THE GIST OF RISKY DECISION MAKING AND JUDGMENT

IN HEALTH AND WELL BEING

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Across three papers and seven experiments, I test predictions based in fuzzy-trace theory that

individuals' decisions will be affected by a combination of reward sensitivity (a neurobiological

construct related to increased activity in the dopaminergic reward pathways in the brain),

inhibitory mechanisms which have been associated with prefrontal areas of the brain, and mental

representations of the decision problems. In the first chapter, we report that subjects showed

standard framing effects (i.e., risk taking for losses and risk aversion for gains) regardless of

Cognitive Reflection Test (CRT) score if expected values are equal. However, verbatim

calculation trumped the gist in those with high CRT scores when expected values were unequal.

The second chapter reports tests of the prediction that qualitative representation of options or

health state will be preferentially relied on compared to quantitative representations, which is

tested through manipulation of quantitative risk information and of qualitative health status quo

to examine the effect on likelihood of starting a medication. Controlling for side effect,

quantitative risk, age, sex, ethnicity, and numeracy in a multivariate model, the status quo and all

three qualitative (i.e., ordinal) risk dimensions (worry, risk perception, and overall gist of

options) predicted likelihood of taking the medication, while objective risk and numeracy did

not. Finally, I test a model that predicts that global assessments such as life satisfaction will

endure as gist representations, whereas tasks requiring precise judgments, such as numeric ratings of happiness, will activate verbatim representations that are subject to greater interference over time, resulting in less consistency between ratings in the moment and recollections of happiness judgments. We support these predictions by introducing a new measure of instability that captures the level of verbatim detail incorporated into judgments of well-being, and corroborate a growing body of research that demonstrates that focusing attention on verbatim details can have detrimental effects on judgment in real-world outcomes. These results are consistent with a theoretical mechanism in which the perception of the gist of choices, as well as individual differences in reward salience and neurobiological responsiveness, each account for unique variance in predicting risk-taking.

BIOGRAPHICAL SKETCH

Evan Wilhelms has been a PhD student in Cornell University's Department of Human Development. He earned his B.S. in Psychology and Philosophy from Baldwin-Wallace College in 2004 and his M.A. in Developmental Psychology from Cornell University in 2013. He grew up in Cleveland, OH and now resides in Ithaca, NY. His current research interests lie in the field of cognitive and developmental psychology, with primary topics of interest in judgment and decision making, with implications for financial and health well being in adolescents and adults.

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CHAPTER 1

Introduction

Across three papers and seven experiments, I test predictions based in fuzzy-trace theory regarding risky decisions in a variety of lab tasks pertaining to health and well-being. Risky choices permeate many facets of life with consequences for our health, well-being, and longevity. Several biases exist that prevent people from being consistent in risky choices, or prevent people from selecting the healthiest outcomes (Kahneman, 2003; Reyna, 2012). Traditional frameworks for describing risky decision making pit logic against intuition, with intuition representing a less advanced form of thought that produces biases and fallacies. Many of the effects found when investigating behavior in this field has been described in terms of heuristics and biases; shortcuts and errors people make in their thinking. I describe an alternative framework grounded in memory theory, fuzzy-trace theory (FTT), emphasizing the benefits that might come from intuitive thinking, such as when those with expert training are able to make better decisions based on less information. This framework is organized based on retrieval and processing of gist—or essential meaning—of information as opposed to rote, verbatim analysis.

The theory describes judgments as reliant on these memory representations (verbatim and gist), which is also the case when people make judgments about their own subjective well-being. These judgments can be made about emotions and well-being in the present, about memories of emotions in response to past events, and predictions of emotions and well-being about future events. In fact, forecasts of the future tend to rely on our memories of similar experiences from the past. In addition, people will often base important decisions on what emotions they expect to feel as a result of the decision. These decisions could be selecting between monetary gambles

(Mellers & McGraw, 2001), considering unsafe sexual risks (Richard, Van der Plight & DeVries, 1996), or selecting between consumer brands (Shiv & Huber, 2000; Rosenzweig & Gilovich, 2012). Other life choices, such as what career to pursue, whom to marry, and where to live may also be influenced by these forecasts of emotional reactions and subjective well-being, and the accuracy of those predictions can have a permanent influence in one's life (Wilson & Gilbert, 2003). Specifically, these measures of subjective well-being are predictive of people's objective well-being, such as physical health and longevity (Diener, 2000). It would thus be beneficial to make accurate judgments of what will make us happy and satisfied in our future lives and to understand how and why these judgments are often inaccurate. Recent research has also investigated the role that affective forecasting--people's predictions about their future emotions-- plays in several other decision-making paradigms. For example, one recent study has found that loss aversion in gambling tasks was at least partially the result of people overestimating the impact the loss would have on their emotions compared to an equivalent gain, when in fact, if they lost the gamble, the loss did not have the impact they predicted (Kermer, Driver-Linn, Wilson, & Gilbert, 2006).

The experiments presented herein test predictions of fuzzy trace theory (FTT; Reyna & Brainerd, 2011), as they apply to risky choice framing tasks as well as health and well-being. FTT is a dual-process theory of both memory and reasoning that predicts that both deliberative, analytic reasoning, which relies on verbatim memory, and intuitive processes which rely on gist memory develop with experience. In predicting advances in both verbatim (relying on precise representations) and gist (relying on intuitive, meaningful representations) processes with age, FTT can predict when reasoning biases will decrease and increase with experience depending on a number of factors relating to the task. FTT differs from other dual process models in that

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impulsivity is distinguished from intuition. Specifically, FTT proposes that intuition (fuzzy, often unconscious processing) is supported by gist memory representations that capture bottom-line meaning of experience (e.g., there is a small chance of rain today), and that analytic deliberation is supported by verbatim representations that capture the precise details of experience (e.g., there is a 23% chance of rain today; Reyna, 2012).

This theory is based on four foundational principles. First, information is encoded in multiple representations with varying levels of precision. At one end of the continuum, gist representations preserve the bottom-line meaning of information; at the other end, verbatim representations capture low-level details and surface form, including exact numerical values. These representations form an hierarchy from verbatim to gist, roughly analogous to scales of measurement (exact numerical values, ordinal, and categorical distinctions; Rivers, Reyna, and Mills, 2008). Second, gist and verbatim representations of experience are encoded, stored, and retrieved independently (Reyna & Brainerd, 2011). This independence allows the possibility that a person may have distinct and even contradictory representations of the same information. The existence of these independent, occasionally contradictory representations are supported by research that reveals that memory for frequencies is based on verbatim representations and is independent of the accuracy of probability judgments, which are based on gist representations (Reyna & Brainerd, 1994; see also Reyna & Kiernan, 1994, for foundational research on psycholinguistics).

Third, adults and advanced reasoners tend to rely on gist representations in their decision making and judgments, referred to as a fuzzy processing preference. This preference for the simplest representation necessary to complete a task has been used to explain several other effects including framing effects (Kühberger & Tanner 2010). Finally, the preference for

reliance on gist representations increases with experience with a given task, also resulting in increases in gist processing with age and expertise (Reyna & Ellis, 1994; Reyna et al., 2011; Reyna, Chick, Corbin, & Hsia, 2013). In contrast to traditional theories that describe development as a progression from intuitive or heuristic processing to analytic deliberative processing (Stanovich, West, & Toplak, 2011), this perspective predicts and accounts for several developmental reversals found in memory and reasoning literature, such as reversals in false memories and framing effects (Brainerd, Reyna, & Zember, 2011; Reyna et al., 2011).

The developmental shift from verbatim to gist processing from adolescence to adulthood is paralleled by developmental differences that occur at the level of the brain. Synaptic "pruning" of weak or unused synapses, resulting in a significant reduction of gray matter, occurs in conjunction with increased myelination of axons to facilitate speed and efficiency of information transfer during childhood and adolescence (Chick & Reyna, 2012; Giedd et al. 2012). Increased myelination and the development of longer connections (e.g. between the prefrontal cortex and parietal, subcortical, and association areas; Asato, Terwilliger, Woo, & Luna, 2010; Klingberg et al., 1999; Mukherjee & McKinstry, 2006) could support an increased capacity to integrate information (Chick & Reyna, 2012; Reyna & Brainerd, 2011). Maturing brain networks that can integrate information enable the processing of fewer, higher quality aspects of information (in less time) for overall better decision-making as adolescents approach adulthood (Reyna, 2011; Reyna, Chapman, Dougherty, & Confrey, 2012).

Neuroimaging evidence supports the idea that adolescents rely on more deliberation in their decision making. For example, one such study has shown that adolescents take longer to deliberate over risky decisions that they ultimately reject, such as deciding whether it is a good idea to set one's hair on fire (Baird & Fugelsang, 2004; Reyna & Farley, 2006). Although

subjects gave safe and healthy answers in the end (e.g., saying "no" to the prospect of setting one's hair on fire and "yes" to eating a salad), neuroimaging data showed that this delay was correlated with activation in areas associated with deliberation (e.g. parts of the pre-frontal cortex) in adolescents, whereas neuroimaging data of adults, who made the decision faster, showed activation in areas associated with imagery (fusiform gyrus) and gut responses (insula). These results are consistent with FTT's prediction that, although both gist and verbatim representations are encoded, adolescents rely more on an alternative mechanism to make on quantitative verbatim representations to make decisions rather than the qualitative, meaningful representations used by adults.

Because FTT predicts a developmental pattern of gist and verbatim processing in which verbatim processing is relied on more readily before gist processing, differences between adolescent and adult judgment can demonstrate how reliance on gist representations can result in one judgment while verbatim representations can result in another. A number of reasoning biases that have been shown to increase with age—referred to as developmental reversals—are explained by FTT's proposition that verbatim and gist processing operate independently and in parallel. Examples of developmental reversals include age increases from childhood to adulthood in framing biases (i.e., inconsistencies in preferences for gambling depending on wording), the representativeness heuristic (i.e., a mental shortcut that produces reasoning fallacies), and false memories (e.g., Furlan, Agnoli, & Reyna, 2013; Reyna & Brainerd, 1994). In Chapter 2, we test hypotheses regarding how an increased reliance on gist processing has been shown to make adults more susceptible to bias in risky choice framing tasks (Reyna, Chick, Corbin & Hsia, 2014). Such "intelligent" errors are evidence for the shift to gist processing predicted by FTT. These developmental reversals belie the overall advantages to the fuzzy

processing preference that have been demonstrated in multiple contexts, such as protection against potentially catastrophic risk taking (e.g., Mills, Reyna, & Estrada, 2008). Chapter 2 specifically tests the relationship between framing and the Cognitive Reflection Test (Frederick, 2005), and the subsequent capacity for this lab-based task to predict real-world risk taking.

Chapter 3 presents tests of hypotheses regarding FTT's application to medical treatment decisions. FTT predicts that experts, including medical experts, will rely more on gist, which features rough qualitative distinctions (e.g., no risk vs. some risk, or more or less risk), compared to novices. This results in the prediction that experts will, given the benefit of their advanced domain-specific knowledge, process information based on fewer dimensions, making simpler, all-or-none distinctions. An illustration of the application of these basic principles of memory—the independent processing of verbatim and gist—to professional expertise can be found by comparing the oral presentation of an experienced clinician to that of a medical student (Lloyd & Reyna 2009). Whereas the student presents a patient's symptoms as a list of memorized facts (e.g., fever, cirrhosis, pneumonia, and urinary tract infection), the experienced clinician's presentation is organized according to meaningful connections: e.g., the patient's cirrhosis compromises the immune system, which in turn leads to enterococcal bacteremia and concerns about endocarditis. Expressing the symptoms in this way reflects an *understanding* of the connections among the symptoms, which is the defining characteristic of gist representations. The processing and understanding based on the gist leads to accurate understanding of causes, and appropriate medical decisions (Lloyd & Reyna 2009; Reyna, 2008).

This prediction has been confirmed in several studies pertaining to medical expertise. Medical experts, for example, will make more accurate diagnostic judgments that rely on fewer pieces of information. A study demonstrated this in which physicians from a variety of

specialties representing a range of knowledge levels regarding cardiology (including cardiology, internal medicine, emergency medicine, family practice, and medical school students) were asked to evaluate descriptions of 9 hypothetical patients that were categorized as either low, medium, or high risk according to the guidelines for unstable angina (Reyna & Lloyd, 2006). The specialists in cardiology were all more accurate in assessing how patients' likelihood of adverse cardiac outcomes, even though they used less information (i.e., only considering patients' heart attack risk alone rather than risk of heart attack and coronary artery disease). Specifically, they were more likely to place the high-risk patients at a higher triage level, as well as predict a higher probability of admission. This study demonstrated that, although experts were just as susceptible to certain advanced reasoning errors, they processed fewer dimensions of information in coming to treatment decisions and were more willing to deviate from verbatim protocols (Lazar, 2012).

Chapter 3 also tests predictions regarding treatment decisions in a hypothetical scenario involving a rheumatoid arthritis study. This builds on work in which 30 expert rheumatologists were given options on how best to characterize the treatment decision for rheumatoid arthritis (Reyna, 2008b). Participants were presented with a series of four descriptions of patients, their medical histories, and their treatment regimens. The rheumatologists were asked to assess the risks and benefits of the medications taken by the patients, as well as select a gist among several options, including examples such as "trade off precise degrees of risk against precise amounts of benefits," "avoid fatal side effects," and "slow down disease progression" that represented the bottom line of the patients' treatment decisions. None of the expert rheumatologists sampled chose the option in which they would trade off risks and benefits, although they demonstrated accurate assessment of the risks and benefits for each patient. Preferring categorical to precise

statements provides evidence that few experts endorse the classical decision theory approach that describes rational decision making as a compensatory process in which probabilities and outcomes trade off. Such studies thus demonstrate that experts tend to rely on gist-based evaluations as opposed to verbatim trade-offs or risks and benefits   Further, this evidence demonstrates that development from novice to expert in adulthood can be associated with increasing reliance on gist. Experts are able to distinguish signal from noise, zeroing in on information that provides them with categorical distinctions between less and more risk rather than trying to incorporate every bit of information into a precise estimate of risk (Reyna et al., 2014). The experiments in this chapter test whether novices in such a hypothetical scenario—as most patients would be novices—base their treatment choice on similar gists, and also tests whether their perceived health state can be manipulated while holding physical health constant. This manipulation can be interpreted as analogous to risky choice framing problems, in that potential patients can perceive themselves as either generally healthy (with more to lose) or generally unhealthy (with more to gain), and predictions described in this chapter extend from this principle.

Chapter 4 tests FTT's predictions regarding memory for emotional states in specific gist and verbatim memory representations. Specifically, the experienced valence of an emotional experience is encoded as a categorical gist representation (as either positive or negative, good or bad), and that these gists will endure in memory and subsequently be relied on for judgments and decisions. One's level of arousal at the time of encoding an emotional experience, however, can result in a greater focus on the gist of the experience and a de-emphasis on peripheral details, subsequently enhancing the memory for the gist. This effect of arousal is predicted because verbatim memories have been shown to be sensitive to interference, such as that produced by

stress and strong emotion (Rivers et al, 2008). As people tend to rely on these gists for most judgments, this will include judgments of future or past well-being. As Wilson and Gilbert (2003) noted, making predictions about the emotions of future experiences is based on recalling feelings from the past.

FTT can provide predictions regarding the accuracy of SWB memories and predictions from these principles. Memories for categorical emotional content, including simple judgments of valence and some discrete emotional states, will tend to be robust and endure over time as gist representations. These gist representations will also form the basis of predicted judgments of well-being and happiness, as simulating and forecasting the future has been found to rely largely on the same neural networks as recalling the past (Schacter et al., 2012). Whether these forecasts are accurate will depend on the response format of the questions. If people are asked to recall or predict the valence or categorical emotional state they have experienced or will experience, people will generally be accurate, as this judgment elicits a categorical gist memory that tends to be robust over time. Exceptions will tend to occur when people do not have relevant experience to make predictions. However, when tasks require precise values, such as specific numeric ratings of happiness, people will activate specific verbatim representations that are subject to greater interference over time. This will result in less consistency between forecasts, ratings in the moment, and recollections of emotions regarding a specific stimulus or event. If the ratings in the moment are the standard against which accuracy is based, then the forecasts and recollections of those judgments will be inaccurate in comparison. Contrary to momentary emotional reactions, global assessments of well-being will tend to be based on enduring gist representations and thus be stable over time; inaccuracies in forecasts and memories will tend to arise from misleading verbatim details. Although FTT has not been applied previously to explain effects in

affective forecasting, evidence from this literature supports these aforementioned predictions, as we discuss below.

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CHAPTER 2

Abstract

We examined relations among intuitive processes (i.e., gist), temporal discounting, sensation seeking (reward sensitivity), and risk-taking in health domains such as alcohol use and food choices. Fuzzy-trace theory (FTT) predicts that individuals' decisions will be affected by a combination of reward sensitivity (a neurobiological construct related to increased activity in the dopaminergic reward pathways in the brain), inhibitory mechanisms associated with prefrontal areas of the brain, and individuals' mental representations of the decision problems. If these principles are true, biases should increase when gist processing is relied on relative to verbatim processing. In the present study, subjects completed a series of framing and temporal discounting tasks in a full-factorial mixed design, as well as a series of individual difference measures such as sensation seeking (reward sensitivity) and cognitive reflection (inhibition). Subjects showed standard framing effects regardless of CRT score if expected values are equal; however, verbatim calculation trumped the gist in those with high CRT scores when expected values are unequal. Consistent with FTT, risk-taking was predicted by both reward sensitivity and gist mental representations. These results are consistent with a theoretical mechanism in which the perception of the gist of choices, as well as individual differences in reward salience and neurobiological responsiveness, each account for unique variance in predicting risk-taking.

