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The Effect of Disfluency on the Framing Effect

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Cover Page Footnote
"Jon Baldwin and Haley Newton are graduates of Wingate University awaiting word of their next adventure. Their emails are jo.baldwin@wingate.edu and ha.newton@wingate.edu, respectively. Matthew Davis is an Assistant Professor of Psychology at Wingate University. Correspondence concerning this article should be sent to Matthew Davis at m.davis@wingate.edu."

The Effect of Disfluency on the Framing Effect

Every day people make a multitude of decisions. These range in importance, having varying degrees of impact on areas of our life including health, financial, and life satisfaction. People often try to make rational decisions, but this endeavor can frequently be undermined by faulty thinking which is often a result of cognitive biases. The way we view decisions and problems in the real world depends upon how we process the information. Unfortunately, this processing does not always follow rational or well-thought out steps or procedures. There are several factors that can affect processing such as when the information is received, how the information is presented, and whether other sensory information is available (Levin & Gaeth, 1988).

Given there are a wealth of decisions people make, with a host of information and stimuli that individuals encounter, some decisions are made without considering all facets and instead depend more on prior experience and intuitive judgments. However, in more complex cases, it can become essential to consider a decision's criteria more explicitly, analyzing each facet one by one. This duality of decision making is captured by the dual process theory which describes two broad systems of thinking, namely a more intuitive System 1 and a more analytical System 2 (Kahneman & Frederick, 2002). The majority of the time System 1 processes are sufficient for decision making, but an increased propensity to use System 1 processes can lead individuals astray. In the present study, we examined how the way information is presented can influence decision making, while also analyzing individuals' propensity for more intuitive or analytical thinking.

In this study, we examined the impact of disfluency within the context of the framing effect. The framing effect has been demonstrated in numerous studies and highlights how the

way information is presented can influence the option that an individual prefers (Levin & Gaeth, 1988; Tversky & Kahneman, 1981). While much is known of the framing effect, little is known about the role fluency may play in susceptibility to the framing effect. The present study seeks to unite this literature and obtain a more complete portrait of the impact of disfluency on the framing effect. Prior research has found that fluency, or how quickly and accurately information can be processed, affects decision making. In one study, it was observed that individuals tend to use System 1 processing when the question is posed in a fluent manner, but use System 2 processing when information is presented in a disfluent manner (Alter, Oppenheimer, Epley, & Eyre, 2007). The present study seeks to investigate whether a similar fluency manipulation can influence framing susceptibility.

Dual Process and the Framing Effect

The dual process model reviewed by Kahneman and Frederick (2002) describes System 1 and System 2 processing. System 1 is considered the more primitive system responsible for quick intuitive judgments. This system is responsible for automatic, low effort thinking which is used often as it typically leads to the correct decision. System 2 is responsible for the slower, rational, and controlled thinking, which is high effort and used less often (Kahneman & Frederick, 2002). Research has looked at the power of shifting thinking from System 1 to System 2 in order to reduce errors in judgment (Larrick, 2004; Mussweiler, Strack, & Pfeiffer, 2000). In order to process and respond to large amounts of information System 1 relies on heuristics, which are essentially intuitive judgments. These are typically effective, but they can result in errors. System 2 monitors System 1 and can make adjustments when necessary. However, System 2 is not always active, and in its absence people can fall victim to erroneous judgments.

Often these flaws in rational thinking are described by common cognitive biases (Kahneman & Frederick, 2002).

Cognitive biases are when mental processes give a distorted impression of reality (Haselton, Nettle, & Murray, 2016, p. 968). These instances of bias occur when humans predictably respond in ways that are "systematically distorted compared to some aspect of objective reality" (Haselton, Nettle, & Murray, 2016, p. 968). One such cognitive bias is the framing effect. This bias operates when "reversals of preference by variations in the framing of acts, contingencies, or outcomes" occurs (Tversky & Kahneman, 1981, p. 453). One would expect that when presented the same information in different ways, people should still choose the same options, however, Tversky and Kahneman (1981) found that this is not necessarily the case. The way a problem is presented influences decisions and preferences, which can change depending on how the problem is framed. If humans were fully rational, there would not be shifts in preference based on framing; instead people would be able to see past the presentation and preferences would not be affected. The framing effect interferes with rational decision making and allows an arbitrary factor to influence what choices are made. For example, sales highlight the saved cost (25% off) as opposed to the incurred cost (75% of original price). Consumers would likely alter their purchasing habits if this was reversed, even though the costs and savings are the same. The framing effect can have a significant impact on choice simply by manipulating the way information is presented.

