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SELF-EVALUATION OF SKILLS AND OVERCONFIDENCE VULNERABILITY: ARE MOST PEOPLE BLIND TO THEIR OWN DECISION MAKING BIASES?

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SELF-EVALUATION OF SKILL AND OVERCONFIDENCE VULNERABILITY:
ARE MOST PEOPLE BLIND TO THEIR DECISION MAKING BIASES?

A THESIS APPROVED FOR THE
DEPARTMENT OF PSYCHOLOGY

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Dedicated to my grandfather Robert J. Brunel

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Abstract

Skilled decision making is an acquired skill that often leads to better life outcomes (e.g. wealth, health, and happiness) (Cokely et al., 2012; 2018). There is a growing body of literature centered on Bias Blind Spot which states that individuals are biased in self-evaluation. On average, people inaccurately perceive themselves as better decision makers than the public, regardless of individual differences (Pronin Lin, & Ross, 2002; Scopelliti et al., 2015; West, Meserve, & Stanovich, 2012). Given that skilled decision makers tend to better understand themselves compared to others, it is hypothesized that those who are more numerate are less biased and know it (Kruger & Dunning, 1999; Ghazal, Cokely, Garcia-Retamero, 2014). To test this, 309 participants answered high fidelity tests of decision making skill and completed a newly formed bias blind spot measure that includes representative questions of both social and cognitive biases. Results suggest that skilled decision makers tend to be better than average on decision tasks and their confidence reflects accuracy in their performance. Findings indicate that quality of self-evaluation may be a function of general decision making skill. Implications for training and self-regulated learning are discussed.

Chapter 1: Numeracy and Self-Evaluation of Decision Skill

General decision making skill refers to the stable differences in judgment and decision making quality across diverse domains and is correlated with positive life outcomes (e.g., health, wealth, and happiness). The best predictor of general decision making skill is numeracy (Cokely et al., 2012; 2014; 2018; Peters et al., 2006; Reyna, Nelson, Han, & Dieckman, 2009). Numeracy tends to mechanically show how an individual can expertly employ metacognitive, heuristic, or gist-based strategies to problem solving which can potentially lead to important lifesaving outcomes, like not ignoring the signs of a heart attack (Cokely & Kelly, 2009; Ghazal, Cokely, & Garcia-Retamero, 2014; Reyna & Mills, 2014; Petrova et al., 2016). One example of displaying metacognitive skill can be found in Ghazal et al. (2014) where the goal of the article was to answer the question of why numerate individuals do better on decision making tasks. A curvilinear relationship was found between performance and confidence parallel to the results found with unskilled and unaware studies (Kruger & Dunning, 1999). Interestingly, the research on numerate individuals knowing their own and others' decision making capabilities is at odds with previous research looking at the phenomenon known as the *bias blind spot*. Research on the bias blind spot implies that a skilled decision maker would be able to recognize bias within others, but not within themselves. Are people blind to their biases?

1.1 An Overview of the Bias Blind Spot

In the initial bias blind spot paper, by Pronin, Lin, and Ross (2002), individuals spanning from students to airline passengers believed themselves to be less biased than their peers on average. The study investigated the issue of biases that compromise lay

inferences and judgments from the perspective that all individuals perceive the world uniquely due to the experiences that they bring and the distorting lens of values and ideology. The paper takes the stance that people 1) can perceive decision bias in others and 2) that people lack the ability to recognize these biases in themselves or recognize them to a less degree; "people recognize the existence, and the impact, of most of the biases that social and cognitive psychologists have described over the past few decades. What they lack recognition of, I argue, is the role that those same biases play in governing their own judgments and inferences" (p. 369). The first assertion, that people can explain their own biases, has been demonstrated in other studies (VanBoven, Kamada, & Gilovich, 1999; Kruger & Gilovich, 1999; Miller & Ratner, 1998), but no other study has looked at the perceptual asymmetry of recognizing bias within ourselves and others.

To address the issue of bias blind spot Pronin et al. (2002) used three studies. Each study described biases that asked participants to assess their own susceptibility and how susceptible others would be. The first looked at perception of the self versus the average American on eight distinct biases (self-serving attributions for success versus failure, dissonance reduction after free choice, the positive halo effect, biased assimilation of new information, reactive devaluation of proposals from one's negotiation counterparts, perceptions of hostile media bias toward one's group or cause, the fundamental attribution error (FAE) in "blaming the victim," and judgments about the "greater good" influenced by personal self-interest). Twenty-four Stanford students rated how susceptible they would be to display the above biases on a likert scale from 1 (*not at all*) to 9 (*strongly*). (Thirteen students were asked to rate themselves and then to

rate the average American, while the other eleven rated the average American and then rated themselves) For each bias rating there was a significant difference between self (M = 5.31) and the average American (M = 6.75, $t(23) = 8.31$, $p < .0001$; $d = 3.47$). The second study replicated the first but changed the comparison group from the average American to the average classmate. The study also added three additional items that held more relevance to students (procrastination, fear of public speaking, and the planning fallacy). The authors predicted that having more experience with these three biases would lead to a more equal bias rating between self and others than the previous eight biases. Results were as predicted with significant differences for self (M =5.05) versus the average classmate (M = 5.85) for the original eight biases (t (28) = 4.64, $p <$ .0001; d = 1.75), but there was no significant difference for the three items that students had more experience with ($t(28) = 1.49$, $p = .15$; $d = 0.56$). In other words, those skilled with a bias may perceive themselves to be as biased as others.

The third study looked at 76 airline passengers answering similar bias questions, added seven new biases (friend enhancement, trust of strangers, trust of borrowers, generous attribution, downward comparison bias, upward comparison bias, and gambler's fallacy), and used raters to determine which biases would be considered high or low availability (high availability meaning that the bias is more common). The implications here were that biases that people have less experience with will ultimately lead to a more divergent rating of self versus others, while people will be better attuned to more common biases. The results spoke to this prediction by finding significant differences in bias ratings for the original eight biases ($t(74) = 3.67$, $p < .0005$; $d =$ 0.85), but none of the additional biases. In that participants rated themselves to be less

susceptible than other travelers for the rated low availability biases (M = .53, $t(74)$ = 3.51, $p < .001$; d = 0.82), but equally susceptible to the high availability biases (M = .04). Two more studies were conducted on ratings of self-enhancement and better than average effect respectively. The idea from these studies is that people see bias as an attribution of a "loser" and less bias as an attribution of a "winner." Thus people will activate ego-defensive processes and self-enhancement to not rate themselves as biased.

This finding was examined in depth in Pronin and colleagues' later studies of the bias blind spot in which they suggested potential reasons why people would rate themselves as less biased than others (Ehrlinger, Gilovich, & Ross, 2005; Pronin, 2007, 2008; Pronin, Gilovich, & Ross, 2004; Pronin & Kugler, 2007). One reason for this is thought to be the introspection illusion. This is the inability to recognize that unconscious processes have impeded conscious introspective judgments about ourselves, while we assess others' overt behaviors to determine if they are biased or not. The second reason given for the bias blind spot is the idea of naïve realism. Naïve realism is the idea that people view their perceived world as the "objective reality" and that those who do not share this same world view are biased (Robinson, Dacher, Ward, & Ross, 1995; Ross & Ward, 1996). These theories have been demonstrated in two important papers about bias blind spot. The papers by West, Meserve, and Stanovich (2012) and Scopelliti et al. (2015) both serve as demonstrations of how to measure bias blind spot in both a social and cognitive context.

West et al. (2012) further investigated the phenomenon that individuals rated themselves as less biased compared to others for cognitive decision tasks. To do this, the authors chose the Cognitive Reflection Test (CRT) to examine how individual

differences in rationality play into perceptions of bias in ourselves and others. The CRT has been shown to be predictive of many types of problem solving tasks important to decision making (e.g. temporal discounting, framing, expected value, intelligence, etc.) and is commonly used in individual differences studies (Frederick, 2005; Toplak, West, & Stanovich, 2011). The authors predicted that under a System 1 (fast, automatic heuristic processing that is prone to error) or System 2 (slow, analytic decision making) framework that processes like naïve realism and introspection tend to operate under System 1, thus predicting that intelligence (higher amounts of System 2 processing, higher CRT scores) would not be correlated with the bias blind spot due to its System 1 nature.

The first study had 482 undergraduates complete the CRT, give their SAT scores, take The Thinking Disposition Questionnaire, The Actively Open-Minded Thinking (AOT) Scale, The Need for Cognition Scale, and rate their levels of biases like the Pronin et al. (2002) study (one self-evaluation question which is compared to a question about the average student's susceptibility to the bias). West et al. (2012) concentrated on seven cognitive biases: outcome bias, base rate neglect, framing bias, conjunction fallacy, anchoring bias, myside bias, and a brief statement about the danger of cell phone use while driving. Participants then completed a battery of decision making and heuristics problems corresponding to each of the biases asked in the bias blind spot questionnaire. Results found significant differences between the self-ratings and the ratings of the average student for all biases (all $p < .001$, $t(481) = 8.31$-11.97, $d = .341$-$.603$). When looking at the composite of all the bias blind spot rating differences there was a significant, positive correlation with the CRT (.096), SAT total score (.176),

Need for Cognition Scale (.260), and The Actively Open-Minded Thinking Scale (.119). This indicates that those who are more cognitively sophisticated rate themselves to be less biased than their peers.

The authors concluded that cognitive sophistication is not adequate protection from the bias blind spot, "the correlation between the composite blind spot score and the four measures of cognitive sophistication: the CRT, SAT total score, Need for Cognition Scale, and AOT Scale. All four of these correlations (.096, .176, .260, and .119) were statistically significant. Interestingly, however, all four of the correlations were positive in direction—indicating that more cognitively sophisticated participants showed larger bias blind spots" (p. 511). This suggests that the discrepancy in bias evaluations for ourselves and for others is the use of inaccurate introspection to evaluate oneself and use of overt behaviors to evaluate others. The authors also state that bias blind spot is not mitigated by cognitive ability, like the trends found with the myside bias and noncausal base-rate neglect, as the biases are not controlled strategically and are instead fundamental. Theories aside, West et al. (2012) provided the framework to measure the bias blind spot in the cognitive realm. This was extended to the social realm in the work by Scopelliti et al. (2015).

In five studies, Scopelliti et al. (2015) was able to create and initially validate a bias blind spot measurement, see how decision making competency and social bias blind spot are related, show where bias blind spot may be important in the real world via advice taking, and make notions toward the reduction of bias blind spot in individuals. The first step the authors took was to create and validate a measurement of bias blind spot. A total of 172 Amazon Mechanical Turk workers rated 27 bias

questions written by the authors and from previous bias blind spot studies including Pronin (2002). There were no cognitive biases like those found in the West et al. (2012) paper, but it is stated that the bias blind spot is a latent variable that would influence responses for specific biases, thus the exact bias questions asked may not be as important as the general trend of responses. The final measurement consisted of 14 social biases ranging from the action-inaction bias to ingroup favoritism which were chosen via correlation (all items had a correlation of .4 or higher, anything lower was removed) and had a reliability of 0.86. The authors performed an exploratory factor analysis finding a single factor that accounted for 35% of the total variance. The second study was able to look at the bias blind spot on several different measures. Select results include: a significant and negative correlation with the CRT (r (99) = −0.22, p = 0.02), no correlation with all of the parts of the A-DMC battery (all rs < 0.14, all ps > 0.18, average r = 0.08), significant and positive correlation with self-esteem (r (258) = 0.15, p = 0.02), a significant and positive correlation with need for uniqueness (r (258) = 0.16, p < 0.01), and a significant and positive correlation with openness (r (96) = 0.33, p <0.01). All other measures were non-significant.

Further, it was found that people who exhibited higher levels of susceptibility to bias blind spot were more susceptible to better-than-average effects, more likely to ignore advice due to their overconfidence (calculated via weight on advice relative to each object before and after advice is given to the participant $b1$ = 0.104, SE = 0.044, z = 2034, p = 0.02), and may be harder to debias (calculated via an interaction between training and susceptibility to the bias blind spot X^2 (1) = 4.73, p = 0.03). Overall, the

studies found that there was extensive variance across participants in the amount of bias blind spot they reported.

West et al. (2012) and Scopelliti et al. (2015) make strides toward uncovering the individual differences that lay within the variance of bias blind spot scores. They do so with separate measurements that may be perceived differently by individuals. That is, do people view cognitive biases the same way as social biases? If seen differently, it may also be that different predictors would factor into how perceptions are made. For instance, this could be a reason why there are conflicting CRT correlational directions between the two studies. This brings about my second research question: Would decision making skill and metacognitive skills change how biases are perceived in ourselves and others and how would this differ between cognitive and social biases? Put another way, is self-evaluation part of general decision making skill?

1.2 Bias Blind Spot and How it Relates to General Decision Making Skill

Individuals who are more numerate tend to be more aware of the context in which decision problems exist and understand the problem in a more representative fashion (Cokely & Kelly, 2009). That is, skilled decision makers tend to imagine how the decision will alter not only their life, but the lives of others in a meaningful way. This elaborative processing would suggest that while some people are aware of their biases and how they influence others, the unskilled decision makers are unaware (Kruger & Dunning, 1999). This would also imply that accurate self-evaluation is needed to avoid overconfidence. Deriving from Skilled Decision Theory, this could mean that numeracy is shaping self-evaluative skills. This is contradictory to over a decade of work exploring how humans are inherently unfeeling or off-kilter about their

own biases (e.g. the bias blind spot), leading to a supposed cascade of harmful perceptions of others and decreased decision making potential. To help resolve some tension, a study examining decision making skill and self-evaluations of bias was conducted.

Hypothesis 1: There will be a difference between social and cognitive bias perceptions. A representative measure of both cognitive and social biases must be created. If there is a difference between the measures of social and cognitive bias blind spot, then there will be implications for how bias blind spot relates to decision making skill. It would make sense that latent perceptions of cognitive bias would be most influenced by actual metacognitive decision skill (e.g., numeracy and actual performance on descriptive decision tasks). This predicts that there would be an association between cognitive bias blind spot scores and numeracy, but no association of numeracy and social bias blind spot. This then would predict that skill and experience lead to better calibrated bias perceptions of ourselves and others (a true reflection and understanding of skill) and not that perceptions of ourselves versus others as the result of an overly positive self-view that intrudes our biased decision making as previously put forth.

Hypothesis 2: Numeracy scores via the Berlin Numeracy Test (Cokely, 2012) ought to predict that individuals who are lowest in numeracy will be highest in bias blind spot with trends moving toward accuracy, then underconfidence (a positive bias blind spot score, but still beneath where their numeracy score would be). I say underconfidence as a positive bias blind score is true in the case of high numeracy scores. Those who are less biased know that they are less biased compared to others,

showing a positive correlation between decision making skill and bias blind spot. Reasoning that those who are higher in numeracy would be more familiar with the asked biases within themselves and others (Pronin et al., 2002). Put another way, numerate individuals should have better confidence competence (e.g. less vulnerable to overconfidence) in domain general decision making task performance relative to others.

Hypothesis 3: Special knowledge/experiences of the world will lead to increased ratings of social bias blind spot (accuracy in one's own social perceptions). Knowing that decision makers have mental model representations of themselves and others allows for the investigation of individual differences that give rise to those perceptions. What are some specific reasons that an individual might think themselves to be less biased than the average person? I supposed that there could be differences in perceptions depending on which biases were being measured. People may vary on their ability to encode social information compared to cognitive information. That is, according to Skilled Decision Theory, people may have special information or experience (e.g., being a minority) that would alter social bias perceptions as it would make the bias more available (Cokely et al., 2016; Pronin et al., 2002). Given this, a positive correlation is predicted between special representative understanding of the world and the bias blind spot ("I am not as sexist as others because I know how it feels to be discriminated against"). Taken together, showing evidence for the hypotheses would imply that our bias perceptions would be a skill integrated into our general decision making ability. Therefore, if you wanted to calibrate/train self-evaluation of decision making skill (reduce overconfidence), then general decision making training would be a viable solution.

Chapter 2: Participants and Measurements

2.1 Participants

A sample of 515 University of Oklahoma students volunteered to participate in a 5-hour study that was completed in 8 segments over the course of 5-8 weeks, in exchange for class credit. A total of 309 participants completed all segments of the study in accord with study and course requirements and instructions.[1] The first segment was completed in a face-to-face session in a research lab and was completed in about one-and-a-half hours. The remaining seven segments were completed in a specific order designed to require about half an hour each and were completed via an online platform (e.g., could be completed at home, in a computer lab, on a mobile phone, etc.) to provide adequate breaks and considerable flexibility for busy college student participants. All participants were advised that once started, the entire segment should be completed in a quiet setting that would allow for uninterrupted concentration for 30 consecutive minutes. The average age of all participants who completed the study was 18-24 years (male = 112 (36.2%), female = 197 (63.7%)). Testing was completed over the span of 8-9 months (Fall and Spring semester 2016-2017).

2.2 Procedure and Materials

All the materials except the National Adult Reading Test (NART) were administered online via Qualtrics, a survey hosting service. For a complete list of all measures given to the participant see Table 1. The first part of the study was in lab and

[1] Due to the at home nature of the study many participants ignored or otherwise substantially deviated from task requirements, skipping or rapidly advancing through sections at rates implying that instructions could not have been read or followed (e.g., participants who spent less than 60 seconds on the Ravens, 60 seconds on the wonderlick, and/or less than 70 seconds on any of the four parts of the Cattell where categorized non-respondents)

was completed on a lab computer. The participant completed an online informed consent form and then was directed to the study. Participants were then given brief instructions and completed several numeracy tests, a personality scale, the CRT, the NART (proctored by a research assistant), and a working memory test. The remaining measures were given to the participant at home, where they could take the surveys at any time that was convenient for them.

The at-home portion of the study was broken into seven parts. The first part was risky decision making, followed by: The Adult Decision Making Competence index, the Wonderlic (Wonderlic & Hovland, 1939), the Science Literacy Scale (Petrova et al., 2016), Bias Blind Spot, descriptive decision tasks, Ravens Progressive Matrices (Raven, Raven, & Court, 2003), the Cattel Culture Fair III Intelligence Test (Cattell & Cattell, 1973), the Decision Outcome Inventory (DOI; Bruine de Bruin, Parker, & Fischhoff, 2007), and demographics. Once the participant completed the final at-home section they were debriefed and thanked for their time. Metadata was collected on each of the surveys including time on page, reaction times, and time to first click. This was used to help identify which participants were malingering.

Because the overall data collection and investigation involved multiple measures and studies, here we focus on only those measures and tests that were identified a priori as the target of the current investigation. Other notable instruments and ad hoc analyses are provided in the appendix.

Bias Blind Spot Measure

The bias blind spot measure used was an adapted version of the one in Scopelliti et al. (2015). Nine additional items were added to the original fourteen. The items were

written to mimic the original style of describing the bias and giving a brief example. Additional items are based on the cognitive biases found in West et al. (2012). Each item consisted of the participant reading the description of the bias and then making a rating (from *not at all* (1) to *very much* (7)) of how often they exhibit the bias. The participant then made a rating of how often the average American exhibits the bias. The difference was taken and averaged across each item.

Numeracy

The Berlin Numeracy Test – Schwarts (BNT-S) (Cokely et al., 2012; RiskLiteracy.org) was used to assess general decision making skill. The BNT-S consists of the traditional BNT items with the addition of the Schwartz et al. (1997) easy items. The additional items allow for higher discriminability and psychometric sensitivity among individuals with low-to-moderate numeracy, which may be found within the sampled population. Subjective numeracy (Fagerlin et al., 2007) and BNT-Components (Ghazal, 2014) were also assessed, though they were not used to assess general decision making skill.

Descriptive Decision Tasks

Decision tasks were taken from Toplak, West, & Stanovich (2011). The items used in Toplak et al. (2011) were used to validate the CRT (Frederick, 2005) in its use for decision making skill. The battery included 15 tasks that span the classical heuristics and biases such as the gambler's fallacy and regression to the mean. Toplak et al. (2011) found a strong correlation between performance on the CRT and on the composite of the 15 tasks. The tasks were said to estimate rational thought. Accordingly, I believe that performance on these tasks would be indicative of decision

skill. Additional decision tasks include: the full Adult Decision Making Competency (ADMC; Bruine de Bruin et al., 2007). The ADMC consists of the following: resistance to framing, recognizing social norms, under/overconfidence, applying decision rules, consistency in risk perception, resistance to sunk costs, and path independence. The ADMC was analyzed in amalgam as well as each piece individually. The DOI was measured in supplement to the ADMC.

Standard Cognitive Abilities

Cognitive ability measurements were used to measure general fluid intelligence, crystallized intelligence, and other domain literacy. The battery included the Ravens' Progressive Matrices (Raven, Court, & Raven, 1993), Wonderlic (Wonderlic & Hovland, 1939), and Science Literacy (Petrova et al., 2016).[2]

[2] All other measured predictors were analyzed post hoc, thus they will not be included in the main analysis and are relegated to the appendix. No evidence shows that the conclusions drawn in the thesis was found contrary. Non included scales are as follows: Catell Culture Fair Intelligence Test (Cattell, 1973), Letter Memory (Morris & Jones, 1990), NART (Nelson & McKenna, 1975), Employee Aptitude Survey (Ruch & Ruch, 1963), Medical Decision Making, real life medical decision making, Financial Decision Making, Intertemporal choice, consistency in lotteries, expected value tasks, Civic Science Literacy (Miller, 1998), GRIT (Duckworth, 2007), Basic Financial Literacy, and Sophisticated Financial Literacy (Lusardi & Mitchell, 2011; 2014).

Chapter 3: Methods and Results

The analysis on the data aimed to replicate and extend previous studies. To begin I replicated previous bias blind spot studies by looking at self-versus other perceptions in aggregate. I then factor analyzed the items to test whether individuals answer bias perception questions similarly for social and cognitive biases, replicating the one social factor found in Scopelliti et al. (2015) and finding a second, cognitive factor (Hypothesis 1). I then looked at each bias factor and decision making skill in aggregate, extending results found in West et al., (2012) which only looked at bias perception and the corresponding bias question. I then conducted a preliminary mediation analysis to see what might form our decision making perceptions and what these perceptions influence (Hypothesis 2). Finally, I looked at confidence competence by using a quadratic regression to see if numeracy would predict a curvilinear relationship with confidence (like Ghazal et al., 2014). Overall, evidence suggests that our decision skill and experience drive our confidence competence measured via the newly formed cognitive bias blind spot measure.

3.1 Bias Blind Spot Replication

The first step was to investigate the surface level aggregate bias blind spot measure. This was to replicate the traditional findings from Pronin et al. (2002) and West et al. (2012). The distributions for the overall bias blind spot measure (M = 1.13, SD = .73), the self-ratings of bias (M = .58, SD = .11), and the ratings of the average American (M = .73, SD = .107) showing an effect size of d = 1.38 and can be found in Figure 1. There was a significant difference between the self-ratings and the average American ratings (F (65, 236) = 2.15, $p < .001$), indicating that, on average, people

rated themselves to be less biased than the average American (Figure 1, 2). There was a small positive and significant correlation for the bias blind spot measure and the Ravens intelligence test (r = .152, n = 309, p = .008), science literacy (r = .163, n = 309, p = .004), confidence skill (r = .180, n = 309, p = .001), and the Adult Decision Making Competency (r = .172, n = 309, p = .002). See Table 3 for the correlation matrix. These two analyses replicate the classic bias blind spot studies and the idea that there is a positive correlation between cognitive sophistication and thinking you are less biased than the average American.

