any kind of identifying information (e.g. SSN) were not obtained. Thus, each participants' privacy was protected.

Participants were a convenience sample recruited from the VA Connecticut Healthcare System, West Haven campus; and the Whitney Center, Continuing Care Retirement Facility in Hamden. This project was approved by the VA Connecticut Human Investigations Committee and representatives of the Medical Board at the Whitney Center.

After consenting to participate in the study, each participant was directed into a private room and shown a 5-minute video. As briefly mentioned above, the video consisted of a doctor explaining to a patient that his or her CT scan from last visit showed an abdominal aortic aneurysm. Then the doctor explained the natural progression of the aneurysm if left untreated and the possible treatment options for the aneurysm, especially detailing the risks involved with abdominal aortic aneurysm surgical repair. (Please see Appendix A for full dialogue.)

The risks discussed with the patient were:

- 1) Death, from a heart attack that occurs either during or after the surgery.
- 2) Limb loss, as one or both legs may not receive adequate blood after the surgery.

- 3) Bloody or painful urination, due to injury to the ureters during the surgery.
- 4) Infection, resulting from the surgery and causing fever, chills, and cough.
- 5) Pain, swelling, and redness around the belly, due to the incision site of the surgery.

Each participant was randomly assigned to one of three experimental conditions: A, B, or C. Participants in group A watched the video with risks in a 1, 2, 3, 4, 5 (most grave to least grave) order as listed above. Participants in group B watched the video with risks in a 3, 5, 1, 4, 2 (crescendo-decrescendo gravity) order. And participants in group C watched the video with risks in a 5, 4, 3, 2, 1 (least grave to most grave) order. Participants were randomized by rotating each of the three videos, one after the other, for each subsequent participant. As neither the investigator nor the participant knew which of the three videos each participant was watching during the study, then the double-blinded design was preserved.

After watching the video, each participant was then asked to fill out a questionnaire including questions which asked them hypothetically to make a decision about surgery, to explain how they were influenced by risks if they declined surgery, and to rank how dangerous they felt the surgery would be. Information on their age, gender, and prior surgical history was also collected. (Please see Appendix B for full questionnaire.) Each participant was then debriefed on the study and thanked for his or her participation.

The data was analyzed to determine whether the percentage of those who would have decided to undergo the abdominal aortic aneurysm repair differs, with statistical significance, between participants in conditions A, B, and C. Assuming an alpha set at 0.05, a sample size of 90 (30 per each of the three conditions) was estimated to achieve 80% power to detect a difference between groups. The data was analyzed using Pearson

chi square methods to determine whether a statistically significant difference exists among the three different experimental conditions. Furthermore, the means of the “danger” scorings were compared across the three conditions (A, B, and C) using ANOVA, as well as using direct planned comparisons of each of the three two-group comparisons (A and B, A and C, and B and C).

Results

The mean age of all 90 participants was 76.2 years, with a standard deviation of 11.1. Gender breakdown of participants showed 57 women and 33 men; 13 potential participants were excluded because they refused to participate in the study and 4 potential participants were excluded because their cognitive skills and decision-making capacity did not meet the criteria for the study. Among the 90 participants, 72 indicated having undergone some form of surgery prior to this study.

As shown in table 1 (a and b) below, 7 of the 30 participants in condition A would have chosen to undergo the surgery, 18 of the 30 participants in condition B would have chosen to undergo the surgery, and 12 of the 30 participants in condition C would have chosen to undergo the surgery. The differences in theoretical desire to undergo the surgery between the three experimental conditions, as shown below, is statistically significant [$X^2(2) = 8.35, p = 0.015$], with results according with the predicted direction (surgery selection rate of B > surgery selection rate of C > surgery selection rate of A).

Table 1(a): Conditions A, B, and C with counts of 'yes' vs. 'no' as to Whether or Not

Participants Would Undergo Abdominal Aortic Aneurysm Surgical Repair

			'no'	'yes'	Total
condition	A	Count	23	7	30
		Std. Residual	1.3	-1.5	
	B	Count	12	18	30
		Std. Residual	-1.3	1.6	
	C	Count	18	12	30
		Std. Residual	.1	-.1	
Total		Count	53	37	90

Table 1(b): Chi-Square Testing for the Above Data

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	8.353	2	.015
Likelihood Ratio	8.549	2	.014

					for Mean				
					Lower Bound	Upper Bound			
Condition A	30	9.20	1.448	.264	8.66	9.74	5	10	
Condition B	30	5.30	2.322	.424	4.43	6.17	2	10	
Condition C	30	7.80	1.584	.289	7.21	8.39	3	10	
Total	90	7.43	2.427	.256	6.93	7.94	2	10	