One of the problems created to test the framing effect is known as the Asian Disease problem (Tversky & Kahneman, 1981). The problem describes a situation where there is an outbreak of an Asian disease that is expected to kill 600 people. The participants are then presented with two options to combat the disease, one posed in a gain frame and the other a loss

frame. In the gain frame, the description states, “If Program A is adopted 200 people will be saved. If Program B is adopted, there is ⅓ probability that 600 people will be saved, and ⅔ probability that no people will be saved.” In the loss frame, the description states “If Program C is adopted 400 people will die. If Program D is adopted there is ⅓ probability that nobody will die, and ⅔ probability that 600 people will die.” In each frame the participants were asked which choice they prefer (Tversky & Kahneman, 1981). It was observed that when the problem was framed in terms of a potential gain, such as “people will be saved,” participants showed a greater preference for the less risky option, Program A in this instance, which is considered risk averse decision making behavior (Tversky & Kahneman, 1981). On the other hand, when the problem was framed in terms of a potential loss, such as “people will die,” participants showed a greater preference for the riskier option, Program D, which is considered risk seeking decision making behavior (Tversky & Kahneman, 1981). This highlights a natural flaw in rational decision making that people experience from day to day. If people were fully rational, there would be no differences in selections or preferences between the gain and loss frames.

This difference in preference in the Asian Disease problem was attributed to factors described by prospect theory (Tversky & Kahneman, 1979). Prospect theory is an alternative model for decision making in situations involving risk, which takes into account factors that the utility theory, the prominent model at the time, failed to account for. Some of the principles taken into account by prospect theory were people's tendency to underweight probable options compared to certain ones, a cognitive bias known as the certainty effect. This is said to contribute to risk averse behavior in gain frame scenarios and risk seeking behavior in loss frame scenarios. Another factor taken into account by prospect theory is the finding that potential losses appear to carry more weight in decision making scenarios than potential gains. This tendency to weight

losses more heavily than gains seems to contribute to the framing effect (Tversky & Kahneman, 1979).

Research has shown that there are multiple additional factors that can affect susceptibility to the framing effect, including sex, numeracy, age, and GPA (Dunegan, 2010; Fagley & Miller, 1990; Kim et al., 2005; Levin & Gaeth, 1988; Peters & Levin, 2006). Fagley and Miller (1990) found that females were more likely to be susceptible to the framing effect. Additionally, those low in numeracy have been shown to have a greater susceptibility to the framing effect (Peters & Levin, 2006). A study conducted in older adults found that they were more likely to display risk seeking behavior due to framing (Kim et al., 2005). Research also shows students with a higher GPA are more likely to be affected by the framing effect (Dunegan, 2010).

In a classic framing effect study, Levin and Gaeth (1988) manipulated the labels of the ground beef to specify that it was either "25% fat," consistent with a negative frame, or "75% lean," consistent with a positive frame. The participants were asked to rate the ground beef on several qualitative scales such as greasy/greaseless, good/bad tasting, high/low quality (Levin & Gaeth, 1988). The participants were broken into groups: the first, received the label for the meat before being allowed to taste it; and second, tasted the meat before being given the label (Levin & Gaeth, 1988). Levin and Gaeth found that ratings for the ground beef on the aforementioned scales were higher in the "75% lean" positive frame condition when compared to the "25% fat" condition. "75% lean" frame participants rated the meat as less greasy, better tasting, and of higher quality than those in the "25% fat" frame. Results also showed a larger framing effect on these scales when participants tasted the meat after being given the label compared with those who tasted the meat before receiving the label (Levin & Gaeth, 1988). Together these results

again demonstrate the framing effect and suggest that the label information plays a part in the assessment and evaluation of the product.

In another instance, McNeil et al. (1982) examined the influence of positive and negative frames in medical decisions when choosing between therapy options that were framed differently, but in actuality were the same. When describing the likelihood of surviving, the treatment options were presented as the probability of living, which is a positive frame, or as the probability of dying which is a negative frame. Despite the probabilities being equivalent, the participants showed a greater preference for treatment when it was framed positively (McNeil et al., 1982). This finding mimics the pattern shown with the preference towards the lives saved gain frame within the Asian Disease problem and highlights how framing can have a significant impact on important decisions (Tversky & Kahneman, 1981).