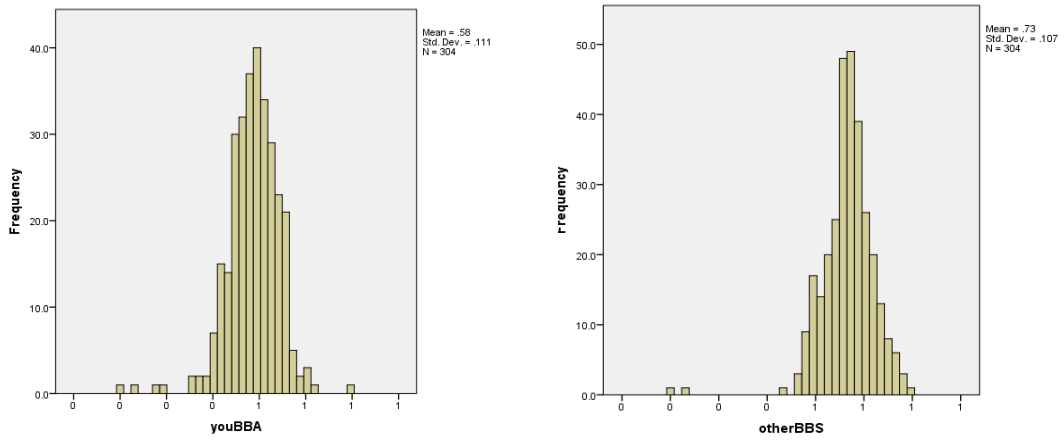


Figure 1. This depicts the distributions of average bias blind spot self ratings versus ratings of others. This replicates previous findings by showing that the ratings of others are, on average, significantly greater than the ratings for oneself (F (65, 236) = 2.15, p < .001; d = 1.38), indicating that people were more inclined to say that others are more biased than themselves.

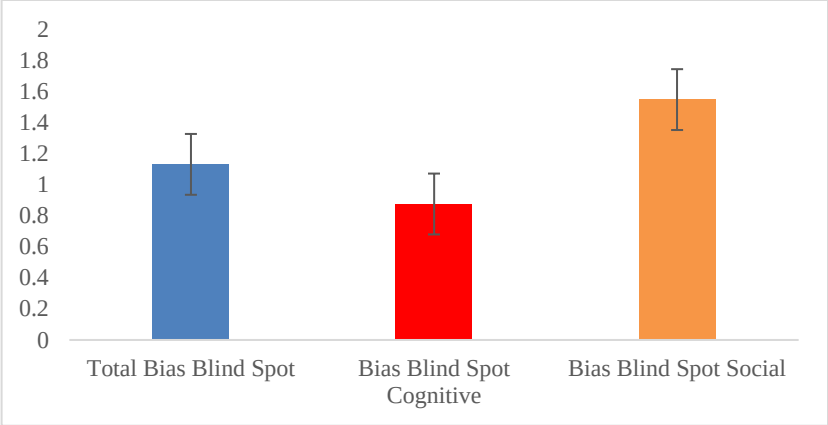


Figure 2. This shows the average bias blind spot score for the total and the two factors used. A score closer to 0 would indicate that individuals said they are just as biased as others. Notice the significant difference ($t(304) = -7.10$, $p = < .001$; $d = 0.82$) between the average bias blind spot scores for the cognitive items compared to the social items.

3.2 Factor Analysis and Creation of Cognitive Bias Blind Spot Measure

The second step was to replicate and further the findings in Scopelliti et al. (2015), while also exploring my cognitive bias blind spot measure. If bias blind spot is a latent variable of skill (given Skilled Decision Theory) then a measurement of bias perceptions should include a wide suite of representative bias items, social and cognitive. As the original bias blind spot measure only has large social representation with little cognitive, I decided to build my own instrument. I based the additional nine representative cognitive items on those asked in West et al. (2012) and then adapted their questions to match the style of Scopatelli et al. (2015). For a complete list of questions asked see Table 2 and Appendix B.

An exploratory factor analysis via principle components was conducted on the aggregated bias blind spot measure. Figure 3 shows the eigenvalues corresponding to the found four factors (1. Cognitive, 2. Social, 3. Self-preservations, 4. Avoidance) with item alphas above .4 for all items except hindsight bias. A parallel analysis was

conducted to reduce noise found within the factor analysis. The first two factors (deemed cognitive bias blind spot and social bias blind spot) were significant and account for 38.5% of the variance, while the other two biases (which contained half of the original bias blind spot scale) fell out (Horn, 1965). The two found factors were used in the remaining analyses (means for the two factors can be seen in Figure 2).

Correlations were again analyzed with the separated factors (see Table 3). The cognitive bias blind spot was significantly correlated with the following: descriptive decision tasks (r = .207, n = 309, p < .001), Ravens (r = .205, n = 309, p = .008), Cattell intelligence test (r = .138, n = 309, p = .015), Berlin Numeracy Test plus Schartz (r = .145, n = 309, p = .011), confidence skill (r = .126, n = 309, p = .027), DOI (r = .146, n = 309, p = .010), ACT scores (r = .122, n = 309, p = .031), and race (lower numbers indicates reporting to be white r = -.135, n = 309, p = .018). Note when the cognitive factor is separated from the aggregate bias blind spot measure that decision making skill and numeracy are now significant. For the social bias blind spot, the following correlations are significant: confidence skill (r = .112, n = 309, p = .049) and identifying as Hispanic (r = -.143, n = 309, p = .012). These data indicate that while the cognitive bias questions are related to decision making skill, the social bias questions are not, lending to the idea that there are two factors on which people base their bias perceptions.

Table 1
Descriptive Statistics For Key Study Variables.

	Mean	Median	Standard Dev.
1. BBS total	1.13	1.13	.73
2. BBS cog	.87	.78	.74
3. BBS soc	1.27	1.29	.85
4. Dec. Tasks	6.74	7.00	2.68
5. BNTS	3.23	3.00	1.60
6. Ravens	6.15	6.00	2.75
7. Wonderlic	23.02	23.00	5.07
8. ADMC	.63	.67	.19
9. Science Lit.	3.53	4.00	-1.23
10. Confidence Skill	0.85	0.91	0.21
11. DOI	129.81	134	28.41

Table 2
Descriptive Statistics For Bias Blind Spot Question Answers

Bias Blind Spot	Mean	Standard Deviation	Standard Error
1. Action-Inaction	1.12	1.20	0.07
2. Bandwagon effect	1.28	1.39	0.08
3. Confirmation	1.22	1.39	0.08
4. Disconfirmation	0.49	1.10	0.06
5. Diffusion of Resp.	1.52	1.64	0.09
6. Escalation of Com.	1.45	1.56	0.09
7. Fund. Attr. Error (Victim Blaming)	1.46	1.66	0.10
8. Halo Effect	1.11	1.40	0.08
9. Ingroup (Racism)	1.98	1.67	0.10
10. Ostrich Effect	0.87	1.32	0.08
11. Projection	1.21	1.66	0.10
12. Self Interest	0.91	1.31	0.08
13. Self-serving	1.24	1.38	0.08
14. Stereotyping (Sexism)	2.00	1.83	0.10
15. Framing	0.63	1.01	0.06
16. Sunk Cost	0.41	1.36	0.08
17. Ratio Bias	1.46	1.52	0.09

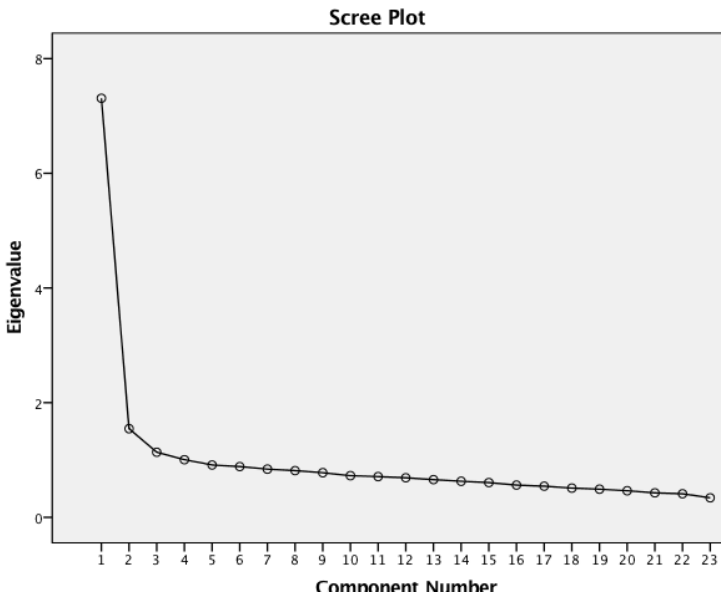
18. Representative	0.65	1.04	0.06
19. Availability	0.79	1.22	0.07
20. Gambler's Fallacy	1.39	1.53	0.09
21.Conjunction	1.04	1.19	0.07
22. Hindsight	0.61	1.13	0.06
23. Regr. to the mean	0.80	1.14	0.07

Table 3

Correlations Among For Key Study Variables.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1. BBS total	-	.813**	.779**	.066	-.009	.152**	.049	.172**	.163**	.235**	.092
2. BBS cog	.813**	-	.411**	.207**	.145**	.205**	.108	.148**	.218**	.166*	.146*
3. BBS soc	.338**	.201**	-	-.023	-.102	.053	-.016	-.009	-.016	.058	-.049
4. Dec. Tasks	.066	.230**	-.015	-	.436**	.354**	.338	.129*	.325**	.035	.125*
5. BNTS	-.009	.155**	-.007	.436**	-	.375**	.451**	.114*	.235**	-.040	.070
6. Ravens	.152**	.200**	-.020	.326**	.368**	-	.365**	.263**	.248**	.099	.087
7. Wonderlic	.049	.108	-.016	.322**	.454**	.365**	-	.245**	.335**	.136*	.110
8. ADMC	.172**	.148**	-.009	.129*	.114*	.263**	.245**	-	.162**	.725**	.060
9. Sci. Lit.	.163**	.218**	-.016	.325**	.235**	.248**	.335**	.162**	-	.088	.154**
10. Confidence	.235**	.166**	.058	.035	-.040	.099	.136*	.725**	.088	-	.028
11. DOI	.092	.146*	-.049	.125*	.070	.087	.110	.060	.154**	.028	-

Notes. * = $p < .05$, ** = $p < .001$



Bias Blind Spot 2 Factor Solution

	Factor	
	Social	Cognitive
B1 Action-Inaction	**.354**	.174
B2 Bandwagon	**.410**	.421
B3 Confirmation	**.386**	.291
B4 Disconfirmation	**.245**	.252
B5 Diffusion of Resp	**.546**	.251
B6 Escalation of Com	**.485**	.250
B7 Fund. Attr. Error	**.506**	.215
B8 Halo	**.377**	.303
B9 Ingroup Favorite	**.815**	.022
B10 Ostrich	.164	**.532**
B11 Projection	**.662**	.126
B12 Self-Interest	**.376**	.266
B13 Self-Serving	**.399**	.478
B14 Stereotyping	**.653**	.073
B15 Framing	.301	**.573**
B16 Sunk Cost	.084	**.346**
B17 Ratio Bias	.245	**.496**
B18 Representative	.184	**.567**
B19 Availability	.109	**.510**
B20 Gamblers Fallacy	.092	**.553**
B21 Conjunction	.168	**.433**
B22 Hind Sight	.257	**.453**
B23 Regress to Mean	.093	**.473**

Extraction Method: Principal Axis Factoring.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 3 iterations.

Figure 3. The factor analysis scree plot (left) shows a strong factor 1 loading, but two factors are significant in initial principle components factor analysis and after parallel analysis. The breakdown of the bias blind spot measurement factor analysis (right) shows the loadings and the divide between cognitive and social biases.

3.3 Showing Over and Under Confidence in General Decision Making via Bias Blind Spot, Decision Tasks, and Numeracy

After establishing preliminary validity of the created cognitive bias blind spot measure, it was time to further investigate the relationships between the two types of bias blind spot and decision making skill. Regressions were used to predict cognitive and social bias blind spot ratings. As seen in Figure 4 the scatterplots of the regression show that there is a significant, positive relationship between performance on descriptive decision tasks (Toplak et al., 2011) and cognitive bias blind spot ratings (F (1, 307) = 13.80, $p < .001$, $R^2 = .043$). There is also a significant, positive relationship between decision tasks and numeracy (Cokely, 2012) (F (1, 307) = 6.63, $p = .011$, R^2 =

.021). There is no significant relationship between the social bias blind spot and decision tasks (F (1, 307) = .92, p = .334, R^2 = .003) or numeracy (F (1, 307) = 3.522, p = .062, R^2 = .011; this is trending in the negative direction, meaning those with higher bias blind spot ratings have lower numeracy). Looking at the various scatterplots it becomes instantly clear that those who are highest in bias blind spot are those lowest in skill (top left quadrant of the scatterplot). It is important to note that those who are highest in decision skill and numeracy are reporting differences from the average American still below their skill level (e.g. underconfidence). The lower significance of numeracy and cognitive bias blind spot compared to decision skill also implies mediation (which is shown in results section 3.4). This lends evidence to the hypothesis that individuals who are high in numeracy will better know their skill in relation to the average American than those lower in numeracy, though both will have positive bias blind ratings.

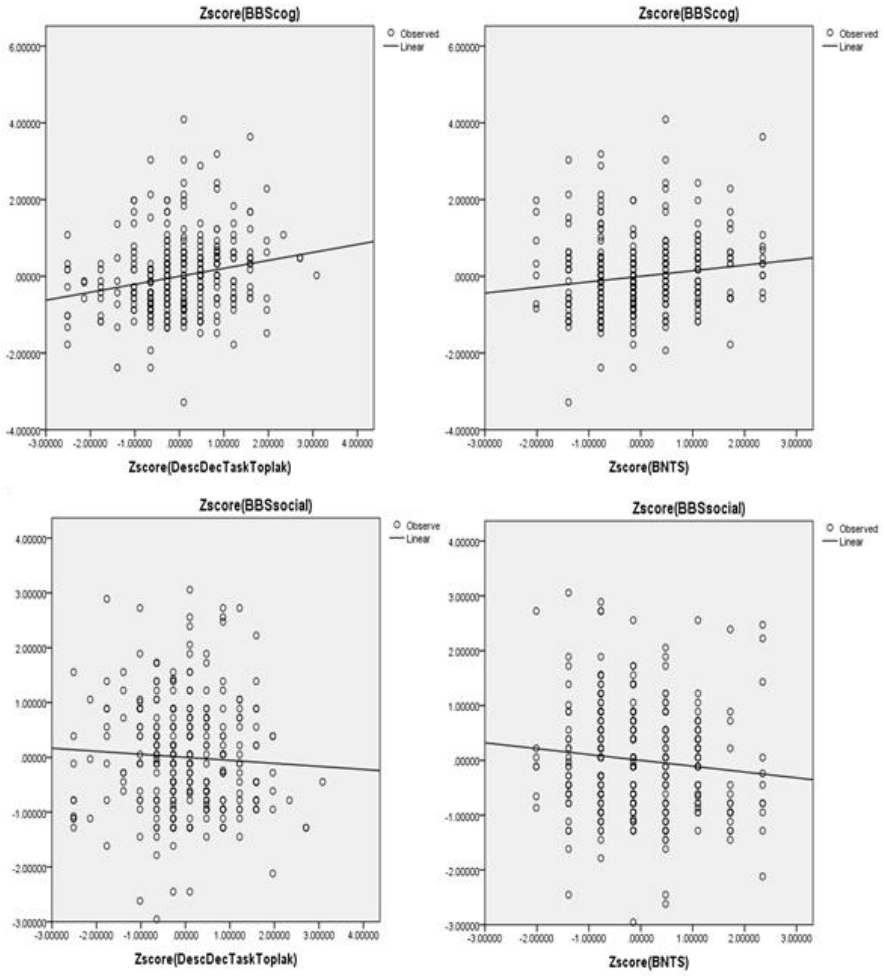


Figure 4. Cognitive (top) and social (bottom) bias blind spot scores in relation to skill. On the left is performance on descriptive decision tasks in relation to bias blind spot scores and on the right is numeracy related to bias blind spot scores. Notice the lack of any relation between social bias blind spot and decision making skill and the positive trend of decision making skill and bias blind spot. Particularly with descriptive decision task performance and bias blind spot scores (top left) a clear indication of unskilled and unaware phenomenon is present with the highest bias blind scores being made by average or low skill individuals. Those who are highest in skill are reporting aggregate cognitive bias blind spot scores lower than their skill, indicating underconfidence.

3.4 What Predicts Perceptions of Cognitive and Social Decision Skill?

After replication of previous bias blind spot studies, creation and initial investigation of a cognitive bias blind spot measure and showing that there are differences in social and cognitive bias blind spots in relation to decision making skill, the next step was to see what predicts these self-evaluated confidence judgments (coined confidence competence). Skilled Decision Theory predicts that our decision making confidence is attuned to mental models built from an experiential skill. This would imply that numeracy, decision skill, and the ADMC would predict subjective perceptions of accurate or inaccurate bias within ourselves. For the social bias blind spot measure, a more exploratory approach was taken as the study did not include objective measures of social bias. Skilled Decision Theory hypothesizes that special knowledge about the world (e.g. gender, race, etc.) would be associated with knowing relative bias within ourselves and others.

To answer the question of how people are making these perceptions a stepwise regression and mediation analysis was used to see what predicts cognitive and social bias blind spots. The final stepwise regression of cognitive bias blind spot can be seen in Appendix B. The full model explains 8.2% of the variance and includes, in order of most variance contributed to least, descriptive decision task performance (t (4, 304) = 3.837, $p < .001$), social bias blind spot (t (4, 304) = 3.814, $p < .001$), confidence skill (t (4, 304) = 2.590, $p = .010$), and Decision Outcome Inventory (DOI; t (4, 304) = 2.382, $p = .018$). After further investigation it looks as though there is mediation of numeracy and decision task performance which can be seen in the path structure in Figure 5.

A stepwise regression of social bias blind spot can be seen in Appendix B. The full model explains 5% of the variance and includes, in order of most variance contributed to least, cognitive bias blind spot (t (4, 304) = 3.834, p < .001) and gender (positive direction indicates identifying as female; t (4, 304) = 2.389, p = .018). This would indicate that our social bias blind spot perceptions are related to our cognitive bias blind spot perceptions, which are created from our decision skill and special representative understanding of the world. The path structure can be seen in Figure 6.

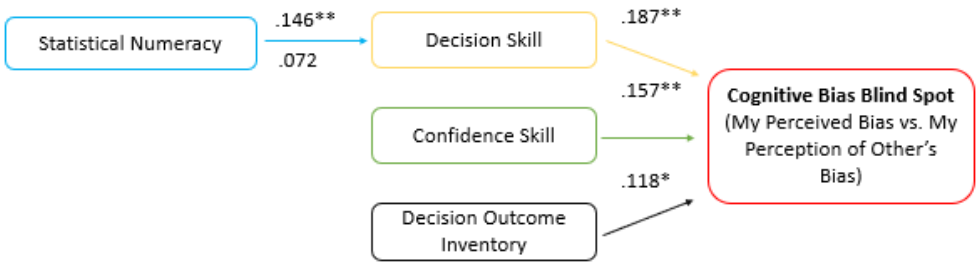


Figure 5. The mediation analysis (numbers are standardized Beta coefficients) above shows the model of predicting cognitive bias blind spot scores (R^2 = .082). Decision skill mediates the relationship between numeracy scores (BNT) and cognitive bias blind spot (Toplak et al., 2011) with an independent influence of confidence skill (ADMC) and the Decision Outcome Inventory (DOI). This implies that our perceptions of decision making bias is influenced by our general decision making skill and our decision making experiences.

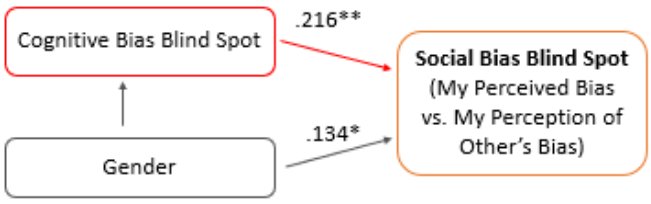


Figure 6. Mediation analysis (numbers are standardized Beta coefficients) of what predicts social bias blind spot scores (R^2 = .052). There is also a positive correlation between gender and perceptions indicating that those who are female are likely to say they are less biased than the average American on social biases (e.g. discrimination, victim blaming, etc,).

Chapter 4: Confidence Competence and Self-Evaluation as Skills Related to General Decision Making Skill and Numeracy

In recent decades, a groundswell of controversy has been growing in the decision making community over a shift in the perception and meaning of *heuristic* (e.g. rules of thumbs like using gaze to catch a fly ball or knowing that 10% of a number is just the same number with the decimal moved one digit to the left) (for more details see Gigerenzer, 2007). As detailed in the 2009 article by Gerd Gigerenzer and Henry Brighton, "Homo Heuristicus: Why Biased Minds Make Better Inference," the argument revolves around the changing of how the public and decision scientists saw heuristics once as human computational tools and now as hindrances to our own intelligence. "In the 1970s, the term heuristic acquired a different connotation, undergoing a shift from being regarded as a method that makes computers smart to one that explains why people are not smart. Daniel Kahneman, Amos Tversky, and their collaborators published a series of experiments in which people's reasoning was interpreted as exhibiting fallacies" (p. 109). The idea that individuals use heuristics to negatively bias their decision making has molded decision science around pessimistic presumptions about human behavior. From medical decision making to financial decisions, efforts have been put forth to "debias" and strip individuals of crucial decision tools without recalibration (Thaler & Sunstein, 2008; Larrick, 2004; Morewedge et al., 2015). This has been contrasted by the theory that decision making is a skill needing training framed within bounded rationality (Gigerenzer, Todd, & the ABC Research Group, 1999; Cokely et al., 2016; Cokely & Kelly, 2009; Simon, 1990).

This controversy has extended to the idea that everyone's perceptions of our own and others' decision making skill is deleteriously biased.

Over the years it has been theorized that unconscious biases that impede an individual's judgment cannot be recognized in oneself but can be recognized in others (Nisbett & Wilson, 1977). This is in the vein of people displaying systemic biases in judgment that can lead to error in specific environments (Tversky and Kahneman, 1974) and is missing the collaborated larger picture of that encompasses decision science. Further, these negative ideals postulate the idea that an individual is unaware that they wrongly perceive themselves as less biased than their peers. This phenomenon is called the *bias blind spot* (Pronin, Lin, & Ross, 2002; Pronin, Gilovich, & Ross, 2004; Pronin & Kugler, 2007; Scopelliti et al., 2015). The idea that everyone is biased and unable to recognize these biases needs refinement and contrary view points (e.g. Skilled Decision Theory and/or the unskilled and unaware phenomenon) to fully understand the important subject of perceptions of decision making skill, as skilled decision making requires accurate appraisal of others, ourselves, and the environment (Cokely et al., 2016; Dunning & Kruger, 1999).