Table 2(b): ANOVA of Perceived Danger Levels Between Conditions

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	234.200	2	117.100	35.142	.000
Within Groups	289.900	87	3.332		
Total	524.100	89			

Table 2(c): Contrast Coefficients for Planned Comparisons Below

Contrast	COND		
	A	B	C
1	1	-1	0
2	1	0	-1
3	0	1	-1

Table 2(d): Contrast Tests for Each Two-Group Comparison

		Contrast	Value of Contrast	Std. Error	t	df	Sig. (2-tailed)
RATING	Assume equal variances	1	1.40	.471	2.970	87	.004
		2	3.90	.471	8.275	87	.000
		3	2.50	.471	5.304	87	.000
	Does not assume equal variances	1	1.40	.392	3.573	57.536	.001
		2	3.90	.500	7.807	48.596	.000
		3	2.50	.513	4.872	51.199	.000

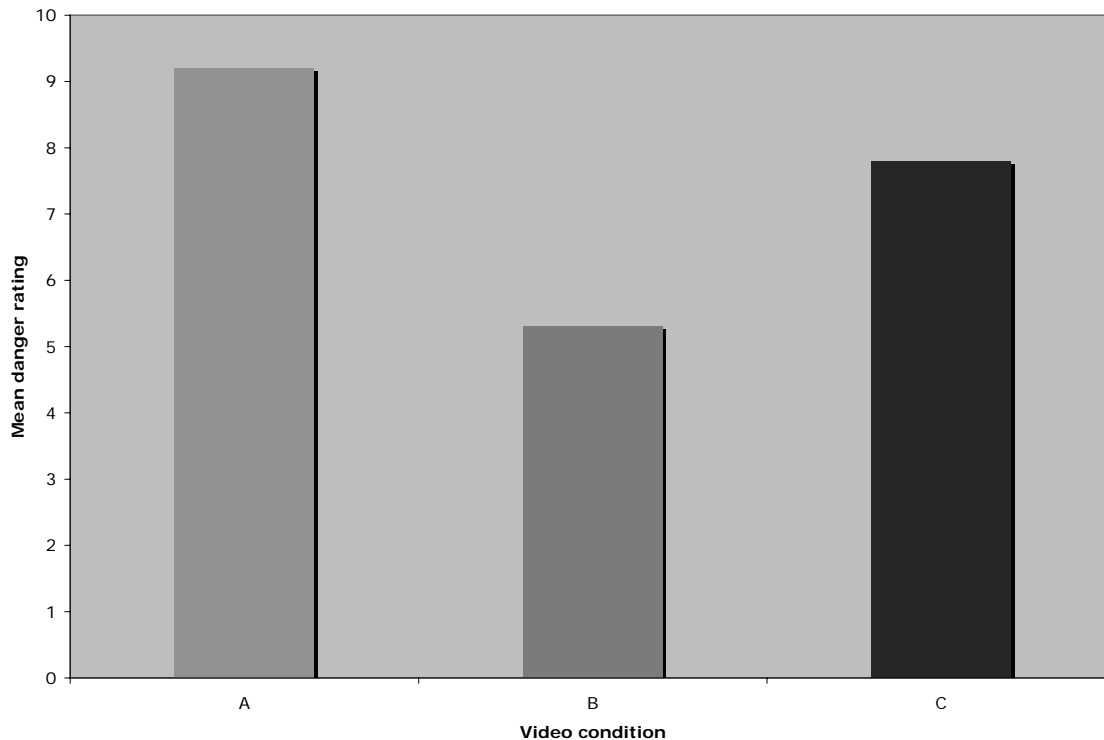


Figure 2: Mean Danger Scoring Versus Video Condition: mean danger scorings of condition A (9.2 with a SD of 1.45) > mean danger scorings of condition C (7.80 with a SD of 1.58) > mean danger scorings of condition B (5.30 with a SD of 2.32).

The participants who indicated that they would not have undergone the surgery were asked in the questionnaire to indicate which risk(s) they found most concerning and influential to their decision not to have the surgery. Results showed that among “no” respondents, 17 of 23 in condition A (73.9%), 7 of 12 in condition B (58.3%), and 12 of 18 in condition C (66.7%) indicated that the risk of death or dying was the risk that was most concerning and influential to their decision.