Beyond Dual Processes in Framing:

A Fuzzy-Trace Theory Account of Risky Decision Making

How people process and decide between options with uncertain outcome is of central importance to the study of decision making, with implications for a variety of fields, such as psychology, economics, law, health, and marketing (Wilhelms & Reyna, 2015). Some populations are particularly risk-prone, for example, adolescents and young adults disproportionately take a variety of risks with lasting consequences, including` unprotected sex, and substance abuse (Reyna, Chapman, Dougherty, & Confrey, 2012; Reyna & Mills, 2014). These risks are often undertaken by people who have the requisite reasoning ability to process the probabilities and outcomes of the risks (Wilhelms & Reyna, 2013). Conversely, some people can be particularly risk-averse, which can also have detrimental outcomes, such as when adults hold low-risk investments instead of higher-risk investments with better lifetime returns (Benartzi & Thaler, 1995).

Most decision theorists--including prospect theory and dual process theories--argue that risk preferences for the same objective circumstances should be consistent (Kahneman & Tversky, 2000). What is often found, however, is that people will shift preferences from risky to safe options based on supposedly superficial elements of the choice. A common demonstration of this effect is found using the risky choice framing task (Stanovich & West, 2008). In this task, people must choose between a sure and risky option with a certain amount at stake overall (e.g., $20 at stake, and a choice between a sure win of $10 and a 50% chance of winning all $20). Framing tasks typically present options of equal expected value, such that the reward in the risky option is equal to the sure reward once it is weighted according to the probability of winning it (e.g., $20*.50 = $10). People shift their preferences based on whether the outcomes

are described in terms of gains (e.g., winning $10) or losses (e.g., losing $10 from the $20 at stake), and tend to prefer the safe option in gains and the risky option in losses.

In explaining such effects, many theoretical approaches to decision making focus on dual processes (Stanovich, West, & Toplak, 2012). Most of these theories characterize two types of thinking as Type 1 and Type 2 processes, the former of which is automatic, fast, and intuitive, and the latter of which is "slow, sequential, and correlated with measures of general intelligence" (Evans & Stanovich, 2013, p. 235). These dual-process theories tend to be default-interventionist, meaning that people tend to rely on Type 1 thinking by default and only override with Type 2 thinking if a need is detected and if working memory and attention is available (Evans & Stanovich 2013; Kahneman, 2011). The cognitive capacities of working memory and intelligence are required to achieve normative responses, such as consistent risk preferences between outcomes whether they are framed as gains or losses. However, according to Stanovich and West (2008) the relationship between intelligence and errors will only be exhibited if a need to override default thinking is detected. For example, in a between-subjects framing experiment in which participants only saw one frame of the risky choice framing problem, SAT score (a proxy for intelligence) did not interact with frame to predict risk preference; participants demonstrated the framing effect regardless of score (Stanovich & West, 2008). According to the dual-process perspective, participants who saw only one of the frames did not recognize that consistency was violated (i.e., consistency between frames), and thus did not override their Type 1 response. When such an experiment is conducted within-subjects, however (i.e., participants are able to see both frames), intelligence and working memory are related to the size of the framing effect, as they sometimes remember the past versions of the problem and perform a calculation to determine that the problems have equivalent outcomes (Bruine de Bruin, Parker, &

Fischhoff, 2007). In this case, cognitive capacity is required for overriding and inhibiting a Type 1 response, and the analytic rules and procedures associated with Type 2 thinking are used.

The ability to inhibit inaccurate responses in reasoning tasks is often presumed to be analogous to inhibition of reward response and arousal mechanisms. The arousal mechanisms in question include dopaminergic circuits related to reward processing and emotion, and are often posited to be measured by individual differences such as sensation seeking (Reyna, Chapman, Dougherty, and Confrey, 2012; Zuckerman, 1994). Sensation seeking is defined as "a need for varied, novel, and complex sensations and experiences and the willingness to take physical and social risks for the sake of such experiences" (Zuckerman, 1979, p.11). This trait has been associated with the magnitude of nucleus accumbens response, as well as heightened reward salience in adolescence (Galvan et al., 2006). The hypothesized effect is that failure to inhibit reward responses associated with sensation seeking results in unhealthy risk-taking, particularly in adolescence. In laboratory tasks such as the risky choice framing task, the trait has been associated with increased choice of the risky option for high magnitude risks, particularly in the gain frame--notably in opposition to the commonly observed framing effect that involves rejecting the risky option (Reyna et al., 2011). Thus, according to predictions of FTT, the reward response--and inhibition thereof--is an important consideration regarding whether people will demonstrate common framing effects.

This ability to reflect and inhibit is often considered to be assessed using measures such as the cognitive reflection test (CRT; Frederick, 2005). This assessment consists of three questions, each of which is designed to have an intuitive, incorrect answer that must be inhibited to arrive at an accurate answer that may require additional calculation. This measure was designed according to the paradigm in which Type 1 thinking generates the incorrect intuitive

response, and thus accuracy on the test would be associated with Type 2 thinking (as well as general intelligence). The CRT has been useful in predicting resistance to logical fallacies, as well as preference for options with higher expected value (Campitelli & Labollita, 2010; Cokely & Kelley, 2009; Oechssler, Roider, & Schmitz, 2009). Recent work, however, has found that this model may be incomplete in describing how participants come to correct answers on this assessment, and that it may instead rely on differences in mindless matching, metacognitive monitoring, mathematical ability, as well as inhibition (Liberali, Reyna, Furlan, Stein, & Pardo, 2011). Furthermore, although the dual-process model on which it is based makes predictions regarding when cognitive ability will be related to errors (such as framing errors), it does not make any explicit predictions of the opposite effect, that errors will increase with cognitive ability.

Thus, in the present study, fuzzy trace theory was used to inform predictions relating to the relationship of complex measures of cognitive abilities such as the CRT and the framing effect. According to fuzzy-trace theory, information in decision problems are encoded in both verbatim and gist mental representations (Reyna & Brainerd, 2011). Verbatim representations encode exact numbers and quantities as well as exact surface forms and details of information. With these representations, people can combine information multiplicatively to weigh risks and benefits, sometimes in the form of conscious, deliberate calculation, but often unconsciously trading off in a manner consistent with expected utility. Gist representations, however, encode the bottom-line meaning of information such as qualitative categorical distinctions, which can vary depending on context, culture, and background knowledge. Fuzzy trace theory predicts that processing with both representations increases with age, but reliance on verbatim processing develops before reliance on gist processing, such that adolescents may rely more on verbatim

processing than adults (Reyna & Farley, 2006). Both kinds of representations are formed based on the same information, and the theory posits that people tend to use the simplest gist representation necessary to make a decision, only turning to finer distinctions (such as ordinal or continuous distinctions) if the simplest gist results in indifference.

When applied to risky choice framing problems, fuzzy-trace theory posits that people retrieve simple values and apply them to the choice options, preferring to rely on categorical distinctions between the options (Reyna, 2012). For example, in the gain frame, in which participants must choose between a sure 200 lives saved and a ⅓ chance of saving all 600 people at risk, most participants represent these choice options categorically as "some people will be saved" and "maybe people will be saved and maybe not." As most participants tend to retrieve a simple value such as "saving some lives is better than saving none," this leads most people to prefer the first option in this frame. When the mathematically equivalent options are expressed as losses--a sure 400 people dying versus a ⅔ chance of all 600 people dying--most represent the options as a choice between "some people will die" and "maybe some people will die." Retrieving a similar value, most people then prefer the option in which there is a possibility of no loss of life.

This explanation of framing effects has been supported through experimental manipulations that either emphasize or de-emphasize the categorical gist contrast, resulting in an increase or decrease (respectively) in framing effects compared to the common framing task (Kuhberger & Tanner, 2010). Specifically, the traditional version of the task contains mathematically redundant information in the risky option (e.g., "a ⅓ chance 600 people will be saved and a ⅔ chance no one will be saved"). Removing one of the redundant elements has the effect of either increasing the categorical gist contrast between options by removing the first part

(e.g., "some people saved" vs. "maybe no one saved") or decreasing it by removing the second part (e.g., "some people saved" vs. "maybe some people saved"); crucially, the "missing" information is supplied to subjects so that problems are not ambiguous (Chick, Reyna, & Corbin, 2015). These manipulations result in an increase in framing effects in the first case and a decrease in framing effects in the second, supporting the account that the categorical gist contrast underlies framing effects and that common explanations of framing effects are ruled out (Reyna, et al., 2014).

As fuzzy trace theory also makes the prediction that gist-based thinking increases with development and expertise in a domain, this can result in "developmental reversals," or the pattern of effects in which errors or biases can increase with age, contrary to the usual expectation that adults would outperform children on cognitive tasks. As the framing effect has been found to be based in reliance on gist representations of the choices, this results in a finding that framing effects can increase with age and expertise (Reyna et al., 2011; Reyna, Chick, Corbin, Hsia, 2014). Similar effects have been found with other errors that rely on remembering the gist of events, such as spontaneous false memories (Brainerd, Reyna, & Zember, 2011). This finding of increased semantic error is often in contrast to dual-process theory predictions that errors will be inversely related to measures of intelligence and working memory—despite concurrent increases in verbatim processing with age. Expertise in a domain, however, is understandably shown to improve decision making in practical real-world tasks (as opposed to lab tasks), including those related to health and well-being (Reyna & Adam, 2003; Reyna & Lloyd, 2006; Reyna & Mills, 2014).

Expertise, however, is not the same thing as general intelligence or numerical ability. Although the CRT was designed as a test of cognitive ability and correlates with other measures

of numeracy, its relationship with other numeracy scales is often low or unreliable (Liberali et al., 2011). Furthermore, the CRT was not correlated with other measures that are posited to measure primitive "intuitive answers" (i.e., Faith in Intuition). According to fuzzy-trace theory, intuition is based in gist representations and processing, and merely the fact that an answer springs to mind automatically does not mean it is "intuitive." The questions that compose the CRT illustrate this principle; the common wrong answers to those questions reflect a lack of comprehension or merely matching information in the problem verbatim. Although many researchers use the word "intuitive" in this sense--mindless matching or "dumb" intuition--it does not represent advanced cognition that results from insight or expertise. As mentioned, the CRT is a complicated measure that requires the inhibition of a misleading mindless response, an understanding of the question, and the numeric ability to reach the correct answer. We thus predict that this measure will be associated inversely with framing when expected values are not exactly equal between choice options, and the better outcome opposes the gist. We test this prediction in Experiments 1 and 2. We also predict that the CRT will be positively associated with reliance on the gist in risky choice framing tasks when endowments (e.g. stated number of lives at stake prior to choices) are removed from the tasks—a manipulation that removes the need for metacognitive monitoring for equivalence of outcomes between frames, but maintains the gist of the options. We test this prediction in Experiment 2. Finally, as fuzzy-trace theory predicts that individuals' decisions will be affected by a combination of reward sensitivity, inhibitory mechanisms, and individuals' mental representations of the decision problems, we predict that risk-taking in the framing task will also be associated with these measures of reward sensitivity, in particular with risk-taking in the gain frame.

Experiment 1

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Method

  Participants. Participants were mostly undergraduates who were offered extra credit in introductory courses for participation in the study. A total of 745 subjects participated in the study, 67% of whom were female. The average age of participants was 20.30 with a standard deviation of 3.602. The total range of ages of participants was from 18-77, although 98% of the participants were under 24. The sample was 63% Caucasian, 5% African American, 30% Asian and 2% mixed race or other. 11% identified as Hispanic.

  Design, Materials, and Procedure. The questionnaire was administered as an online survey and was organized according to a $2 \times 2 \times 2 \times 2 \times 2$ within-subject factor design of framing questions (Kahneman & Tversky, 1979; Kahneman, 2003). Questions took the form of: Which would you choose? a) 6 drinks for sure or b) ⅔ chance of getting 9 drinks and a 1⅓ chance of getting nothing," in the gain frame and "Assume you have already won 12 drinks. Which would you choose? a) Lose 6 drinks for sure or b) A ⅔ chance of losing 9 drinks and a ⅓ chance of losing nothing," in the loss frame. These questions varied across the following within-subject factors: the *frame* of the question (gain or loss), the *product* at risk (either candy or alcohol), the *magnitude* of the sure option (one or six), the *probability* of the risky outcome the question (⅓ or ⅔ chance), and the *expected values* of the sure and gamble option (either equal or unequal to each other). In unequal expected value questions, the outcomes were manipulated such that the option contrary to the common framing effect was slightly better. In other words, in the gain frame, the risky option had a slightly higher expected value than the safe option, as most people tend to prefer safe outcomes in the gain frame, and vice versa. Subjects were also asked to report their age, gender, ethnicity, height and weight. A number of individual scales were also included in the analyses.

The Brief Sensation Seeking Scale (BSSS; α = .796) is a modified version of the Sensation Seeking Scale V intended for adolescents (Hoyle, Stephenson, Palmgreen, Lorch & Donohew, 2002). It assesses the tendency to seek stimulating experiences with high reward value using eight items and a 5-point response scale ranging from 'Strongly Disagree' to Strongly Agree'. The eight items are divided into four subscales: experience seeking (e.g., "I would like to explore strange places."), boredom susceptibility (e.g., "I get restless when I spend too much time at home."), thrill and adventure seeking (e.g., "I like to do frightening things.") and disinhibition (e.g., "I like wild parties.").

The Adolescent Risk-Taking Questionnaire (ARQ; α = .756) is intended to gauge the risk-taking behaviors of adolescents by asking the frequency with which they participate in an array of risks (Gullone, Moore, Moss & Boyd, 2000). The questionnaire includes four subscales: Thrill Seeking (e.g., inline skating, parachuting), Rebellious Behaviors (e.g., underage drinking, smoking, taking drugs), Reckless Behavior (e.g., drinking and driving, unprotected sex) and Antisocial Behaviors (e.g., cheating, sniffing gas or glue). The four subscales include 22 items that were rated on a five-point scale ranging from never to very often.

Also included was the Alcohol Use Disorders Identification Test (AUDIT; α = .793), developed by the World Health Organization to diagnose excessive alcohol consumption habits (Babor, Higgins-Biddle, Saunders & Monteiro, 2001). The test consists of 10 items divided into the categories of hazardous alcohol use, harmful alcohol use, and symptoms of dependence.

The Cognitive Reflection Test (CRT; KR-20 = .637) was also included with the survey (Frederick, 2005). The CRT is a three-item test that is designed to encourage intuitive incorrect answers from test takers. For example, one item reads, "If it takes 5 machines 5 minutes to make 5 widgets, how long would it take 100 machines to make 100 widgets?" The intuitive incorrect

answer is 100 minutes, as simple pattern completion would lead one to believe (the correct answer is actually 5 minutes). The CRT was developed under the standard dual-process system, which suggests here that the intuitive "Type 1" leads to an incorrect response while the careful and controlled "Type 2" allows one to reach the correct answer. More recent findings point towards a different understanding of the CRT beyond just mathematical ability and impulsivity control (Liberali, Reyna, Furlan, Stein & Pardo, 2012). For example, it captures aspects such as monitoring and editing responses, as well as actively open-minded thinking, an ability that allows one to generate multiple possible responses to a problem.

A new scale called the Gist of Delayed Gratification scale (DG-Gist; $\alpha = .810$), which measures financial riskiness and well-being as well as financial problem outcomes, was also included in the survey (Reyna & Wilhelms, submitted). Examples from the twelve-item scale include, "I am worried about the amount of money that I owe," and "I believe in sacrifice now, enjoy later." Subjects respond to these items using a five-point scale ranging from 'strongly disagree' to 'strongly agree'.

Results

Framing bias for binary choice (0 for the sure option, 1 for risky option) was measured by subtracting the score of a given gain frame question from the score of a matched loss frame question (similar to Reyna, Chick, Corbin, Hsia, 2014). This final framing bias score could vary from -1 (reverse framing; risky choice in the gain frame and safe choice in the loss frame) to 1 (standard framing; safe choice in the gain frame and risky choice in the loss frame). Score on the CRT was included as a between-subjects factor (as distribution of CRT scores was roughly uniform: 28.3% scored 0, 25.1% scored 1, 23.9% scored 2, and 22.7% scored 3). Additionally, a median split was performed with scores on the BSSS, and the two levels of *high* and *low* BSSS

scores was included as a between-subjects factor. Since this scoring incorporates the frame into the final framing bias score, the final ANOVA conducted was a 2 (product: candy or alcohol) × 2 (probability: ⅓ or ⅔) × 2 (magnitude: 1 or 6) × 2 (expected value: equal or unequal) × 4 (CRT score, 0-3) × 2 (BSSS score, low or high) design.