In this study, I aimed to supplement previous research by looking at bias blind spot within the context of both cognitive and social biases simultaneously. To better understand the larger picture of decision making perceptions I asked questions such as when are individuals (un)calibrated in their decision making (heuristic) perceptions, what gives rise to the (in)correct perceptions, and how do these perceptions influence our behavior? To answer these questions many predictors were used including: numeracy, decision making skill, performance on specific decision making tasks, fluid

and crystalized intelligence, confidence, race, and gender. What I found is that people tend to be aware of their own level of bias when they have an appropriate level of decision making skill, that is, people who are skilled are aware. This bias awareness includes having special representative understandings of the world that may contribute to their perceptions of bias in themselves and how they perceive others in both a cognitive and social context. Cognitive bias blind spot may be a subset of a domain general decision making skill that is predicted by actual decision making skill and decision making familiarity. I found that perceptions of social biases are partially influenced by one's perceptions of cognitive biases, meaning that people who are vulnerable in showing bias blind spot in a cognitive context may also be vulnerable to displaying bias blind spot in social contexts. Given the evidence it seems that the bias blind spot measure may be used as a confidence measure. Those who are more skilled in decision making would have accurate confidence competence of others and themselves. Post hoc we were able to examine whether there was a curvilinear relationship between confidence and skill.

4.1 Using Bias Blind Spot to Identify Overconfidence

We have shown that general decision skill predicts relative skill judgments via cognitive bias blind spot and is related to confidence. If this is true, then cognitive bias blind spot could be used to predict confidence competence of general decision skill relative to others. This would also implicate that relative assessment of bias would be predicted by general decision making skill, thus showing that those high in skill would be accurate in their own assessments of decision making aptitude. To test this, we standardized Toplak et al., (2011) scores and subtracted standardized perceptions of

yourself cognitive bias blind spot ratings. We then used a stepwise regression to find the top predictors of confidence competence. What we found was that there were three significant predictors explaining 11% of total variance as seen in Appendix B. The predictors in order of variance explained are: Ravens (t (3, 279) = 3.156, p = .002), perceptions of other people's bias (t (3, 279) = -3.756, p < .001), and the Berlin Numeracy Test – Schwartz (t (3, 279) = 2.031, p = .043).

The nature of confidence is often not linear as seen with Ghazal et al. (2014) and Dunning & Kruger (1999). Quadratic regressions were then performed with confidence competence and numeracy. Results indicate a significant and better fit for the quadratic regression (R^2 = .039 for linear, R^2 = .046 for quadratic, $R^{2change}$ = .07) and can be seen in Figure 7, implicating that numeracy is a great predictor of confidence, overconfidence, and underconfidence. Further, this supports the hypothesis that general decision making skill predicts subjective interpretations of actual skill, meaning that skilled people can know their relative ability compared to others and can report their subjective skills accurately.

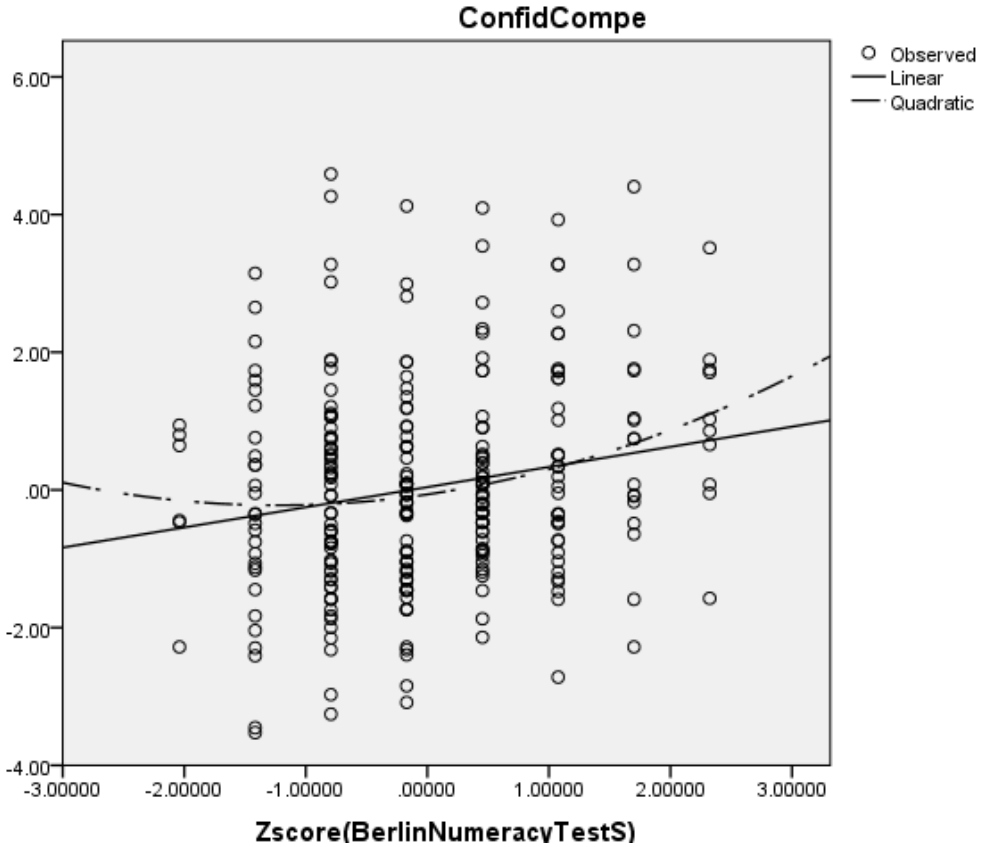


Figure 7. The curvilinear relationship between confidence competence and general decision making skill (numeracy). There appears to be levels of high confidence on the low end of skill (unskilled and unaware) and underconfidence on the high end of skill.

4.2 Train self-evaluation not the bias blind spot to protect from overconfidence

It seems that our cognitive bias perceptions partially rise from our actual skill and decision making experiences, which is probably why individuals who are less skilled in decision making are most susceptible to overconfidence (e.g. bias blind spot). Overall, I supported my hypotheses, but also found that these perceptions may only be accurate if skilled metacognitive strategies are present. That is, numerate individuals seem to know best how biased they are compared to the average individual. Taking into consideration that both cognitive bias blind spot and confidence competence is predicted by numeracy implies that these self-evaluative judgments are part of Skilled

Decision Theory. Thus, if you were to increase one's decision making skill then you would also improve key metacognitive processes important in relating personal skill to the skill of others. Knowing where one accurately stands (not being overconfident) is especially important for training (Dunlosky & Rawson, 2012**;** Yaniv & Kleinberger, 2000). When an individual is overconfident in their skill they tend to ignore advice and retain less.

Fortunately, research is being done currently to improve general decision making skill (Woller-Carter, 2015; Ybarra et al., 2017). The riskliteracy.org tutor has been shown to improve decision making skill for specific biases by over one standard deviation ($F(3, 87) = 10.08$, $p \leq .001$, $R^2 = .033$, $d = 1.30$). This would imply that if an individual trained using our lab's tutor there would be potential to calibrate their confidence competence. If an individual's confidence competence is calibrated, then they will have the tools to gather information from others to reflect on their own skill, potentially leading to further expertise gaining behavior. Unfortunately, the current practices in training confidence competence is to tell every individual that they are biased and that they should be overly aware of their "lack" of skill, which stems from the perpetual attitudes of the heuristics and biases school of thought (Morewedge et al., 2015). This combined with the fact that our study found that the bias blind spot did not and has not predicted any direct decision making behavior makes for reason to use caution when attempting to debias individuals of the bias blind spot.

The lack of decision behaviors that are predicted from bias blind spot ratings makes it difficult to predict and identifies an area in which research can improve. Being blind or not to our biases had no precedent on decision skill, intelligence, or risk taking,

but rather, our bias perceptions are formed *from* our decision skill. This may be a reason to not "debias" our perceptions of our performance as there is little evidence that altering our amount of bias blind spot will change decision making behavior. Further (and perhaps more damning toward altering bias blind spot levels), conclusions of this study show that most people are not unskilled and unaware if numerate. In fact, most individuals are accurate in their perceptions of the amount of bias they have. This would implicate that not everyone needs debias training. This is juxtaposed by the current practice of giving blanket training to everyone that lowers their levels of bias blind spot, as seen in Morewedge et al. (2015). This practice will make many individuals who were correctly attuned to their performance now inaccurate. Combining the unknown quantity of lowering bias blind spot on behavior with the unnecessary bias blind spot training for most people (that resolves with more inaccuracy than before) is enough to reflect on current powerful debias practices and suggest a new approach (such as the discussed riskliteracy.org trainer).

4.3 Confidence Competence as Evidence for Subjective Measures

Over the recent years several subjective measures have been used to identify vulnerability in knowledge, skill, and usability (e.g. numeracy**,** Fagerlin et al., 2007; graph literacy, Garcia-Retamero, Cokely, and Ghazal, 2016; the System Usability Scale; Brook, 1996). If all the evidence for the bias blind spot held then it would be impossible to get an accurate or approximate self-evaluation of skill. The evidence shown in this study by quadratically displaying that numerate people know that they are skilled in the realm of general decision making indicates the possibility that a subjective measure of decision skill/bias is not only feasible, but potentially also accurate. Further, this shows

evidence for accuracy in all subjective ratings of skill, not just decision making. The reasoning for this is that subjective scales leverage the idea that skilled individuals have displayed metacognitive behaviors about the subject. Those who are practiced in chess will stimulate metacognition by thinking about chess, plan how to act upon their current understanding of the game, evaluate others at their ability in chess, and evaluate others in general (personality, learning style, etc.) to try and build their own personal expertise (Sternberg, 1998). Specifically, self-evaluation is theoretically needed for self-regulation.

Previous research has shown that self-regulated learning includes self-evaluation (Zimmerman, 1989; 1990; 2000). This has implications for the measurement of self-regulation in relation to training, such as that you may be able to subjectively probe the knowledge of current learners and grasp an accurate approximation of their own skill and then adjust the training to better match knowledge components. This also means that one can perhaps obtain self-regulation outside of social agents (e.g. parents, teachers, etc.). General decision skills training that focuses on metacognitive strategies may create students that are motivated to attain further knowledge. This is due to the idea that self-evaluation is in large part a function of decision making skill. More numerate students may reallocate their limited resources in a way that would optimize learning that is best for them, understand their skill better in relation to others, then change their behaviors to match or exceed the performance of others, and set better, attainable goals suited to match themselves. Overall, numerate students would better employ their metacognitive skills in a way that is better, faster, and stronger than those who are overconfident.

4.4 Metacognition: The Mechanics of Why General Decision Training Works and Why Subjective Evaluations of Skill are Accurate

Individuals who are expert decision makers will know the limits to their decision making capabilities due to their extensive mental models of themselves (Cokely et al., 2016). People who are more numerate tend to profoundly know their own individual experiences, habits, values, preferences, goals, and desires. This would include the encoding of situations in which their decision making was erroneous as well as how to correct the error. This situational awareness not only applies to the self, but also to the world around them. An expert decision maker takes note and integrates the world into a probabilistic mental model to sample from, so as to inductively navigate problems (Gigerenzer, Hoffrage, & Kleinbolting, 1991). In short, an expert decision maker knows what their decision making abilities are compared to the approximate perceived ability of others. This is akin to skilled metacognition (thinking about thinking; Flavell, 1979; Garofalo & Lester, 1985; Lucangeli & Cornoldi, 1997; Rhodes & Tauber, 2011; see also Dunlosky & Metcalfe, 2009).

Individuals who are high in numeracy and have the necessary metacognitive skills will be able to expertly navigate the world via inductive reasoning (Cokely et al., 2016; Ghazal, Cokely, & Garcio-Retamero, 2014). This allows an individual to extensively deliberate heuristic choice, avoiding costly mistakes by applying metacognitive strategies such as: disconfirming, reframing, resampling, double checking, base-rate conditioning, and coherence checking. An individual more expert in these metacognitive strategies is less susceptible to biases in their decision making (revealed via performance on descriptive bias tasks). This is compared to personal-

orientated deliberation alone (without adequate metacognitive expertise) as this could lead to biases in judgment (e.g. biased sampling, confirmation bias, etc.). To emphasize, this is not about knowing situations in which common biases exist; people are not thinking “this decision problem is a classic example of the gambler’s fallacy and this is the correct strategy to apply.” Instead, people have the expert skills to navigate and understand the biased sample which is presented in a gambler’s fallacy context. In sum, those who are higher in numeracy are less susceptible to cognitive biases like ratio bias, framing, sunk cost, etc., and know it.

Chapter 5: People are Not Blind to Their Biases

Not everyone is not blind to their biases. Most people can subjectively know their skill relative to others. Those who cannot are overconfident, stemming from a lack of metacognitive skills or special representative understanding of the world (Cokely & Kelly, 2009; Cokely et al., 2016; Ghazal, Cokely, & Garcia-Retamero, 2014; Reyna, 2014). An individual has the potential to overcome "inherent bias" by learning from the environment, independent of help, given they have the necessary tools. One of these tools is self-evaluation. Moreover, self-evaluation is a skill related to numeracy. Luckily, general decision skill and decision experience is trainable. Intelligent tutors built from cognitive processes (like the riskliteracy.org tutor) are an effective means of giving people true metacognitive, heuristic based tools that will help improve self-regulated learning behaviors (Zimmerman, 1989). Even more fortunately, we are inching ever closer toward the vision of a tutor that is accessible and educational to all, skilled and unskilled.

References

Acevedo, M., & Robbins, J. M. (2005). Self as sample. In J. I. Krueger (Author), *Information sampling and adaptive cognition* (pp. 353-377). New York: Cambridge University Press.

Allan, J. N., Ripberger, J. T., Ybarra, V. T., & Cokely, E. T. (2017, September). The Oklahoma Warning Awareness Scale: A Psychometric Analysis of a Brief Self-Report Survey Instrument. In *Proceedings of the Human Factors and Ergonomics Society Annual Meeting* (Vol. 61, No. 1, pp. 1203-1207). Sage CA: Los Angeles, CA: SAGE Publications.

Benoit, J., & Dubra, J. (2011). Apparent Overconfidence. *Econometrica, 79*(5), 1591-1625.

Boven, L. V., Kamada, A., & Gilovich, T. (1999). The perceiver as perceived: Everyday intuitions about the correspondence bias. *Journal of Personality and Social Psychology, 77*(6), 1188-1199.

Brooke, J. (1996). SUS-A quick and dirty usability scale. Usability evaluation in industry, 189(194), 4-7.

Bruine de Bruin, W., Parker, A., & Fischoff, B. (2007). Individual Differences in Decision-Making Competence. *Journal of Personality and Social Psychology, 92*(5), 938.

Cokely, E. T., & Kelley, C. M. (2009). Cognitive abilities and superior decision making under risk: A protocol analysis and process model evaluation. *Judgment and Decision Making, 4*(1), 20-33.

Cokely, E. T., Feltz, A., Ghazal, S., Allan, J. N., Petrova, D., & Garcia-Retamero, R. (2016). Decision making skill: From intelligence to numeracy and expertise. In *Cambridge Handbook on Expertise and Expert Performance*. Cambridge: Cambridge University Press.

Cokely, E. T., Galesic, M., Schulz, E., Ghazal, S., & Garcia-Retamero, R. (2012). Measuring risk literacy: The Berlin Numeracy Test. *Judgment and Decision Making, 7*(1), 25-47.

Cokely, E. T., Ghazal, S., & Garcia-Retamero, R. (2014). Measuring numeracy. *Numerical Reasoning in Judgments and Decision Making about Health,* 11-38.

Cornoldi, D. L. (1997). Mathematics and Metacognition: What Is the Nature of the Relationship? *Mathematical Cognition, 3*(2), 121-139.

Duckworth, A. L., Peterson, C., Matthews, M. D., & Kelly, D. R. (2007). Grit: Perseverance and passion for long-term goals. *Journal of Personality and Social Psychology, 92*(6), 1087-1101.

Dunlosky, J., & Metcalfe, J. (2009). *Metacognition*. SAGE publication.

Dunlosky, J., & Rawson, K. A. (2012). Overconfidence produces underachievement: Inaccurate self evaluations undermine students' learning and retention. Learning and Instruction, 22(4), 271-280.

Ehrlinger, J., Gilovich, T., & Ross, L. (2005). Peering into the Bias Blind Spot: People's Assessments of Bias in Themselves and Others. *Personality and Social Psychology Bulletin, 31*(5), 680-692.

Ericsson, K. A., Prietula, M. J., & Cokely, E. T. (2007). The making of an expert. Harvard business review, 85(7/8), 114.

Fagerlin, A., Zikmund-Fisher, B. J., Ubel, P. A., Jankovic, A., Derry, H. A., & Smith, D. M. (2007). Measuring Numeracy without a Math Test: Development of the Subjective Numeracy Scale. *Medical Decision Making, 27*(5), 672-680.

Flavell, J. H. (1979). Metacognition and cognitive monitoring: A new area of cognitive-developmental inquiry. *American Psychologist, 34*(10), 906-911.

Frederick, S. (2005). Cognitive Reflection and Decision Making. *Journal of Economic Perspectives, 19*(4), 25-42.

Garcia-Retamero, R., Cokely, E. T., Ghazal, S., & Joeris, A. (2016). Measuring graph literacy without a test: A brief subjective assessment. Medical Decision Making, 36(7), 854-867.

Garofalo, J., & Lester, F. K. (1985). Metacognition, Cognitive Monitoring, and Mathematical Performance. *Journal for Research in Mathematics Education, 16*(3), 163.

Ghazal, S. (2014). *Component numeracy skills and decision making* (Doctoral dissertation, Michigan Technological University). Michigan Technological University.

Ghazal, S., Cokely, E., & Garcia-Retamero, R. (2014). Predicting biases in very highly educated samples: Numeracy and metacognition. *Judgment and Decision Making, 9*(1), 15-34.

Gigerenzer, G., & Brighton, H. (2009). Homo Heuristicus: Why Biased Minds Make Better Inferences. *Topics in Cognitive Science, 1*(1), 107-143.

Gigerenzer, G., & Selten, R. (2002). *Bounded rationality: The adaptive toolbox*. Cambridge, MA: MIT Press.

Gigerenzer, G., & Todd, P. M. (2001). *Simple heuristics that make us smart*. Oxford: Oxford University Press.

Gigerenzer, G., Gaissmaier, W., Kurz-Milcke, E., Schwartz, L. M., & Woloshin, S. (2007). Helping Doctors and Patients Make Sense of Health Statistics. *Psychological Science in the Public Interest, 8*(2), 53-96.

Gigerenzer, G., Hoffrage, U., & Kleinbolting, H. (1991). Probabilistic mental models: A Brunswikian theory of confidence. *Psychological Review, 98*(4), 506-528.

Griffin, D., & Tversky, A. (1992). The weighing of evidence and the determinants of confidence. *Cognitive Psychology, 24*(3), 411-435.

Healy, P. J., & Moore, D. A. (2007). The Trouble With Overconfidence. *Psychological Review, 115*(2), 502-517.

Horn, J. L. (1965). A rationale and test for the number of factors in factor analysis. *Psychometrika, 30*(2), 179-185.

Klayman, J., Soll, J. B., GonzÃlez-Vallejo, C., & Barlas, S. (1999). Overconfidence: It Depends on How, What, and Whom You Ask. *Organizational Behavior and Human Decision Processes, 79*(3), 216-247.

Krueger, J. (2000). The projective perception of the social world: A building block of social comparison processes. *Handbook of Social Comparison*, 323-351.

Kruger, J., & Dunning, D. (1999). Unskilled and unaware of it: How difficulties in recognizing one's own incompetence lead to inflated self-assessments. *Journal of Personality and Social Psychology, 77*(6), 1121-1134.

Kruger, J., & Gilovich, T. (1999). "Naive cynicism" in everyday theories of responsibility assessment: On biased assumptions of bias. *Journal of Personality and Social Psychology, 76*(5), 743-753.

Larrick, R. P. (2004). Debiasing. In *Blackwell handbook of judgment and decision making* (pp. 316-338).

Lusardi, A., & Mitchell, O. S. (2011). Financial literacy and planning: Implications for retirement wellbeing (No. w17078). National Bureau of Economic Research.

Lusardi, A., & Mitchell, O. S. (2014). The economic importance of financial literacy: Theory and evidence. Journal of economic literature, 52(1), 5-44.

Miller, D. T., & Ratner, R. K. (1998). The disparity between the actual and assumed power of self-interest. *Journal of Personality and Social Psychology, 74*(1), 53-62.

Miller, J. D. (1998). The measurement of civic scientific literacy. Public understanding of science, 7, 203-223.

Morewedge, C. K., Yoon, H., Scopelliti, I., Symborski, C. W., Korris, J. H., & Kassam, K. S. (2015). Debiasing Decisions: Improved Decision Making With a Single Training Intervention. *Policy Insights from the Behavioral and Brain Sciences, 2*(1), 129-140.

Morris, N. & Jones, D. M. (1990). Memory Updating in Working Memory: The Role of the Central Executive. *British Journal of Psychology, 81(1)*. 111-121.

Mueller, M. L., & Thiede, K. W. (2016). Methodology for Investigating Human Metamemory: Problems and Pitfalls. In J. Dunlosky (Author), *The Oxford Handbook of Metamemory*.

Nelson, H. E., & McKenna, P. A. T. (1975). The use of current reading ability in the assessment of dementia. British Journal of Clinical Psychology, 14(3), 259-267.

Nisbett, R. E., & Wilson, T. D. (1977). Telling more than we can know: Verbal reports on mental processes. *Psychological Review, 84*(3), 231-259.

O'Connor, B. P. (2000). SPSS and SAS programs for determining the number of components using parallel analysis and Velicer's MAP test. Behavior Research Methods, Instrumentation, and Computers, 32, 396-402.

Peters, E., Vastfjall, D., Slovic, P., Mazzocco, K., & Dickert, S. (2006). Numeracy and decision making. *Psychological Science, 17*(5), 407-413.

Petrova, D., Garcia-Retamero, R., Catena, A., Cokely, E., Carrasco, A. H., Moreno, A. A., & HernÃ¡ndez, J. A. (2016). Numeracy Predicts Risk of Pre-Hospital Decision Delay: A Retrospective Study of Acute Coronary Syndrome Survival. *Annals of Behavioral Medicine, 51*(2), 292-306.

Pronin, E., & Kugler, M. B. (2007). Valuing thoughts, ignoring behavior: The introspection illusion as a source of the bias blind spot. *Journal of Experimental Social Psychology, 43*(4), 565-578.

Pronin, E. (2006, November 28). Perception and misperception of bias in human judgment. Retrieved from https://www.sciencedirect.com/science/article/pii/S1364661306002993

Pronin, E., Gilovich, T., & Ross, L. (2004). Objectivity in the Eye of the Beholder: Divergent Perceptions of Bias in Self Versus Others. *Psychological Review, 111*(3), 781-799.

Pronin, E., Lin, D. Y., & Ross, L. (2002). The Bias Blind Spot: Perceptions of Bias in Self Versus Others. *Personality and Social Psychology Bulletin, 28*(3), 369-381.

Raven, J. C. Court, JH & Raven, JC (1993). Manual for Raven‟ s Progressive Matrices and Vocabulary Scales–Section 1: General Overview. London: HK Lewis.

Reyna, V. F., & Mills, B. A. (2014). Theoretically motivated interventions for reducing sexual risk taking in adolescence: A randomized controlled experiment applying fuzzy-trace theory. *Journal of Experimental Psychology: General, 143*(4), 1627-1648.

Reyna, V. F., Nelson, W. L., Han, P. K., & Dieckmann, N. F. (2009). How numeracy influences risk comprehension and medical decision making. *Psychological Bulletin, 135*(6), 943-973.