Fluency and Dual Process Theory

While the framing effect and other cognitive biases have been consistently observed, researchers have identified some groups that are not as prone to these biases as well as ways to reduce bias susceptibility. Factors such as an individual's propensity for System 1 or System 2 thinking and even seemingly insignificant ones like what font is used have been shown to impact susceptibility to biases. We want to highlight both of these factors as they were investigated in the current study.

Dual process theory contends that individuals differ in their willingness or propensity to engage System 1 or System 2 processes to solve a variety of problems and make decisions. Researchers have come up with a simple measure to ascertain one's propensity to use System 2 processing. First developed by Shane Frederick, the Cognitive Reflection Test (CRT) is a quick test designed to measure analytical thinking and System 1 or System 2 engagement (Frederick,

2005). Each problem has an intuitive System 1 response that happens to be incorrect and a more reflective, and correct, System 2 response. For these problems the intuitive response is often the first answer people think of and the key element with this test is do participants reconsider and reflect on their answer before submitting. For instance, the classic bat and ball problem reads as follows: “A bat and a ball cost $1.10 in total. The bat costs a dollar more than the ball. How much does the ball cost?” If you answered $0.10 you might want to reconsider your answer. In addition to measuring dual process propensities, the CRT has also been shown to be a reliable predictor of framing susceptibility (Toplak, West, & Stanovich, 2014). Using the same Asian Disease and School Dropout Prevention problems that we used in the current study, Toplak and colleagues found that those who more often use System 1 processes are more likely to show differences in preferences based on framing. This finding highlights the ability of the CRT to predict framing across individuals varying in their dual process propensities.

While individuals may vary in their framing susceptibility and engagement in System 1 or System 2 processing, there is research to suggest that participants may be pushed towards using System 2 processing. For instance, manipulating fluency has been shown to activate System 2 processes, which in turn improves analytical thinking (Alter et al., 2007). Alter and colleagues compared two groups, a control group who took the CRT typed in an easy-to-read font and an experimental group with the CRT typed in a difficult-to-read font. The researchers found that the participants in the experimental group answered more CRT questions correctly on average and thus concluded that these participants were more likely to have System 2 processes activated via this font manipulation (Alter et al., 2007). They contended that System 2 processing is triggered when the participants experience difficulty reading the items in the disfluent font (Alter et al., 2007). This simple font manipulation seems to provide a means to disrupt the

heuristic prone System 1, allowing for more reflective processing. These findings demonstrate how disfluency can activate System 2 processing and thereby reduce bias susceptibility or trigger more reflective or rational decision making. It would stand to reason that susceptibility to the framing effect could be reduced through a similar manipulation.

Considering that disfluency has been shown to activate System 2 processes to improve analytical thinking, we wanted to explore the impact of disfluency on the framing effect. Building on the prior literature, in the current study we used a similar disfluency manipulation as Alter et al. (2007) to see if we could activate System 2 processes and therefore lessen the effects of framing. Additionally, comparisons across groups dichotomously split as high or low CRT were drawn to once more assess the impact of dual process theory on framing susceptibility. The purpose of our study was to better understand the framing effect, the impact of dual process theories on framing susceptibility, and the impact that disfluency has on activating System 2 processes and in turn reducing susceptibility. We hypothesized that participants higher in CRT performance and those reading disfluent text would be less susceptible to framing compared to their low CRT or fluent text counterparts.

Method

Participants

Participants included 107 students (67 females and 40 males) from introductory psychology courses at a small private southeastern university. All participants received course credit for participating in the study. Participants were selected through convenience sampling from introductory psychology classes. The ages of the participants ranged from 18 to 21 years old, with a mean age of 18.45 (SD = 0.65).

Measures

Framing effect questionnaires. To assess the framing effect, we used the Asian Disease problem (Tversky & Kahneman, 1981), School Dropout Prevention problem (Fagley & Kruger, 1986) and Fatal Disease problem (Wang et al., 2001). In all problems participants were asked to choose between two options with equal utility, where one is indicative of more risk seeking behavior and the other risk averse. These measures are some of the most common framing effect problems and have shown robust and consistent findings in prior research. For the purpose of this study the problems were typed in an easy-to-read Arial font or a hard-to-read Arial font that was made smaller (10-point font), gray, and italicized (similar to Alter et al., 2007). This allowed us to assess whether fluency has an impact on the framing effect. Initially, we included a fourth decision making problem, the Cancer Treatment problem (McNeil et al., 1982), but it was dropped as its structure was not consistent with the other problems. In addition to manipulating fluency, the problems were either presented in the gain frame, "lives saved," or the loss frame, "lives lost," and each participant only saw one version of the problems. The full problems across fluency and gain and loss frames are presented in the Appendix for reference.