The ANOVA analysis revealed several main effects and interactions (a full table of which, as well as means, may be found in the appendix). Of primary theoretical interest in the present study, however, was the interaction between expected value and CRT score to predict framing bias. Framing bias depended first on main effects of both CRT score, $F(3, 736) = 6.718$, $p < .001$, $\eta_p^2 = .027$, and expected value, $F(1, 700) = 417.102$, $p < .001$, $\eta_p^2 = .362$. Those with higher CRT scores were more likely to display reverse framing (scoring 0, $M = .039$, $SE = .017$; scoring 1, $M = -.011$, $SE = .018$; scoring 2, $M = -.016$, $SE = .019$; scoring 3, $M = -.076$, $SE = .019$). Reverse framing was also more likely when expected values were unequal ($M = -.152$, $SE = .012$) than when equal ($M = .120$, $SE = .011$) as the objectively favorable option was always the option representing the opposite of the standard framing effect. These two main effects interacted, $F(3, 736) = 5.486$, $p = .001$, $\eta_p^2 = .022$, such that the relationship between CRT and reverse framing was only seen when expected values were unequal (scoring 0, $M = -.065$, $SE = .022$; scoring 1, $M = -.128$, $SE = .023$; scoring 2, $M = -.168$, $SE = .024$; scoring 3, $M = -.247$, $SE = .025$). When expected values were equal, no difference was found in framing bias depending on CRT score (scoring 0, $M = .143$, $SE = .020$; scoring 1, $M = .105$, $SE = .022$; scoring 2, $M = .137$, $SE = .022$; scoring 3, $M = .094$, $SE = .023$). This interaction is depicted in Figure 1. In addition to these effects, extent of framing bias was also found to be an effect of the magnitude, $F(1, 736) = 7.465$, $p = .006$, $\eta_p^2 = .010$, and the probability in the risky option, $F(1, 736) = 194.526$, $p < .001$, $\eta_p^2 = .209$. More reverse-framing effects were found at low

magnitudes ($M = -.032$, $SE = .011$) than high magnitudes ($M = .000$, $SE = .011$). Standard framing effects were found with ⅓ probability in the risky option ($M = .112$, $SE = .013$), and reverse framing effects were found with ⅔ probability in the risky option ($M = -.145$, $SE = .013$).

Table 1 depicts the correlations between framing indices and sums of risky choices (split between gain and loss frames) and all outcomes and individual differences. Risky choice in framing scores was related to sensation seeking, the AUDIT, and the ARQ, driven largely by risky choices in the gain frame. This effect was largely limited to unequal expected value framing problems, but was robust enough to persist in the overall score (collapsed over equal and unequal framing problems). The risky choice framing problems were also associated with the DG-gist scale (such that more risk-taking was associated with more problems with money) but this effect was largely limited to loss-framed risky choices. The correlation analysis also corroborated the interaction effect between CRT and expected value found in the ANOVA analysis. Specifically, the CRT was negatively associated with risks in loss-framed unequal expected value problems, and positively associated with risks in gain-framed unequal expected value framing problems (the reverse framing effect). This effect persisted as a negative relationship between overall framing difference scores and the CRT. No effect was found for any equal expected value framing score, again corroborating the null results in the ANOVA.

Experiment 2

Methods

Participants. Participants were 908 undergraduates with a mean age of 20 years and a standard deviation of 1.54 years. 65% of the sample was female. The sample included 64% Caucasian, 5% African American, 23% Asian, and 8% mixed race or other. 8% of the sample identified as Hispanic.

Design, Materials, and Procedure. The design was a 2 × 2 × 2 × 2 × 3 factor within-subject design that mostly replicated the design of Experiment 1 above, however with an additional level in the *product* factor: candy, alcohol, and now money as well. The other 4 factors remained the same as in Experiment 1: *magnitude* of the sure option (one or six), *probability* of the risky outcome (⅓ or ⅔), the *expected values* of the sure and gamble option (either equal or unequal to each other) and *frame* (gain or loss). For each framing choice question, participants were also asked their confidence in their choice on a five-point scale.

In addition to the scales that were used as in Experiment 1, Experiment 2 also included the Kirby Monetary Choice Questionnaire (MCQ; Kirby, 2009). The Kirby is a compilation of 27 delay-discounting questions which vary reward magnitudes (between $11 and $85) and time intervals of delay (7 to 186 days). Questions on the test take the form of "Would you prefer (a) $34 today or (b) $35 in 186 days?" and are used to estimate participants' discount rates. The scale demonstrates test-retest reliability over the period of one year.

Results

Two ANOVAs were conducted in Experiment 2, the first of which was closely matched to the binary choice framing bias analysis in Experiment 1. CRT score was again nearly uniform (23.4% scored 0, 25.7% scored 1, 25.4% scored 2, and 25.4% scored 3), and was included as a factor in both ANOVAs, as was a median split of BSSS, as described in Experiment 1. With the additional *product* category of *money,* the final ANOVA conducted was a 3 (product: candy, alcohol, or money) × 2 (probability: ⅓ or ⅔) × 2 (magnitude: 1 or 6) × 2 (expected value: equal or unequal) × 4 (CRT score, 0-3) × 2 (BSSS score, low or high) design. For this first ANOVA, binary choice framing indices were calculated as they were in Experiment 1, and were treated as the dependent variable.

Additionally, an ANOVA was conducted on a transformed measure of signed confidence. For this measure, confidence ratings were given a negative sign if the sure option was chosen and a positive sign if the risky option was chosen, resulting in a scale ranging from -5 to 5 (similar to Reyna et al., 2014). Signed confidence framing bias scores were then calculated similarly to the binary choice scores (See Experiment 1), such that signed confidence in the gain frame was subtracted from signed confidence in the loss frame, resulting in a range of -10 (maximum confidence in reverse-framing choices) to 10 (maximum confidence in standard framing choices).

The ANOVA analysis on framing indices of binary choice revealed several main effects and interactions (a full table of which, as well as means, may be found in the appendix). Of primary theoretical interest in the present study, however, was the interaction between expected value and CRT score to predict framing bias. Although there was a main effect of expected value to predict framing score, $F(1, 604) = 1174.795$, $p < .001$, $\eta_p^2 = .660$, this was qualified by an interaction with CRT score, $F(3, 604) = 23.684$, $p < .001$, $\eta_p^2 = .105$. The main effect of expected value reflected the predicted pattern that equal expected value framing problems revealed the standard framing effect, $M = .250$, $SE = .012$, whereas the unequal expected value problems revealed reverse-framing effects, $M = -.205$, $SE = .014$. The interaction between the two revealed the effect that those with higher CRT scores revealed a greater reverse-framing pattern under unequal expected value conditions (scoring 0, $M = -.118$, $SE = .027$; scoring 1, $M = -.202$, $SE = .028$; scoring 2, $M = -.186$, $SE = .028$; scoring 3, $M = -.313$, $SE = .027$). When responding to equal expected value framing questions, however, those with higher CRT scores displayed more of the standard framing effect (scoring 0, $M = .190$, $SE = .023$; scoring 1, $M = .235$, $SE = .024$; scoring 2, $M = .273$, $SE = .024$; scoring 3, $M = .302$, $SE = .023$). These means

are also depicted in Figure 2. Main effects were also observed for the probability in the risky option, $F(1, 604) = 96.057$, $p < .001$, $\eta_p^2 = .137$, such that greater framing was observed at a ⅓ probability in the risky option, $M = .124$, $SE = .016$, than at a ⅔ probability, $M = -.079$, $SE = .014$. The framing effect also depended on the magnitude, $F(1, 604) = 50.049$, $p < .001$, $\eta_p^2 = .077$, such that greater framing was observed at low magnitudes, $M = .067$, $SE = .012$, than high magnitudes, $M = -.022$, $SE = .013$. And finally, the framing effect also depended on the product, $F(2, 604) = 35.667$, $p < .001$, $\eta_p^2 = .056$, such that participants were more likely to reverse frame for money, $M = -.052$, $SE = .014$, than for candy, $M = .069$, $SE = .014$, or alcohol, $M = .051$, $SE = .014$.

Similar patterns of effects were found in the ANOVA with signed confidence of framing choices as a dependent variable. A full list of uncorrected effects is available in the Appendix. Similar to the binary choice ANOVA, this analysis replicated the main effect of expected value to predict framing score, $F(1, 604) = 928.347$, $p < .001$, $\eta_p^2 = .661$, and this was qualified by an interaction with CRT score, $F(3, 604) = 17.154$, $p < .001$, $\eta_p^2 = .097$. The main effect of expected value reflected the predicted pattern that equal expected value framing problems revealed the standard framing effect, $M = 2.117$, $SE = .101$, whereas the unequal expected value problems revealed reverse-framing effects, $M = -1.436$, $SE = .123$. The interaction between the two revealed the effect that those with higher CRT scores revealed a greater reverse-framing pattern under unequal expected value conditions (scoring 0, $M = -.758$, $SE = .251$; scoring 1, $M = -1.481$, $SE = .250$; scoring 2, $M = -1.110$, $SE = .254$; scoring 3, $M = -2.397$ $SE = .232$). When responding to equal expected value framing questions, however, those with higher CRT scores displayed more of the standard framing effect (scoring 0, $M = 1.709$, $SE = .207$; scoring 1, $M = 1.987$, $SE = .206$; scoring 2, $M = 2.405$, $SE = .208$; scoring 3, $M = 2.367$, $SE = .190$). The means

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in this effect are also depicted in Figure 3. Similar to the binary choice ANOVA, probability in the risky option had an effect on the signed confidence framing index, $F(1, 604) = 57.839$, $p < .001$, $\eta_p^2 = .108$, such that greater framing was observed at a ⅓ probability in the risky option, $M = 1.020$, $SE = .139$, than at a ⅔ probability, $M = -.340$, $SE = .124$. The signed confidence framing index also depended on the magnitude, $F(1, 604) = 46.818$, $p < .001$, $\eta_p^2 = .089$, such that greater framing was observed at low magnitudes, $M = .705$, $SE = .105$, than high magnitudes, $M = -.024$, $SE = .16$. And finally, the signed confidence framing index also depended on the product, $F(2, 604) = 31.668$, $p < .001$, $\eta_p^2 = .062$, such that participants were more likely to reverse frame for money, $M = -.249$, $SE = .119$, than for candy, $M = .672$, $SE = .118$, or alcohol, $M = .598$, $SE = .129$. All significant effects in the signed confidence framing index ANOVA were also found in the binary choice ANOVA, with the one exception of the additional between-subject effect of BSSS score, $F(1, 604) = 4097$, $p = .044$, $\eta_p^2 = .009$. Those with high sensation seeking framed significantly less, $M = .145$, $SE = .136$, than those with low sensation seeking, $M = .536$, $SE = .138$.

Table 2 depicts the correlations between framing indices and sums of risky choices (split between gain and loss frames) and all outcomes and individual differences. Risky choice in framing questions is significantly related to sensation seeking as well as the ARQ, driven largely by risky choices in the gain frame. This effect was found for equal or unequal expected values, and was replicated for both binary choices and signed confidence framing scores. Unlike Experiment 1, no risky choice score or framing score was associated with either the AUDIT or DG-Gist. The relationship found between CRT and framing was corroborated by these correlations, such that CRT scores correlated positively with equal expected value framing indices, and negatively with unequal expected value framing indices. The predicted pattern also

was borne out when correlated with either the gain or loss framed risks individually; higher CRT scores correlated with more risk taking for loss-framed equal expected value problems, and with less risk taking for gain-framed equal expected value problems. The opposite pattern was observed for unequal expected values. Finally, risk-taking in the framing problems was predictive of the MCQ scores, such that more risk-taking was associated with less discounting of future rewards. Framing indices, however, had the opposite relationship, such that more discounting was associated with more framing.

Discussion

Although both those who score high and those who score low on the CRT demonstrate the standard framing effect when expected values are equal, CRT score interacts with expected value such that those with high CRT scores demonstrate more of the "reverse framing" pattern (i.e., seeking risks in gains and safe options in losses), reflecting how problems were constructed. The low sensation-seekers did not show a difference in framing between equal and unequal expected value problems. The high sensation seekers, however, were more risky overall if they scored low on the CRT, but if they scored high on the CRT, high sensation seekers refrained from choosing the risky option. Risk taking in the framing task was also associated with self-reported real-world risk-taking as measured by the ARQ.

The relationship between framing and the CRT demonstrates that the framing bias is not merely the result of lack of calculation, since subjects frame regardless of CRT score if expected values are equal; those with high CRT scores choose the higher expected value option (i.e., they show the reverse of the framing effect). Framing problems stated as gains appeared to reflect an approach-based reward sensitivity that is also captured in sensation-seeking measures. Specifically, high sensation seekers with high CRT modulated their risk preference based on

expected value, whereas high sensation seekers with low CRT consistently prefered the risky option. These results are consistent with a theoretical mechanism in which the perception of the gist of choices, as well as individual and group differences in reward salience and neurobiological responsiveness, each account for unique variance in predicting risk-taking and unhealthy choices, spanning from risky health outcomes to financial troubles.

This model of framing choices is distinct from traditional dual process accounts that focus on constructs such as intelligence and self-control (Stanovich, West, & Toplak, 2012). According to these perspectives, biases result from Type 1 processes, which are automatic and intuitive, and must be intervened with by Type 2 processes, which are correlated with measures of general intelligence (Evans & Stanovich, 2013). Measures such as the CRT are posited to assess the ability for a person to inhibit Type 1 processing and intervene with Type 2 processing, which requires working memory and intelligence. Applying these principles to risky choice framing tasks, when the framing effect is observed between-subjects, it is the result of a failure to recognize a need to override the Type 1 response. Often in between-subjects experiments, no relationship is observed between measures of cognitive ability and framing (e.g., no interaction between frame and SAT scores to predict risky choice; Stanovich & West, 2008). However, this effect changes when framing tasks are administered within-subjects, such that measures of cognitive capacity and working memory are inversely related to the framing effect (Bruine de Bruin, Parker, & Fischhoff, 2007). This is because those with high cognitive capacity remember past versions of the same problem, recognize that a reasoning principle is being violated, and possibly sustain a calculation to produce a normative (i.e., unbiased) response.

The results of the present study require more nuance than the above explanation provides. First of all, if the CRT is considered to be merely a measure of cognitive capacity as described

above, then the present study is in conflict with work that finds cognitive capacity to be inversely related to the framing effect. These results, however, support the conclusion that the CRT is a measure that incorporates mindless matching, metacognitive monitoring, mathematical ability, as well as inhibition (Liberali et al., 2011). In other words, mere inhibition and cognitive capacity are not enough to obtain a correct answer on the CRT if the problem is not fully understood. In addition, many of the incorrect answers commonly given to CRT problems represent rote verbatim matching of numbers taken from the problem text. In finding that correct responses on these problems are positively related with the framing effect as in Experiment 2, this corroborates fuzzy trace theory's explanation that those who score low on the CRT questions are relying on verbatim content of the problem, as well as relying more on the verbatim numbers in the framing tasks. Those who have an accurate understanding of the CRT questions also show more reliance on the simple gist distinctions that have been found to result in the framing effect (Kuhberger & Tanner, 2010; Reyna et al., 2014). This explanation of accuracy on the CRT would also be corroborated by demonstrations of developmental reversals on the test, paralleling developmental reversals that are observed with framing (Reyna et al., 2011). This effect--a decline in CRT with age--has been occasionally found in other studies (e.g., Albaity, Rahman, & Shahidul, 2014; Royzman, Landy, & Leeman, 2014), but has not been tested a priori in a manner that controls for education (and other factors unrelated to development). Future research should specifically test for this effect.

Furthermore, the present research fits into a body of evidence that argues that the framing effect is not merely a "dumb" bias but actually represents more advanced thinking (Reyna et al., 2011; Reyna et al., 2014). The dual-process models described above allow for a possibility that some biases may be positively correlated with intelligence, "when a problem is too difficult for

everyone… the more intelligent respondents are more likely to agree on a plausible error than to respond randomly" (Kahneman & Frederick, 2002, p. 68). This explanation can not be applied to developmental reversals in the framing task, as it is the same task that also demonstrates negative relationships between bias and intelligence, the developmental reversal can not be the result of an increase in difficulty (Stanovich & West, 2008). Similarly, it has been argued that some Type 2 processes can become practiced to the point of intuitive automaticity and appear like Type 1 processes (Kahneman & Klein, 2009). This characterization of intuition as an automatic process appears to be indistinct from associative processing such as "implicit learning and conditioning," (Evans & Stanovich, 2013, p.236), and does not predict a relationship with meaning and insight that would be required to produce the effects found in the present study. Without insight, rote experience does not make processing more gist-based (Reyna et al., 2014). Instead, these results support that the framing effect, though a bias, is the output of cognitively advanced mechanisms of insight and meaning-making.

These results also corroborate results from other laboratory tasks that show that risky choice framing problems predict real-world behavior (Reyna et al., 2011). According to fuzzy trace theory, verbatim deliberation is a unique route to risk taking, as benefits of risky behavior are often high while the probability of negative consequences are low, even if catastrophic (Reyna & Farley 2006). The gist and verbatim thinking that is measured by framing tasks explains unique variance in risk-taking beyond sensation seeking and inhibition, which seems to suggest that cognitive, social, and motivational factors are required to explain mechanisms of risk-taking. This growing body of evidence suggests that meaning and context plays a role in determining whether people take risks, with predictable effects relating to age, cognitive ability, and expertise.

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Table 1. Pearson correlation coefficients between risky choice framing indices, outcomes and individual differences in Experiment 1.