Discussion

The logic behind the hypothesis for this study was that simply changing the order with which risks for a particular medical or surgical treatment are presented to patients will alter a) how such patients view that treatment, and b) the likelihood that such patients will decide to undergo that treatment. This topic was investigated by using a randomized double-blinded controlled study, whereby participants were shown a video interaction of a doctor explaining to a patient that he has an abdominal aortic aneurysm. The doctor then explains the treatment options (including that of watchful waiting), detailing the abdominal aortic aneurysm surgical repair option and the risks involved with that option. Participants, after watching the video, are asked to fill out a questionnaire; the questions include 1) whether if they were in the patient's shoes, would they choose to undergo the surgery, 2) if not, why not, and 3) how dangerous do they consider the surgery to be. The key to the experiment is that participants were randomized into one of three experimental conditions that differ solely on the order that participants saw the risks being outlined to the patient by the doctor (participants in condition A saw the risks presented in a most grave to least grave order, participants in condition C saw the risks presented in a least grave to most grave order, and participants in condition B saw the risks presented in crescendo-decrescendo order of gravity). Thus, any difference observed in dependent variables gathered from participants across the three experimental conditions is attributable to the independent variable, the order of risk presentation.

In comparing the data from participants' responses as to whether they would undergo the surgery if they were in the patient's position, the results showed a

statistically significant difference (p-value of 0.015) between three experimental conditions. Thus, the null hypothesis is rejected and the experimental hypothesis is confirmed. The results accorded with the predicted direction, with participants in condition A (most grave to least grave) being least likely to have undergone the surgery, participants in condition C (least grave to most grave) being next least likely to have undergone the surgery, and participants in condition B (crescendo-decrescendo order of gravity) being most likely to have undergone the surgery. As this result is consistent with the hypothesis, different sub-theories may now be proposed that account for the predicted result and hopefully spur future research.

As noted in the introduction, Murdock (1962) initially demonstrated the existence of both a primacy effect and a recency effect in studying working memory. The primacy effect showed that, when asked to recall as many words as possible verbally presented to them from a list, participants tended to remember words that were in the initial serial position of the list. He also found that participants tended to remember words that were in the final serial position of the list, termed the recency effect. The latter finding has been explained via use of the phonological loop technique, whereby participants are better able to remember the list-final words because 1) they heard them most recently, 2) there are no other words after those final words distracting their attention or working memory, and/or 3) they are able to repeat those words in their mind to keep them in their working memory. The former finding has been explained via 1) they are the most salient words as their lexical meaning has been entered first and/or 2) there are no other words in their working memory upon presentation of the initial words so this data can be encoded without distraction.

Using this knowledge from the psychological literature, one may propose that participants in the current study also are using the recency and primacy effects subconsciously or even consciously to interpret the data of the surgical risks. Evidence of this mechanism is that participants in each of the three groups who decided that they would not have undergone the surgery indicated that death or dying was the major concern that was influential to their decision. Yet in both condition A, whereby death was listed list-initially, and in condition C, whereby death was listed list-finally, participants showed more salience (and higher rates of having declined the surgery) for death as the reason why they would not have chosen to undergo the surgery: 73.9% of participants who chose not to have undergone the surgery in condition A, and 66.7% of participants who chose not to have undergone the surgery in condition C, indicated that the risk of death or dying was the risk that was most concerning and influential to their decision. This finding is in contrast to condition B, whereby death was listed list-internally (with two risks both preceding and following it). In condition B, 58.3% of participants who chose not to have undergone the surgery indicated that the risk of death or dying was the risk that was most concerning and influential to their decision. These results could be interpreted as condition B being likely as a real-life presentation order of the surgical risks of an abdominal aortic aneurysm repair. With the percentages of indicated death-salient participants in condition A and condition C being larger than that of participants in condition B, this argues for the existence of both a primacy (condition A) and recency (condition C) effect present in the data for this study.

It is interesting to note, however, that Murdock (1962) found the recency effect to be more pronounced than the primacy effect. In the current study, though, the primacy

effect was found to be more pronounced than the recency effect. What could account for this discrepancy between the psychological literature and the current study? The author would like to propose that this indeed is where the gravity of medical decision-making exerts its own influence over the realm of psychological principles of working memory. In the psychological literature, such working memory studies have typically been performed with random words that do not hold much emotional valence for the participants. With the current study, the participants are, in-effect, asked to make a personal health decision as to whether or not they are going to undergo a surgery. Therefore, the words that the doctor uses in presenting the risks of the surgery to the patients are not emotionally-vacant concepts. Rather, the words bear immediate relevance to each patient's emotional state. The risk of death or dying, itself being the most feared risk of the proposed surgery, seems to exert additional influence outside of its location in the presented order. One could argue that it is the combination of 1) the emotional valence of death as a risk of the surgery and 2) the location of death in the list of risks that has played a large role in determining whether or not participants would have undergone the surgery themselves.