Cognitive Reflection Test. To assess System 1 and System 2 thinking, a three item CRT scale has been widely used (Frederick, 2005); however, an expanded CRT has been found to be a better predictor (Toplak, West, & Stanovich, 2014). We used this expanded CRT and have included the seven items in the Appendix. Answering these items incorrectly is said to be an indicator of using System 1 processes, whereas answering correctly was taken as an indication of System 2 processes. If participants had lower accuracy, this was taken as an indication that they have a stronger propensity to depend on System 1 processes.

Demographic questionnaire. Participants were also asked to report their age and gender. This information allowed for comparisons of framing susceptibility across these dimensions. However, comparisons across gender and age showed no significant differences.

Design

In this between-subjects design, the participants were randomly assigned to one of the four conditions. Group A and Group B were part of the control group with easy-to-read font, while Group C and Group D were the experimental group with hard-to-read font on their framing problems. The independent variables for the study were fluency, which was manipulated by the font of the questionnaire, and the frame, which was manipulated by the gain and loss framed options, also described as positive or negative frames. The dependent variable was a preference for either the risk seeking or the risk averse option. Table 1 summarizes the experimental manipulation and group design.

Control conditions. The control group was broken into two subgroups, Group A and Group B. Group A was given the gain/positive frame questionnaire typed in the text that was in easy-to-read fluent Arial font. Group B was given the loss/negative frame questionnaire that was typed in the same easy-to-read fluent Arial font.

Experimental conditions. The experimental group was broken into two subgroups, Group C and Group D. Group C was given the gain/positive frame questionnaire that had been typed in the hard-to-read disfluent font (*Arial, 10-point font, gray and italicized*). Group D received the loss/negative frame questionnaire that was typed in the hard-to-read disfluent font (*Arial, 10-point font, gray and italicized*). These conditions and manipulations are summarized in Table 1.

Table 1

Framing Experimental Manipulation

Group	*Frame*	*Font*	*Example*
A	Gain	Easy-to-read	Arial 12-pt font
B	Loss	Easy-to-read	Arial 12-pt font
C	Gain	Hard-to-read	*Arial 10-pt font, gray, and italicized*
D	Loss	Hard-to-read	*Arial 10-pt font, gray, and italicized*

Procedure

This study was conducted in introductory psychology classrooms. Students in these classes who wished to participate were asked to read and sign the informed consent form. Any student that signed the informed consent form and wished to be part of the study was then randomly assigned to one of the groups. Participants were told to come to the front and turn in their informed consent forms and pick up a questionnaire packet corresponding to one of the four conditions. The stapled questionnaire packets were placed in a random order before the researchers entered the classroom. After the participants completed both questionnaires they were asked to turn them in and sit back down until everyone was finished. Once everyone was completely finished the participants were debriefed about purpose of the study and any questions were answered by the researchers. Students received research credit for participating, a necessary component for all introductory psychology students.

Results

Participants were assigned to one of the four conditions. There were 25 participants in the positive fluent condition, 22 participants in the negative fluent condition, 30 participants in the positive disfluent condition and 30 participants in the negative disfluent condition.

Effects of Fluency on Framing Susceptibility

It was hypothesized that participants in the disfluent groups (Groups C and D) would be less influenced by framing when compared to the control groups (Groups A and B). Multiple chi-square tests were conducted to compare preferences across positive and negative frames, as well as between fluent and disfluent conditions for each of the three decision problems (Asian Disease, School Dropout Prevention, and Fatal Disease).

Fluent versus Disfluent

We used a set of chi-square analyses to examine framing susceptibility contrasting the positive and negatives frames within the fluent and disfluent conditions. We first examined potential framing effects within the fluent condition. When the problems were presented in a fluent manner there was a significant effect of framing for the Asian Disease, X^2 (1, N = 46) = 4.26, $p < .05$, and the School Dropout problems, X^2 (1, N = 46) = 4.26, $p < .05$. These findings highlight a significant difference in selected options, risk averse or risk seeking, between the positive and negative frames. We did not find a significant effect of framing for the Fatal Disease problem.

Next, we examined the potential framing effects within the disfluent condition. The chi-square analyses within the disfluent condition showed no significant differences in preferences as a function of framing. While the Asian Disease and School Dropout problems showed significant effects of framing in the fluent condition, there were no observed framing effects in the disfluent condition. These results support the hypothesis that altering fluency can reduce framing susceptibility as there were not significant differences across frames for the disfluent participants, yet there was a difference across frames in the fluent conditions.