	BSSS	ARQ	AUDIT	DG-Gist	CRT
Risky Choice in Loss - Equal EV	-.026	.002	.053	.085*	-.054
Risky Choice in Loss - Unequal EV	.012	.018	.031	.135**	-.144**
Risky Choice in Loss - Overall	.007	.025	.079*	.103**	-.094*
Risky Choice in Gain - Equal EV	.066	.090*	.091*	.080*	-.001
Risky Choice in Gain - Unequal EV	.107**	.103**	.111**	.055	.123**
Risky Choice in Gain - Overall	.104**	.137**	.177**	.056	.104**
Framing Difference Score - Equal EV	-.066	-.058	-.014	.020	-.046
Framing Difference Score - Unequal EV	-.084*	-.076*	-.073*	.051	-.210**
Framing Difference Score - Overall	-.083*	-.096**	-.088*	.035	-.164**

*$p < .05$; ** $p < .01$

Table 2. Pearson correlation coefficients between risky choice framing indices (binary choice and signed confidence), outcomes and individual differences in Experiment 2.

	BSSS	ARQ	AUDIT	DG-Gist	CRT	MCQ
Binary Choice						
Risk in Loss - Equal EV	.046	.071*	.046	.013	.076*	-.069*
Risk in Loss - Unequal EV	.056	.044	.016	.038	-.156**	.012
Risk in Loss - Overall	.056	.063	.036	.030	-.041	-.030
Risk in Gain - Equal EV	.086*	.075*	.058	.009	-.080*	-.080*
Risk in Gain - Unequal EV	.091**	.104**	.065	-.022	.118**	-.203**
Risk in Gain - Overall	.098**	.099**	.068	-.008	.028	-.159**
Framing Score - Equal EV	-.028	.002	-.005	.004	.127**	.003
Framing Score - Unequal EV	-.027	-.053	-.037	.048	-.202**	.173**
Framing Score - Overall	-.033	-.032	-.027	.032	-.06	.111**
Signed Confidence						
Risky in Loss - Equal EV	.059	.048	.031	.031	-.145**	.012
Risky in Loss - Unequal EV	.051	.068	.040	-.016	.067	-.081*
Risky in Loss - Overall	.060	.064	.039	.008	-.046	-.038
Risky in Gain - Equal EV	.093**	.079*	.055	.004	-.076*	-.079*
Risky in Gain - Unequal EV	.091**	.104**	.062	-.043	.120**	-.203**
Risky in Gain - Overall	.100**	.101**	.064	-.023	.031	-.158**
Framing Score - Equal EV	-.021	-.020	-.016	.024	-.071*	.075*
Framing Score - Unequal EV	-.038	-.040	-.023	.025	-.053	.118**
Framing Score - Overall	-.032	-.032	-.022	.026	-.068	.104**

* $p < .05$; ** $p < .01$

Figure 1. Interaction between CRT and Expected Value to predict framing bias in Experiment 1
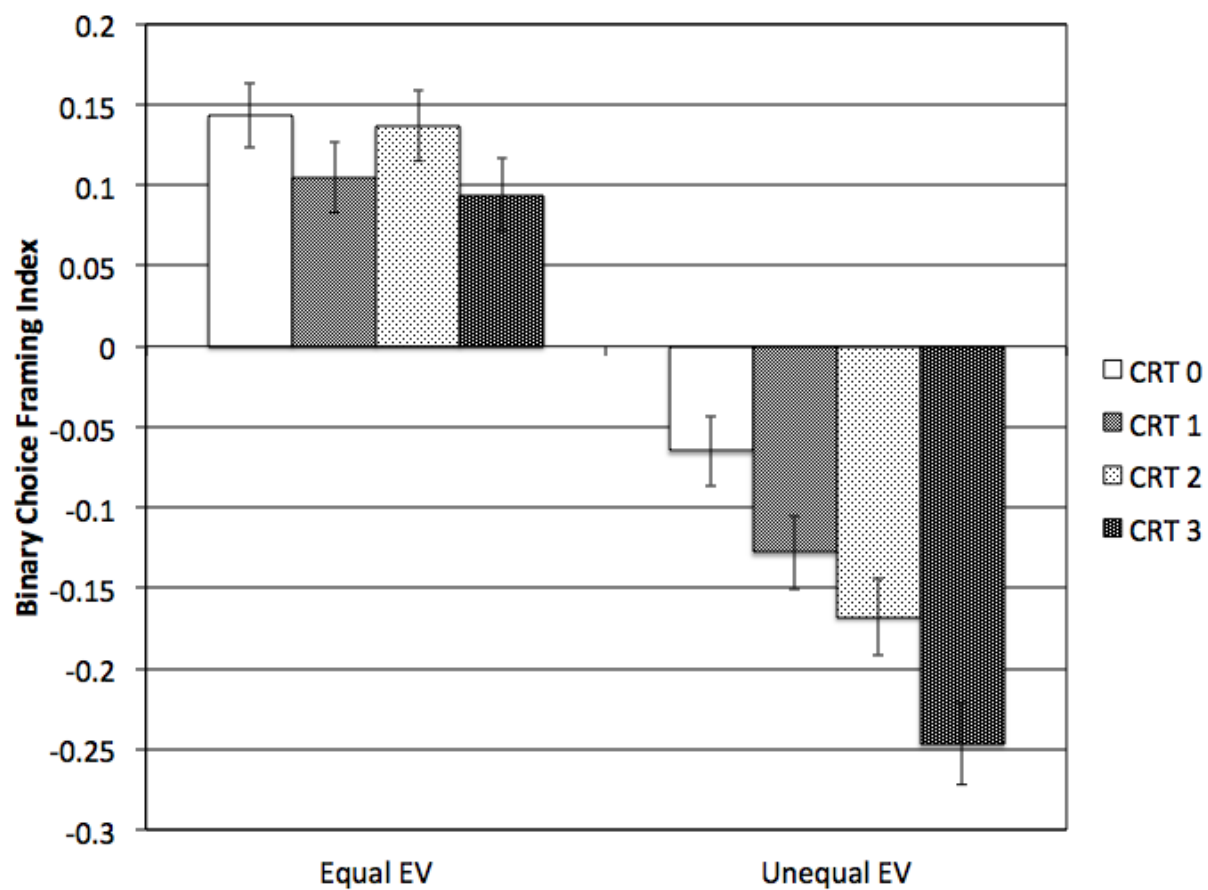
Figure 2. Interaction between CRT and Expected Value to predict framing bias in Experiment 2.
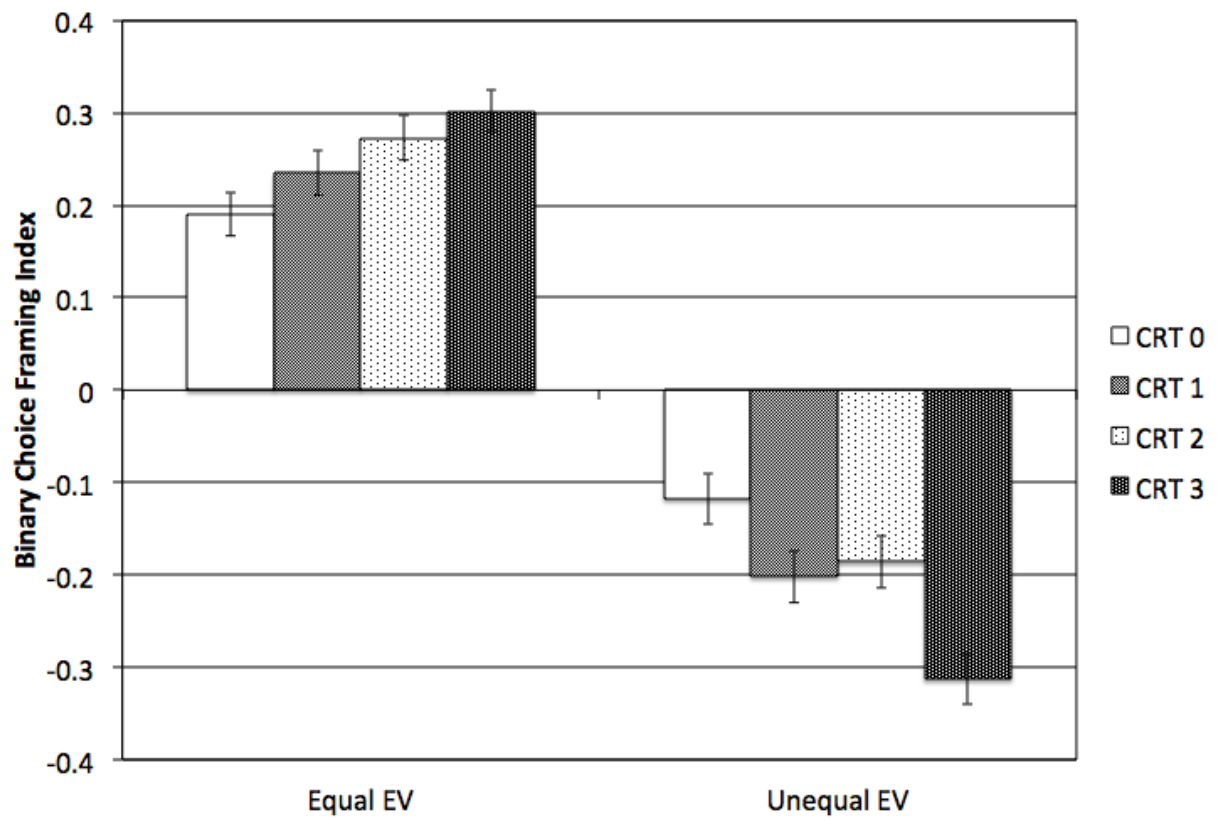
Figure 3. Interaction between CRT and Expected Value to predict signed confidence in

Experiment 2.
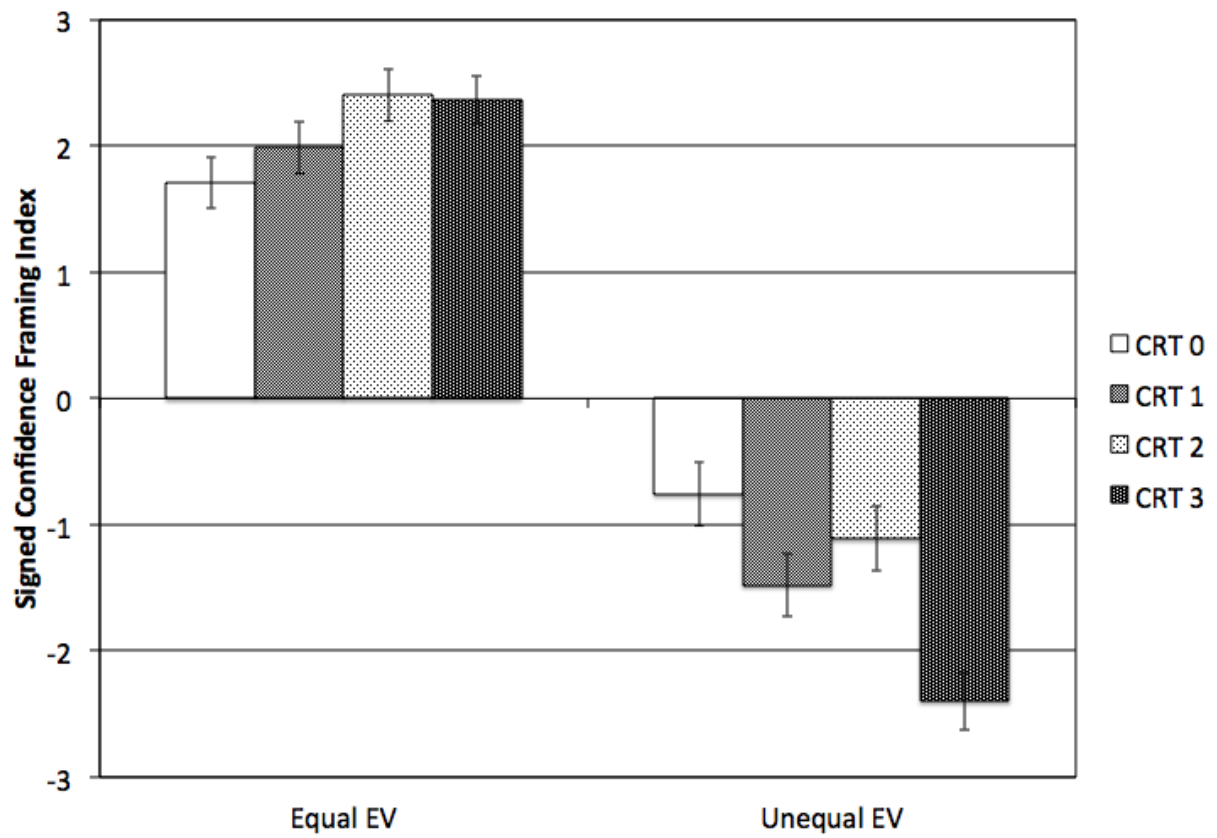
CHAPTER 3

Abstract

Although many are calling for a mandate to disclose objective risks associated with medications, recent research reveals that people rely more on qualitative representations to guide decisions. Fuzzy-trace theory predicts that qualitative "gist" representations of options will be preferentially relied on compared to quantitative "verbatim" representations, which is tested through manipulation of quantitative risk information and qualitative health status quo on the effect of likelihood of starting a medication. In an online survey, 415 college students were asked to imagine themselves as a patient with arthritis in a clinical encounter during which a physician described a new medication. We varied health status quo (acceptable or unacceptable), adverse side effect (AE; pneumonia or cancer), and quantitative risk (1/100,000 to 1/100). Controlling for AE, quantitative risk, age, sex, ethnicity, and numeracy in a multivariate model, the status quo and all three qualitative (ordinal) risk dimensions (worry, risk perception, and overall gist of options) predicted likelihood of taking the medication, while objective risk (presented explicitly to subjects) and numeracy did not. This evidence supports the prediction that encoded gists of the decision-maker's categorical status quo and the ordinal gist of options are primarily relied on in making decisions. Decision support thus must extend beyond presentation of quantitative risk information (e.g. reappraisal of consequences) to ensure informed choice and to prevent overweighing of rare AEs.

Gist, Worry and Status Quo Outpredict Objective Numeracy

and Objective Risk in Medication Decisions.

Informed decision making requires that patients are aware of which treatment options are available and that they understand the expected benefits and the possible risks associated with each alternative (Fischhoff, Brewer, & Downs, 2011). Numerous studies have found, however, that patients have a relatively poor understanding of the risks related to their current medications, as well as proposed new medications (Lloyd, 2001). Multiple reasons underlie the difficulties associated with understanding risk information, including poor health literacy and numeracy skills, cognitive biases (e.g., overestimation of small probabilities), and the lack of familiarity with decision-relevant information about many medical disorders (Brust-Renck, Reyna, Corbin, Royer, & Weldon, in press; Peters, Hart, Tusler, & Fraenkel, 2013; Peters, Hibbard, Solvic, & Dieckmann, 2007; Reyna & Brainerd, 2008). Moreover, many risks (e.g. cancer) evoke strong emotional responses (e.g. fear and/or dread) which can have a significant negative impact on the quality of decision making (Slovic, Peters, Finucane, & Macgregor, 2005; Reyna, Nelson, Han & Pignone, 2015).

As a result, significant efforts have been made to determine how best to present information to patients to ensure that they have an accurate understanding of the quantitative probabilities associated with adverse outcomes. While there is substantial debate on how best to inform patients, there is a strong consensus that the process of risk communication should include numerical estimates (Fischhoff, Brewer, & Downs, 2011). This conclusion stems from studies demonstrating that people vary significantly in how they interpret specific descriptive terms (such as "very unlikely") and that the use of verbal descriptors alone leads to systematic misestimation of risk (Berry, Knapp, & Raynor, 2002; Peters, Hart, & Fraenkel, 2013).

Traditional views are based on the premise that if people think quantitatively about risks and benefits, they will arrive at the choice that results in maximum utility or value (von Neumann & Morgenstern, 195?; see Reyna & Farley, 2006). Building on this tradition, classic decision-analysis approaches assume that greater amounts and precision of information (e.g., about risks and benefits of alternative therapies) facilitate good decision making (Elwyn, Edwards, Eccles, & Rovner, 2001). However, extant data do not support this assumption, suggesting that this approach does not facilitate making good decisions with real world health consequences (Badia, Roset & Herdman, 1999; Cook, Ashton, & Byrne, 2001; Oliver, 2004; Reyna & Brainerd, 2008). The results of behavioral experiments and mathematical models indicate that people code and retrieve information using both verbatim and gist mental representations, a central principle of fuzzy-trace theory (Reyna, 2008). In this context, verbatim representations refer to the literal risk. They are specific, quantitative and without meaning. The verbatim representation of a "1% risk of pneumonia" is a "1% risk of pneumonia." Gist refers to the overall picture or the general meaning that people attach to a medication. Gist is qualitative, subjective, and is dependent on factors known to influence meaning including education, culture, and experience. For example, the gist representation of the 1 in 100,000 risk of progressive multifocal leukoencephalopathy for one patient might be "I could get something like mad cow disease and die" (Reyna, 2008).