Rhodes, M. G., & Tauber, S. K. (2011). The influence of delaying judgments of learning on metacognitive accuracy: A meta-analytic review. *Psychological Bulletin, 137*(1), 131-148.

Robinson, R. J., Keltner, D., Ward, A., & Ross, L. (1995). Actual versus assumed differences in construal: "Naive realism" in intergroup perception and conflict. *Journal of Personality and Social Psychology, 68*(3), 404-417.

Ross, L., & Ward, A. (1996). Naive realism: Implications for social conflict and misunderstanding. In *Values and Knowledge* (pp. 103-135). Stanford, CA: Stanford Center on Conflict and Negotiation, Stanford University.

Ruch, F. L., & Ruch, W. W. (1963). *Employee aptitude survey: Technical report*. Los Angeles: Psychological Services.

Schwartz, L. M., Woloshin, S., Black, W. C., & Welch, H. G. (1997). The Role of Numeracy in Understanding the Benefit of Screening Mammography. *Annals of Internal Medicine, 127*(11), 966.

Scopelliti, I., Morewedge, C. K., Mccormick, E., Min, H. L., Lebrecht, S., & Kassam, K. S. (2015). Bias Blind Spot: Structure, Measurement, and Consequences. *Management Science, 61*(10), 2468-2486.

Simon, H. (1990). Invariants Of Human Behavior. *Annual Review of Psychology, 41*(1), 1-19.

Sniezek, J. A., & Buckley, T. (1991). Confidence depends on level of aggregation. *Journal of Behavioral Decision Making, 4*(4), 263-272.

Sternberg, R. J. (1998). Metacognition, abilities, and developing expertise: What makes an expert student?. Instructional science, 26(1-2), 127-140.

Thaler, R. H., & Sunstein, C. R. (2008). *Nudge: Improving decisions about health, wealth, and happiness*. New York: Penguin Books.

Toplak, M. E., West, R. F., & Stanovich, K. E. (2011). The Cognitive Reflection Test as a predictor of performance on heuristics-and-biases tasks. *Memory & Cognition, 39*(7), 1275-1289.

Tversky, A., & Kahneman, D. (1974). Judgment under uncertainty: Heuristics and biases. *Science, 185*(4157), 1124-1131.

West, R. F., Meserve, R. J., & Stanovich, K. E. (2012). Cognitive sophistication does not attenuate the bias blind spot. *Journal of Personality and Social Psychology, 103*(3), 506-519.

Woller-Carter, M. (2015). *Development of the intelligent graphs for everyday risky decisions tutor* (Doctoral dissertation, Michigan Technological University). Michigan Technological University.

Wonderlic, E. F., & Hovland, C. I. (1939). The Personnel Test: a restandardized abridgment of the Otis S-A test for business and industrial use. Journal of Applied Psychology, 23(6), 685-702.

Yaniv, I., & Kleinberger, E. (2000). Advice taking in decision making: Egocentric discounting and reputation formation. Organizational behavior and human decision processes, 83(2), 260-281.

Ybarra, V., Cokely, E. T., Adams, C., Woller-Carter, M., Allan, J. N., Feltz, A., & Garcia-Retamero, R. (2017). Training Graph Literacy: Developing the RiskLiteracy. org Outreach Platform. *Cogsci Proceedings 2017*, 3566-3571.

Zimmerman, B. J. (1989). A social cognitive view of self-regulated academic learning. Journal of educational psychology, 81(3), 329.

Zimmerman, B. J. (1990). Self-regulated learning and academic achievement: An overview. Educational psychologist, 25(1), 3-17. Chicago.

Zimmerman, B. J. (2000). Attaining self-regulation: A social cognitive perspective. In Handbook of self-regulation (pp. 13-39).

Appendix A: Exploratory Factor Analysis

Details of the bias blind spot factor analysis are found below. The first step was to run an exploratory principle components analysis which found 4 factors (cognitive, social justice, self-preservation, and social avoidance). The cognitive factor was made up of the cognitive questions added to the original 14 item social bias blind spot measure. The last three were made up of the social bias blind spot measure from Scopelliti et al. (2015). To ensure that noise was not in the model a parallel analysis was conducted (Horn, 1965; O'Connor, 2000), which runs a Monte Carlo simulation of the factor analysis and sees which factors remain significant after X simulations. The results show that significant eigen values for the first two factors (cognitive and social justice).

1) The initial four factor principle components analysis.

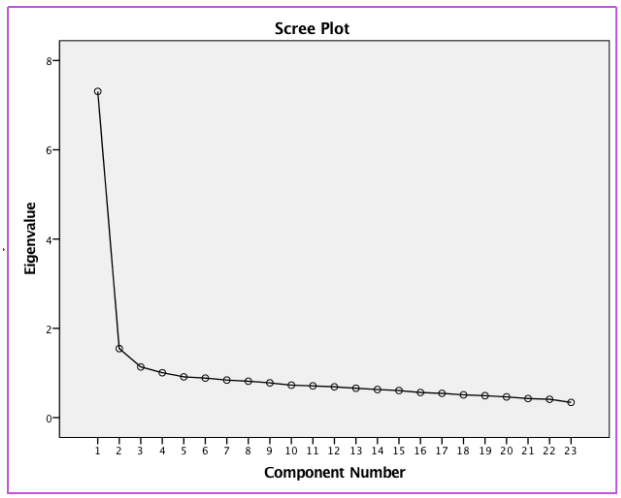
Rotated Component Matrix[a]

	Component				
	1 cognitive	2 social justice	3 (self prez)	4 (avoid)	5
B21 (conjunction)	.717	.239	-.035	-.022	-.189
B20 (gamblers fallacy)	.624	.034	.195	-.180	.310
B17 (ratio bias)	.578	.222	.145	.052	.117
B18 (representative)	.577	.135	.143	.043	.344
B23 (regression to the mean)	.548	-.003	.033	.310	-.006
B15 (framing)	.469	.140	.277	.364	.185
B19 (availability)	.464	-.180	.437	.160	.013
B13 (self-serving)	.436	.257	.417	.107	.085
B22 (hind sight)	.379	.081	.305	.257	.151

B9 (racism)	.076	.764	.340	.050	-.082
B14 (gender)	.041	.745	.170	.046	.205
B11 (underestimate people feelings)	.139	.726	.147	.207	-.006
B7 (victim blaming)	.234	.637	.052	.103	.178
B6 (escalation of commitment)	.100	.254	.685	.021	.002
B2 (bandwagon)	.309	.126	.652	.169	-.099
B3 (Confirmation)	.008	.143	.626	.103	.342
B5 Diffusion of responsibility)	.097	.354	.545	.236	-.011
B4 disconfirmation	-.009	.082	.101	.771	.187
B1 action-inaction	.069	.291	.155	.505	-.113
B10 ostrich	.423	-.003	.139	.466	.244
B8 halo	.264	.251	.323	.333	-.177
B16 sunk cost	.207	.074	-.055	.133	.764
B12 self-interest	.094	.315	.348	.034	.411

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.[a]

a. Rotation converged in 7 iterations.



Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	7.309	31.779	31.779	7.309	31.779	31.779	3.583	15.576	15.576
2	1.546	6.722	38.502	1.546	6.722	38.502	3.181	13.830	29.407
3	1.136	4.937	43.439	1.136	4.937	43.439	2.643	11.493	40.899
4	1.006	4.373	47.812	1.006	4.373	47.812	1.590	6.913	47.812
5	.914	3.972	51.784						
6	.885	3.849	55.634						
7	.841	3.655	59.288						
8	.815	3.543	62.832						
9	.778	3.385	66.216						

2) Monte Carlo principle components. If the Eigen values in the “Raw Data” column is higher than the Eigenvalue in the “Prcntyle” column, then the factor is considered significant.

```
Run MATRIX procedure:

PARALLEL ANALYSIS:

Principal Components & Random Normal Data Generation

Specifications for this Run:
Ncases     505
Nvars       23
Ndatsets  1000
Percent     95

Raw Data Eigenvalues, & Mean & Percentile Random Data Eigenvalues
         Root     Raw Data        Means     Prcntyle
```

1.000000	7.309258	1.404793	1.467944
2.000000	1.546163	1.337201	1.386900
3.000000	1.135612	1.288187	1.327344
4.000000	1.005823	1.246307	1.282464
5.000000	.913537	1.205851	1.238364
6.000000	.885343	1.170445	1.201545
7.000000	.840589	1.137662	1.167269
8.000000	.814985	1.104464	1.131159
9.000000	.778451	1.073715	1.099731
10.000000	.726986	1.044366	1.068647
11.000000	.710434	1.015075	1.039846
12.000000	.690178	.987002	1.010460
13.000000	.657126	.959106	.983255
14.000000	.629572	.931157	.954926
15.000000	.606781	.903568	.927589
16.000000	.562721	.876330	.901086
17.000000	.543684	.848743	.874068
18.000000	.509735	.821789	.847172
19.000000	.490835	.793532	.819155
20.000000	.463800	.763785	.792058
21.000000	.426643	.732256	.759881
22.000000	.411126	.698540	.728605
23.000000	.340617	.656128	.693511

------ END MATRIX -----

Appendix B: Stepwise Regression of Bias Blind Spot

A stepwise regression was used to explore what predicts cognitive and social bias blind spot. In the initial stepwise the social bias blind spot was used as a predictor but was later removed due to lack of a priori prediction. The full model is below ad hoc.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.217[a]	.047	.044	.72211	.047	14.883	1	302	.000
2	.299[b]	.089	.083	.70708	.042	13.977	1	301	.000
3	.332[c]	.110	.101	.70010	.021	7.029	1	300	.008
4	.356[d]	.127	.115	.69471	.017	5.672	1	299	.018
5	.374[e]	.140	.125	.69069	.013	4.494	1	298	.035

a. Predictors: (Constant), DescDecTaskToplak

b. Predictors: (Constant), DescDecTaskToplak, BBSsocnew

c. Predictors: (Constant), DescDecTaskToplak, BBSsocnew, ADMCconfPer

d. Predictors: (Constant), DescDecTaskToplak, BBSsocnew, ADMCconfPer, DOI

e. Predictors: (Constant), DescDecTaskToplak, BBSsocnew, ADMCconfPer, DOI, Ravens

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	.462	.112		4.118	.000		
	DescDecTaskToplak	.060	.015	.217	3.858	.000	1.000	1.000
2	(Constant)	.226	.127		1.778	.076		
	DescDecTaskToplak	.061	.015	.221	4.025	.000	.999	1.001
	BBSsocnew	.179	.048	.206	3.739	.000	.999	1.001
3	(Constant)	-.171	.195		-.874	.383		
	DescDecTaskToplak	.059	.015	.216	3.953	.000	.998	1.002
	BBSsocnew	.171	.047	.197	3.614	.000	.996	1.004
	ADMCconfPer	.605	.228	.145	2.651	.008	.995	1.005

4	(Constant)	-.591	.262		-2.255	.025		
	DescDecTaskToplak	.055	.015	.201	3.691	.000	.985	1.015
	BBSsocnew	.177	.047	.203	3.753	.000	.994	1.006
	ADMCconfPer	.587	.227	.140	2.590	.010	.994	1.006
	DOI	.003	.001	.130	2.382	.018	.984	1.017
5	(Constant)	-.666	.263		-2.533	.012		
	DescDecTaskToplak	.045	.016	.163	2.850	.005	.886	1.128
	BBSsocnew	.171	.047	.197	3.640	.000	.990	1.010
	ADMCconfPer	.544	.226	.130	2.405	.017	.986	1.014
	DOI	.003	.001	.125	2.308	.022	.982	1.018
	Ravens	.032	.015	.121	2.120	.035	.884	1.132

a. Dependent Variable: BBScog

Excluded Variables[a]

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics		
						Tolerance	VIF	Minimum Tolerance
1	BNTS	.080[b]	1.327	.186	.076	.858	1.166	.858
	DOI	.125[b]	2.218	.027	.127	.987	1.013	.987
	ADMCconfPer	.156[b]	2.813	.005	.160	.998	1.002	.998
	Ravens	.153[b]	2.595	.010	.148	.896	1.116	.896
	BBSsocnew	.206[b]	3.739	.000	.211	.999	1.001	.999
2	BNTS	.104[c]	1.744	.082	.100	.849	1.178	.849
	DOI	.135[c]	2.447	.015	.140	.985	1.016	.985
	ADMCconfPer	.145[c]	2.651	.008	.151	.995	1.005	.995
	Ravens	.139[c]	2.412	.016	.138	.892	1.121	.892
3	BNTS	.112[d]	1.902	.058	.109	.847	1.181	.847
	DOI	.130[d]	2.382	.018	.136	.984	1.017	.984
	Ravens	.127[d]	2.199	.029	.126	.885	1.130	.885
4	BNTS	.109[e]	1.863	.063	.107	.847	1.181	.847
	Ravens	.121[e]	2.120	.035	.122	.884	1.132	.884
5	BNTS	.080[f]	1.304	.193	.075	.774	1.292	.774

a. Dependent Variable: BBScog

b. Predictors in the Model: (Constant), DescDecTaskToplak

c. Predictors in the Model: (Constant), DescDecTaskToplak, BBSsocnew

d. Predictors in the Model: (Constant), DescDecTaskToplak, BBSsocnew, ADMCconfPer

e. Predictors in the Model: (Constant), DescDecTaskToplak, BBSsocnew, ADMCconfPer, DOI

f. Predictors in the Model: (Constant), DescDecTaskToplak, BBSsocnew, ADMCconfPer, DOI, Ravens

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.207[a]	.043	.040	.72367	.043	13.804	1	307	.000
2	.262[b]	.068	.062	.71518	.025	8.331	1	306	.004
3	.287[c]	.082	.073	.71105	.014	4.566	1	305	.033

a. Predictors: (Constant), DescDecTaskToplak

b. Predictors: (Constant), DescDecTaskToplak, ADMCconfPer

c. Predictors: (Constant), DescDecTaskToplak, ADMCconfPer, DOI

The below tests show the mediation of numeracy to cognitive bias blind spot ratings by descriptive decision task performance.

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3.549	1	3.549	6.625	.011[b]
	Residual	164.455	307	.536		
	Total	168.004	308			

a. Dependent Variable: BBScog

b. Predictors: (Constant), BNTS

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	7.229	1	7.229	13.804	.000[b]
	Residual	160.775	307	.524		
	Total	168.004	308			

a. Dependent Variable: BBScog

b. Predictors: (Constant), DescDecTaskToplak

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	.485	.112		4.343	.000		
	DescDecTaskToplak	.057	.015	.207	3.715	.000	1.000	1.000

a. Dependent Variable: BBScog

Excluded Variables[a]

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics		
						Tolerance	VIF	Minimum Tolerance
1	BNTS	.078[b]	1.296	.196	.074	.857	1.167	.857

a. Dependent Variable: BBScog

b. Predictors in the Model: (Constant), DescDecTaskToplak

The following is the Social Bias Blind Spot stepwise regression. The only significant predictors are cognitive bias blind spot and gender (being a female).

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.201[a]	.040	.037	.83384	.040	12.663	1	302	.000
2	.241[b]	.058	.052	.82742	.018	5.705	1	301	.018

a. Predictors: (Constant), BBScog

b. Predictors: (Constant), BBScog, Gender

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	8.804	1	8.804	12.663	.000[b]
	Residual	209.977	302	.695		
	Total	218.781	303			
2	Regression	12.710	2	6.355	9.283	.000[c]
	Residual	206.071	301	.685		
	Total	218.781	303			

a. Dependent Variable: BBSsocnew

b. Predictors: (Constant), BBScog

c. Predictors: (Constant), BBScog, Gender

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	1.075	.074		14.588	.000		
	BBScog	.231	.065	.201	3.558	.000	1.000	1.000
2	(Constant)	.673	.184		3.662	.000		
	BBScog	.248	.065	.216	3.834	.000	.987	1.013

Excluded Variables[a]

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics		
						Tolerance	VIF	Minimum Tolerance
1	DescDecTaskToplak	-.070[b]	-1.209	.228	-.070	.953	1.049	.953
	BNTS	-.135[b]	-2.387	.018	-.136	.977	1.023	.977
	DOI	-.080[b]	-1.411	.159	-.081	.978	1.022	.978
	ADMCconfPer	.025[b]	.444	.657	.026	.973	1.028	.973
	Wonderlic	-.039[b]	-.688	.492	-.040	.988	1.012	.988
	Ravens	.012[b]	.204	.839	.012	.957	1.045	.957
	ADMC	-.040[b]	-.696	.487	-.040	.978	1.023	.978

	Race	.046[b]	.810	.418	.047	.981	1.019	.981
	Gender	.134[b]	2.389	.018	.136	.987	1.013	.987
2	DescDecTaskToplak	-.039[c]	-.664	.507	-.038	.898	1.113	.898
	BNTS	-.106[c]	-1.813	.071	-.104	.905	1.105	.905
	DOI	-.064[c]	-1.114	.266	-.064	.961	1.040	.961
	ADMCconfPer	.018[c]	.325	.746	.019	.970	1.031	.959
	Wonderlic	-.032[c]	-.574	.566	-.033	.985	1.015	.976
	Ravens	.012[c]	.214	.831	.012	.957	1.045	.946
	ADMC	-.040[c]	-.715	.475	-.041	.978	1.023	.965
	Race	.043[c]	.760	.448	.044	.981	1.019	.970

a. Dependent Variable: BBSsocnew

b. Predictors in the Model: (Constant), BBScog

c. Predictors in the Model: (Constant), BBScog, Gender

Appendix C: Bias Blind Spot

The bias blind spot measure used was an adapted version of the one in Scopelliti et al. (2015). Nine additional items were added to the original fourteen. The items were written to mimic the same style of describing what the bias is and a brief example. Additional items are based on the cognitive biases found in West et al. (2012). Each item consisted of the participant reading the description of the bias then making a rating (from *not at all* (1) to *very much* (7)) of how often they exhibit the bias, the participant then makes a rating of how often the average American exhibits the bias. The difference is then taken and averaged across each item.

1. Action-inaction bias

Some people show a tendency to judge a harmful action as worse than an equally harmful inaction. For example, this tendency leads to thinking it is worse to falsely testify in court that someone is guilty, than not to testify that someone is innocent.

2. Bandwagon effect

Psychologists have claimed that some people show a tendency to do or believe a thing only because many other people believe or do that thing, to feel safer or to avoid conflict.

3. Confirmation bias

Many psychological studies have shown that people react to counterevidence by actually strengthening their beliefs. For example, when exposed to negative evidence about their favorite political candidate, people tend to implicitly counterargue against that evidence, therefore strengthening their favorable feelings toward the candidate.

4. Disconfirmation bias

Psychologists have claimed that some people show a "disconfirmation" tendency in the way they evaluate research about potentially dangerous habits. That is, they are more critical and skeptical in evaluating evidence that an activity is dangerous when they engage in that activity than when they do not.

5. Diffusion of responsibility

Psychologists have identified an effect called "diffusion of responsibility," where people tend not to help in an emergency situation when other people are present. This happens because as the number of bystanders increases, a bystander who sees other people standing around is less likely to interpret the incident as a problem, and also is less likely to feel individually responsible for taking action.

6. Escalation of commitment

Research has found that people will make irrational decisions to justify actions they have already taken. For example, when two people engage in a bidding war for an object, they can end up paying much more than the object is worth to justify the initial expenses associated with bidding.

7. Fundamental attribution error

Psychologists have claimed that some people show a tendency to make "overly dispositional inferences" in the way they view victims of assault crimes. That is, they are overly inclined to view the victim's plight as one he or she brought on by carelessness, foolishness, misbehavior, or naivetë.

8. Halo effect

Psychologists have claimed that some people show a “halo” effect in the way they form impressions of attractive people. For instance, when it comes to assessing how nice, interesting, or able someone is, people tend to judge an attractive person more positively than he or she deserves.

9. Ingroup favoritism

Extensive psychological research has shown that people possess an unconscious, automatic tendency to be less generous to people of a different race than to people of their race. This tendency has been shown to affect the behavior of everyone from doctors to taxi drivers.

10. Ostrich effect

Psychologists have identified a tendency called the “ostrich effect,” an aversion to learning about potential losses. For example, people may try to avoid bad news by ignoring it. The name comes from the common (but false) legend that ostriches bury their heads in the sand to avoid danger.

11. Projection bias

Many psychological studies have found that people have the tendency to underestimate the impact or the strength of another person’s feelings. For example, people who have not been victims of discrimination do not really understand a victim’s social suffering and the emotional effects of discrimination.

12. Self-interest bias

Psychologists have claimed that some people show a “self-interest” effect in the way they view political candidates. That is, people’s assessments of qualifications, and their

judgments about the extent to which particular candidates would pursue policies good for the American people as a whole, are influenced by their feelings about whether the candidates' policies would serve their own particular interests.

13. Self-serving bias

Psychologists have claimed that some people show a "self-serving" tendency in the way they view their academic or job performance. That is, they tend to take credit for success but deny responsibility for failure. They see their successes as the result of personal qualities, like drive or ability, but their failures as the result of external factors, like unreasonable work requirements or inadequate instructions.

14. Stereotyping

Psychologists have argued that gender biases lead people to associate men with technology and women with housework.

15. Framing

Many psychological studies have found that people react differently to presented information depending on how it is "framed". For example, information framed positively will be interpreted differently compared to the same information framed negatively.

16. Sunk Cost

Some people show a tendency to continue an endeavor once an investment in money, effort, or time has been made. This tendency leads to thinking that it is better to invest further into an endeavor even if it is better to not. For example, sitting through a movie after you realize it was awful halfway through.

17. Ratio Bias

Some people show a tendency to choose probabilities that are larger ratios over probabilities that are equal or superior but are expressed with smaller ratios. For example, people would choose a drug that cures 10/100 patients over 1/10 patients, even though they cure equal amounts of individuals.

18. Representativeness Heuristic

Extensive psychological research has shown that when presented with a new situation that people will compare the likelihood of the event to an event we think is similar. For example, people think medical symptoms resemble their causes, for instance people mistakenly believe ulcers are caused by stress.

19. Availability

Many psychological studies have found that people tend to weigh their judgments toward more recent information. That is, people may believe that an event is more likely to happen based on the amount of current news coverage rather than actual prevalence.

20. Gamblers Fallacy

Psychologists have claimed that people exhibit a "gambler's fallacy" when an event happens more frequently than normal as it is falsely thought that there is a chance that it will happen less frequently in the future and vice-versa. For example, when you are playing a slot machine and losing, someone may believe that they are "due" for a win.

21. Conjunction Problem

Psychologists have claimed that people believe that two events happening together is more probably than one event. For example, people believe it is more probable that

Katy Perry will release a hit single and win a Grammy than if Katy Perry will just release a hit song.

22. Hindsight Bias

Psychological research has shown that people may display a "knew-it-all-along" effect after an event has occurred. That is, people will see an outcome as predictable, despite there being little basis to predict it beforehand.

23. Regression to the Mean

People often fail to notice the statistical likelihood that after an initial measurement of an extreme score, the following scores will move towards the average after additional measurements. For example, people tend to think that a rookie baseball player who breaks records in their first year will continue to excel, but the athlete's performance the next year is likely to be average compared to other players.

Appendix D: BNT-C Numeracy Battery

Solving Numeracy Problems: 4 Sections, 9 Questions Each

Part 1: Operations - 9 Questions

A school is having a field trip and many parents are going on the fieldtrip with the children. What is the child to parent ratio if there are 20 children and 5 parents?