Low CRT versus High CRT

We used additional chi-square analyses to further test susceptibility to the framing effect, again contrasting the positive and negative frames, this time examining the influence of cognitive reflection, as measured with the CRT. We split participants into two groups, with low CRT participants including those who correctly answered 0 or 1 of the 7 items, while high CRT participants correctly answered 2 or more of the 7 items. This split resulted in an uneven 72 low CRT participants and 32 high CRT participants. When examining the low CRT participants there was a significant effect of framing for the Asian Disease, X^2 (1, N = 72) = 6.72, $p < .05$, and the School Dropout problems, X^2 (1, N = 72) = 8.00, $p < .01$. The effect of framing for the Fatal Disease problem also approached significance, X^2 (1, N = 72) = 3.56, $p = .059$.

The chi-square analyses within the high CRT group showed no significant preferences for the risk averse or risk seeking options in the positive versus negative frames. These results support the hypothesis that cognitive reflection can help to reduce framing susceptibility, as there were preference differences across frames for the low CRT participants, but not for the high CRT participants. In summation, the framing effect was observed in participants who were low in cognitive reflection, but not for those high in cognitive reflection. This difference in bias susceptibility is consistent with prior literature and will be discussed.

Discussion

As we have noted, the framing effect is a robust phenomenon that can be captured both in lab and real world settings (Dunegan, 2010; Kim et al., 2005; Levin & Gaeth, 1988; Peters & Levin, 2006). Our study was conducted in hopes of expanding knowledge surrounding the framing effect while also assessing if a hard-to-read disfluent font would decrease susceptibility to framing. We hoped to activate System 2 processing similar to what Alter et al. (2007) did in

their study utilizing disfluency. We reasoned that activation of System 2 processing would reduce susceptibility to the framing effect as it has been shown to reduce the effects of other cognitive biases (Alter et al., 2007). Further, those who are more likely to use System 2 processes show less framing susceptibility (Toplak, West, & Stanovich, 2014). While our design and analysis puts us in the impossible position of trying to prove a null, we did consistently find that those in the fluent font condition and low CRT participants showed greater susceptibility to framing than the disfluent font and high CRT participants across nearly all of our decision problems. Findings from the Asian Disease and School Dropout problems support the notion that altering font may inspire individuals to use System 2 analytical processing. The changes in font and greater cognitive reflection appeared to reduce the influence in selections attributable to framing. By making the text more difficult to read, individuals appear to show less framing susceptibility. This indicates that font manipulations may be a simple avenue to reduce the effect of biases.

While results so far are relatively scant, the potential of using a simple font manipulation to inspire more rational decision making offers many cost-effective benefits. For instance, this could offer a way to nudge people towards more analytical thinking. Similar to how choice architecture proposes to use framing to improve decision making, font manipulations offer another avenue to do the same. With so much of our world digitized today, alterations to font can occur with a few clicks of the mouse, offering a quick and cost-effective way to promote more rational decision making and analytical thinking.

Limitations and Future Considerations

While the results presented herein are promising, it is important that we note a few limitations of the present study. To begin, all participants completed only one condition for each

of the framing problems. This means that we cannot compare framing in a within-subjects manner, but instead compare across subjects between the gain and loss frames for each problem. Additionally, this lowers our sample size within each condition to between 22 and 30 participants in each group. With our analysis aimed at detecting reduced susceptibility this puts us in a position where we may simply not be detecting a difference based on framing in the disfluent font and high CRT conditions because we do not have enough power to detect these differences given our sample sizes. The uneven split of CRT performance with unequal groups should be specially noted here once more.

Individual differences could also account for the results we found. There are a number of factors that influence framing susceptibility and it is possible that the participants were not similar enough to be compared to one another. To account for these limitations, a within-subjects design could be utilized in future studies so that the same participants would be exposed to both gain and loss frames and both font manipulations and potentially offer a more fruitful comparison.

Additionally, we did not test the validity of the framing problems when combined on a single measure before conducting the study. These items have been shown to be valid on an individual basis; however, it is possible that combining the questions on a single measure may have influenced the results. For instance, it is possible that once participants answered the first problem, they noticed a pattern in the way the framing problems were presented and continued to answer in a consistent manner. In the future, researchers could manipulate font and gain and loss framing within each item, such that each individual is exposed to a variety of manipulations.