Gist representations can be hierarchical, roughly analogous to scales of measurement (e.g., nominal/categorical, ordinal, or interval). The simplest gist representations are categorical, either/or understandings of information; slightly more complex are ordinal representations, and the most precise representations encode exact continuous values (Reyna & Brainerd, 2011). Fuzzy trace theory posits that people make decisions using the simplest (e.g. categorical)

representation that the options allow, and they will only move to more complex representations if the simplest representations do not provide a distinction among choice options. In facing choices about health and treatment options, people will draw from their representations of their own health and well-being, as well as their representations of the choices (Wilhelms, Helm, Setton, & Reyna, 2015). In this study, we examine gist, through a manipulation of perceived health status quo—in addition to manipulation of precise risk as factors in a hypothetical scenario. We also assess how people perceive the risks associated with those factors.

To examine the overall gist of the decision options was measured by a multiple choice item that integrates the probability and side effects in a simple, qualitative form. These qualitative gists were designed to incorporate the distinction between automatic preclusion of deliberation (e.g., focusing on survival) versus weighing of risks and benefits of treatment options, as qualitative research found that nearly all patients use one of these two strategies (McIlvennan et al., 2014).

In addition to measuring the global gist of the decision options, we manipulated the categorical gist of the patient's health state in the hypothetical scenario. Unlike other theories of decision making, fuzzy trace theory posits that memory representation (gist or verbatim) is a separate construct from emotion and affect. Thus, we hypothesize that affective measures such as worry explain unique variance in likelihood of starting medication, in addition to the categorical gist, reflecting that both cognitive and affective processes influence such decisions (Rivers, Reyna, Mills, 2008). Therefore, to shape the gist, we manipulated the qualitative state— that is, the status quo of chronic disease as acceptable versus unacceptable—while holding constant the level of physical sickness in the scenario. Preference for status quo has been previously found to be a barrier to treatment, but the new aspect of our research is whether the

status quo is acceptable or not (Fraenkel, Cunningham, & Peters, 2014). According to fuzzy-trace theory, people represent their disease status as essentially "okay" or "not okay," (which does not necessarily map onto the objective status of the disease process; Reyna 2008, 2012). Given that altering the categorical status quo alters the global gist of the options, we predict that participants will be more likely to try a new medication when the status quo is unacceptable. It has been previously shown in theoretically motivated research that people will rely more on the gist representations than the verbatim details in making their decisions (Reyna & Brainerd, 2011). Thus, subjects will be more likely to change their behavior as a result of a change in the qualitative representation of their status quo and decision options, even though they encode both the verbatim and gist representations of decision information (Reyna, 2008).

To summarize, we tested these hypotheses by developing scenarios to examine the influence of a range of quantitative risks along with affect (i.e., worry), perceived riskiness, and global gist of the options on subjects' stated likelihood of starting a medication. The scenario varied the specific adverse events (AEs) involved as well as one's current health state or status quo to assess their effect on willingness to accept the risk of an adverse side effect. In order to increase generalizability of our findings we evaluated the impact of quantitative risk and risk perceptions on likelihood of starting medications across two different AEs—pneumonia and cancer—and two different health status quos framed to emphasize contrasting "bottom lines" or gist according to fuzzy-trace principles.

Experiment 1

Methods

Participants. College students were invited to complete an online survey. Participants were offered extra credit in introductory psychology courses for participation in the study. 415

subjects completed the survey. Their mean age was 19.8 (SD = 1.8) and the majority (72.5%) were women. 61.3% were Caucasian, 5.6% Black and 26.2% Asian and 6.9 were of mixed race or other. 12% reported Hispanic ethnicity. The experiment took place online using the Qualtrics Online Survey Platform (Qualtrics Labs Inc., Provo, UT). This project was approved by the Cornell Institutional Review Board. 67% of those surveyed indicated that either they or someone close to them "has ever had cancer," and 44% indicated the same about pneumonia.

Design. We developed 16 scenarios (manipulated using a 4x2x2 design) describing a patient with rheumatoid arthritis. Each subject responded to a single, randomly-assigned scenario, using randomization algorithms built into Qualtrics Survey Software. An example of one of the scenarios is provided in the Appendix. We first described the impact of rheumatoid arthritis and subsequently asked subjects to imagine themselves as a patient with this disease in a clinical encounter during which a physician described a new treatment option to them. Route of administration, benefit, and cost were held constant. We varied the scenarios across two health status quos: either *acceptable*, "You are feeling worse, but you are able to keep up with your responsibilities at home and at work;" or *unacceptable*, "You have more joint pain and stiffness. You are now at a point that you can no longer keep up with your responsibilities and you are worried that you may lose your job and/or that you will have trouble taking care of yourself." According to fuzzy-trace theory, this represents a categorical shift in qualitative state, and subjects with a less acceptable health status quo should be more willing to accept treatment.

Scenarios were also varied across two AEs with which people are familiar. We included pneumonia because it is the most frequent serious AE associated with many of the newer treatments for rheumatoid arthritis. Cancer, also a risk of these medications, was chosen as the second AE to examine to examine whether the findings would differ by the amount of fear or

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dread associated with specific risks. In order to examine the impact of quantitative risk, we varied likelihood of the AE across four levels: 1 per 100, 1 per 1,000, 1 per 10,000 and 1 per 100,000. These levels of risk were selected because they represent realistic risks of side effects for arthritis (e.g., 1/100 risk of pneumonia, 1/1000 risk of cancer).

      Materials. We included three measures of risk perception regarding the scenario each participant was given. The first was a measure of perceived riskiness, assessed using the question "How risky do you think this side effect is?" Responses ranged from "not at all risky" to "very risky" on a five-point Likert scale. The second was a measure of worry, assessed with the question, "How worried would you feel after hearing that 1 per 100 (or 1 per 1,000, 10,000, or 100,000) people develop pneumonia (or cancer)?" Possible responses ranged from "not at all worried" to "very worried" on a five-point Likert scale. Finally, participants were asked to identify the global gist of the options in which they were asked to select the statement that best reflected how they felt about the risk described in the scenario. The possible responses to this item were, "This is a serious side effect but the probability is so small that there is basically no risk to worry about," "The probability is small, but it is reasonable," "Even though the probability is small – this risk is unacceptable," "It doesn't matter how small the probability is – I can still get it," and "If none of these statements reflect how you feel, please tell us what your feelings are." Open-ended responses were coded as "other." Analyses of this global gist item were conducted by omitting the "other" option and treating the remaining four options as an ordinal scale (the ordinal scale produced monotonic relationships with other variables in the study, see Table 2). Sixteen subjects (3.5%) selected other, and there was no clear pattern to their open responses. This ordinal scale item produced monotonic relationships with all the other dependent variables. It is worth noting how under an acceptable status quo, a shift from

pneumonia to cancer results in fewer people evaluating the risk as "basically no risk to worry about," and more people evaluating the risk as "reasonable" or "unacceptable;" however, under an unacceptable status quo, both side effects are evaluated similarly.

The final question regarding the hypothetical scenario was the likelihood of starting the medication, and was measured by asking, "How likely would you be to start this medication?" with possible responses ranging from "not likely at all" to "very likely" on a five-point Likert scale. In addition, we assessed numeracy using the Lipkus-Peters numeracy scale (Peters, Dieckmann, Dixon, Hibbard, & Mertz, 2007; KB-20 = .542). This scale has been previously used to predict difficulties associated with understanding risk information (Peters, Hibbard, Solvic, & Dieckmann, 2007). We also collected demographic information.

Results

ANOVA analyses were conducted with each question that pertained to the scenario as a dependent variable (three risk perception questions and the likelihood of starting the new medication). Overall, the mean perceived riskiness score was 3.20 (i.e., somewhat risky; SD = .97), the mean worry score was 2.90 (i.e., somewhat worried; SD = 1.15), the mean global gist of the options was 2.11 (i.e., probability is small, but it is reasonable; SD = 1.01), and the mean likelihood of starting the medication was 3.30 (e.g., somewhat likely; SD = 1.15).

ANOVA results for risk perception, worry, global gist, and likelihood of starting medication. Mean risk perception, worry, ordinal gist, and likelihood to start the medication for each level of probability are provided in Table 1. In predicting risk perception, ANOVA analysis revealed main effects of AE, $F(1, 398) = 27.53$, $p < 0.001$, $\eta_p^2 = .061$, in which cancer, $M = 3.43$, $SE = .061$, was perceived as more risky than pneumonia, $M = 2.97$, $SE = .062$; health status quo, $F(1, 398) = 4.91$, $p = 0.027$, $\eta_p^2 = .012$, in which those in an unacceptable health state,

$M = 3.298$, $SE = .061$ perceived the new medication as more risky than those in an acceptable

health state, $M = 3.105$, $SE = .062$; and quantitative risk, $F(3, 398) = 12.83$, $p < 0.001$, $\eta_p^2 = .084$,

in which higher levels of numeric risk led to higher perceived risk (1/100, $M = 3.630$, $SE = .088$;

1/1000, $M = 3.195$, $SE = .089$; 1/10,000, $M = 3.081$, $SE = .087$; 1/100,000, $M = 2.8900$, $SE = .085$). No significant interactions were found among factors.

Regarding level of worry for each scenario, ANOVA analysis revealed main effects of

AE, $F(1, 398) = 68.28$, $p < 0.001$, $\eta_p^2 = .139$, such that pneumonia, $M = 2.50$, $SE = .069$, resulted

in less worry than cancer, $M = 3.30$, $SE = .069$, and quantitative risk, $F(3, 398) = 15.96$, $p < 0.001$, $\eta_p^2 = .102$, such that higher levels of quantitative risk resulted in more worry (1/100, $M = 3.392$, $SE = .098$; 1/1000, $M = 3.036$, $SE = .099$; 1/10,000, $M = 2.594$, $SE = .098$; 1/100,000, $M = 2.586$, $SE = .095$). There was no main effect of status quo, nor was any significant interaction

found among any factors. Subjects differentiated between the two highest and the two lowest

quantitative risks of pneumonia and cancer under the acceptable health status quo condition. In

contrast, subjects' worry was similar across the three lowest quantitative risks under the

unacceptable heath status quo condition for both AEs.

In predicting the global gist of the options, ANOVA analysis revealed main effects of

AE, $F(1, 398) = 5.66$, $p = 0.018$, $\eta_p^2 = .013$, such that risks are considered more reasonable and

less unacceptable for pneumonia, $M = 2.091$, $SE = .063$, than they are for cancer, $M = 2.302$, $SE = .063$; and quantitative risk, $F(3, 398) = 5.35$, $p = 0.001$, $\eta_p^2 = .037$, in which higher risks are

considered less reasonable and more unacceptable (1/100, $M = 2.405$, $SE = .089$; 1/1000, $M = 2.340$, $SE = .090$; 1/10,000, $M = 2.022$, $SE = .089$; 1/100,000, $M = 2.019$, $SE = .086$). There was

no main effect of status quo, nor was any significant interaction found among any factors in

predicting ordinal gist representation.

Subjects' likelihood of starting the medication appears to reflect the risk perception, worry, and gists reported in the previous analyses. ANOVA analysis revealed main effects of AE, $F(1, 398) = 25.37$, $p < .001$, $\eta_p^2 = .057$, in which people are less likely to start a new medication with cancer, $M = 3.059$, $SE = .073$, as a side effect than pneumonia, $M = 3.581$, $SE = .073$; current health status quo, $F(1, 398) = 4.90$, $p = .027$, $\eta_p^2 = .011$, in which those with unacceptable status quo, $M = 3.435$, $SE = .073$ are more likely to start a new medication than those with acceptable status quo, $M = 3.206$, $SE = .074$, and quantitative risk, $F(3, 398) = 7.91$, $p < .001$, $\eta_p^2 = .053$, in which people are more likely to start a new medication that carries lower risk (1/100, $M = 2.970$, $SE = .104$; 1/1000, $M = 3.205$, $SE = .105$; 1/10,000, $M = 3.491$, $SE = .104$; 1/100,000, $M = 3.616$, $SE = .101$). No significant interaction was found among any factors. Note in the effects described above that people were more likely to start a new medication when the status quo was unacceptable, despite perceiving it as more risky

Associations between risk perceptions, probabilities, and likelihood to start medication. We performed bivariate correlations to examine the relationships between each of the predictors (riskiness, worry, global gist of the options, and numeracy) and likelihood of starting the medication. In bivariate analyses, lower worry, lower riskiness, and gist evaluations were associated with greater likelihood of taking the medication in all conditions (Table 2).

A linear regression model was constructed to predict likelihood of starting the medication using health status quo, type of AE, quantitative risk, risk perception, worry, and global gist after adjusting for age, sex, ethnicity, and numeracy. Levels of ethnicity were treated as dummy variables. Numeracy was permitted to interact with the quantitative risk of the AE to account for how numerical ability may play a role in representing the verbatim probabilities of possible effects (with the expectation that higher levels of numeracy would accompany a greater effect of

the quantitative risk on likelihood of starting medication) although no interaction was found. In the full model (containing all predictors and covariates), current health status quo and all three risk perceptions (riskiness, worry and global gist) remained significantly associated with likelihood of taking the medication, while quantitative risk information was not (Table 3).

Mediation analyses were also conducted to test the hypothesis that each of the qualitative representations (riskiness, worry, and global gist) has a direct effect in likelihood of starting the medication, in addition to the effect of the quantitative probability. Risk perception, worry, and global gist of the options each partially mediated the relationship between quantitative risk and likelihood of taking the medication (Figure 1).

Experiment 2

Method

Participants. Study 2 consisted of 292 college undergraduates who were recruited in exchange for credit in introductory psychology courses. The sample was 65.5% female, and had a mean age of 20.1 (SD = 1.36). 55.3% of the sample reported being White/Caucasian, 7.6% were Black, 29.8% were Asian, 7.3% were mixed or other. 7.6% of the sample was Hispanic. Participants in Experiment 2 also took the survey online through Qualtrics Online Survey Platform and the project was approved by the Cornell Institutional Review Board (Qualtrics Labs Inc., Provo, UT). 70% of those surveyed indicated that either they or someone close to them has ever had cancer, and 47% indicated the same about pneumonia.

Design, Materials, and Procedure. Experiment 2 largely resembled Experiment 1 in most aspects, but with slight revisions to ensure clarity of variables and manipulations. First, the manipulation of health status quo was revised such that the critical text of the scenario read "You are feeling worse, *but you are not* to the point that something has to change," in the acceptable

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condition, and "You are feeling worse, and you are to the point that something has to change," in the unacceptable condition. Although the manipulation of health status quo in Experiment 1 did not have an effect on perceived worry, this revision was made to ensure that no variation of worry, emotion, or affect, was manipulated in the health status quo factor.

The measure of global gist was also revised slightly such that the choice options are clearer. Participants could select between "This is a serious side effect…but the probability is so small that there is basically no risk to worry about," "This is a serious side effect…but the probability is small (acceptable)," "This is a serious side effect…and the probability is too large (unacceptable)," "Even though the probability is small – this side effect is unacceptable," "It doesn't matter how small the probability is – the only thing that matters is that I can get this side effect," or "If none of these statements reflect how you feel, please tell us what your feelings are." Selection of the last option also permitted entering of a free response, however only 8 participants selected this response.

In addition to the hypothetical scenario and numeracy test described in Experiment 1, participants in Experiment 2 also completed a Subjective Numeracy Scale (SNS; Fagerlin et al., 2007). This scale (α = .799) correlates highly with objective measures of numerical ability and is of lower burden than those that resemble math tests, although it occasionally shows reduced relationships with some behavioral outcomes. Also included was the Berlin Numeracy Scale (KR-20 = .668), which predicts comprehension of everyday risks, and explains variance in risk outcomes beyond other numeracy measures (Cokely, Galesic, Schulz, Ghazal, 2012). As the objective numeracy test showed few relationships in Experiment 1, these scales were included to corroborate the effects of Experiment 1, and to test to see if more robust measures would have more explanatory power.

Results

ANOVA analyses were conducted regarding each question that pertained to the scenario in Experiment 2. Overall, the mean perceived riskiness score was 3.35 (i.e., somewhat risky; SD = 1.02), the mean worry score was 2.92 (i.e., somewhat worried; SD = 1.09), the mean global gist of the options was 2.48 (i.e., the probability is small (acceptable); SD = .98), and the mean likelihood of starting the medication was 3.52 (i.e., likely; SD = 1.19).

ANOVA results for risk perception, worry, global gist, and likelihood of starting medication. Mean risk perception, worry, ordinal gist, and likelihood of starting the medication for each level of quantitative risk are provided in Table 4. In predicting risk perception, the only effect was a main effect of quantitative risk, $F(3, 281) = 3.43$, $p = .017$, $\eta_p^2 = .035$, such that lower quantitative risks were perceived as less risky (1/100, $M = 3.623$, $SE = .116$; 1/1000, $M = 3.467$, $SE = .118$; 1/10,000, $M = 3.307$, $SE = .117$; 1/100,000, $M = 3.120$, $SE = .116$).

Level of worry caused by the scenario varied by manipulated AE, $F(1, 281) = 17.71$, $p < .001$, $\eta_p^2 = .059$, and by quantitative risk, $F(3, 281) = 12.56$, $p < .001$, $\eta_p^2 = .118$, but both of these effects were qualified by an interaction between the two factors. $F(3, 281) = 6.55$, $p > .001$, $\eta_p^2 = .065$. Although mean level of worry was lower overall for pneumonia ($M = 2.705$, $SE = .080$) than for cancer ($M = 3.181$, $SE = .080$), the AE of cancer produced a monotonic effect (1/100, $M = 3.810$, $SE = .163$; 1/1000, $M = 3.211$, $SE = .158$; 1/10,000, $M = 3.187$, $SE = .163$; 1/100,000, $M = 3.516$, $SE = .156$), whereas pneumonia demonstrated a spike in worry at the lowest level of quantitative risk (1/100, $M = 3.201$, $SE = .156$; 1/1000, $M = 2.688$, $SE = .156$; 1/10,000, $M = 2.105$, $SE = .158$; 1/100,000, $M = 2.824$, $SE = .163$).