- ❍ 2 children for every one parent
- ❍ 20 children for every 1 parent
- ❍ 1 child to every 5 parents
- ❍ 5 children to every 1 parent
- ❍ 4 children to every 1 parent

The mileage meter of an old motorcycle is malfunctioning and registers only 3 miles for every 4 miles driven. If the meter indicates 54 miles, how many miles has the motorcycle actually driven?

- ❍ 162
- ❍ 108
- ❍ 72
- ❍ 53
- ❍ 36

Kristie has a collection of adventure, comic, and romantic novels. If the ratio of adventure novels to comic novels is 5 to 1 and the ratio of comic to romantic novels is 5 to 3, what is the ratio of adventure to romantic novels?

- ❍ 5:3
- ❍ 10:5
- ❍ 6:3
- ❍ 20:3
- ❍ 25:3

Imagine that goods imported into a country increased by 40% and exports decreased by 30% during a certain year. What was the ratio of imports to exports at the end of the year compared to the beginning of the year?

- ❍ 1/2
- ❍ 3/2
- ❍ 4/3
- ❍ 2/1
- ❍ 1

If a sack of dried dog food feeds 4 dogs or 5 puppies for one week, then 5 sacks of the food will feed 15 puppies and how many dogs in one week?

_____

The odometer of a new automobile functions improperly and registers only 2 miles for every 3 miles driven. If the odometer indicates 48 miles, how many miles has the automobile actually been driven?

- ❍ 144
- ❍ 72
- ❍ 64
- ❍ 32
- ❍ 24

Helpers are needed to prepare for the fete. Each helper can make either 2 large cakes per hour or 35 small cakes per hour. The kitchen is available for 3 hours and 20 large cakes and 700 small cakes are needed. How many helpers are required?

- ❍ 10
- ❍ 15
- ❍ 20
- ❍ 25
- ❍ 30

If United States imports increased 20 percent and exports decreased 10 percent during a certain year, the ratio of imports to exports at the end of the year was how many times the ratio at the beginning of the year?

- ❍ 12/11
- ❍ 4/3
- ❍ 11/8
- ❍ 3/2
- ❍ 2

n and p are integers greater than 1.

5n is the square of a number.

75np is the cube of a number.

The smallest value for n + p is

- ❍ 14
- ❍ 18
- ❍ 20
- ❍ 30
- ❍ 50

Part 2: Probability - 9 Questions

People often roll dice when playing games. Most dice have 6 sides and each side has a different number on it ranging from 1-6. If you rolled one of the dice, on average what is the probability that it would land on 5?

- ❍ 1 time out of 6 rolls of the dice
- ❍ 5 times out of 6 rolls of the dice
- ❍ 1 time out of 2 rolls of the dice
- ❍ 1 out of 5 rolls of the dice
- ❍ 6 out of 1 roll of the dice

Imagine that you are throwing 2 regular 6-sided dice up in the air. If each side has a different number on it ranging from 1-6, on average what is the probability that both of them land on even numbers?

- ❍ 1 out of 36 rolls of the dice
- ❍ 3 out of 6 rolls of the dice
- ❍ 1 out of 4 rolls of the dice
- ❍ 2 out of 6 rolls of the dice
- ❍ 2 out of 36 rolls of the dice

Imagine that the probability of a child getting sunburned at the beach is 65% while the probability of an adult getting sunburned at the beach is 15%. If there were 300 people

who spent a day at the beach, and 60% of the people were children, how many people are likely to get a sunburn?

- About 195
- About 150
- About 135
- About 80
- About 64

Suppose you are taking an 8 question multiple choice test and each question has 4 options. Imagine that you don't know anything about the test and so you guess without reading the questions. What's the probability that you would get 100% correct on this test just by chance alone?

- 1/4
- 1/8
- 1/4096
- 1/16384
- 1/65536

Imagine that you are throwing 6 dice up in the air. What is the probability that all of them would land on even numbers?

- 1/432
- 3/216
- 1/64
- 3/6
- 1/21

Imagine you are drawing a picture, and are missing 2 spots you want to color. There are 7 colors to choose from. What's the probability that both spots end up colored orange?

- 1/49
- 2/49
- 1/7
- 2/7
- 6/7

Imagine you are throwing 8 dice up in the air. What's the probability that half will land on an even number, while the other half land on 1?

- 1/10368
- 1/20736
- 1/432
- 1/1728
- 1/6

Phil is holding 4 cards in his hand: 8 of clubs, 5 of hearts, king of hearts, and ace of diamonds. If he places them on a table in random order, what is the probability that the first and last cards will both be hearts?

- 1/2
- 1/3
- 1/4
- 1/6
- 1/8

n is an integer chosen at random from the set {5, 7, 9, 11}

p is chosen at random from the set {2, 6, 10, 14, 18}

What is the probability that n + p = 23?

- ❍ 0.1
- ❍ 0.2
- ❍ 0.25
- ❍ 0.3
- ❍ 0.4

Part 3: Geometry - 9 Questions

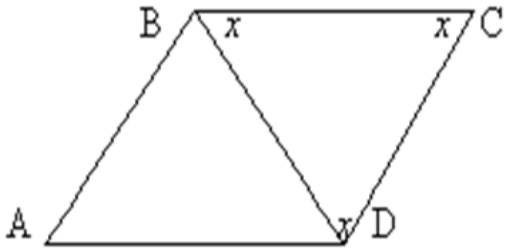
Imagine there is a rectangle that has an area of 20 square meters. If its length is 4 meters, what is its width?

- ❍ 10
- ❍ 5
- ❍ 4
- ❍ 3
- ❍ None of the above

The slope of a line through points P (1, 4) and Q (-5, X) is 1/3. What is the value of X?

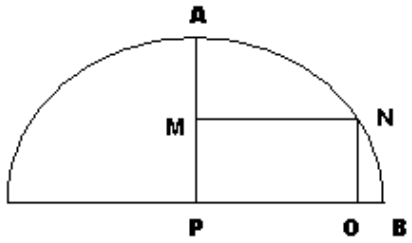
- ❍ 1
- ❍ 2
- ❍ 3
- ❍ 4
- ❍ 5

The perimeter of the parallelogram ABCD is 16. Each angle in the triangle BCD is equal. What is the length of the side AD?



- ❍ 2√16
- ❍ √16
- ❍ 2
- ❍ 2√2
- ❍ 4

APB is a quarter circle. MNOP is a rectangle with sides MN = 4 and MP = 3. What is the length of the arc ANB?



- ❍ 2.5π
- ❍ 5π
- ❍ 10π
- ❍ 7
- ❍ 10

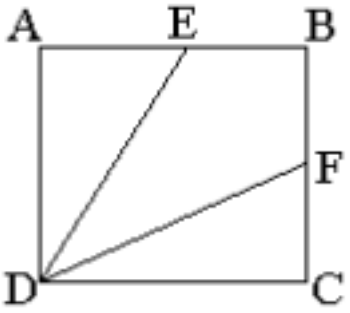
The slope of a line through points P (1, 1) and Q (k, 7) is 3/2. What is the value of k?

- ❍ 4
- ❍ 5
- ❍ 6
- ❍ 7
- ❍ 8

A, B, C, and D are points on a line, with D the midpoint of BC. The lengths of AB, AC and BC are 10, 2, and 12, respectively. What is the length of AD?

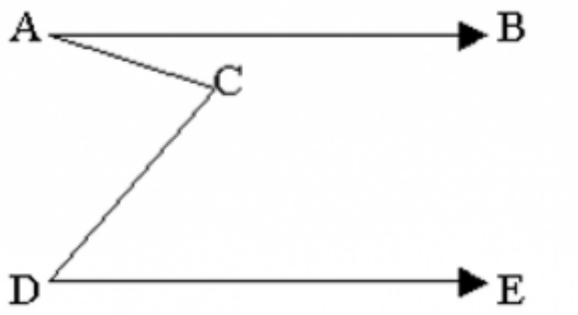
- ❍ 2
- ❍ 4
- ❍ 6
- ❍ 10
- ❍ 12

ABCD is a square of side 3, and E and F are the mid points of sides AB and BC respectively. What is the area of the quadrilateral EBFD?



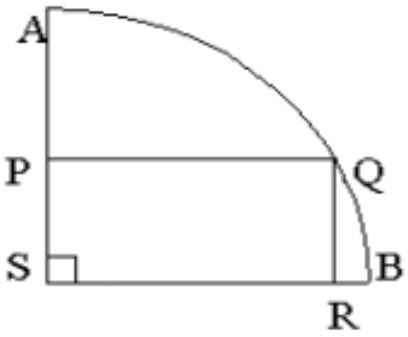
- 2.25
- 3
- 4
- 4.5
- 6

AB and DE are parallel. Angle BAC = 30, angle CDE = 50. What is the measure of angle ACD? (figure not to scale)



- 100
- 90
- 80
- 70
- cannot be determined from the information

ASB is a quarter circle. PQRS is a rectangle with sides PQ = 8 and PS = 6. What is the length of the arc AQB?



- ❍ 5π
- ❍ 10π
- ❍ 25
- ❍ 14
- ❍ 28

Part 4: Algebra - 9 Questions

If 40/X = 5, what is the value of X?

- ❍ 5
- ❍ 8
- ❍ 10
- ❍ 15
- ❍ None of the above

Solve for b in this equation: a + b = d

- ❍ b = a - d
- ❍ b = a + d
- ❍ b = ad
- ❍ b = d - a
- ❍ None of the above

What is the value of a - c + b in this equation? $(2x - 1)(x + 3) = ax^2 + bx + c$.

- 5
- 8
- 9
- 10
- 11

What is the simplified result of following the three steps below performed in order?

1-Add 2a to 3b

2-Multiply the sum by 4

3-Subtract a + b from the product

- 7a + 13b
- 7a + 11b
- 7a + 7b
- 8a + 12b
- a + 2b

If the equation of a line p in the coordinate plane is $y = 3x + 2$, what is the equation of line q which is a reflection of line p in the x-axis?

- $y = -3x + 2$
- $y = -3x - 2$
- $y = 3x - 2$
- $y = -1/3x - 5$
- $y = -1/3x + 5$

$(3x + 2)(2x - 5) = ax^2 + kx + n$. What is the value of a - n + k?

- 5
- 8
- 9
- 10
- 11

If $f(x) = x^2 - 3$, where x is an integer, which of the following could be a value of f(x)?

I 6

II 0

III -6

- I only
- I and II only
- II and III only
- I and III only
- I, II and III

Six years ago Anita was P times as old as Ben was. If Anita is now 17 years old, how old is Ben now in terms of P?

- 11/P + 6
- P/11 + 6
- 17 - P/6
- 17/P
- 11.5P

If x / y is an integer, which of the following statements must be true?

- both x and y are integers
- x is an integer
- either x or y is negative
- y / x is an integer
- x = ny where n is an integer

Appendix E: Berlin Numeracy Test (BNT-S; Cokely et al., 2012)

You will now be asked to solve a few problems. Please note that you are allowed to enter numbers that include up to 2 decimal points (for example, 1.11). You are also welcome to use a calculator to help solve these problems.

Imagine that we flip a fair coin 1,000 times. What is your best guess about how many times the coin would come up heads in 1,000 flips?

_____

In the BIG BUCKS LOTTERY, the chance of winning a $10 prize is 1%. What is your best guess about how many people would win a $10 prize if 1,000 people each buy a single ticket to BIG BUCKS?

_____

In ACME PUBLISHING SWEEPSTAKES, the chance of winning a car is 1 in 1,000. What percent of tickets to ACME PUBLISHING SWEEPSTAKES win a car?

_____ percent

Out of 1,000 people in a small town 500 are members of a choir. Out of these 500 members in a choir 100 are men. Out of the 500 inhabitants that are not in a choir 300 are men. What is the probability that a randomly drawn man is a member of the choir? Please indicate the probability as a percent.

_____ percent

Imagine we are throwing a five-sided die 50 times. On average, out of these 50 throws how many times would this five-sided die show an odd number (1, 3 or 5)?

_____

Imagine we are throwing a loaded die (6 sides). The probability that the die shows a 6 is twice as high as the probability of each of the other numbers. On average, out of these 70 throws how many times would the die show the number 6?

_____

In a forest, 20% of the mushrooms are red, 50% are brown, and 30% are white. A red mushroom is poisonous with a probability of 20%. A mushroom that is not red is poisonous with a probability of 5%. What is the probability that a poisonous mushroom in the forest is red? Please indicate the probability as a percent.

_____ percent

Appendix F: Heuristic and Biases (Toplak et al., 2011)

1. The Caldwells had long ago decided that when it was time to replace their car they would get what they called “one of those solid, safety-conscious, built-to-last Swedish cars”-either a Volvo or a Saab. As luck would have it, their old car gave up the ghost on the last day of the closeout sale for the model year both for the Volvo and for the Saab. The model year was changing for both cars and the dollar had recently dropped substantially against European currencies; therefore, if they waited to buy either a Volvo or a Saab, it would cost them substantially more-about $1200. They quickly got out their Consumer Reports where they found that the consensus of the experts was that both cars were very sound mechanically, although the Volvo was felt to be slightly superior on some dimensions. They also found that the readers of Consumer Reports who owned a Volvo reported having somewhat fewer mechanical problems than owners of Saabs. They were about to go and strike a bargain with the Volvo dealer when Mr. Caldwell remembered that they had two friends who owned a Saab and one who owned a Volvo. Mr. Caldwell called up the friends. Both Saab owners reported having had a few mechanical problems but nothing major. The Volvo owner exploded when asked how he liked his car. “First that fancy fuel injection computer thing went out: $250 bucks. Next I started having trouble with the rear end. Had to replace it. Then the transmission and the clutch. I finally sold it after 3 years for junk.”

   Given that the Caldwells are going to buy either a Volvo or a Saab today, in order to save $1200, which do you think they should buy?

   - ❍ Volvo
   - ❍ Saab

2. A certain town is served by two hospitals. In the larger hospital about 45 babies are born each day, and in the smaller hospital about 15 babies are born each day. As you know, about 50 percent of all babies are boys. However, the exact percentage varies from day to day. Sometimes it may be higher than 50 percent, sometimes lower. For a period of 1 year, each hospital recorded the days on which more than 60 percent of the babies born were boys. Which hospital do you think recorded more such days?

   - ❍ The larger hospital
   - ❍ The smaller hospital
   - ❍ About the same (that is, within 5 percent of each other)

3. A game of squash can be played either to 9 or to 15 points. Holding all other rules of the game constant, if A is a better player than B, which scoring system will give A a better chance of winning?

   ❍ Playing to 9 points

   ❍ Playing to 15 points

   ❍ Both scoring systems would give player A a better chance of winning

4. After the first 2 weeks of the major league baseball season, newspapers begin to print the top 10 batting averages. Typically, after 2 weeks, the leading batter often has an average of about .450. However, no batter in major league history has ever averaged .450 at the end of the season. Why do you think this is? Circle one:

   ❍ When a batter is known to be hitting for a high average, pitchers bear down more when they pitch to him.

   ❍ Pitchers tend to get better over the course of a season, as they get more in shape. As pitchers improve, they are more likely to strike out batters, so batters' averages go down.

   ❍ A player's high average at the beginning of the season may be just luck. The longer season provides a more realistic test of a batter's skill.

   ❍ A batter who has such a hot streak at the beginning of the season is under a lot of stress to maintain his performance record. Such stress adversely affects his playing.

   ❍ When a batter is known to be hitting for a high average, he stops getting good pitches to hit. Instead, pitchers "play the corners" of the plate because they don't mind walking him.

5. When playing slot machines, people win something about 1 in every 10 times. Julie, however, has just won on her first three plays. What are her chances of winning the next time she plays?
   Please give your answer in the format: "____ out of ____."

   _____

6. Imagine that we are tossing a fair coin (a coin that has a 50/50 chance of coming up heads or tails) and it has just come up heads 5 times in a row.
   For the 6th toss do you think that:

   - ❍ It is more likely that tails will come up than heads.
   - ❍ It is more likely that heads will come up than tails.
   - ❍ Heads and tails are equally probable on the sixth toss.

7. Linda is 31 years old, single, outspoken, and very bright. She majored in philosophy. As a student, she was deeply concerned with issues of discrimination and social justice, and also participated in anti-nuclear demonstrations.
   Is it more likely that...

   - ❍ Linda is a bank-teller
   - ❍ Linda is a bank-teller and a feminist

8. A doctor had been working on a cure for a mysterious disease. Finally, he created a drug that he thinks will cure people of the disease. Before he can begin to use it regularly, he has to test the drug. He selected 300 people who had the disease and gave them the drug to see what happened. He selected 100 people who had the disease and did not give them the drug in order to see what happened. The table below indicates what the outcome of the experiment was:

   Judge whether this treatment was positively or negatively associated with the cure

for this disease by selecting a number from the scale ranging from −10 (strong negative association) to +10 (strong positive association).

- ❍ -10
- ❍ -8
- ❍ -6
- ❍ -4
- ❍ -2
- ❍ 0
- ❍ 2
- ❍ 4
- ❍ 6
- ❍ 8
- ❍ 10

9. The city of Middleopolis has had an unpopular police chief for a year and a half. He is a political appointee who is a crony of the mayor, and he had little previous experience in police administration when he was appointed. The mayor has recently defended the chief in public, announcing that in the time since he took office, crime rates decreased by 12%. Which of the following pieces of evidence would most deflate the mayor's claim that his chief is competent?

   ❍ The crime rates of the two cities closest to Middleopolis in location and size have decreased by 18% in the same period.

   ❍ An independent survey of the citizens of Middleopolis shows that 40% more crime is reported by respondents in the survey than is reported in police records

   ❍ Common sense indicates that there is little a police chief can do to lower crime rates. These are for the most part due to social and economic conditions beyond the control of officials

   ❍ The police chief has been discovered to have business contacts with people who are known to be involved in organized crime

10. Imagine yourself meeting David Maxwell. Your task is to assess the probability that he is a university professor based on some information that you will be given. This will be done in two steps. At each step you will get some information that you may or may not find useful in making your assessment. After each piece of information you will be asked to assess the probability that David Maxwell is a university professor. In doing so, consider all the information you have received to that point if

you consider it to be relevant. Your probability assessments should be numbers between 0 and 1 that express your degree of belief. 1 means "I am absolutely certain that he is a university professor." .65 means "The chances are 65 out of 100 that he is a university professor," and so forth. You can use any number between 0 and 1, for example, .15, .95, etc.

Step One: You are told that David Maxwell attended a party in which 25 male university professors and 75 male business executives took part, 100 people all together.
Question: What do you think the probability is that David Maxwell is a university professor?

_____

Step Two: You are told that David Maxwell is a member of the Bears Club. 70% of the male university professors at the above-mentioned party were members of the Bears Club, and 90% of the male business executives at the party were members of the Bears Club.
Question: What do you think the probability is that David Maxwell is a university professor?

_____

11. 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 estimate of the consequences of the programs 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 no people will be saved.
Which of the two programs would you favor?

- ❍ Program A
- ❍ Program B

12. 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 estimate of the consequences of the programs 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?

- ❍ Program C
- ❍ Program D

13. Assume that you are presented with two trays of black and white marbles: a large tray that contains 100 marbles and a small tray that contains 10 marbles. The marbles are spread in a single layer on each tray. You must draw out one marble (without peeking, of course) from either tray. If you draw a black marble, you win $2. Consider a condition in which the small tray contains 1 black marble and 9 white marbles, and the large tray contains 8 black marbles and 92 white marbles. From which tray would you prefer to select a marble in a real situation?

    - ❍ Small Tray
    - ❍ Large Tray

14. A die with 4 red faces and 2 green faces will be rolled 60 times. Before each roll you will be asked to predict which color (red or green) will show up once the die is rolled. You will be given one dollar for each correct prediction. Assume that you want to make as much money as possible. What strategy would you use in order to make as much money as possible by making the most correct predictions?

    - ❍ Strategy A: Go by intuition, switching when there has been too many of one color or the other.
    - ❍ Strategy B: Predict the more likely color (red) on most of the rolls but occasionally, after a long run of reds, predict a green.
    - ❍ Strategy C: Make predictions according to the frequency of occurrence (4 of 6 for red and 2 of 6 for green). That is, predict twice as many reds as greens.
    - ❍ Strategy D: Predict the more likely color (red) on all of the 60 rolls.
    - ❍ Strategy E: Predict more red than green, but switching back and forth depending upon “runs” of one color or the other. Which Strategy is best?

15. You are staying in a hotel room on vacation. You paid $6.95 to see a movie on pay TV. After 5 minutes you are bored and the movie seems pretty bad. Would you continue to watch the movie or not?

    - ❍ Continue to watch
    - ❍ Turn it off

16. You are staying in a hotel room on vacation. You turn on the TV and there is a movie on. After 5 minutes you are bored and the movie seems pretty bad. Would you continue to watch the movie or not?

    - ❍ Continue to watch
    - ❍ Turn it off

17. A 55 year old man had a heart condition. He had to stop working because of chest pain. He enjoyed his work and did not want to stop. His pain also interfered with other things, such as travel and recreation.
    A type of bypass operation would relieve his pain and increase his life expectancy from age 65 to age 70. However, 8% of the people who have this operation die from the operation itself.
    His physician decided to go ahead with the operation. The operation succeeded.
    Evaluate the physician's decision (on a scale from 1 (incorrect, a very bad decision) to 7 (clearly correct, an excellent decision) to go ahead with the operation.

    - ❍ 1 (incorrect, a very bad decision)
    - ❍ 2
    - ❍ 3
    - ❍ 4 (neither correct nor incorrect)
    - ❍ 5
    - ❍ 6
    - ❍ 7 (clearly correct, an excellent decision)

18. A 60-year-old man was having trouble walking due to a hip condition. He had to stop most activity (such as work and enjoyment) as the pain was unbearable with excessive movement.
    Arthroplasty (hip replacement) would relieve his pain and increase his life expectancy from 65 to age 75. However, 2% of the people who have this operation die from the operation itself.
    His physician decided to go ahead with the operation. Unfortunately, the patient died during the operation.

Evaluate the physician's decision (on a scale from 1 (incorrect, a very bad decision) to 7 (clearly correct, an excellent decision) to go ahead with the operation.

- ❍ 1 (incorrect, a very bad decision)
- ❍ 2
- ❍ 3
- ❍ 4 (neither correct nor incorrect)
- ❍ 5
- ❍ 6
- ❍ 7 (clearly correct, an excellent decision)

Appendix G: Ecological Decision Battery

Ecological Risk Literacy – Medical

Cervical cancer is very rare. 4 out of 100,000 women are affected by this cancer. The human papillomavirus (HPV) vaccine is federally approved and is being promoted as a method that helps reduce cervical cancer. Research studies suggest that the vaccine is 90 percent effective in preventing transmission of certain virus types. This conclusion is based on the results from a large international medical trial of 18,525 women aged 15-25, sponsored by the drug's manufacturer. 23 cases of the HPV virus were detected in the medical trial. Two of these cases were among the 9,258 women receiving the HPV vaccine, and 21 were among the 9,267 controls, who received a hepatitis A vaccine. The mean follow-up time was 14.8 months.

To what extent is the conclusion that "the vaccine was 90% effective" correct?

Please provide an answer in using the following 7 point scale.

- ❍ 1 - Completely confident that conclusion is right
- ❍ 2
- ❍ 3
- ❍ 4
- ❍ 5
- ❍ 6
- ❍ 7 - Completely confident that conclusion is wrong

What is the relative effectiveness of the vaccine? (express your answer as a percentage)

_____

What is the absolute effectiveness of the vaccine? (express your answer as a percentage)

_____

What are the chances that a woman gets cervical cancer after getting vaccinated? (express your answer as a percentage)

_____

What did the women receive in the control group?