Lastly, we collected data in introductory psychology classrooms in a group setting. This could have led to the students influencing each other's responses on the questionnaires. While we

watched to ensure that students did not look at their neighbor's responses, the presence of other students in the classroom could have impacted their participation and responses. It is recommended that in the future participants take the tasks individually in an effort to reduce potential confounds.

Building off of the promising results showing reduced susceptibility to framing in the disfluent font condition and with the high CRT group, we feel there is support for continuing this line of research. Researchers have looked for ways to nudge people towards System 2 thinking and perhaps font manipulations offer a cost-effective way of doing so (Milkman, Chugh, & Bazerman, 2009). Manipulating the fluency of font has been shown before to lead to improved accuracy and presumably engagement of System 2 analytical thinking, so it stands to reason that it could lead to more rational decision making outside of the CRT itself. Noting some of our design limitations, it would be beneficial to attempt to replicate this study with a within-subjects design, attempting to control for some of the aforementioned limitations simultaneously. Nonetheless, we feel there is value in expanding this research. There is a benefit to investigating the role disfluency may have in reducing other cognitive biases. If disfluency can reduce framing, perhaps similar results could be found in other biases, where more rational decision making is possible. For example, in the way individuals arbitrarily stick with an anchor and insufficiently adjust there is potential that this font manipulation could promote more reflective decision making based on more relevant cues.

In summation, cognitive reflection plays a powerful role in the choices individuals make. With improved cognitive reflection, more rational decision making and reduced errors due to biases have been observed. It appears possible to nudge individuals towards more rational decision making by altering font in order to promote more analytical processes. We suggest that

additional investigation identify how font manipulations might be implemented to reduce biases and positively influence choices and decisions.

References

Alter, A. L. (2013). The benefits of cognitive disfluency. *Current Directions in Psychological Science, 22*(6), 437-442.

Alter, A. L., Oppenheimer, D. M., Epley, N., & Eyre, R. N. (2007). Overcoming intuition: Metacognitive difficulty activates analytic reasoning. *Journal of Experimental Psychology, 136*(4), 569-576.

Dunegan, K. (2010). GPA and attribute framing effects: Are better students more sensitive or more susceptible? *Journal of Education for Business*, *85*(4), 239-247.

Fagley, N. S., & Kruger, L. (1986). *Framing effects on the program choices of school psychologists*. Paper presented at the annual meeting of the American Psychological Association, Washington, DC.

Fagley, N. S., Miller, P. M. (1990). The effect of framing on choice: Interactions with risk-taking propensity, cognitive style, and sex. *Personality and Social Psychology Bulletin, 16*, 496-510.

Frederick, S. (2005). Cognitive reflection and decision making. *Journal of Economic Perspectives, 19*, 25-42.

Haselton, M. G., Nettle, D., Murray, D. R. (2016). The evolution of cognitive bias. *Handbook of Evolutionary Psychology, 2*, 968-987.

Kahneman, D. & Frederick, S. (2002). Representativeness revisited: Attribute substitution in intuitive judgement. In T. Gilovich, D. Griffin, & D. Kahneman (Eds.), *Heuristics and biases: The psychology of intuitive judgment* (pp. 49-81). Cambridge: Cambridge University Press.

Kim, S., Goldstein, D., Hasher, L., & Zacks, R. T. (2005). Framing effects in younger and older adults. *The Journals of Gerontology. Series B, Psychological Sciences and Social Sciences, 60*(4), 215–218.

Larrick, R. P. (2004). Debiasing. In D.J. Koehler & N. Harvey (Eds.), *Blackwell handbook of judgment and decision making* (pp. 316-337). Oxford, United Kingdom: Blackwell.

Levin, I. P., & Gaeth, G. J. (1988). How consumers are affected by the framing of attribute information before and after consuming the product. *Journal of Consumer Research, 15*, 374–378.

McNeil, B. J., Pauker, S.G., Sox, H. C. Jr, Tversky, A. (1982). On the elicitation of preferences for alternative therapies. *New England Journal of Medicine, 306*(21), 1259–1262.

Milkman, K. L., Chugh, D., & Bazerman, M. H. (2009). How can decision making be improved? *Perspectives on Psychological Science*, *4*(4), 379-383.

Mussweiler, T., Strack, F., & Pfeiffer, T. (2000). Overcoming the inevitable anchoring effect: Considering the opposite compensates for selective accessibility. *Personality and Social Psychology Bulletin, 26,* 1142-1150.

Peters, E., & Levin, I. P. (2008). Dissecting the risky-choice framing effect: Numeracy as an individual-difference factor in weighting risky and riskless options. *Judgment and Decision Making, 3*(6), 435-448.