In predicting the ordinal global gist of the options, there was an overall main effect of manipulated AE, $F(1, 281) = 9.21$, $p = .003$, $\eta_p^2 = .032$; however, this was qualified by an

interaction with level of quantitative risk, $F(3, 281) = 2.65$, $p = .049$, $\eta_p^2 = .028$. This interaction represented a pattern similar to that found for level of worry, in that the AE of cancer produced a monotonic effect (1/100, $M = 2.698$, $SE = .161$; 1/1000, $M = 2.737$, $SE = .157$; 1/10,000, $M = 2.765$, $SE = .161$; 1/100,000, $M = 2.384$, $SE = .155$), whereas pneumonia demonstrated a spike in at the lowest level of quantitative risk (1/100, $M = 2.639$, $SE = .155$; 1/1000, $M = 2.142$, $SE = .163$; 1/10,000, $M = 2.053$, $SE = .157$; 1/100,000, $M = 2.387$, $SE = .161$).

Finally, likelihood of starting the medication varied according to main effects of all three manipulated variables. Likelihood of starting the medication varied according to AE, $F(1, 281) = 29.81$, $p > .001$, $\eta_p^2 = .096$, such that participants were more likely to start a medication with a risk of pneumonia ($M = 3.837$, $SE = .086$) than a risk of cancer ($M = 3.171$, $SE = .086$). Likelihood of starting also varied according to the quantitative level of risk, $F(3, 281) = 3.81$, $p = .011$, $\eta_p^2 = .039$, such that higher levels of risk produced lower likelihood of starting (1/100, $M = 3.174$, $SE = .121$; 1/1000, $M = 3.493$, $SE = .123$; 1/10,000, $M = 3.646$, $SE = .122$; 1/100,000, $M = 3.704$, $SE = .121$). And last, likelihood of starting the medication varied according to the manipulated health status quo, $F(1, 281) = 5.82$, $p = .016$, $\eta_p^2 = .020$, such that those in the acceptable condition ($M = 3.357$, $SE = .086$) were less likely to start a new medication than those in the unacceptable condition ($M = 3.651$, $SE = .086$). No interaction was found between any factors to predict starting the new medication.

Associations between risk perceptions, probabilities, and likelihood to start medication. Bivariate correlation analyses between each psychological predictor (risk perception, worry, global gist of the options, and numeracy) and likelihood of starting the medication are reported in Table 5. As in Experiment 1, risk perception, worry, and global gist of options were all negatively correlated with likelihood of starting the medication in all

conditions. The additional numeracy scales included in Experiment 2 were, in some conditions predictive of willingness to start the new medication, such that higher numeracy scores were indicative of higher willingness to start the new medication.

A linear regression model was constructed parallel to the model tested in Experiment 1, and the pattern of significant predictors was largely consistent (Table 6). Categorical health status quo, the AE, and the global gist of the options predicted willingness to start the new medication, after controlling for demographic factors. In contrast to Experiment 1, there was a marginal effect of an interaction between numeracy and quantitative risk to predict likelihood of taking the medication. Similar regression models were tested, however, replacing the Lipkus-Peters numeracy test with either of the additional numeracy tests in Experiment 2, the Subjective Numeracy Scale and Berlin Numeracy Scale. In either case, the effect of numeracy disappeared and the pattern of remaining predictors was the same (and thus these models are not reported).

As in Experiment 1, mediation analyses were conducted to test the hypothesis that each psychological variable (risk perception, worry, and global gist) have direct effects on the likelihood of starting the medication, in addition to the effect of manipulated quantitative risk. These mediation analyses are reported in Figure 2, depicting that risk perception partially mediated the effect of quantitative risk on likelihood of starting, level of worry fully mediated the risk, and global gist did not mediate the effect.

Discussion

Consistent with fuzzy-trace theory, qualitative perceptions of risk, status quo, affect, and global gist of the options predicted treatment preference. These predictors reflect that both cognitive and affective processes influence medication decision (Reyna, Nelson, Han & Pignone, 2015). The quantitative risks stated in the hypothetical scenarios varying by several orders of

magnitude did not predict likelihood of taking the medication once other qualitative predictors were taken into account, suggesting that these variations were incorporated into subjective risk perceptions, including the global gist of the options. Moreover, we found no effect of numeracy on one's willingness to start the medication, suggesting that numerical expertise and the ability to evaluate verbatim probabilities does not add additional predictive power beyond the qualitative perceptions. These results support the premise that people preferentially rely on gist, and not verbatim, representations when making decisions (Reyna, 2008; Reyna & Brainerd, 2008).

We also found that manipulating the status quo altered the categorical gist of the decision in a way that influenced likelihood of starting the medication. According to fuzzy-trace theory, although people encode and use both verbatim and gist representations of decision information, people are more likely to change their behavior as a result of a change in the qualitative representation of their status quo and options (Reyna, 2008). This experiment supported this prediction, in that participants indicated that they were more likely to try a new medication in the unacceptable status quo condition. This was not a manipulation of affect, as there was no effect of health status quo on reported worry This effect was in spite of difference in risk perceptions associated with pneumonia between the acceptable and unacceptable status quo conditions—that participants viewed the side effect of pneumonia as more risky when their current treatment was framed as unacceptable. This effect is parallel to standard framing behavior in risky choice framing; when the scenario is defined as unacceptable, people react as if they are in a loss frame, and become willing to take more risk, including beginning a risky new medication (e.g., Reyna, Chick, Corbin, & Hsia, 2014). In contrast, when the status quo is framed as acceptable, people prefer to avoid risk, and are less likely to accept the chance of an AE.

Results are consistent with predictions that framing of the status quo represents a shift in the categorical gist of the decision to start a new medication. As predicted by fuzzy-trace theory, this gist will be relied on by adults in their decisions, and thus framing the gist as either acceptable or unacceptable will influence the risk assessments of future prospects (i.e., how risky is a medication with possible deadly side effects). The exact numeric values had a direct effect in mediation analyses after qualitative risk perceptions were controlled for, although risk perception, worry, and global gist of the options each partially mediated that relationship. Such results are consistent with a dual-process cognitive model in which risk information is processed in parallel *both* as exact verbatim traces and as bottom-line assessments of the meaning of the possible risk.

Ethical and legal principles dictate that physicians disclose serious AEs when prescribing new treatment. However, while the principles of patient autonomy mandate full disclosure, our results point to possible unintended consequences associated with this policy. Full disclosure of extremely rare AEs (e.g., FDA black box warnings) assumes that people include the expected frequency of the specific AE in their evaluations of proposed treatment options. While subjects' behavioral intentions did vary between levels of quantitative risk, our results suggest that risk perceptions explained unique variance in behavioral intentions, and point to the possible harms that may be associated with disclosure of rare AEs. Beyond increasing patient anxiety, overweighing of rare AEs can lead to rejection of medications in which the likelihood of benefits likely to result in improved health outcomes far outweigh the risk of AEs, which may or may not be associated with the proposed medication.

The consistent response across levels of quantitative risk may indicate that people's risk perceptions and behavioral intentions are reflective of strongly held beliefs (e.g. protected

values; Baron & Leshner, 2000). If true, this would indicate that methods outside of those directed at merely improving the understanding of numbers per se (such as through the use of rulers or graphs) may be required to ensure an accurate appreciation of risk benefit trade-offs and high quality decision making. For example, a recent paper by Petrova, van der Plight, and Garcia-Retamero (2013) found that having participants reappraise the consequences of a negative outcome markedly decreased their overweighing of infrequent risks. This study examined a relatively inconsequential choice, however (i.e., loss of a camera), and whether such interventions are helpful for improving decision making in health care requires future research.

There are also important limitations of the study. Most notably, subjects were college students, though most had personal familiarity with the possible AEs in the study. Thus future research is needed to replicate the results over more diverse populations. Of note, subjects recruited from the general population are likely to have lower numeracy levels than the students participating in this study, and given that overweighing of rare events is higher in subjects with low numeracy (Peters, 2008), our findings are very likely to be as, or more, significant in population-based samples. In addition, we used standardized scenarios to measure the influence of quantitative risk information and risk perceptions on behavioral intentions. While scenario-based studies are important to gain insight into the mechanism underlying decisions, they do not necessarily replicate decisions made in clinical practice.

In summary, we found that subjects' decision making was a result of a confluence of perceived risk, affect, and mental representations. Reactions to risk information, whether measured by cognitive, emotional, global gist or behavioral intentions are very similar across a very large range of quantitative risk estimates, with few exceptions. The results suggest that decision support must extend beyond presentation of quantitative risk information in order to

ensure informed choice.

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Table 1. Mean Responses In Experiment 1Across All Scenarios for Risk Perception, Worry, Gist, and Likelihood to Start Medication

Mean (SD) Response for Acceptable Status Quo Scenarios	Quantitative Risk of Pneumonia				Quantitative Risk of Cancer			
	1/100	1/1,000	1/10,000	1/100,000	1/100	1/1,000	1/10,000	1/100,000
Risk Perception	3.17 (.70)	2.75 (.89)	2.68 (.90)	2.66 (.61)	4.07 (.84)	3.46 (1.10)	3.29 (1.05)	2.86 (1.09)
Worry	2.70 (.84)	2.57 (1.14)	2.04 (1.10)	2.24 (.83)	3.97 (.94)	3.73 (1.22)	3.00 (1.05)	2.76 (1.06)
Global Gist of the Options	2.36 (.87)	2.23 (.99)	1.88 (1.05)	2.14 (.95)	2.72 (.98)	2.48 (.92)	2.18 (.86)	1.90 (.98)
Likely to Start Medication	3.27 (.87)	3.32 (1.28)	3.89 (1.03)	3.69 (1.20)	2.24 (.95)	2.62 (1.20)	3.00 (1.15)	3.48 (1.02)

Mean (SD) Response for Unacceptable Status Quo Scenarios								
Risk Perception	3.44 (.75)	3.11 (.92)	3.19 (1.00)	2.80 (.85)	3.93 (.70)	3.50 (1.00)	3.17 (1.00)	3.28 (.92)
Worry	3.11 (.89)	2.71 (1.05)	2.30 (.99)	2.33 (.84)	3.90 (.98)	3.18 (1.09)	3.00 (1.22)	3.03 (.91)
Global Gist of the Options	2.15 (.72)	2.19 (1.04)	1.93 (.83)	1.86 (.79)	2.39 (.96)	2.46 (1.04)	2.10 (.82)	2.18 (.98)
Likely to Start Medication	3.52 (1.01)	3.36 (1.16)	3.70 (1.27)	3.90 (.96)	2.66 (.90)	3.46 (1.04)	3.38 (1.15)	3.41 (1.12)

Note. ANOVA analysis revealed main effects of AE, health status quo and quantitative risk in predicting risk perception. In predicting worry, there were main effects of AE, and quantitative risk, but not health status quo. To predict global gist of the options, analysis revealed main effects of AE, and quantitative risk, but not health status quo. Finally, to predict likelihood to start medication, analysis revealed main effects of AE, current health status quo, and quantitative risk. No significant interaction was found between any factors for any dependent variable.

Table 2. Spearman Rho Correlations between Qualitative Risk Dimensions, Objective Numeracy and Likelihood of Starting Medication in Experiment 1

	Acceptable Status Quo		Unacceptable Status Quo	
	Pneumonia	Cancer	Pneumonia	Cancer
Risk Perception	-.422**	-.598**	-.351**	-.446**
Worry	-.416**	-.643**	-.452**	-.558**
Global Gist of the Options	-.566**	-.538**	-.434**	-.436**
Lipkus-Peters ONS	0.044	0.171	0.031	0.13
p < .05, ** *p* < .01				

Table 3. Regression to Predict Likelihood of Starting Medication in Experiment 1

Variable	B	Std. Error	Wald Chi-Square	Significance
Categorical Health Status Quo	.248	.089	7.888	.005
Adverse Event	-.137	.093	2.180	.140
Quantitative Risk of Adverse Event*	.060	.047	1.665	.197
Global Gist of the Options*	-.333	.048	48.424	>.001
Risk Perception*	-.190	.060	9.921	.002
Worry*	-.300	.064	21.784	>.001
Lipkus-Peters ONS*	.040	.066	.375	.540
Sex	-.084	.098	.738	.390
Age*	.010	.045	.050	.823
Ethnicity=White Hispanic**	-.152	.209	.531	.466
Ethnicity=Asian**	-.184	.104	3.168	.075
Ethnicity=Black**	-.279	.197	2.000	.157
Ethnicity=Other**	-.357	.173	4.234	.040

* Standardized Beta
** White non-Hispanic = referent group.

Table 4. Mean Responses In Experiment 2 Across All Scenarios for Risk Perception, Worry, Gist, and Likelihood to Start Medication

Mean (SD) Response for Acceptable Status Quo Scenarios	Quantitative Risk of Pneumonia				Quantitative Risk of Cancer			
	1/100	1/1,000	1/10,000	1/100,000	1/100	1/1,000	1/10,000	1/100,000
Risk Perception	3.45 (.76)	3.11 (1.02)	2.95 (1.22)	3.12 (.78)	3.88 (.86)	3.63 (1.07)	3.32 (1.01)	3.11 (1.29)
Worry	3.35 (.88)	2.61 (.78)	2.26 (1.15)	2.65 (.79)	3.88 (.99)	3.37 (1.12)	3.32 (1.00)	2.63 (1.01)
Global Gist of the Options	2.70 (.80)	2.17 (.79)	2.26 (.80)	2.35 (1.00)	2.76 (1.03)	2.78 (1.03)	3.00 (1.20)	2.36 (1.12)
Likely to Start Medication	3.40 (.88)	3.83 (.92)	3.95 (.78)	3.59 (1.28)	2.82 (1.01)	3.16 (1.21)	1.95 (1.31)	3.16 (1.17)
Mean (SD) Response for Unacceptable Status Quo Scenarios								
Risk Perception	3.37 (.83)	3.71 (.85)	3.32 (.82)	3.16 (.83)	3.79 (.85)	3.42 (1.30)	3.65 (1.00)	3.10 (1.25)
Worry	3.05 (.97)	2.76 (.97)	1.95 (.91)	3.00 (.88)	3.74 (.93)	3.05 (.91)	3.06 (1.09)	2.40 (1.10)
Global Gist of the Options	2.58 (1.12)	2.12 (.78)	1.84 (.37)	2.42 (1.02)	2.63 (.83)	2.68 (1.06)	2.53 (1.12)	2.40 (1.05)
Likely to Start Medication	3.58 (1.02)	3.82 (.88)	4.16 (.76)	4.37 (.68)	2.89 (.88)	3.16 (1.30)	3.53 (1.42)	3.70 (.98)

Note. ANOVA analysis revealed main effects of AE, health status quo and quantitative risk in predicting risk perception. In predicting worry, there were main effects of AE, and quantitative risk, but not health status quo. To predict global gist of the options, analysis revealed main effects of AE, and quantitative risk, but not health status quo. Finally, to predict likelihood to start medication, analysis revealed main effects of AE, current health status quo, and quantitative risk. No significant interaction was found between any factors for any dependent variable.

Table 5. Spearman Rho Correlations between Qualitative Risk Dimensions, Objective Numeracy

and Likelihood of Starting Medication in Experiment 2

	Acceptable Status Quo		Unacceptable Status Quo	
	Pneumonia	Cancer	Pneumonia	Cancer
Risk Perception	-.263*	-.342**	-.306**	-.219
Worry	-.283*	-.444**	-.370**	-.454**
Global Gist of the Options	-.486**	-.644**	-.385**	-.607**
Lipkus-Peters ONS	.156	.013	.132	.155
Berlin Numeracy Scale	.261*	.035	.052	.071
Subjective Numeracy Scale	.135	.069	.354**	.237*
*$p < .05$, ** $p < .01$				

Table 6. Regression to Predict Likelihood of Starting Medication in Experiment 2

Variable	B	Std. Error	Wald Chi-Square	Significance
Categorical Health Status Quo	-.226	.104	4.729	.030
Adverse Event	.465	.1058	19.317	.000
Quantitative Risk of Adverse Event*	-.125	.1185	1.106	.293
Global Gist of the Options*	-.521	.0597	75.99	>.001
Risk Perception*	-.088	.0628	1.954	.162
Worry*	-.093	.0656	1.997	.158
Lipkus-Peters ONS*	-1.073	.6181	3.013	.083
Lipkus-Peters/Quantitative Risk interaction	.328	.1669	3.857	.050
Sex	.049	.1172	.176	.675
Age*	.056	.0383	2.15	.143
Ethnicity=White Hispanic**	.029	.2595	.013	.911
Ethnicity=Asian**	.081	.309	.069	.792
Ethnicity=Black**	.121	.2639	.21	.647
Ethnicity=Other**	-.216	.3115	.48	.488

* Standardized Beta
** White non-Hispanic = referent group.