Studies have also shown that some words are so emotionally-charged that participants show selective hearing for varying time-periods after hearing the emotionally-charged word(s). The most well-known example of this is the use of the word "cancer." Studies have shown (Shields, 1998) that patients often do not hear much of what a doctor says for various time-periods after being told that they may indeed have cancer. Similarly, in this study, it may also be the case that the emotional valence of the risk of "death" is so large that participants are not able to concentrate on much of what

the doctor says for some time-period after hearing that death is indeed a risk of the surgery. This would contribute to why participants in condition A (whereby death was listed as the first risk) chose most reticently to have undergone the surgery. This theory in and of itself, however, would not inherently explain why participants in condition C (whereby death was listed as the last risk) chose more reticently to have undergone the surgery than participants in condition B (where death was listed risk-internally). Thus, evidence is again granted to the recency effect as in condition C, no additional risks, after the presentation of death, can be thought-blocked because death is risk-final in that condition.

Other supporting evidence for risk order playing an important role in how patients' hear and interpret risks of a medical or surgical treatment is found in participants' responses to the question of how dangerous they believe the surgery to be. Participants were asked to rank how dangerous they believed the surgery to be on a 0 (least dangerous) to 10 (most dangerous) scale. The data showed a statistically significant difference among the three conditions (p -value of < 0.001), with the direction of association consistent with the predicted results. Specifically, participants in condition A scored the surgery as most dangerous (mean of 9.2), participants in condition C scored the surgery as next most dangerous (mean of 7.8), and participants in condition B scored the surgery as least dangerous (mean of 5.3) among the three experimental conditions. As the order of presented risks is the only independent variable, it must account for this difference in participants' perceptions of the danger of abdominal aortic aneurysm surgical repair. Again, the second null hypothesis is rejected and the second experimental hypothesis is confirmed.

For the same reasons as described above, the hypothesis is validated by participants in condition A perceiving the surgery as the most dangerous of the three conditions. Firstly, participants are likely displaying the primacy effect, with the risk of death proving very salient in their working memories. Secondly, as stated above, 73.9% of participants in condition A who chose not to have undergone the surgery chose death as the most concerning and influential reason accounting for their choice. As this rate of response is higher than that of either participants in condition B or C, it seems likely that such participants would indeed rank the surgery to be the most dangerous. In fact, participants in condition A do indeed rank the surgery as most dangerous (mean of 9.2 on a 0-to-10 scale). Additionally, it must be pointed out that the ranking scores of the danger of the surgery was given by all participants, not simply the participants who would not have chosen to undergo the surgery. Therefore, the high score on the danger scale for participants in condition A takes into account all participants in condition A, the ones who would have chosen to undergo the surgery in addition to the ones who would not have chosen to undergo the surgery. Clearly then, whether or not participants in condition A would have chosen to undergo the abdominal aortic aneurysm surgical repair, it is the case that these participants did indeed perceive the surgery to be the most dangerous of the three groups—indicating that the most grave to least grave risk order presentation influences how such participants perceive the risks of the surgery.

Alternately, participants in condition C are likely displaying the recency effect, with the risk of death proving more salient in their working memories as compared to participants in condition B (whereby death is couched in the middle of the risk list). As shown above, 66.7% of participants in condition C who chose not to have undergone the

surgery chose death as the most concerning and influential reason accounting for their choice. As this rate of response is higher than that of participants in condition B but lower than that of participants in condition A, it seems likely that such participants would indeed rank the surgery to be the more dangerous than those in condition B but less dangerous than those in condition A. In fact, participants in condition C do indeed rank the surgery as such (mean of 7.8 on a 0-to-10 scale). Again, it must be pointed out that the ranking scores of the danger of the surgery was given by all participants, not simply the participants who would not have chosen to undergo the surgery. As a result, the high score (relative to control condition B) on the danger scale for participants in condition C takes into account all participants in condition C, the ones who would have chosen to undergo the surgery in addition to the ones who would not have chosen to undergo the surgery. Clearly then, whether or not participants in condition C would have chosen to undergo the abdominal aortic aneurysm repair, it is the case that these participants did indeed perceive the surgery to be the more dangerous than that of control condition B. Such a finding indicates that the least grave to most grave risk order presentation does indeed influence how such participants perceived the risks of the surgery. In other words, participants in condition C perceived the danger level of the surgery to be greater than that of condition B but not as great as that of condition A. This finding accords with the explanation above as to the existence of both the primacy and the recency effect, with the primacy effect dominant over the recency effect.