Toplak, M. E., West, R. F., & Stanovich, K. E. (2014). Assessing miserly information processing: An expansion of the Cognitive Reflection Test. *Thinking & Reasoning, 20(2),* 147-168.

Tversky, A., & Kahneman, D. (1981). The framing of decisions and the psychology of choices. *Science, 211,* 453-458.

Tversky, A., & Kahneman, D. (1986). Rational choice and the framing of decisions. *The Journal of Business, 59,* S251-S278.

Tversky, A., & Kahneman, D. (1979). Prospect theory: An analysis of decision under risk. *Econometrica, 47*(2), 263-291.

Wang, X.T., Simons, F., Brédart, S. (2001). Social cues and verbal framing in risky choice. *Journal of Behavioral Decision Making, 14*, 1-15.

Appendix

Group A Questionnaire:

1. **Asian Disease Problem (From Tversky & Kahneman, 1981)**
   Imagine that the U.S is preparing for the outbreak of an unusual Asian disease, which is expected to kill 600 people. Two alternative programs to combat the disease have been proposed. Assume that the exact scientific estimates of the consequences of the problems are as follows:
   -If Program A is adopted, 200 people will be saved.
   -If Program B is adopted, there is 1/3 probability that 600 people will be saved, and 2/3 probability that 0 people will be saved .
   Which of the two programs would you favor?

2. **School Dropout Prevention Problem (From Fagley & Kruger, 1986)**
   Imagine that in one particular state it is projected that 1000 students will drop out of school during the next year. Two programs have been proposed to address this problem, but only one can be implemented. Based on the other states' experiences with the programs, estimates of the outcomes that can be expected from each program can be made Assume for purposes of this decision that these estimates of the outcomes are accurate and are as follows:
   -If Program 1 is adopted, 400 of the 1000 students will stay in school.
   -If Program 2 is adopted there is 2/5 chance that all 1000 students will stay in school and 3/5 chance that none of the 1000 will stay in school.
   Which program would you favor for implementation?

3. **Fatal Disease Problem (Wang, Simons, & Brédart, 2001)**
   Imagine that the entire human population on the earth (i.e., approximately 6 billion people) is infected by a fatal disease. Without treatment they will die. Two alternative medical plans to treat the disease have been proposed. Assume that the exact scientific estimates of the consequences of the plans are as follows:
   -If plan A is adopted, 2 billion people will be saved.
   -If plan B is adopted, there is a one-third probability that all 6 billion people will be saved and two-thirds probability that none of them will be saved.
   Which plan would you prefer?

Group B Questionnaire:

1. **Asian Disease Problem (From Tversky & Kahneman, 1981)**
   Imagine that the U.S is preparing for the outbreak of an unusual Asian disease, which is expected to kill 600 people. Two alternative programs to combat the disease have been proposed. Assume that the exact scientific estimates of the consequences of the problems are as follows:
   -If Program C is adopted 400 people will die.
   -If Program D is adopted there is 1/3 probability that nobody will die, and 2/3 probability that 600 people will die.
   Which of the two programs would you favor?

2. **School Dropout Prevention Problem (From Fagley & Kruger, 1986)**
   Decision Problem
   Imagine that in one particular state it is projected that 1000 students will drop out of school during the next year. Two programs have been proposed to address this problem, but only one can be implemented. Based on the other states' experiences with the programs, estimates of the outcomes that can be expected from each program can be made Assume for purposes of this decision that these estimates of the outcomes are accurate and are as follows:
   -If Program 1 is adopted, 600 of the 1000 students will drop out of school.
   -If Program 2 is adopted there is 2/5 chance that none of the 1000 will drop out of school and 3/5 chance that all 1000 students will drop out of school.
   Which program would you favor for implementation?

3. **Fatal Disease Problem (Wang, Simons, & Brédart, 2001)**
   Imagine that the entire human population on the earth (i.e., approximately 6 billion people) is infected by a fatal disease. Without treatment they will die. Two alternative medical plans to treat the disease have been proposed. Assume that the exact scientific estimates of the consequences of the plans are as follows:
   -If plan A is adopted, 4 billion people will die.
   -If plan B is adopted, there is a one-third probability that none of them will die and two-thirds probability that all 6 billion people will die.
   Which plan would you prefer?