Figure 1. Mediation analyses testing the effects of risk perception (a), worry (b), and global gist of the options (c) on the relationship between numeric probability and likelihood of starting medication in Experiment 1, each demonstrating partial mediation.
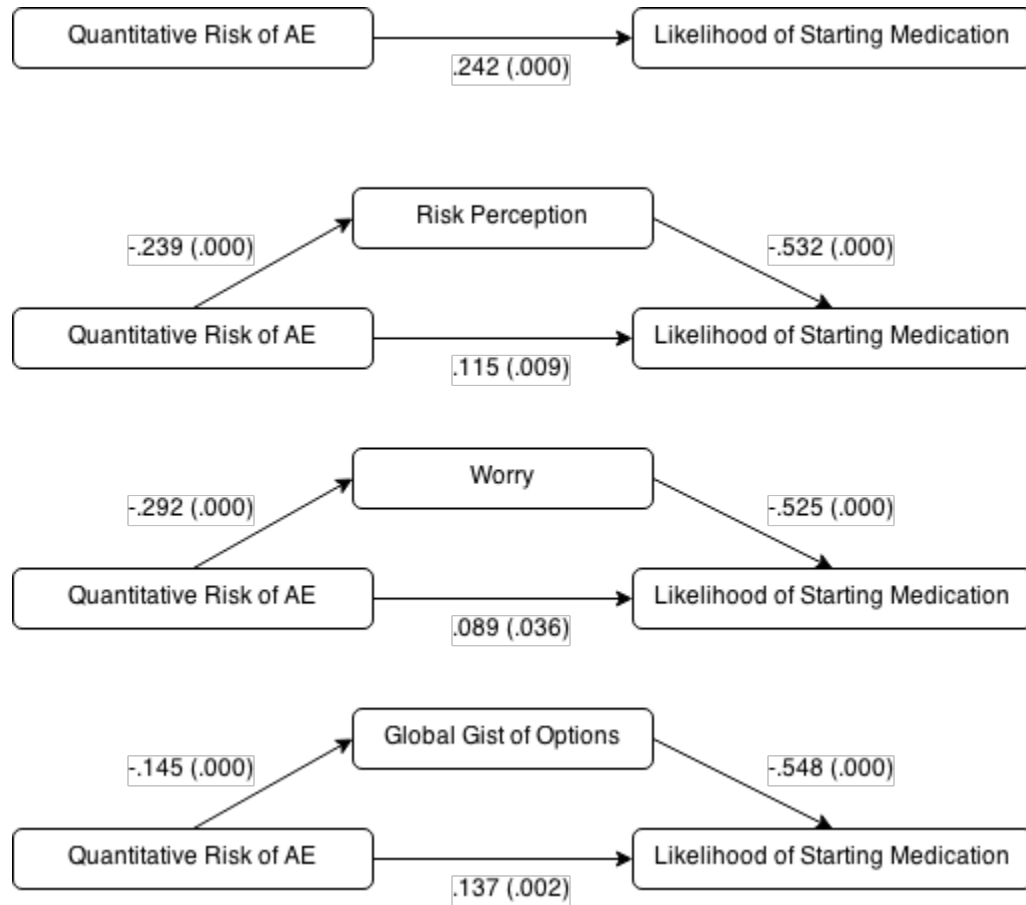
Figure 2. Mediation analyses testing the effects of risk perception, worry, and global gist of the options on the relationship between numeric probability and likelihood of starting medication in Experiment 2.
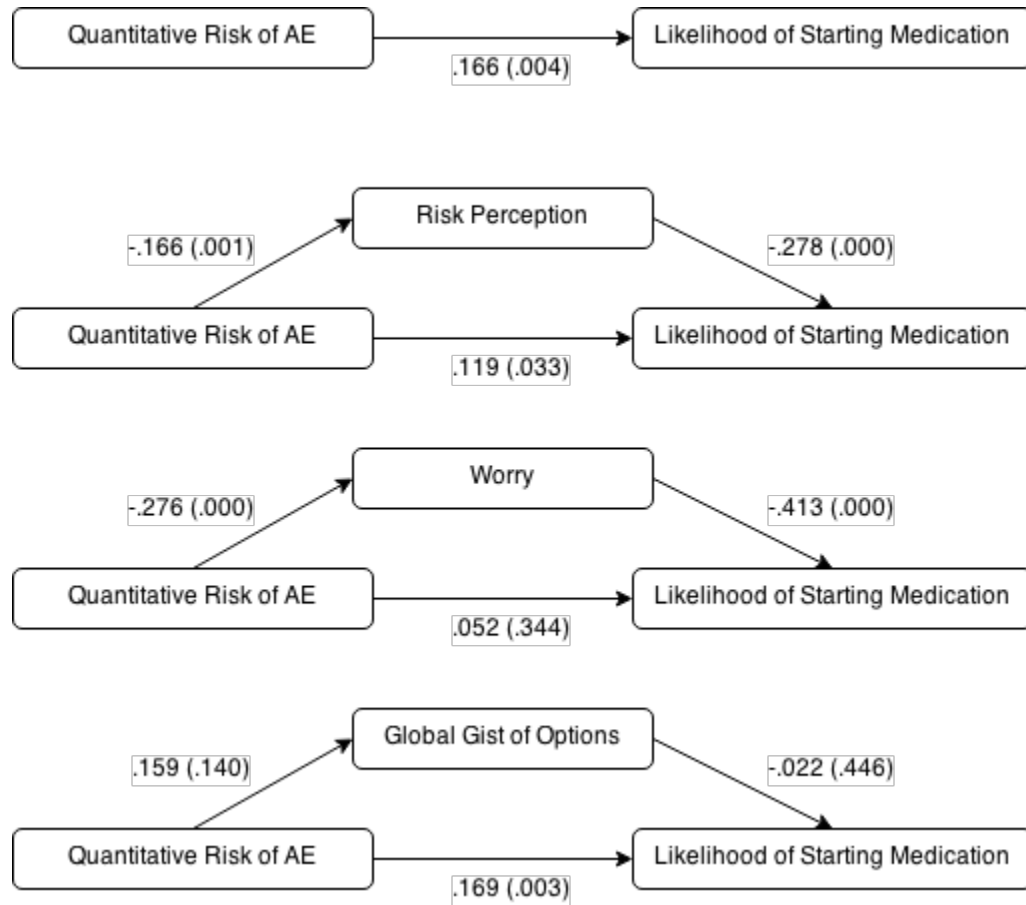
CHAPTER 4

Abstract

Fuzzy-trace theory predicts that global assessments such as life satisfaction will endure as gist representations, whereas tasks requiring precise judgments, such as numeric ratings of happiness, will activate verbatim representations that are subject to greater interference over time, resulting in less consistency between ratings in the moment and recollections of happiness judgments. We support these predictions by introducing a new measure of instability that captures the level of verbatim detail incorporated into judgments of well-being, and corroborate a growing body of research that demonstrates that focusing attention on verbatim details can have detrimental effects on judgment in real-world outcomes.

The Gist of Happiness: Precision of Representation of Subjective Well-being

Predicts Risk Judgments and Choice in Adolescents and Adults.

Decisions are made not just based on the objective outcomes of the decision, but also based on what emotions people expect to feel as a result. Major life decisions, such as where to live, what careers to take, and who to marry are often influenced by people's predictions of how happy they expect to be in their daily life, and how satisfied with their life as a whole they will be as result (Wilson & Gilbert, 2003). As many of these decisions are long-term commitments, the accuracy of these predictions could have a permanent influence on their subjective well-being as a result. Additionally, subjective well-being--as measured by happiness and life satisfaction--is strongly predictive of objective well-being, including one's physical health and longevity (Diener, 2000).

It is common for these predictions to be inaccurate (Wilhelms, Helm, Setton, & Reyna, 2015), and this inaccuracy has been found to play a role in other decision making paradigms, such as loss aversion in framing (Kermer, Driver-Linn, Wilson, & Gilbert, 2006). Neuroscientific approaches have made progress in explaining this inaccuracy, finding that predicting enjoyment of future events is associated with less ventromedial prefrontal cortex activation than making similar judgments of present events (Mitchell, Schirmer, Ames, & Gilbert, 2011). The accuracy of these self-referential projections, however, tend to rely on our memories of similar experiences in the past, as both the forecasts of future experiences and recollections of past experiences rely on the same neural network (Schacter, Addis, & Buckner, 2008, Wilson & Gilbert, 2003). Thus, a critical element to understanding how inaccuracies arise in predictions of future emotional experiences is understanding how emotional events are encoded and recalled in memory.

In this article, we test hypotheses regarding the basis of emotional judgments in memory representations as described by fuzzy-trace theory, given previous successes of this paradigm in integrating cognitive and emotional content to predict judgments and behavior (e.g. Reyna & Mills, 2014). Fuzzy-trace theory is a theory of memory, decision making, and the development thereof, the central tenet of which is the distinction between two types of memory representations: verbatim representations, which encode literal facts and details of experiences and underlie deliberate analysis, and gist representations, which encode the bottom-line meaning of experiences and underlie advanced intuition (Reyna, 2012). These representations can be described as lying on opposing ends of a continuum, roughly analogous to scales of measurement: the simplest gists are stored as categorical distinctions, followed by ordinal distinctions, on through the most fine-grained and detailed distinctions. The theory posits that processing with both of these representations increases with age. However, adults prefer to rely more on the simplest gist representations for a choice or task, whereas adolescents can rely more on verbatim details (the latter of which can result in unhealthy risk-taking; Reyna & Farley, 2006).

Applying these principles, fuzzy-trace theory has been applied to predict and explain effects in the risky choice framing task (Reyna, Chick, Corbin, Hsia, 2014). In this task, people must decide between a sure and risky option with equivalent expected value (defined as the reward value weighted by the probability of receiving the reward in the risky option). People's choices have been demonstrated to differ based on whether the outcomes are framed as gains or losses, even as the objective outcomes are held equivalent between frames (e.g., losses are withdrawn from an endowment given prior to the choice options; Tversky & Kahneman 1986). Fuzzy-trace theory has posited that this effect is the result of the categorical gist differences

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between the two options--for example, "save lives for sure" or "maybe save lives and maybe not"--as well as the retrieval of simple values (e.g., save lives whenever possible) that determine most people's choices in the task (Reyna, 2012). Contrarily, a focus on the verbatim values expressed in the task (e.g., the exact magnitude of gains, losses, or the probabilities of each) can result in reductions of the framing effect, or even reversals of the effect, such as when adolescents are presented with high magnitude risky options (Reyna et al., 2011). Support for this explanation has been found through testing the prediction that manipulations that change the level of representation encoded of the options without changing the objective outcomes can either increase or decrease the framing effect (Kuhberger & Tanner, 2010). For example, a risky option in the original framing problem, "a ⅓ chance of saving 600 lives and a ⅔ chance of saving 0 lives" can be expressed as either "a ⅓ chance of saving 600 lives" or "a ⅔ chance of saving 0 lives" removing redundant information (given that 600 is the stated number of lives at risk in the question) but effectively altering the encoded gist of the option. "A ⅓ chance of saving 600 lives" results in a gist of "maybe some lives saved," resulting in a smaller framing effect when compared to the safe option that saves lives; "a ⅔ chance of saving 0 lives" results in a gist of "maybe no lives saved," highlighting the contrast between saving some lives versus possibly saving none in the risky option, and, thus, a larger framing effect compared to focusing on numbers (Kuhberger & Tanner, 2010; Reyna et al., 2014). Note that ambiguity is not a factor in explaining these results (Chick, Reyna, & Corbin, 2015).

Although the theory has previously found success in describing how these memory representations underlie probability and risk judgments, it also posits that these same representations underlie judgments of subjective well-being, regarding the past, present, and future (Wilhelms et al., 2015). Predictions regarding the accuracy of memories of emotional

states should consider how emotions and assessments of well-being are stored as either gist or verbatim memories. In discussing the content of emotional experience, a delineation is often made between the valence of an emotion--whether the experience is positive or negative--and the arousal associated with it--the intensity of the experience that is commonly associated with an autonomic reaction. The simplest gists usually take the form of dichotomous categorical distinctions, including valence which tends to be stored as a categorical gist memory (Rivers, Reyna, & Mills, 2008). Amygdala damage (excluding the adjacent medial-temporal lobe) is associated with deficits in encoding the gist of emotional stimuli, although memory for verbatim details is retained (Adolphs, Tranel, & Buchanan, 2005). Exposure to a stimulus contributes to the enduring memory for the valence and a preference for the stimulus also supports that valence is encoded as gist (Zajonc, 2001).

Arousal has a more complex effect on the encoding of emotional experience, and seems to affect how information is encoded (Rivers, Reyna, and Mills, 2008). High arousal is associated with enhanced memory for the gist of an experience but reduced accuracy in memories of verbatim details, particularly for negatively valenced stimuli. (Adolphs, Denburg, & Tranel, 2001). Young adults, however, can have an inverse effect for central details, recalling them better, while leaving peripheral details unaffected (Kensinger, Garoff-Eaton, & Schacter, 2006). This effect of arousal is predicted by fuzzy-trace theory, given that verbatim memories for detail are subject to interference, whereas gist memories tend to be robust through interference. Overall, level of arousal at the time of encoding an emotional experience results in a greater focus on the gist (and occasionally details that are central to that gist) and reduced focus on any peripheral details. As people tend to rely on these gists for most judgments, this will

include judgments of future or past well-being, unless the judgment cue primes specific verbatim details (Wilhelms et al., 2015).

Questions eliciting judgments of subjective well-being can cue different memory representations of emotional states. This is often intentional, as in cases of questions of life satisfaction, requiring a global judgment of one's well-being (Diener, 2000). That global measures of well-being like life satisfaction are supported by different memory representations than more ephemeral measures (such as momentary happiness) is supported by evidence showing that these measures share different relationships with other outcomes and explanatory variables. Other research finds, for example, similar risk judgments can show opposing relationships with outcomes based on the memory cue elicited (Mills, Reyna, Estrada, 2008). Similarly, life satisfaction is more strongly associated with income and education, but momentary daily happiness is related to smoking, health, and loneliness (Kahneman & Deaton, 2010). Although the two measures of well-being are positively correlated, the memory representations that are elicited in making these judgments of well-being predict different outcomes. By separating judgments of subjective well-being by representations that underlie them, one can make predictions about how these measures will differentially relate to outcomes.

The following study tests predictions about the basis of happiness judgments in memory representations, as well as provides preliminary evidence that focus on verbatim details in happiness judgments is associated with more risk-taking in real-world outcomes. Fuzzy-trace theory predicts that global assessments of subjective well-being such as life satisfaction will tend to reflect gist representations. However, when tasks require precise judgments, such as specific numeric ratings of happiness, people will activate specific verbatim representations that are subject to greater interference over time. This will result in less consistency between ratings in

the moment and recollections of well-being judgments. To assess this consistency, we introduce a measure of well-being instability, aimed at capturing how much verbatim detail is included in a judgment of well-being, with the specific prediction that this instability will go down as time passes since the remembered event (such as recalling happiness from a week or more ago). Instability will also be reduced through interference with verbatim detail (such as thinking about the past) or when primed to think about meaningful memories (as opposed to detailed memories; Brainerd & Reyna, 1993). Stability in ratings of happiness over time has previously been found to relate to individual intelligence, surviving the mediating effects of education, wealth, and accuracy (Kanazawa, 2014). Additionally, as a growing body of research demonstrates that focusing attention on verbatim details reflects reward-related processes (e.g. Reyna et al., 2011), we predict that this measure of instability will predict more sensation seeking and risk-taking in real world outcomes.

Experiment 1

Method

Participants and Procedure. The subjects recruited for Experiment 1 were 116 college undergraduates who enrolled online in exchange for extra credit in courses. The sample was 74% female with a mean age of 20.2 (SD = 1.67). The sample was 59% White/Caucasian, 8% Black/African American, 18% Asian, 4% Asian Indian, 11% Mixed race or Other. 13% of the sample identified as Hispanic. Participants responded to all experimental tasks and survey questions online through Qualtrics Survey Software.

Design

A series of questions regarding the participants' SWB were created according to a 3 × 3 × 2 design. These varied according to the precision of representation elicited by the question

(precision), the response scale of the question (scale), and the day about which the question asked (day). The precision of representation ranged from most global to most precise, with the most global question asking for the participant's life satisfaction (i.e., "how satisfied are you with your life overall?"), the most precise question asking about the participant's happiness that day, (i.e., "how happy are you today?"), and an intermediate option asking about happiness lately (i.e., "how happy are you lately in your life?"). These questions were each presented with three different response scales, either a binary choice (i.e., "happy/unhappy" or "satisfied/unsatisfied"), a 7-point ordinal scale (ranging from "extremely happy/satisfied" to "extremely unhappy/unsatisfied") or a continuous 1-100 scale. The 9 questions that result from these factors were grouped together and presented in a randomized order (i.e., different for each subject).

A parallel set of these 9 questions about their present well-being (today) were constructed to elicit the same judgments about a day a week prior (delay). This section of questions was counterbalanced with the questions that were asked about the present day, and the 9 questions appeared in a random order. The section was preceded by a preamble to orient the participant, "The following few questions ask you to think back to one week ago today. For example, if you are currently taking this survey on a Tuesday, think back to your day on the previous Tuesday one week ago, and answer about that day." The phrasing of the questions varied slightly to match the orientation of the day in question and identify that the person should be recalling a memory of their well-being (i.e., "how happy were you a week ago today?" "how happy would you have said you are you lately in your life, a week ago today?" and "how satisfied would you have said you are with your life overall, a week ago today?"). As the order of question sets (today or delay) was counterbalanced, the final design of this section of questions was a 2 (order)

$\times$ 3 (precision) $\times$ 3 (scale) $\times$ 2 (day) design, although some analyses required collapsing across factors, the details of which are below.