In control condition B (whereby risks were presented in a crescendo-decrescendo order of gravity), participants are not influenced by the primacy effect or by the recency effect. Based solely on those psychological principles of working memory, participants

should be relatively unbiased in their determinations of both the danger of the surgery as well as whether or not they would undergo the surgery. Assuming that the dialogue represents a rather even, unbiased source of information about the surgery, its risks, and the risks of not undergoing the surgery, participants in condition B should theoretically select to undergo the surgery with a rate of 50% and participants should rank the surgery as a 5/10 on the danger scoring. However, it must be kept in mind that the principle of shock value discussed still applies to some degree in this case, as there are two more risks relayed after participants hear that death is a risk of the aneurysm repair. Being free from the primacy and recency effect but being influenced by the shock value theory, one would propose that participants in condition B should rate the danger of the surgery as moderately above 5. In fact, these participants rated the danger of the surgery as a 5.3 out of 10. Such data, as predicted by the hypothesis, suggests the absence of the primacy and recency effects with the presence of the shock value principle for participants in condition B.

With this baseline understanding of how varying the presented order of risks affects a) participants' understanding of how dangerous the surgery and b) their likelihood of undergoing such a surgery, one could design future studies that investigate the mechanics of the primacy effect, the recency effect, the emotional valence of personal medical risk factors, and the shock value principle.

For instance, one could perform a related study whereby a long list of risks for a particular medical or surgical treatment is presented to participants. Different conditions of the study could vary according to the location of the risk of death in this list. Participants' task would then be to recall as many of the risk factors as possible. If

participants tended to frequently recall the risk of death and its preceding risks but infrequently recall risks presented after presenting death, then more evidence would be lent to the shock value principle.

Additionally, one could perform a related study whereby a long list of similarly-charged risks (i.e., not death) for a particular medical or surgical treatment is presented to participants. Participants' task would again be to recall as many of the risk factors as possible. If participants tended to recall the list-initial risks, then the primacy effect would be validated in the realm of medical decision-making. If participants tended to recall the list-final risks, then the recency effect would be validated. With this proposed study, one could lend more credence to both the primacy and the recency effects in the realm of medical decision making. Additionally, as this study would contain a list with similarly-charged risks, then the primacy and recency effects in the realm of medical decision-making would be tested directly. It would be interesting to note whether in this case the two working memory principles would be equally strong (or with the recency effect outweighing the primacy effect as in the psychological literature), unlike the current study whereby the primacy effect outweighed the recency effect, likely due to the emotional valence of the risk of death.

Taking into account these various sub-theories to support the hypothesis in this study, however, it appears to be a combination of the primacy effect, the recency effect, and the shock value principle that account for the data. More specifically, the relative means for the danger of the surgery (condition A > condition C > condition B) and the 'yes' rates for choosing to have undergone the surgery (condition B > condition C > condition A) seems to support the following principles. In governing emotionally salient

personal medical information, the primacy effect outweighs the recency effect, at least when using the greatest indicated risk (i.e., death). Additionally, the shock value principle applies at any point in a serial list of surgical risks, but works synergistically with either the primacy or recency effect. Therefore, with both the primacy effect and the shock value principle applying list-initially (i.e., condition A), one would predict the lowest rate of choosing to have undergone the surgery and the highest ranking of danger of the surgery—both predicted and found to be true of participants in condition A. With both the recency effect and the shock value principle applying list-finally (i.e., condition C), one would predict the next highest rate of choosing to have undergone the surgery and the next lowest ranking of danger of the surgery—both predicted and found to be true of participants in condition C. Finally, with neither the primacy nor the recency effects applying with the indicated highest-danger risk, but still the shock value principle applying list-internally (i.e. condition B), one would predict the highest rate of choosing to have undergone the surgery and the lowest ranking of the danger of the surgery—both predicted and found to be true of participants in condition B.

One potential weakness of the current study is that the paradigm used a convenience sample, which could have theoretically limited the results. The specifics of how exactly this weakness would alter the results of study is unclear, however, and thus, it is uncertain whether using a convenience sample altered the results of the study.