_____

Ecological Risk Literacy – Financial

Imagine that you take out a $50,000 federal student loan to help pay for college. You are offered four possible repayment plans. The table below provides examples of the monthly repayments for each plan. Note: For the Graduated (10 years) plan, you would start by paying the minimum amount; the payment amount then increases every two years up to the maximum amount.

Look at the table carefully and answer the following questions.

Debt When Loan Enters Repayment	Standard (10 years)		Graduated (10 years)			Extended-Fixed (25 years)		Extended-Graduated (25 years)		
	Payment	Total Paid	Minimum Payment	Maximum Payment	Total Paid	Payment	Total Paid	Minimum Payment	Maximum Payment	Total Paid
$10,000	$115	$13,810	$66	$199	$14,860	-	-	-	-	-
$20,000	$230	$27,619	$133	$398	$29,720	-	-	-	-	-
$30,000	$345	$41,429	$199	$598	$44,580	-	-	-	-	-
$40,000	$460	$55,239	$266	$797	$59,439	$278	$83,289	$227	$397	$90,207
$50,000	$575	$69,048	$332	$996	$74,300	$347	$104,111	$283	$496	$112,762
$60,000	$690	$82,858	$398	$1,195	$89,160	$416	$124,933	$340	$595	$135,314
$70,000	$806	$96,667	$465	$1,393	$104,020	$486	$145,755	$397	$694	$157,865
$80,000	$921	$110,477	$531	$1,593	$118,880	$555	$166,577	$453	$793	$180,427
$90,000	$1,036	$124,287	$597	$1,791	$133,740	$625	$187,399	$510	$892	$202,980
$100,000	$1,151	$138,096	$664	$1,991	$148,600	$694	$208,222	$567	$992	$225,531

What is the total amount of interest payable on the Extended-Fixed (25 years) plan?

_____

How confident are you in your previous answer?

- ❍ 0
- ❍ 1
- ❍ 2
- ❍ 3
- ❍ 4
- ❍ 5
- ❍ 6
- ❍ 7
- ❍ 8
- ❍ 9
- ❍ 10

Which option has the minimum interest payment (least expensive overall)?

_____

What is the total interest paid in percentage if you have borrowed $50,000 and returned $69,048?

_____

Assume someone has borrowed $50,000 for his studies, and he hopes to get a good job after his graduation in 5 years (when he will be able to pay more toward his debt). In this case which option should he choose?

- ❍ Standard
- ❍ Graduated
- ❍ Extended fixed
- ❍ Extended graduated

Prospect Evaluations – Expected Values & Choice Consistency in Lotteries

For the following questions, please indicate which of the two options you prefer:

- ❍ Lose $50
- ❍ 50% chance to lose $400

- ❍ Lose $120
- ❍ 5% chance to lose $1600

- ❍ Lose $200
- ❍ 1% chance to lose $3000

- ❍ Lose $275
- ❍ 20% chance to lose $900

- ❍ Lose $400
- ❍ 70% chance to lose $480

For the following questions, please indicate which of the two options you prefer:

- ❍ Gain $50
- ❍ 50% chance to win $400

- ❍ Gain $120
- ❍ 5% chance to win $1600

- ❍ Gain $200
- ❍ 1% chance to win $3000

- ❍ Gain $275
- ❍ 20% chance to win $900

- ❍ Gain $400
- ❍ 70% chance to win $480

For the following questions, please indicate which of the two options you prefer:

- ❍ $100 for sure
- ❍ 75% chance of $200

- ❍ Lose $100 for sure
- ❍ 60% chance to lose $250

- ❍ $500 for sure
- ❍ 15% chance of $1,000,000

- ❍ Lose $100 for sure
- ❍ 5% chance to lose $7000

For the following questions, please indicate which of the two options you prefer:

- ❍ 25% chance to win $6,000
- ❍ 25% chance to win $4000 and 25% chance to win $2000

- ❍ 33% chance to win $2500 and 67% chance of winning nothing
- ❍ 34% chance of winning $2400 and 66% chance of winning nothing

---

- ❍ 15% chance to lose $20 and 85% chance to lose nothing
- ❍ 10% chance to lose $25 and a 90% chance of losing nothing

---

Prospect Evaluations – Intertemporal Choice

For the following questions, please indicate which of the two options you prefer:

- ❍ $3400 this month
- ❍ $3800 next month

- ❍ $100 now
- ❍ $140 next year

- ❍ $100 now
- ❍ $1100 in 10 years

- ❍ $9 now
- ❍ $100 in 10 years

- ❍ $40 immediately
- ❍ $1000 in 10 years

- ❍ $100 now
- ❍ $20 every year for 7 years

- ❍ $400 now
- ❍ $100 every year for 10 years

- ❍ $500 in eight months
- ❍ $1060 in sixteen months

- ❍ $500 now
- ❍ $2400 in 2 years

- ❍ $1000 in six months
- ❍ $2400 in two years

- ❍ $100 now
- ❍ $200 next year

What is the smallest amount in 4 days preferred to $170 in 2 months?

Please express your answer in dollars ($).

Reference Class & Class-Inclusion Illusions

With the new drug BENOFRENO, the risk of death from a heart attack reduced for people with high cholesterol. A study of 900 with high cholesterol showed that 80 of the 800 people who have not taken the drug died after a heart attack, compared with 16 of the 100 people who did take the drug.

How beneficial was the Benofreno?

- ❍ 1 - Not beneficial
- ❍ 2
- ❍ 3
- ❍ 4
- ❍ 5
- ❍ 6
- ❍ 7 - Very beneficial

How confident are you about your decision?

- ❍ 1 - Not sure
- ❍ 2
- ❍ 3
- ❍ 4
- ❍ 5
- ❍ 6
- ❍ 7 - Very sure

Suppose you have a chance to win $5 by drawing a red ball from either of the two bags. Bag A contains 1 red ball out of 9, and Bag B contains 10 red balls out of 100. Indicate the bag from which you wish to draw a ball:

- ❍ Bag A
- ❍ Bag B

Imagine that you have finished your studies and you need to find a job. You are looking through the newspaper and you read an advertisement from a company that is looking for people like you. This company offers two types of job positions: Type P and Type Q. Both are of the same category and you like them equally. Therefore, you quickly go to the company to present your application to work in either position. Once there, they tell you that you cannot request both at the same time, you have to opt for one of them: P or Q.

For the Type P job, 2 people are needed and only 10 candidates are admitted (one of them would be you).

For the Type Q job, 10 people are needed and only 100 candidates are admitted (one of them would be you).

What job type would you choose?

- ❍ Type P
- ❍ Type Q
- ❍ No preference

What job type do you believe most people would choose?

- ❍ Type P
- ❍ Type Q
- ❍ No preference

What job type do you believe a completely logical person would choose?

- ❍ Type P
- ❍ Type Q
- ❍ No preference

Cancer causes deaths; below are two situations that present cancer risk statistics. Please rate how risky they appear to you.

Cancer kills 1286 people out of 10,000

- ❍ 1 - No risk at all
- ❍ 2
- ❍ 3
- ❍ 4
- ❍ 5
- ❍ 6
- ❍ 7 - Maximum possible risk

Cancer kills 24.14 people out of 100

- ❍ 1 - No risk at all
- ❍ 2
- ❍ 3
- ❍ 4
- ❍ 5
- ❍ 6
- ❍ 7 - Maximum possible risk

Realistic Risky Decisions

Mrs. Jones is told she has a 28 in 1,000 chance of dying from cancer and a 59 in 1,000 chance of dying from a stroke.

Mrs. Jones's doctor tells her that a new pill, STROKEX, will lower her chance of dying from stroke by 50%. Another pill, CANCERX will lower her chance of dying from cancer by 50%.

Assume she can only take 1 pill. Assuming the 2 pills are equally safe and cost the same, which should she take to minimize her risk of death?

- ❍ STROKEX pill
- ❍ CANCERX pill

How confident are you in your previous answer?

- ❍ 0
- ❍ 1
- ❍ 2
- ❍ 3
- ❍ 4
- ❍ 5
- ❍ 6
- ❍ 7
- ❍ 8
- ❍ 9
- ❍ 10

Mrs. Jones decides to take the CANCERX pill. Now, what is her chance of dying from cancer?

- ❍ 0 in 1,000
- ❍ 7 in 1,000
- ❍ 14 in 1,000
- ❍ 21 in 1,000

How confident are you in your previous answer?

- ❍ 0
- ❍ 1
- ❍ 2
- ❍ 3
- ❍ 4
- ❍ 5
- ❍ 6
- ❍ 7
- ❍ 8
- ❍ 9
- ❍ 10

Imagine the weather forecast indicates “There is a 40% chance of rain tomorrow.”

Which interpretation is most appropriate:

- ❍ The forecaster thinks it will rain in about 40% of the region tomorrow.
- ❍ The forecaster thinks it will rain about 40% of the time tomorrow.
- ❍ The forecaster thinks it will rain for at least 1 hour on 4 out of 10 days like tomorrow.
- ❍ The forecaster thinks there is a 50% chance it will rain in about 80% of the region tomorrow.
- ❍ The forecaster thinks there is a 40% chance it will rain in at least 40% of the region tomorrow.

How confident are you in your previous answer?

- ❍ 0
- ❍ 1
- ❍ 2
- ❍ 3
- ❍ 4
- ❍ 5
- ❍ 6
- ❍ 7
- ❍ 8
- ❍ 9
- ❍ 10

Imagine that you see the following advertisement for a new toothpaste:

Zendil—50% reduction in occurrence of gum inflammation.

Zendil is a new toothpaste to prevent gum inflammation. Half as many people using Zendil developed gum inflammation as people using a different toothpaste.

If you wanted to determine how much the average person could benefit from using Zendil, which single piece of information below would be most helpful?

- ❍ The risk of gum inflammation for people who do not use Zendil
- ❍ The risk of gum inflammation for people who use a different brand of toothpaste for the same purpose
- ❍ How many people there were in the group who used a different toothpaste
- ❍ How old the people who participated in the study were
- ❍ How much a weekly dose of Zendil costs
- ❍ Whether Zendil has been recommended by a dentists' association for this use

Prostate cancer screening means checking a man's prostate for cancer with the Prostate specific antigen (PSA) test before there are symptoms of the disease.

The data below shows results from screening for men (50 years or older), depending on whether they participated in prostate cancer screening for 11 years.

From 1,000 men who participated in screening:

7 men died of prostate cancer.

20 men underwent unnecessary cancer treatment. They were diagnosed with prostate cancer but this cancer would not have been found without screening and would not have threatened their lives. The treatment often included surgery to remove the prostate or radiation therapy, which can cause incontinence or impotence.

From 1,000 men who did NOT participate in screening:

7 men died of prostate cancer.

No men were treated unnecessarily.

For each 1,000 men who participated in prostate cancer screening, how many men were saved (i.e., how many men would have died otherwise)?

Please give your answer in terms of "____ men out of 1,000"

_____

If 2,000 men participate in screening for 11 years, how many of these men will undergo unnecessary treatment for prostate cancer?

Please give your answer in terms of "____ men out of 2,000"

_____

Screening reduces the risk of dying from prostate cancer by ____%.

- ❍ 0
- ❍ 20
- ❍ 50
- ❍ 80
- ❍ 100

Appendix H: Adult Decision Making Competency (Bruine de Bruin, Parker, & Fischhoff, 2007)

Resistance to Framing Part 1

Instructions:
Each of the following problems presents a choice between two options. Each problem is presented with a scale ranging from 1 (representing one option) through 6 (representing the other option). For each item, please circle the number on the scale that best reflects your relative preference between the two options.

Problem 1

Imagine that recent evidence has shown that a pesticide is threatening the lives of 1,200 endangered animals. Two response options have been suggested:

If Option A is used, 600 animals will be saved for sure.

If Option B is used, there is a 75% chance that 800 animals will be saved, and a 25% chance that no animals will be saved.

Which option do you recommend to use?

1	2	3	4	5	6
Definitely would choose A					Definitely would choose B

Problem 2

Because of changes in tax laws, you may get back as much as $1200 in income tax. Your accountant has been exploring alternative ways to take advantage of this situation. He has developed two plans:

If Plan A is adopted, you will get back $400 of the possible $1200.

If Plan B is adopted, you have a 33% chance of getting back all $1200, and a 67% chance of getting back no money.

Which plan would you use?

1	2	3	4	5	6
Definitely would choose A					Definitely would choose B

Problem 3

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 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 A is adopted, 400 of the 1000 students will stay in school.

If Program B is adopted, there is a 40% chance that all 1000 students will stay in school and 60% chance that none of the 1000 students will stay in school.

Which program would you favor for implementation?

1	2	3	4	5	6
Definitely would choose A					Definitely would choose B

Problem 4

Imagine that the U.S. is preparing for the outbreak of an unusual 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 programs are as follows:

If Program A is adopted, 200 people will be saved.

If Program B is adopted, there is a 33% chance that 600 people will be saved, and a 67% chance that no people will be saved.

Which program do you recommend to use?

1	2	3	4	5	6
Definitely would choose A					Definitely would choose B

Problem 5

Imagine that your doctor tells you that you have a cancer that must be treated. Your choices are as follows:

Surgery: Of 100 people having surgery, 90 live through the operation, and 34 are alive at the end of five years.

Radiation therapy: Of 100 people having radiation therapy, all live through the treatment, and 22 are alive at the end of five years.

Which treatment would you choose?

1	2	3	4	5	6
Definitely would					Definitely would

choose surgery choose radiation

Problem 6

Imagine that your client has $6,000 invested in the stock market. A downturn in the economy is occurring. You have two investment strategies that you can recommend under the existing circumstances to preserve your client's capital.

If strategy A is followed, $2,000 of your client's investment will be saved.

If strategy B is followed, there is a 33% chance that the entire $6,000 will be saved, and a 67% chance that none of the principal will be saved.

Which of these two strategies would you favor?

1 2 3 4 5 6
Definitely would choose A — Definitely would choose B

Problem 7

Imagine a hospital is treating 32 injured soldiers, who are all expected to lose one leg. There are two doctors that can help the soldiers, but only one can be hired:

If Doctor A is hired, 20 soldiers will keep both legs.

If Doctor B is hired, there is a 63% chance that all soldiers keep both legs and a 37% chance that nobody will save both legs.

Which doctor do you recommend?

1 2 3 4 5 6
Definitely would choose A — Definitely would choose B

Instructions: Each of the following problems ask you to rate your judgment of a product or a situation. Each problem is presented with a scale ranging from 1 (representing the worst rating) through 6 (representing the best rating). For each problem, please circle the number on the scale that best reflects your judgment.

Problem 1

Imagine that a type of condom has a 95% success rate. That is, if you have sex with someone who has the AIDS virus, there is a 95% chance that this type of condom will prevent you from being exposed to the AIDS virus.

Should the government allow this type of condom to be advertised as "an effective method for lowering the risk of AIDS?"

1 2 3 4 5 6

Definitely no Definitely yes

Problem 2

Imagine the following situation. You are entertaining a special friend by inviting them for dinner. You are making your favorite lasagna dish with ground beef. Your roommate goes to the grocery store and purchases a package of ground beef for you. The label says 80% lean ground beef.

What's your evaluation of the quality of this ground beef?

1 2 3 4 5 6
Very low Very high

Problem 3

In a recent confidential survey completed by graduating seniors, 35% of those completing the survey stated that they had never cheated during their college career.

Considering the results of the survey, how would you rate the incidence of cheating at your university?

1 2 3 4 5 6
Very low Very high

Problem 4

As R&D manager, one of your project teams has come to you requesting an additional $100,000 in funds for a project you instituted several months ago. The project is already behind schedule and over budget, but the team still believes it can be successfully completed. You currently have $500,000 remaining in your budget unallocated, but which must carry you for the rest of the fiscal year. Lowering the balance by an additional $100,000 might jeopardize flexibility to respond to other opportunities.

Evaluating the situation, you believe there is a fair chance the project will not succeed, in which case the additional funding would be lost; if successful, however, the money would be well spent. You also noticed that of the projects undertaken by this team, 30 of the last 50 have been successful.

What is the likelihood you would fund the request?

1 2 3 4 5 6
Very unlikely Very likely

Problem 5

Suppose a student got 90% correct in the mid-term exam and 70% correct in the final-term exam, what would be your evaluations of this student's performance?

1 2 3 4 5 6

Very poor Very good

Problem 6

Imagine that a woman parked illegally. After talking to her, you believe that there is a 20% chance that she did not know she parked illegally.

With this in mind, how much of a fine do you believe this woman deserves?

1 2 3 4 5 6
Minimum fine Maximum fine

Problem 7

Imagine that a new technique has been developed to treat a particular kind of cancer. This technique has a 50% chance of success, and is available at the local hospital.

A member of your immediate family is a patient at the local hospital with this kind of cancer. Would you encourage him or her to undergo treatment using this technique?

1 2 3 4 5 6
Definitely no Definitely yes

Recognizing Social Norms Part 1

Instructions:
The following problems ask whether it is sometimes OK to do different things. For each question, please indicate whether *in your opinion* the answer is yes or no.

1. Do you think it is sometimes OK …
   … to steal under certain circumstances?
   Yes No
2. Do you think it is sometimes OK …
   … to smoke cigarettes?
   Yes No
3. Do you think it is sometimes OK …
   … to commit a crime which could put you in jail?
   Yes No
4. Do you think it is sometimes OK …
   … to keep things you find in the street?
   Yes No
5. Do you think it is sometimes OK …
   … to experiment with marijuana?
   Yes No

6. Do you think it is sometimes OK …
   … to use your fists to resolve a conflict?
   Yes No
7. Do you think it is sometimes OK …
   … to drink and drive?
   Yes No
8. Do you think it is sometimes OK …
   … to yell and argue to solve a conflict?
   Yes No
9. Do you think it is sometimes OK …
   … not to hold the door open for people?
   Yes No
10. Do you think it is sometimes OK …
    … not to tell the police when you witness a crime?
    Yes No
11. Do you think it is sometimes OK …
    … not to give directions to someone who is lost?
    Yes No
12. Do you think it is sometimes OK …
    … not to be on time for appointments?
    Yes No
13. Do you think it is sometimes OK …
    … not to return something you borrowed?
    Yes No
14. Do you think it is sometimes OK …
    … not to keep secrets that a friend told you?
    Yes No
15. Do you think it is sometimes OK …
    … not to return phone calls right away?
    Yes No
16. Do you think it is sometimes OK …
    … not to spend time with friends in need?
    Yes No

Under/Over Confidence

Instructions:

This survey presents true/false questions about various aspects of everyday life. Please indicate, for each statement, whether you believe it to be true or false, by circling the "true" or "false". You may think that some items do not have a clear-cut answer. For those items, please try to give the answer that would be true in general, or in most cases.

Please read through the following examples to find out more about this survey.

Example 1:

Pittsburgh's hockey team is the Bruins.

We want you to do two things:

First, answer the question. In this example, you might think "*No, it's the Penguins. So the statement is* FALSE." Then you would circle 'False'.

Pittsburgh's hockey team is the Bruins.

This statement is [True / False].

Second, think about how sure you are of your answer. Give a number from 50% to 100%. In other words, what is the percent chance that you are right? Circle one of the numbers on the scale.

50% 60% 70% 80% 90% 100%

just guessing absolutely sure

If your answer is a total guess, circle 50%. This means that there is a 50% chance that you are right, and a 50% chance that you are wrong. If you are absolutely sure, circle 100%. If you aren't sure, then circle a number in between, to show how sure you are. In this example, you might think "*I'm absolutely sure it's false, so 100%*." So you would circle 100%.

Pittsburgh's hockey team is the Bruins.

This statement is [True / False].

50% 60% 70% 80% 90% 100%

just guessing absolutely sure

Please read the examples below. They show answers given by other people. Read them closely, and make sure you understand their answers.

Example 2:

Thanksgiving Day is on the fourth Thursday of November.

• *Yes, I think that's when Thanksgiving is. I would say* TRUE.

• *I'm pretty sure, but it might be on the third Thursday of November, so 80%.*

Your answer would look like this:

Thanksgiving Day is on the fourth Thursday of November.

This statement is [True / False].

50% 60% 70% 80% 90% 100%

just guessing absolutely sure

Example 3:

Amman is the capital of Jordan.

• *I really don't know, so I'll just take a guess. I'll say, uh,* TRUE.

• *I'm guessing, so 50%.*

Your answer would look like this:

Amman is the capital of Jordan.

This statement is [True / False].

50% 60% 70% 80% 90% 100%

just guessing absolutely sure

Example 4:

The Hudson River doesn't run past New York City.
• *Oh yes it does! I think it's one of the rivers. So that's* FALSE.
• *I'm almost positive that's false, so I'll say 90%.*

Your answer would look like this:
The Hudson River doesn't run past New York City.
This statement is [True / (False)].

50% 60% 70% 80% (90%) 100%
just guessing absolutely sure

Example 5:
Bill Clinton doesn't have a beard.
• *That's right, he doesn't.* TRUE.
• *I think that's right, but I'm not sure, he might have grown one. I'll say 70%.*
Your answer would look like this:
Bill Clinton doesn't have a beard.
This statement is [(True) / False].

50% 60% (70%) 80% 90% 100%
just guessing absolutely sure

For each of the following statements, circle true or false to indicate your answer. Then circle a number on the scale to indicate how sure you are of your answer. The scale ranges from 50% (meaning that you were just guessing) to 100% (meaning that you were absolutely sure).

1. Many smokers use the nicotine in cigarettes to treat depression.

This statement is [True / False].

50% 60% 70% 80% 90% 100%
just guessing absolutely sure

2. Stress makes it easier to form bad habits.

This statement is [True / False].

50% 60% 70% 80% 90% 100%
just guessing absolutely sure

3. You can take wrinkles out of your clothes by putting them in the dryer with a damp towel.

This statement is [True / False].

50% 60% 70% 80% 90% 100%
just guessing absolutely sure

4. After a fight with your partner, you should not focus on who was to blame.

This statement is [True / False].

50% 60% 70% 80% 90% 100%
just guessing absolutely sure

5. There is no way to improve your memory.

This statement is [True / False].

50% 60% 70% 80% 90% 100%
just guessing absolutely sure

6. The grace period on your credit card is the amount of time you do not have to pay interest on outstanding payments.

This statement is [True / False].

50% 60% 70% 80% 90% 100%
just guessing absolutely sure

7. Red wine stains are easier to remove than beer stains.

This statement is [True / False].

50% 60% 70% 80% 90% 100%
just guessing absolutely sure

8. Muscles do not burn calories when you are at rest.

This statement is [True / False].

50% 60% 70% 80% 90% 100%
just guessing absolutely sure

9. Alcohol causes dehydration.

This statement is [True / False].

50% 60% 70% 80% 90% 100%
just guessing absolutely sure

10. Problems with in-laws contribute to more than 30% of divorces.

This statement is [True / False].

50% 60% 70% 80% 90% 100%
just guessing absolutely sure

11. Homosexual couples are not legally allowed to adopt.

This statement is [True / False].

50% 60% 70% 80% 90% 100%
just guessing absolutely sure

12. A promotion means that you will get a more satisfying job.

This statement is [True / False].

50% 60% 70% 80% 90% 100%
just guessing absolutely sure

13. IRS forms are available on-line.

This statement is [True / False].