Group C Questionnaire:

1. ***Asian Disease Problem (From Tversky & Kahneman, 1981)***
   Imagine that the U.S is preparing for the outbreak of an unusual Asian disease, which is expected to kill 600 people. Two alternative programs to combat the disease have been proposed. Assume that the exact scientific estimates of the consequences of the problems are as follows:
   -If Program A is adopted, 200 people will be saved.
   -If Program B is adopted, there is 1/3 probability that 600 people will be saved , and 2/3 probability that o people will be saved .
   Which of the two programs would you favor?

2. ***School Dropout Prevention Problem (From Fagley & Kruger, 1986)***
   Decision Problem
   Imagine that in one particular state it is projected that 1000 students will drop out of school during the next year. Two programs have been proposed to address this problem, but only one can be implemented. Based on the other states' experiences with the programs, estimates of the outcomes that can be expected from each program can be made Assume for purposes of this decision that these estimates of the outcomes are accurate and are as follows:
   -If Program 1 is adopted, 400 of the 1000 students will stay in school.
   -If Program 2 is adopted there is 2/5 chance that all 1000 students will stay in school and 3/5 chance that none of the 1000 will stay in school.
   Which program would you favor for implementation?

3. ***Fatal Disease Problem (Wang, Simons, & Brédart, 2001)***
   Imagine that the entire human population on the earth (i.e., approximately 6 billion people) is infected by a fatal disease. Without treatment they will die. Two alternative medical plans to treat the disease have been proposed. Assume that the exact scientific estimates of the consequences of the plans are as follows:
   -*If plan A is adopted, 2 billion people will be saved.*
   -If plan B is adopted, there is a one-third probability that all 6 billion people will be saved ***and*** *two-thirds probability that none of them will be saved.*
   Which plan would you prefer?

Group D Questionnaire:

1. ***Asian Disease Problem (From Tversky & Kahneman, 1981)***
   Imagine that the U.S is preparing for the outbreak of an unusual Asian disease, which is expected to kill 600 people. Two alternative programs to combat the disease have been proposed. Assume that the exact scientific estimates of the consequences of the problems are as follows:
   -If Program C is adopted 400 people will die.
   -If Program D is adopted there is 1/3 probability that nobody will die, and 2/3 probability that 600 people will die.
   Which of the two programs would you favor?

2. ***School Dropout Prevention Problem (From Fagley & Kruger, 1986)***
   Decision Problem
   Imagine that in one particular state it is projected that 1000 students will drop out of school during the next year. Two programs have been proposed to address this problem, but only one can be implemented. Based on the other states' experiences with the programs, estimates of the outcomes that can be expected from each program can be made Assume for purposes of this decision that these estimates of the outcomes are accurate and are as follows:
   -If Program 1 is adopted, 600 of the 1000 students will drop out of school.
   -If Program 2 is adopted there is 2/5 chance that none of the 1000 will drop out of school and 3/5 chance that all 1000 students will drop out of school.
   Which program would you favor for implementation?

3. ***Fatal Disease Problem (Wang, Simons, & Brédart, 2001)***
   Imagine that the entire human population on the earth (i.e., approximately 6 billion people) is infected by a fatal disease. Without treatment they will die. Two alternative medical plans to treat the disease have been proposed. Assume that the exact scientific estimates of the consequences of the plans are as follows:
   -If plan A is adopted, 4 billion people will die.
   -If plan B is adopted, there is a one-third probability that none of them will die and two-thirds probability that all 6 billion people will die.
   Which plan would you prefer?

Cognitive Reflection Test (CRT)

A bat and a ball cost $1.10 in total. The bat costs a dollar more than the ball. How much does the ball cost? ____ cents

If it takes 5 machines 5 minutes to make 5 widgets, how long would it take 100 machines to make 100 widgets? ____ minutes

In a lake, there is a patch of lily pads. Every day, the patch doubles in size. If it takes 48 days for the patch to cover the entire lake, how long would it take for the patch to cover half of the lake? ____ days

If John can drink one barrel of water in 6 days, and Mary can drink one barrel of water in 12 days, how long would it take them to drink one barrel of water together? _____ days

Jerry received both the 15th highest and the 15th lowest mark in the class. How many students are in the class? _____ students

A man buys a pig for $60, sells it for $70, buys it back for $80, and sells it finally for $90. How much has he made? _____ dollars

Simon decided to invest $8,000 in the stock market one day early in 2008. Six months after he invested, on July 17, the stocks he had purchased were down 50%. Fortunately for Simon, from July 17 to October 17, the stocks he had purchased went up 75%. At this point, Simon has: a. broken even in the stock market, b. is ahead of where he began, c. has lost money.