As is shown by the results of this study, the human mind does not perceive or “hear” informative data the same way that a computer would input data. Rather, the form with which information is presented to people influences and shapes the information itself that people are hearing. Most decisions that we make, certainly the ones in the field

of medicine, are based on gathered information. But as shown in this study, the decisions are dependent on the relevant perceived information, and that perceived information, in turn, depends on the mode of conduction by the informed to the uninformed. This process of conduction of information is in part a subconscious process, a skill that is likely to be largely based on the informer's observations of his or her teachers, as well as his or her own personal experience. Armed with the knowledge from this study, however, it seems imperative that ethical thought be applied additionally to the mode of conductance of information, specifically with attention paid to the order with which choices or risks are presented.

If a doctor such as the one on the video of the current study can cause over 2.5 times the number of participants to decide to undergo the same surgery given the same information, solely presented with risks in a different order, then the presented risk order as a subset of framing effects is very real. Surely one can imagine doctors wielding such knowledge in such a fashion as to bias patients into choosing a certain medical or surgical treatment. On the other hand, one can imagine doctors using such knowledge to present unbiased, yet expert, information to patients concerning medical or surgical treatment. Of course, there are all shades of gray between these two extremes and one could argue where the overt bias should lie. This debate falls into the realm of medical ethics and is hopefully, a debate that will ensue.

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Appendix A: Video Dialogue

DOCTOR: "Good morning, Mr. Johnson. How're you doing?"

PATIENT: "I'm feeling good and I'm not in any pain at all."

DOCTOR: "That's good to hear. I do, however, have something I need to talk with you about. On the CT scan that we took of your belly the last time you were here, we noticed that you have what's called an abdominal aortic aneurysm."

PATIENT: "What's that?"

DOCTOR: "Well, the aorta is a large vessel that carries blood from your heart down to your organs and to your legs. Sometimes, a part of this vessel can weaken and bulge out, forming an aneurysm."

PATIENT: "But I'm not having any pain right now."

DOCTOR: "That's true. But even though you're not having any pain right now, if the aneurysm continues to get bigger in the future, it could rupture. This would be a serious emergency. Depending on how rapidly it's enlarging, it could rupture unexpectedly and your life could be in grave danger."

PATIENT: "OK, so what are my options?"

DOCTOR: "One thing we could do is just wait for some months and see if it has grown any bigger then. If it's the same size and you still aren't having any pain from it, we could wait some more months and then check again, and so on and so forth. However, another option is to repair your aneurysm now before any problems even have the chance to occur."

PATIENT: "What would that involve?"

DOCTOR: "This would involve a surgery that fixes the aneurysm, for example, by inserting a synthetic graft. You'd be under general anesthesia so you would not feel or remember anything during the surgery. There is a recovery period associated with the surgery, but after the surgery, your risk of aneurysm rupture would be significantly less."

PATIENT: "Are there any risks to the surgery?"

DOCTOR: "There are some risks that I'd like you to know about. These risks are not likely to occur but nevertheless I think it's important that you factor them into your decision as to whether or not to undergo the surgery. These risks include*:

- 1) Death, from a heart attack that occurs either during or after the surgery.
- 2) Limb loss, as one or both legs may not receive adequate blood after the surgery.
- 3) Bloody or painful urination, due to injury to the ureters during the surgery.
- 4) Infection, resulting from the surgery and causing fever, chills, and cough.
- 5) Pain, swelling, and redness around the belly, due to the incision site of the surgery."

*note: As discussed in the methods section, each participant was randomly assigned to one of three experimental conditions: A, B, or C. Participants in group A (most grave to least grave) watched the video with risks in a 1, 2, 3, 4, 5 as listed above. Participants in group B (crescendo-decrescendo order of gravity) watched the video with risks in a 3, 5, 1, 4, 2 order. And participants in group C (least grave to most grave) watched the video with risks in a 5, 4, 3, 2, 1 order.

Appendix B: Participant Questionnaire

“If you were in the patient's shoes, would you choose to have the surgery?

yes no

If you selected "no" to the above question, what is the main concern that caused you to make this decision?

If you selected "no" because you were concerned about any of the risks involved in the surgery, which risk or risk(s) did you find most concerning and influential to your decision not to have the surgery?

On a scale of 0-to-10 (0 is least dangerous, and 10 is most dangerous), how dangerous do you think the surgery is?

What is your age?

What is your gender?

Have you had surgery before? If so, what operation(s) have you had?”