50% 60% 70% 80% 90% 100%
just guessing absolutely sure

14. Procrastination is worse when you work in a cluttered environment.

This statement is [True / False].

50% 60% 70% 80% 90% 100%
just guessing absolutely sure

15. A venture capital fund invests in new businesses by providing startup capital.

This statement is [True / False].

50% 60% 70% 80% 90% 100%
just guessing absolutely sure

16. It is wise to handle all negotiations yourself, even if your opponent uses a lawyer.

This statement is [True / False].

50% 60% 70% 80% 90% 100%
just guessing absolutely sure

17. Carbohydrates are fattening no matter how much you eat of them.

This statement is [True / False].

50% 60% 70% 80% 90% 100%
just guessing absolutely sure

18. Young people face few stereotypes when looking for a job.

This statement is [True / False].

50% 60% 70% 80% 90% 100%
just guessing absolutely sure

19. It can be instructive for children to see their parents resolve a fight.

This statement is [True / False].

50% 60% 70% 80% 90% 100%
just guessing absolutely sure

20. There are nonprofit organizations that help people with debt counseling.

This statement is [True / False].

50% 60% 70% 80% 90% 100%
just guessing absolutely sure

21. Assertive behavior makes your brain experience an increase in pleasure.

This statement is [True / False].

50% 60% 70% 80% 90% 100%
just guessing absolutely sure

22. Credit card companies can offer lower payments if you can come up with a lump sum settlement.

This statement is [True / False].

50% 60% 70% 80% 90% 100%
just guessing absolutely sure

23. Contracting a sexually transmitted disease is not an automatic sign that your partner has had an affair.

This statement is [True / False].

50% 60% 70% 80% 90% 100%
just guessing absolutely sure

24. Some sexually transmitted diseases can cause infertility.

This statement is [True / False].

50% 60% 70% 80% 90% 100%
just guessing absolutely sure

25. Self-employed people pay the same amount of taxes as people who work for an employer.

This statement is [True / False].

50% 60% 70% 80% 90% 100%
just guessing absolutely sure

26. When buying a new home, there is little need to have it inspected before you buy it.

This statement is [True / False].

50% 60% 70% 80% 90% 100%
just guessing absolutely sure

27. Creating a routine is an important step in getting unpleasant work done.

This statement is [True / False].

50% 60% 70% 80% 90% 100%
just guessing absolutely sure

28. Once you have experienced an event, your memory of it can not be changed.

This statement is [True / False].

50% 60% 70% 80% 90% 100%
just guessing absolutely sure

29. Meditation slows the heart rate.

This statement is [True / False].

50% 60% 70% 80% 90% 100%
just guessing absolutely sure

30. If you get into an auto accident, let the other person take the lead in handling the details.

This statement is [True / False].

50%	60%	70%	80%	90%	100%
just guessing					absolutely sure

31. There is no way you can negotiate a lower rate with a credit card company.

This statement is [True / False].

50%	60%	70%	80%	90%	100%
just guessing					absolutely sure

32. Obesity increases your risk of type 2 diabetes.

This statement is [True / False].

50%	60%	70%	80%	90%	100%
just guessing					absolutely sure

33. Talking about sex helps romantic relationships.

This statement is [True / False].

50%	60%	70%	80%	90%	100%
just guessing					absolutely sure

34. Hard evidence is lacking that acupuncture helps you to quit smoking.

This statement is [True / False].

50%	60%	70%	80%	90%	100%
just guessing					absolutely sure

Applying Decision Rules

Instructions:

Please read the practice problems on this page carefully before going on to the problems on the next page.

Imagine Chris is going to buy a DVD player with the $369 he received for his birthday. He wants to find out how the DVD players that are available for that price compare to each other. A magazine rated DVD players on each of five features as follows, where higher is better:

Very Low	Low	Medium	High	Very High
1	2	3	4	5

For example, two DVD players and their ratings are listed in the table below:

Features

		Picture Quality	Sound Quality	Program Options	Reliability of Brand	Price
DVD	A	2	2	5	4	$369
	B	2	3	3	3	$369

The following examples use the table above. Please read each carefully.

Example 1. Chris selects the DVD player with the highest rating in Programming Options.

Which **one** of the presented DVD player would Chris prefer? _____*A*_____

Example 2. Chris only wants a DVD player with a sound quality that is rated higher than 4.

Which **one** of the presented DVD player would Chris prefer? _____*none*_____

Example 3. Chris only wants the best in Picture Quality.

Which **two** of the presented DVD players would Chris prefer? ___*A*___, and

___*B*___

The following questions are about other people choosing between DVD players, like the ones above. **Please read each question carefully, because they ask for different answers.** For each question, think about how each person makes their choice, then pick the DVD they choose. But be careful, because the DVD players will change from question to question.

Very Low	Low	Medium	High	Very High
1	2	3	4	5

Question 1:

		Features				
		Picture Quality	Sound Quality	Program Options	Reliability of Brand	Price
DVD	A	5	4	2	1	$369
	B	5	5	3	3	$369
	C	5	2	4	4	$369
	D	1	5	5	3	$369

E	4	5	1	1	$369

Brian selects the DVD player with the highest number of ratings greater than "Medium"
Which **one** of the presented DVD players would Brian prefer? _____

Question 2:

		Features				
		Picture Quality	Sound Quality	Program Options	Reliability of Brand	Price
DVD	A	2	5	5	5	$369
	B	5	4	4	5	$369
	C	5	3	2	5	$369
	D	3	5	2	2	$369
	E	4	4	4	5	$369

Sally first selects the DVD players with the best Sound Quality. From the selected DVD players, she then selects the best on Picture Quality. Then, if there is still more than one left to choose from, she selects the one best on Programming Options.
Which **one** of the presented DVD players would Sally prefer? _____

Very Low	Low	Medium	High	Very High
1	2	3	4	5

Question 3:

		Features				
		Picture Quality	Sound Quality	Program Options	Reliability of Brand	Price
DVD	A	3	1	2	5	$369
	B	5	5	3	2	$369
	C	4	3	3	3	$369
	D	5	5	5	4	$369
	E	2	5	4	4	$369

Pat doesn't want to read through the entire table. He decides to read the table row by row until he finds the very first DVD player that has no ratings below "Medium." He will just choose that DVD player.
Which **one** of the presented DVD players would Pat prefer? _____

Question 4:

Features

		Picture Quality	Sound Quality	Program Options	Reliability of Brand	Price
DVD	A	3	5	5	1	$369
	B	1	2	1	2	$369
	C	5	5	4	4	$369
	D	5	3	4	2	$369
	E	4	5	2	2	$369

LaToya only wants a DVD player that got a "Very High" rating on Reliability of Brand.
Which **one** of the presented DVD players LaToya prefer? _____

Very Low	Low	Medium	High	Very High
1	2	3	4	5

Question 5:

		Features				
		Picture Quality	Sound Quality	Program Options	Reliability of Brand	Price
DVD	A	5	5	5	3	$369
	B	3	5	4	5	$369
	C	5	2	2	4	$369
	D	5	1	2	5	$369
	E	4	2	4	5	$369

From the DVD players with the best available Picture Quality, Tricia selects the DVD players with the lowest number of ratings below "Medium." If there is more than one DVD player left to choose from, she then picks the one that has the best rating on "Reliability of Brand."
Which **one** of the presented DVD players would Tricia prefer? _____

Question 6:

		Features				
		Picture Quality	Sound Quality	Program Options	Reliability of Brand	Price
DVD	A	3	1	5	2	$369
	B	1	2	1	2	$369
	C	5	4	3	1	$369
	D	4	2	3	3	$369
	E	4	4	2	4	$369

Lisa wants the DVD player with the highest average rating across features.
Which **one** of the presented DVD players would Lisa prefer? _____

Question 7:

		Features				
		Picture Quality	Sound Quality	Program Options	Reliability of Brand	Price
DVD	A	5	3	5	5	$369
	B	2	5	4	1	$369
	C	4	5	2	3	$369
	D	3	5	3	1	$369
	E	3	5	3	4	$369

Andy wants the DVD player with the highest average rating he can get while still making sure to keep the best rating on Sound Quality.
Which **one** of the presented DVD players would Andy prefer? _____

Question 8:

		Features				
		Picture Quality	Sound Quality	Program Options	Reliability of Brand	Price
DVD	A	5	4	5	3	$369
	B	5	4	1	2	$369

C	3	3	5	5	$369
D	5	5	1	2	$369
E	3	5	1	3	$369

Shane wants no DVD players that score below "Medium" on Picture Quality, no DVD players that score below "Medium" on Sound Quality, and no DVD players that score "Very Low" on any other feature.
Which **two** of the presented DVD players would Shane prefer? _____ and _____

Very Low	Low	Medium	High	Very High
1	2	3	4	5

Question 9:

		Features				
		Picture Quality	Sound Quality	Program Options	Reliability of Brand	Price
DVD	A	2	1	5	2	$369
	B	1	5	4	2	$369
	C	5	3	1	1	$369
	D	5	4	5	4	$369
	E	3	3	3	3	$369

Tyrone wants a DVD player that either has a "Very High" rating for Programming Options, or one that scores at least "Medium" on every feature.
Which **three** of the presented DVD players would Tyrone prefer?
_____, _____, and _____

Question 10:

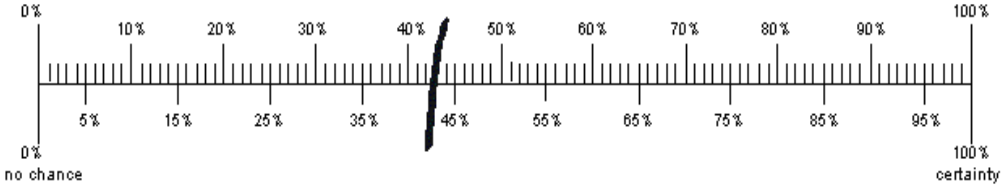
		Features				
		Picture Quality	Sound Quality	Program Options	Reliability of Brand	Price
DVD	A	2	1	5	4	$369
	B	4	5	1	3	$369
	C	1	3	5	5	$369
	D	4	2	5	4	$369
	E	5	5	1	3	$369

Julie wants the best Reliability of Brand, but is willing to give up one point on Reliability of Brand for each increase of at least two points in the rating of Picture Quality. She isn't concerned about the other features.
Which **three** of the presented DVD players would Julie prefer? _____, _____, and _____

Consistency in Risk Perceptions

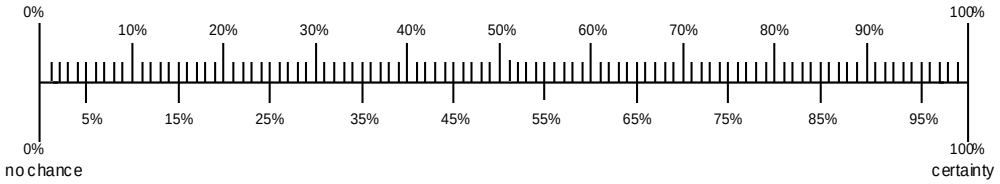
Instructions:

Each of these questions asks for your best guess at the chance that something will happen in the future. They use the "probability" scale that you see below. To answer each question, please put a mark on the scale at one specific tick mark, as follows:

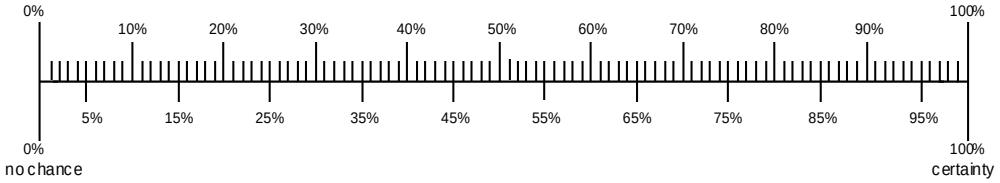


If you think that something has no chance of happening, mark it as having a 0% chance. If you think that something is certain to happen, mark it as having a 100% chance.
Just to make sure that you are comfortable with the scale, please answer the following practice questions.

What is the probability that you will eat pizza during the next year?

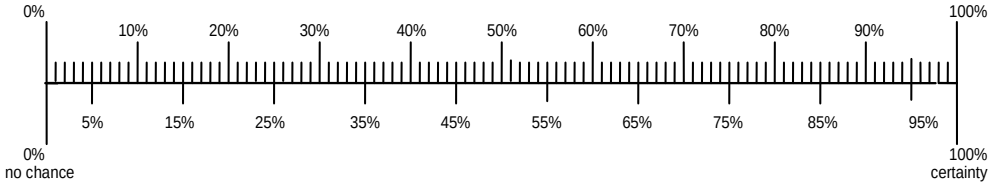


What is the probability that you will get the flu during the next year?

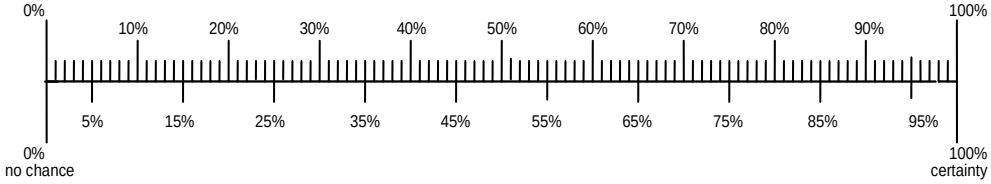


That is the end of the practice. If you have any questions, please ask them now.
A. The following questions ask about events that may happen some time during *the next year*.

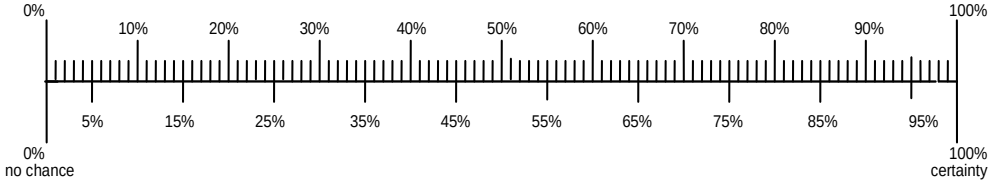
1. What is the probability that you will get into a car accident while driving during the next year?



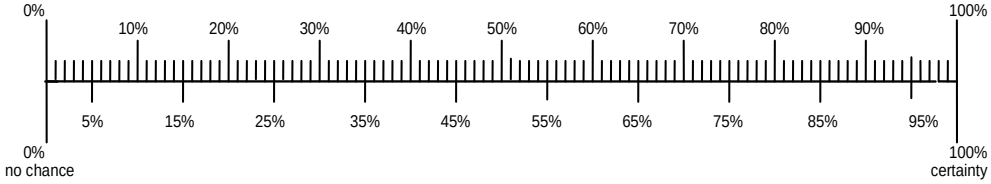
2. What is the probability that you will have a cavity filled during the next year?



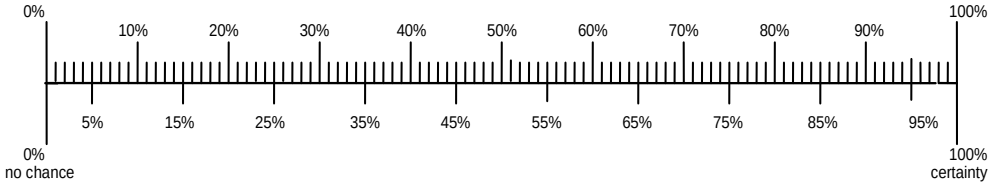
3. What is the probability that you will die (from any cause -- crime, illness, accident, and so on) during the next year?



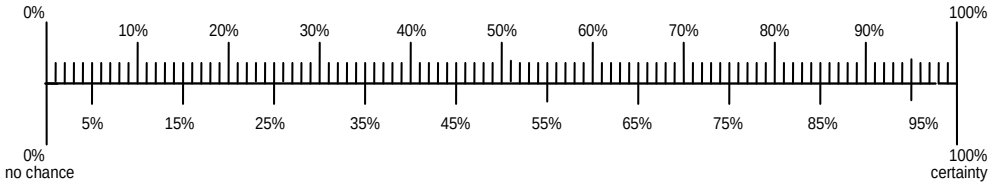
4. What is the probability that someone will steal something from you during the next year?



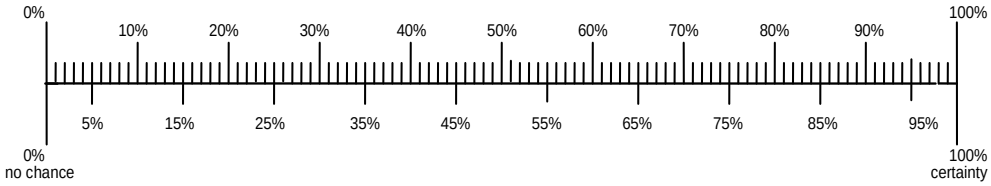
5. What is the probability that you will move your permanent address to another state some time during the next year?



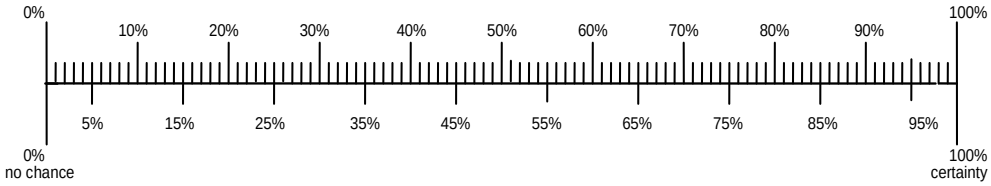
6. What is the probability that you will die in a terrorist attack during the next year?



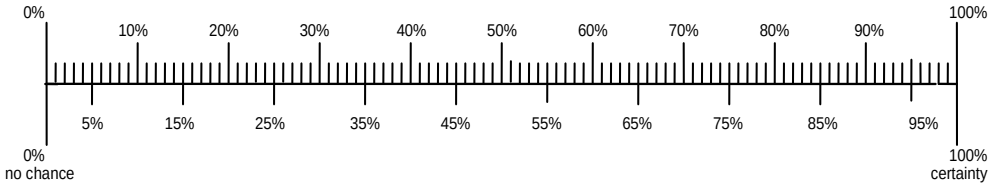
7. What is the probability that someone will break into your home and steal something from you during the next year?



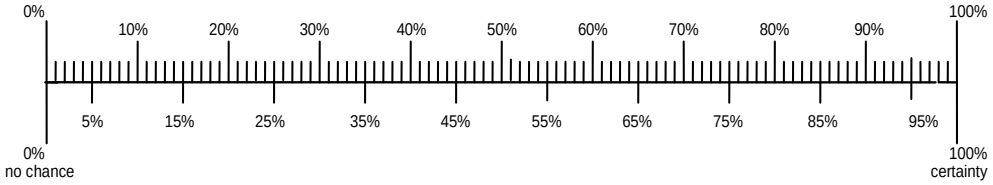
8. What is the probability that you will keep your permanent address in the same state during the next year?



9. What is the probability that you will visit a dentist, for any reason, during the next year?

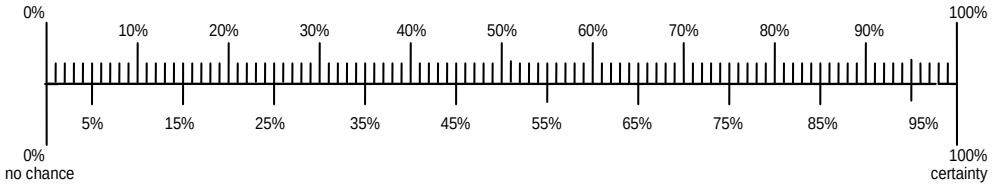


10. What is the probability that your driving will be accident-free during the next year?

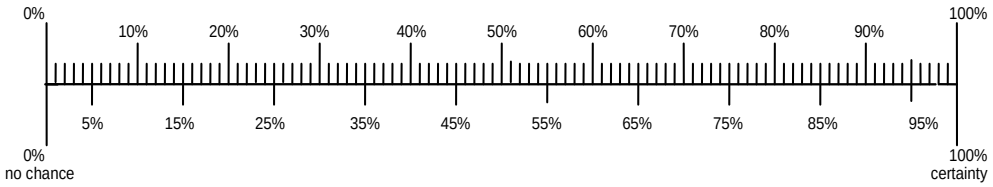


B. The following questions ask about events that may happen some time during *the next 5 years*.

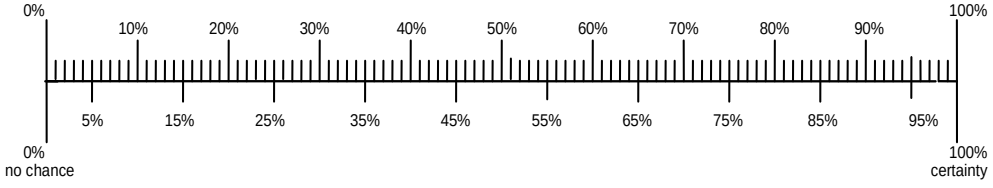
1. What is the probability that you will get into a car accident while driving during the next 5 years?



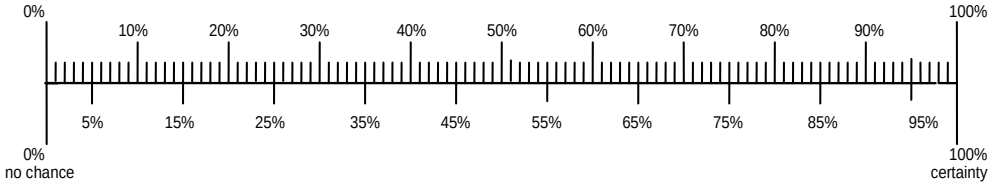
2. What is the probability that you will have a cavity filled during the next 5 years?



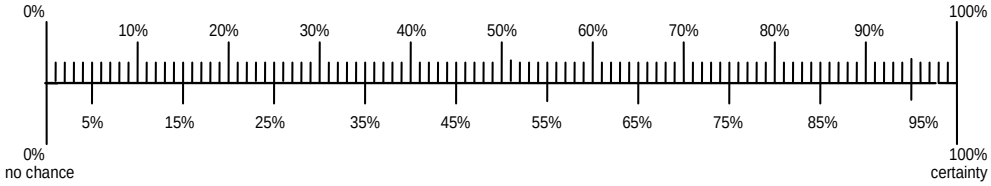
3. What is the probability that you will die (from any cause -- crime, illness, accident, and so on) during the next 5 years?



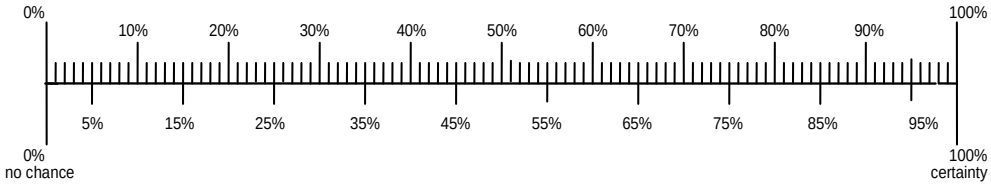
4. What is the probability that someone will steal something from you during the next 5 years?



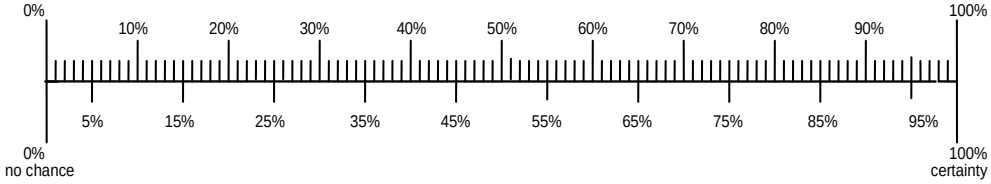
5. What is the probability that you will move your permanent address to another state some time during the next 5 years?



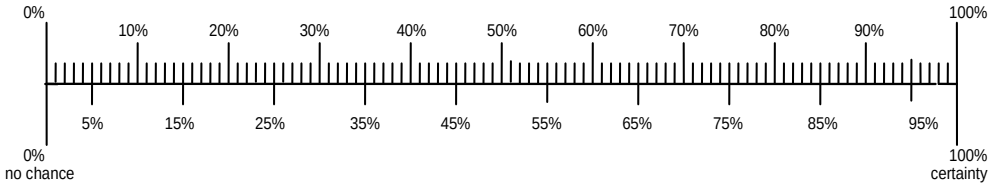
6. What is the probability that you will die in a terrorist attack during the next 5 years?



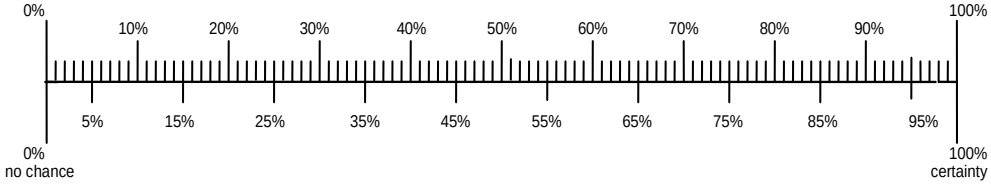
7. What is the probability that someone will break into your home and steal something from you during the next 5 years?



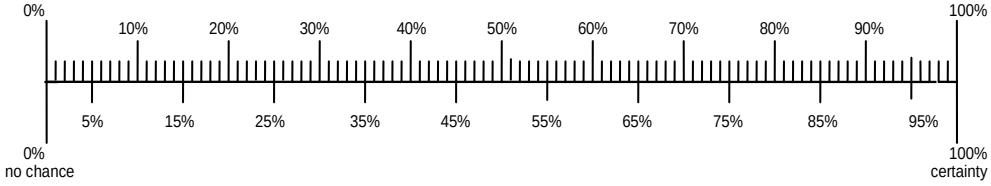
8. What is the probability that you will keep your permanent address in the same state during the next 5 years?



9. What is the probability that you will visit a dentist, for any reason, during the next 5 years?



10. What is the probability that your driving will be accident-free during the next 5 years?



Path Independence

Instructions:
In each of the following problems, choose between flipping a coin and a sure thing. Or, if they both seem the same to you, choose "Doesn't Matter."

1. Which do you like best, (1), (2), or (3)?

(1)	(2)	(3)
Flip a Coin	*Sure Win*	*Doesn't Matter to Me*
If Heads, win **$100**	Win **$50** for sure	
If Tails, win **$0**		
_____	_____	_____

2. Which do you like best, (1), (2), or (3)?

(1)	(2)	(3)
Flip a Coin	*Sure Win*	*Doesn't Matter to Me*
If Heads, win **$100**	Win **$60** for sure	
If Tails, win **$0**		
_____	_____	_____

3. Which do you like best, (1), (2), or (3)?

(1)	(2)	(3)
Flip a Coin	*Sure Win*	*Doesn't Matter to Me*
If Heads, win **$100**	Win **$40** for sure	
If Tails, win **$0**		
_____	_____	_____

The next questions are about losses.

4. Which do you like best, (1), (2), or (3)?

(1)	(2)	(3)
Flip a Coin	*Sure Loss*	*Doesn't Matter to Me*
If Heads, lose **$100**	Lose **$50** for sure	
If Tails, lose **$0**		
_____	_____	_____

5. Which do you like best, (1), (2), or (3)?

(1)	(2)	(3)
Flip a Coin	*Sure Loss*	*Doesn't Matter to Me*
If Heads, lose **$100**	Lose **$60** for sure	
If Tails, lose **$0**		
_____	_____	_____

6. Which do you like best, (1), (2), or (3)?

(1)	(2)	(3)
Flip a Coin	*Sure Loss*	*Doesn't Matter to Me*
If Heads, lose **$100**	Lose **$40** for sure	
If Tails, lose **$0**		
_____	_____	_____

In each of the next questions, choose between flipping two coins and flipping one coin.

7. Which do you like best, (1), (2), or (3)?

(1)	(2)	(3)
Flip Two Coins	*Flip One Coin*	*Doesn't Matter to Me*
If Two Heads, win **$100**	If Heads, win **$50**	
Otherwise, win **$0**	If Tails, win **$0**	

_____ _____ _____

8. Which do you like best, (1), (2), or (3)?

(1)	(2)	(3)
Flip Two Coins	*Flip One Coin*	*Doesn't Matter to Me*
If Two Heads, win **$100**	If Heads, win **$60**	
Otherwise, win **$0**	If Tails, win **$0**	

_____ _____ _____

9. Which do you like best, (1), (2), or (3)?

(1)	(2)	(3)
Flip Two Coins	*Flip One Coin*	*Doesn't Matter to Me*
If Two Heads, win **$100**	If Heads, win **$40**	
Otherwise, win **$0**	If Tails, win **$0**	

_____ _____ _____

The next questions are about losses.

10. Which do you like best, (1), (2), or (3)?

(1)	(2)	(3)
Flip Two Coins	*Flip One Coin*	*Doesn't Matter to Me*
If Two Heads, lose **$100**	If Heads, lose **$50**	
Otherwise, lose **$0**	If Tails, lose **$0**	

_____ _____ _____

11. Which do you like best, (1), (2), or (3)?

(1)	(2)	(3)
Flip Two Coins	*Flip One Coin*	*Doesn't Matter to Me*
If Two Heads, lose **$100**	If Heads, lose **$60**	
Otherwise, lose **$0**	If Tails, lose **$0**	

_____ _____ _____

12. Which do you like best, (1), (2), or (3)?

(1)	(2)	(3)
Flip Two Coins	*Flip One Coin*	*Doesn't Matter to Me*
If Two Heads, lose **$100**	If Heads, lose **$40**	
Otherwise, lose **$0**	If Tails, lose **$0**	

_____ _____ _____

Questions 13 - 18 are just like 7 - 12 above, but one coin was already flipped. It came up <u>heads</u>, so you now have the following choices:

13. If you had already flipped once and it came up heads, which do you like best, (1), (2), or (3)?

(1)	(2)	(3)
Flip Second Coin	*Sure Win*	*Doesn't Matter to Me*
If Heads, win **$100**	Win **$50** for sure	
If Tails, win **$0**		

_____ _____ _____

14. If you had already flipped once and it came up heads, which do you like best, (1), (2), or (3)?

(1)	(2)	(3)
Flip Second Coin	*Sure Win*	*Doesn't Matter to Me*
If Heads, win **$100**	Win **$60** for sure	
If Tails, win **$0**		

_____ _____ _____

15. If you had already flipped once and it came up heads, which do you like best, (1), (2), or (3)?

(1)	(2)	(3)
Flip Second Coin	*Sure Win*	*Doesn't Matter to Me*
If Heads, win **$100**	Win **$40** for sure	
If Tails, win **$0**		

_____ _____ _____

The next questions are about losses.

16. If you had already flipped once and it came up heads, which do you like best, (1), (2), or (3)?

(1)	(2)	(3)
Flip Second Coin	*Sure Loss*	*Doesn't Matter to Me*
If Heads, lose **$100**	Lose **$50** for sure	
If Tails, lose **$0**		

_____ _____ _____

17. If you had already flipped once and it came up heads, which do you like best, (1), (2), or (3)?

(1)	(2)	(3)
Flip Second Coin	*Sure Loss*	*Doesn't Matter to Me*
If Heads, lose **$100**	Lose **$60** for sure	
If Tails, lose **$0**		

18. If you had already flipped once and it came up heads, which do you like best, (1), (2), or (3)?

(1)	(2)	(3)
Flip Second Coin	*Sure Loss*	*Doesn't Matter to Me*
If Heads, lose **$100**	Lose **$40** for sure	
If Tails, lose **$0**		

_____ _____ _____

In each of the next questions, a coin will be flipped to see if you get a choice or not. Without knowing the result of the first flip, what would you choose in each of the following situations?

19. First Flip:

Flip a Coin
If Heads, get the **Choice** below
If Tails, **don't** get the Choice below, win **$0**

Choice: Before the first flip, which do you like best, (1), (2), or (3)?

(1)	(2)	(3)
Flip a Coin	*Sure Win*	*Doesn't Matter to Me*
If Heads, win **$100**	Win **$50** for sure	

If Tails, win **$0**

_____ _____ _____

20. First Flip:

Flip a Coin
If Heads, get the **Choice** below
If Tails, **don't** get the Choice below, win **$0**

Choice: Before the first flip, which do you like best, (1), (2), or (3)?

(1)	(2)	(3)
Flip a Coin	*Sure Win*	*Doesn't Matter to Me*
If Heads, win **$100**	Win **$60** for sure	
If Tails, win **$0**		

_____ _____ _____

21. First Flip:

Flip a Coin
If Heads, get the **Choice** below
If Tails, **don't** get the Choice below, win **$0**

Choice: Before the first flip, which do you like best, (1), (2), or (3)?

(1)	(2)	(3)
Flip a Coin	*Sure Win*	*Doesn't Matter to Me*
If Heads, win **$100**	Win **$40** for sure	
If Tails, win **$0**		

_____ _____ _____

The next questions are about losses.

22. First Flip:

Flip a Coin
If Heads, get the **Choice** below
If Tails, **don't** get the Choice below, lose **$0**

Choice: Before the first flip, which do you like best, (1), (2), or (3)?

(1)	(2)	(3)
Flip a Coin	*Sure Win*	*Doesn't Matter to Me*
If Heads, lose **$100**	Lose **$50** for sure	
If Tails, lose **$0**		

_____ _____ _____

23. First Flip:

Flip a Coin
If Heads, get the **Choice** below
If Tails, **don't** get the Choice below, lose **$0**

Choice: Before the first flip, which do you like best, (1), (2), or (3)?

(1)	(2)	(3)
Flip a Coin	*Sure Win*	*Doesn't Matter to Me*
If Heads, lose **$100**	Lose **$60** for sure	
If Tails, lose **$0**		

_____ _____ _____

24. First Flip:

Flip a Coin
If Heads, get the **Choice** below
If Tails, **don't** get the Choice below, lose **$0**
Choice: Before the first flip, which do you like best, (1), (2), or (3)?

(1)	(2)	(3)
Flip a Coin	*Sure Win*	*Doesn't Matter to Me*
If Heads, lose **$100**	Lose **$40** for sure	
If Tails, lose **$0**		
_____	_____	_____

Resistance to Sunk Costs

Instructions:
Each of the following problems presents a choice between two options. Each problem is presented with a scale ranging from 1 (representing one option) through 6 (representing the other option). For each item, please circle the number on the scale that best reflects your relative preference between the two options.

Problem 1

You are buying a gold ring on layaway for someone special. It costs $200 and you have already paid $100 on it, so you owe another $100. One day, you see in the paper that a new jewelry store is selling the same ring for only $90 as a special sale, and you can pay for it using layaway. The new store is across the street from the old one. If you decide to get the ring from the new store, you will not be able to get your money back from the old store, but you would save $10 overall.

Would you be more likely to continue paying at the old store or buy from the new store?

1	2	3	4	5	6
Most likely to continue paying at the old store					Most likely to buy from the new store

Problem 2

You enjoy playing tennis, but you really love bowling. You just became a member of a tennis club, and of a bowling club, both at the same time. The membership to your

tennis club costs $200 per year and the membership to your bowling club $50 per year. During the first week of both memberships, you develop an elbow injury. It is painful to play either tennis or bowling. Your doctor tells you that the pain will continue for about a year.

Would you be more likely to play tennis or bowling in the next six months?

1	2	3	4	5	6
Most likely to play tennis					Most likely to play bowling

Problem 3

You have been looking forward to this year's Halloween party. You have the right cape, the right wig, and the right hat. All week, you have been trying to perfect the outfit by cutting out a large number of tiny stars to glue to the cape and the hat, and you still need to glue them on. On the day of Halloween, you decide that the outfit looks better without all these stars you have worked so hard on.

Would you be more likely to wear the stars or go without?

1	2	3	4	5	6
Most likely to wear stars					Most likely to not wear stars

Problem 4

After a large meal at a restaurant, you order a big dessert with chocolate and ice cream. After a few bites you find you are full and you would rather not eat any more of it.

Would you be more likely to eat more or to stop eating it?

1	2	3	4	5	6
Most likely to eat more					Most likely to stop eating

Problem 5

You are in a hotel room for one night and you have paid $6.95 to watch a movie on pay TV. Then you discover that there is a movie you would much rather like to see on one of the free cable TV channels. You only have time to watch one of the two movies. Would you be more likely to watch the movie on pay TV or on the free cable channel?

1	2	3	4	5	6
Most likely to watch pay TV					Most likely to watch free cable

Problem 6

You have been asked to give a toast at your friend's wedding. You have worked for hours on this one story about you and your friend taking drivers' education, but you still have some work to do on it. Then you realize that you could finish writing the speech faster if you start over and tell the funnier story about the dance lessons you took together.

Would you be more likely to finish the toast about driving or rewrite it to be about dancing?

1	2	3	4	5	6
Most likely to write about driving					Most likely to write about dancing

Problem 7

You decide to learn to play a musical instrument. After you buy an expensive cello, you find you are no longer interested. Your neighbor is moving and you are excited that she is leaving you her old guitar, for free. You'd like to learn how to play it. Would you be more likely to practice the cello or the guitar?

1	2	3	4	5	6
Most likely to					Most likely to

play cello play guitar

Problem 8

You and your friend are at a movie theater together. Both you and your friend are getting bored with the storyline. You'd hate to waste the money spent on the ticket, but you both feel that you would have a better time at the coffee shop next door. You could sneak out without other people noticing.

Would you be more likely to stay or to leave?

1	2	3	4	5	6
Most likely to stay					Most likely to leave

Problem 9

You and your friend have driven halfway to a resort. Both you and your friend feel sick. You both feel that you both would have a much better weekend at home. Your friend says it is "too bad" you already drove halfway, because you both would much rather spend the time at home. You agree.

Would you be more likely to drive on or turn back?

1	2	3	4	5	6
Most likely to drive on					Most likely to turn back

Problem 10

You are painting your bedroom with a sponge pattern in your favorite color. It takes a long time to do. After you finish two of the four walls, you realize you would have preferred the solid color instead of the sponge pattern. You have enough paint left over to redo the entire room in the solid color. It would take you the same amount of time as finishing the sponge pattern on the two walls you have left.

Would you be more likely to finish the sponge pattern or to redo the room in the solid color?

1	2	3	4	5	6
Most likely to finish sponge pattern					Most likely to redo with a solid color

Resistance to Framing Part 2

<u>Instructions:</u> Each of the following problems presents a choice between two options. Each problem is presented with a scale ranging from 1 (representing one option) through 6 (representing the other option). For each item, please circle the number on the scale that best reflects your relative preference between the two options.

Problem 1

Imagine a hospital is treating 32 injured soldiers, who are all expected to lose one leg. There are two doctors that can help the soldiers, but only one can be hired:

If Doctor A is hired, 12 soldiers will lose one leg.

If Doctor B is hired, there is a 63% chance that nobody loses a leg and a 37% chance that all lose a leg.

Which doctor do you recommend?

1	2	3	4	5	6
Definitely would choose A					Definitely would choose B

Problem 2

Imagine that the U.S. is preparing for the outbreak of an unusual 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 programs are as follows:

If Program A is adopted, 400 people will die.

If Program B is adopted, there is a 33% chance that nobody will die, and a 67% chance that 600 people will die.

Which program do you recommend to use?

1	2	3	4	5	6
Definitely would choose A					Definitely would choose B

Problem 3

Imagine that your client has $6,000 invested in the stock market. A downturn in the economy is occurring. You have two investment strategies that you can recommend under the existing circumstances to preserve your client's capital.

If strategy A is followed, $4,000 of your client's investment will be lost.
If strategy B is followed, there is a 33% chance that the nothing will be lost, and a 67% chance that $6,000 will be lost.

Which of these two strategies would you favor?

1	2	3	4	5	6
Definitely would choose A					Definitely would choose B

Problem 4

Because of changes in tax laws, you may get back as much as $1200 in income tax. Your accountant has been exploring alternative ways to take advantage of this situation. He has developed two plans:
If Plan A is adopted, you will lose $800 of the possible $1200.

If Plan B is adopted, you have a 33% chance of losing none of the money, and a 67% chance of losing all $1200.

Which plan would you use?

1	2	3	4	5	6
Definitely would choose A					Definitely would choose B

Problem 5

Imagine that recent evidence has shown that a pesticide is threatening the lives of 1,200 endangered animals. Two response options have been suggested:

If Option A is used, 600 animals will be lost for sure.

If Option B is used, there is a 75% chance that 400 animals will be lost, and a 25% chance that 1,200 animals will be lost.
Which option do you recommend to use?

1	2	3	4	5	6
Definitely would choose A					Definitely would choose B

Problem 6

Imagine that your doctor tells you that you have a cancer that must be treated. Your choices are as follows:

Surgery: Of 100 people having surgery, 10 die because of the operation, and 66 die by the end of five years.

Radiation therapy: Of 100 people having radiation therapy, none die during the treatment, and 78 die by the end of five years.

Which treatment would you choose?

1	2	3	4	5	6
Definitely would choose surgery					Definitely would choose radiation

Problem 7

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 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 A is adopted, 600 of the 1000 students will drop out of school.

If Program B is adopted, there is a 40% chance that none of the 1000 students will drop out of school and 60% chance that all 1000 students will drop out of school.

Which program would you favor for implementation?

1	2	3	4	5	6
Definitely would choose A					Definitely would choose B

Instructions: Each of the following problems ask you to rate your judgment of a product or a situation. Each problem is presented with a scale ranging from 1 (representing the worst rating) through 6 (representing the best rating). For each problem, please circle the number on the scale that best reflects your judgment.

Problem 1

As R&D manager, one of your project teams has come to you requesting an additional $100,000 in funds for a project you instituted several months ago. The project is already behind schedule and over budget, but the team still believes it can be successfully completed. You currently have $500,000 remaining in your budget unallocated, but which must carry you for the rest of the fiscal year. Lowering the balance by an additional $100,000 might jeopardize flexibility to respond to other opportunities.

Evaluating the situation, you believe there is a fair chance the project will not succeed, in which case the additional funding would be lost; if successful, however, the money would be well spent. You also noticed that of the projects undertaken by this team, 20 of the last 50 have been unsuccessful.

What is the likelihood you would fund the request?

1	2	3	4	5	6
Very unlikely					Very likely

Problem 2

Imagine that a woman parked illegally. After talking to her, you believe that there is an 80% chance that she knew she parked illegally.

With this in mind, how much of a fine do you believe this woman deserves?

1	2	3	4	5	6
Minimum fine					Maximum fine

Problem 3

In a recent confidential survey completed by graduating seniors, 65% of those completing the survey stated that they had cheated during their college career.

Considering the results of the survey, how would you rate the incidence of cheating at your university?

1	2	3	4	5	6
Very low					Very high

Problem 4

Imagine that a new technique has been developed to treat a particular kind of cancer.

This technique has a 50% chance of failure, and is available at the local hospital.

A member of your immediate family is a patient at the local hospital with this kind of cancer. How likely are you to encourage him or her to undergo treatment using this technique?

1	2	3	4	5	6
Definitely no					Definitely yes

Problem 5

Imagine the following situation. You are entertaining a special friend by inviting them for dinner. You are making your favorite lasagna dish with ground beef. Your roommate goes to the grocery store and purchases a package of ground beef for you. The label says 20% fat ground beef.

What's your evaluation of the quality of this ground beef?

1	2	3	4	5	6
Very low					Very high

Problem 6

Imagine that a type of condom has a 5% failure rate. That is, if you have sex with someone who has the AIDS virus, there is a 5% chance that this type of condom will fail to prevent you from being exposed to the AIDS virus.

Should the government allow this type of condom to be advertised as "an effective method for lowering the risk of AIDS?"

1	2	3	4	5	6
Definitely no					Definitely yes

Problem 7

Suppose a student got 10% incorrect in the mid-term exam and 30% incorrect in the final-term exam, what would be your evaluations of this student's performance?

1	2	3	4	5	6
Very poor					Very good

Recognizing Social Norms Part 2

Instructions: The following problems ask *out of 100 people your age,* how many would say that it is sometimes OK to do different things. For each question, please circle a number between 0 (meaning *no one* thinks that it is sometimes OK) and 100 (meaning *everyone* thinks that it is sometimes OK).

1. Out of 100 people your age, how many would say it is sometimes OK …

… to steal under certain circumstances?

0 10 20 30 40 50 60 70 80 90 100
No one Everyone

2. Out of 100 people your age, how many would say it is sometimes OK …
… to smoke cigarettes?
0 10 20 30 40 50 60 70 80 90 100
No one Everyone

3. Out of 100 people your age, how many would say it is sometimes OK …
… to commit a crime which could put you in jail?
0 10 20 30 40 50 60 70 80 90 100
No one Everyone

4. Out of 100 people your age, how many would say it is sometimes OK …
… to keep things you find in the street?
0 10 20 30 40 50 60 70 80 90 100
No one Everyone

5. Out of 100 people your age, how many would say it is sometimes OK …
… to experiment with marijuana?
0 10 20 30 40 50 60 70 80 90 100
No one Everyone

6. Out of 100 people your age, how many would say it is sometimes OK …
… to use your fists to resolve a conflict?
0 10 20 30 40 50 60 70 80 90 100
No one Everyone

7. Out of 100 people your age, how many would say it is sometimes OK …
… to drink and drive?
0 10 20 30 40 50 60 70 80 90 100
No one Everyone

8. Out of 100 people your age, how many would say it is sometimes OK …
… to yell and argue to solve a conflict?
0 10 20 30 40 50 60 70 80 90 100
No one Everyone

9. Out of 100 people your age, how many would say it is sometimes OK …
… not to hold the door open for people?
0 10 20 30 40 50 60 70 80 90 100
No one Everyone

10. Out of 100 people your age, how many would say it is sometimes OK …
… not to tell the police when you witness a crime?
0 10 20 30 40 50 60 70 80 90 100
No one Everyone

11. Out of 100 people your age, how many would say it is sometimes OK …
… not to give directions to someone who is lost?
0 10 20 30 40 50 60 70 80 90 100
No one Everyone

12. Out of 100 people your age, how many would say it is sometimes OK …
… not to be on time for appointments?
0 10 20 30 40 50 60 70 80 90 100
No one Everyone

13. Out of 100 people your age, how many would say it is sometimes OK …

… not to return something you borrowed?

0 10 20 30 40 50 60 70 80 90 100

No one Everyone

14. Out of 100 people your age, how many would say it is sometimes OK …

… not to keep secrets that a friend told you?

0 10 20 30 40 50 60 70 80 90 100

No one Everyone

15. Out of 100 people your age, how many would say it is sometimes OK …

… not to return phone calls right away?

0 10 20 30 40 50 60 70 80 90 100

No one Everyone

16. Out of 100 people your age, how many would say it is sometimes OK …

… not to spend time with friends in need?

0 10 20 30 40 50 60 70 80 90 100

No one Everyone