In addition to the experimental design that elicited judgments of subjective well-being, an additional experimental design of risky choice framing questions was included for the same participants. Each question took the general form of the following text:

> You have a choice. If you pick the spinner on the left, you win $30 for sure. If you pick the spinner on the right, you take a chance. If the spinner were to land on red, you win $60, if the spinner lands on blue, you win nothing. What do you want to do? Win $30 for sure, or take a chance and maybe win $60, maybe win nothing.

The framing questions were varied according to a 3 (magnitude) $\times$ 3 (probability) $\times$ 2 (frame) design. The magnitude was manipulated to be a safe expected win of either $1, $4, or $30, with the expected value of the risky option calculated to be equal to the safe expected win. The probability was manipulated to be either a 1/2, 1/3, or 1/4 chance of winning in the risky option (with the expected value held constant such that the reward in the risky option grew as the probability decreased). Finally, questions were framed as either gains or losses, with the loss-framed questions being described as returning some money from a given endowment. Loss-framed questions took the general form of the following text:

> Pretend I gave you $60. Now you have $60. You have a choice. If you pick the spinner on the left, you give me back $30 for sure. If you pick the spinner on the right, you take a chance. If the spinner lands on blue, you give me back $60. If the spinner lands on red you give me back nothing. What do you want to do? Give back $30 for sure, or maybe give back $60, maybe give back nothing.

All the questions were accompanied by an illustration that depicted two spinners representing the two choice options, with the safe spinner painted entirely of one color and with an image of the dollar amount of the safe gain, and with the risky spinner colored according to the probability stated in the question and the dollar amount of the risky gain depicted on the appropriate section. Participants' confidence in their choice was elicited for each question on a 1-7 scale. Participants either received the set of all the gain-framed questions first or all the loss-framed questions first (i.e., order was counterbalanced), and the 9 questions within each frame were randomized within the set.

Materials. In addition to the two experimental designs described above, participants responded to the questions from two individual difference scales. The first was the Adolescent Risk Questionnaire (ARQ; α = .839), which is an inventory of participation in a wide range of 22 real-world risks, including drunk driving, having unprotected sex, and taking drugs. Participants indicated how often they engaged in each of the 22 risky activities on a 5-point Likert scale (i.e., never, hardly ever, sometimes, often, very often). Participation in these risky behaviors is associated with preventable injury, illness, and death (IOM & NRC, 2011).

Participants also completed the Behavioral Inhibition and Activation Scales (BIS/BAS; Carver & White, 1994). This scale was designed under the theoretical proposition that two countervailing systems underlie behavior: an approach-based system that regulates appetitive motives and drives impulsive behavior, and an inhibition system that avoids unpleasant outcomes and is characterized by the self-control that often results in avoidance of risk. The BAS and   are designed to capture individual differences in sensitivity of these two systems, respectively. The BAS scale items were found to vary according to three different factors,

specifically according to reward responsiveness (α = .874), fun-seeking (α = .850), and drive (α = .847); these are treated as separate scales.

Data analysis. Analyses of variance were constructed in two different ways pertaining to the SWB tasks. First was based on the factors described above, 2 (order) × 3 (precision) × 3 (scale) × 2 (day). As the different response scales prohibited inclusion in the same ANOVA design, three different ANOVAs were conducted on each of three response scales (binary, ordinal 1-7, and continuous 1-100), each with a 2x2x3 design.

As the theoretical motivation behind this study was to assess how more precise representations of well-being demonstrate subjectivity to interference and instability over time, a measure of instability was devised using the continuous response items in the SWB design. Instability indexes were calculated by taking the absolute value of the difference between the measure of life satisfaction and a happiness measure at each of the two remaining levels of precision (now and lately) at each time point on the 1-100 scale. For both today and delay questions, then, two instability indexes were created, measuring the use of precise representation in judgments of happiness lately and happiness now. This resulted in four total instability indexes (today, delay, today-lately, and delay-lately). Mixed ANOVA designs were constructed with instability index as a dependent measure, and a 2 (day) × 2 (precision) × 2 (order) design. Measures of instability were also correlated with individual difference scales.

From the series of risky choice framing tasks, two indexes were created to represent the extent to which participants display the common risky choice framing effect (i.e., safe in gain, risky in loss). The first framing index simply took the sum of risky choices made in the loss frame and subtracted the sum of risky choices made in the gain frame (e.g., displaying the common framing effect every time would result in a score of 9; displaying the reverse framing

effect of a risky choice for all gain problems and vice versa results in a score of -9, etc.). The second framing index incorporated the data from the participants' confidence in each choice. First, signed confidence measures were calculated for each choice using the expression $((b*2)-1)*c$, in which b represents the binary choice coded as either 0 or 1 (representing safe and risky choices, respectively) and c represents confidence on that choice on a scale from 1-7. This produces a measure of signed confidence, in which a 7 represents an extremely confident risky choice, and -7 represents an extremely confident safe choice (e.g., -1 represents the least confident safe choice). Then, signed confidence framing indexes were calculated by taking the mean of all loss-framed signed confidence measures, and subtracting the mean all gain-framed signed confidence measures. This produces an index of the extent to which the participant displays the common framing effect, incorporating their level of confidence, and this was used as a corroborative test of the reliability of the binary choice framing index. Both of these indexes were also tested for correlations with SWB instability indexes and individual differences.

Results

The first ANOVA design was a 2 (order) × 2 (day) × 3 (precision) design with SWB as a dependent measure. Overall there was a main effect of precision of representation on SWB outcome, $F(2,104) = 14.381$, $p < .001$, $\eta_p^2 = .122$, in which higher SWB was reported for more global representations (i.e., life satisfaction, $M = 72.47$, $SE = 1.86$) than for more precise representations (i.e., immediate happiness, $M = 67.70$, $SE = 1.91$; happiness lately was intermediate, $M = 69.54$, $SE = 2.00$). The main effect of level of precision interacted with order, $F(2,104) = 6.990$, $p = .001$, $\eta_p^2 = .063$, as well as with day, $F(2,104) = 5.395$, $p = .005$, $\eta_p^2 = .049$; however, these were further qualified by a three-way interaction between all factors, $F(2,104) = 3.204$, $p = .043$, $\eta_p^2 = .030$. This interaction is characterized by a pattern in which

larger differences are observed between a present-day rating and a week-delayed rating when the rating of SWB is of a global representation (e.g. life satisfaction), and that this effect is larger when questions about the present day were presented first (life satisfaction and happiness lately show an effect of day when questions about today were presented first; however only life satisfaction shows the same effect when the week-delayed questions are presented first). The marginal means from this interaction are depicted in Figure 2. None of these today-delay differences are revealed to be significant in pairwise comparisons, however, corroborated by an insignificant main effect of day, $F(1,104) = 2.695$, p = .104, $\eta_p^2 = .025$.

As described above, an additional Mixed ANOVA design was constructed with instability index as a dependent measure, and a 2 (day) × 2 (precision) × 2 (order) design. Descriptive statistics for the four instability indices can be found in Table 1. Overall there was a main effect of precision on instability, $F(1,108) = 7.711$, $p = .006$, $\eta_p^2 = .067$, in which instability increased when people were asked about immediate happiness ($M = 9.25$, $SE = .80$) than about happiness lately ($M = 7.32$, $SE = .72$). Precision also interacted with the day to predict instability, $F(1,108) = 7.714$, $p = .006$, $\eta_p^2 = .067$, such that the difference between instability lately ($M = 6.96$, $SE = .77$) and instability now ($M = 10.87$, $SE = 1.11$) was only exhibited when asked about their day today. Asked about the week prior, there was no difference in instability index by precision of representation (lately, $M = 7.55$, $SE = .99$; immediate, $M = 7.63$, $SE = 1.02$). Day also interacted with order, $F(1,108) = 5.352$, $p = .023$, $\eta_p^2 = .047$, such that differences in instability between days were only found if responding about today first, in which case answering about today produced higher instability ($M = 11.43$, $SE = 1.08$) than the week prior ($M = 7.83$, $SE = 1.32$). If responding about a week ago first, there was no difference in instability between days (today, $M = 6.52$, $SE = 1.09$; delay, $M = 7.36$, $SE = 1.32$).

Correlations between instability indices and framing indices, risk outcomes (ARQ), and BIS/BAS scales can be found in Table 1. SWB instability relating to the today-lately judgment was correlated negatively with both framing indices, such that displaying a bigger framing effect (higher reliance on gist of choices) was associated with less instability in SWB judgment (higher reliance on the global representation of SWB). SWB instability relating to the today-immediate judgment was correlated with the BIS and BAS drive and BAS reward responsiveness subscales, such that higher instability in happiness judgments was associated with more reward responsiveness and drive, as well as more responsive inhibitory system. BAS fun-seeking was associated only with instability in today-lately and delay-lately SWB judgments. Instability in today-lately SWB judgments were associated with more reported risk-taking as measured by the ARQ, specifically driven by the thrill-seeking subscale, which contains items such as "parachuting" or "flying a plane."

Experiment 2

Method

Participants. The participants for this study consisted of 585 college students (67% female) who participated in an online survey study. Participants were offered extra credit in introductory psychology courses in exchange for participation. Mean age of the sample was 19.15 (SD = 1.187). The sample was 56% Caucasian, 6% African American, 26% Asian, 9% mixed or other. 9% identified as Hispanic.

Design. The design of Experiment 2 largely replicated the SWB design of Experiment 1, but with an added memory prime manipulation. Participants were primed to think try to recall either the meaningful and important things from that day or the details of the day, and to write down as many of either that they could think of. Participants in the detail condition responded to

the prime, "Think about your day today. Think briefly about the details of your day. Write down as many details about the day that you can recall right now." Those in the meaningful condition responded to the prime, "Think about your day today. Think briefly about the meaningful or important things that happened to you or that you did today. Write down as many of these things that you can recall right now." Although this was a between-subjects factor, each participant was given the prime twice, immediately prior to answering questions regarding their day today, and immediately prior to the questions regarding one week ago (the text of the prime was adjusted to refer to the day in question). Aside from this additional factor, the design of Experiment 2 replicated the design of Experiment 1, resulting in a 2x3x3x2 design. There was no framing design in Experiment 2, and data analysis and instability index calculation for the SWB design also replicated that in Experiment 1.

Materials. As in Experiment 1, all participants responded to the ARQ ($\alpha = .799$) and the BIS/BAS (BIS $\alpha = .789$; BAS drive $\alpha = .831$; fun-seeking $\alpha = .826$; reward-responsiveness $\alpha = .895$) questionnaires. Participants also responded to the Alcohol Use Disorders Identification Test (AUDIT; $\alpha = .849$), which is the World Health Organization's tool for identifying and diagnosing harmful habits of alcohol consumption and dependence (Babor, Higgins-Biddle, Saunders & Monteiro, 2001). The AUDIT consists of ten items with three subgroups of questions, assessing the frequency of hazardous alcohol consumption, symptoms of dependence, and the harmful effects of alcohol use.

Results

ANOVA analyses were conducted in Experiment 2 in the same way as Experiment 1, but with the additional factor of *prime*, resulting in a 2 (prime) × 2 (order) × 2 (day) × 3 (precision) design with SWB as a dependent measure. This analysis largely replicated patterns of effects

that were found in Experiment 1. Overall, there was a main effect of precision, $F(2,529) = 44.65$, $p < .001$, $\eta_p^2 = .078$, in which higher SWB was reported for more global representations (i.e., life satisfaction, $M = 71.79$, $SE = .79$) than for more precise representations (i.e., immediate happiness, $M = 67.69$, $SE = .78$; happiness lately was intermediate, $M = 68.95$, $SE = .84$). Level of precision also interacted with order, $F(2, 529) = 3.76$, $p = .024$, $\eta_p^2 = .007$, such that the effect of precision is stronger when asked about today first. The marginal effect of day in Experiment 1 was found in Experiment 2, $F(1,529) = 26.97$, $p < .001$, $\eta_p^2 = .049$, in which people recall having lower SWB a week ago ($M = 68.08$, $SE = .87$), than they report having today ($M = 71.07$, $SE = .76$). Although there were also three way interactions between order, precision, and day, $F(2,529) = 3.77$, $p = .023$, $\eta_p^2 = .007$, as well as between order, precision, and prime, $F(2,529) = 3.109$, $p = .045$, $\eta_p^2 = .006$, these were further qualified by a four-way interaction between all factors, $F(2,529) = 5.043$, $p < .007$, $\eta_p^2 = .009$. This interaction is depicted in Figure 3, and is characterized by a pattern, which appears similar to the three-way interaction in Experiment 1, specifically that participants report bigger differences between global ratings of SWB (i.e. life satisfaction) than they do for precise representations (i.e., immediate happiness). However, the addition of the memory prime results in higher ratings of SWB when given memory prime for meaningful events that happened today. This effect occurred when asking about happiness lately (detail prime, $M = 68.17$, $SE = 1.75$; meaningful prime, $M = 73.27$, $SE = 1.70$) and life satisfaction (detail prime, $M = 73.09$, $SE = 1.62$; meaningful prime, $M = 77.53$, $SE = 1.57$) and was limited to the order condition in which week-delay questions appeared first.

With the addition of *prime* as a factor, the resulting instability index ANOVA was a 2 (prime) × 2 (day) × 2 (precision) × 2 (order) design. Descriptive statistics for the four instability indices can be found in Table 2. Many of the effects from Experiment 1 were replicated in

Experiment 2. Overall, there was a main effect of *precision*, as in Experiment 1, $F(1,529) = 59.261$, p < .001, $\eta_p^2 = .101$, in which instability was higher for ratings of well being now ($M = 9.78$, $SE = .36$) than ratings of well being lately ($M = 7.53$, $SE = .31$). There was also a main effect of *day*, $F(1,529) = 16.506$, p < .001, $\eta_p^2 = .030$, in which instability was higher for ratings given about the present day ($M = 9.54$, $SE = .39$) than about the week prior ($M = 7.78$, $SE = .35$).

Replicating the effects from Experiment 1, *day* also interacted with *order*, $F(1,529) = 18.96$, p = .006, $\eta_p^2 = .035$, such that differences in instability between days were only found if responding about today first. The pattern in this experiment was identical to the pattern in Experiment 1, in which answering about today produced higher instability ($M = 11.24$, $SE = .56$) than the week prior ($M = 7.59$, $SE = .51$). If responding about a week ago first, there was no difference in instability between days (today, $M = 7.84$, $SE = .55$; delay, $M = 7.97$, $SE = .50$).

The new factor of *prime* in Experiment 2 resulted in a three-way interaction with lower-order effects of *precision* and *order*, $F(1,529) = 3.898$, p = .049, $\eta_p^2 = .007$, depicted in Figure 4. When answering questions regarding today first, the prime made no difference regarding responses of instability, and the pattern of responses generally matched the main effect of precision. When responding about the prior week first, however, responding to the meaningful prime resulted lower instability on questions about the present day ($M = 8.28$, $SE = .72$) than did responding to the detail prime ($M = 9.99$, $SE = .71$).

Correlations between instability indices and risk outcomes (ARQ and AUDIT) and BIS/BAS scales from Experiment 2 can be found in Table 2. Experiment 2 replicated the relationship between SWB instability and BIS that was was found in Experiment 1, which was consistent across all measures of instability except delay-lately. A relationship was also found between the today-now measure of instability and the BAS reward-seeking subscale. Regarding

risk outcomes, the relationship between ARQ and SWB instability found in Experiment 1 was largely not found in Experiment 2 despite the larger sample. However, the delay-immediate measure of instability did predict the reckless behavior subscore of the ARQ. Finally, the same delay-immediate measure of SWB instability was predictive of alcohol problems as measured by the AUDIT, both for the overall test and for level of alcohol consumption.

Experiment 3

Method

Participants. The participants for this study consisted of 54 adolescents recruited from local schools in the Ithaca and New York City area. All participants were recruited to complete the survey on a voluntary basis. The mean age of the sample was 16.92 (SD = 5.04) and 59% were female. The sample was 72.5% White, 25.5% Asian, and 2% of mixed or other. 7.8% of the sample identified as Hispanic.

Design & Materials. Experiment 3's design was similar to Experiment 2, except for the addition of an additional level of the memory *prime* factor. This additional level was a condition in which participants received no prime, but were instead instructed to think of the specific day in question in a manner identical to Experiment 1. The additional two memory primes remained as two other levels of the factor resulting in a three-level *prime* factor and a final design of 3 (prime) × 2 (order) × 2 (day) × 3 (precision). The rest of the experimental design was the same as Experiment 2.

Results

Similarly to Experiments 1 and 2, the first ANOVA conducted was a 3 (prime) × 2 (order) × 2 (day) × 3 (precision) with the raw rating of SWB as the dependent measure. The only effect found in this sample relating to the rating of SWB was a main effect of precision, $F(2,90)$

= 10.410, $p < .001$, $\eta_p^2 = .188$. This effect was characterized by an increase in SWB as the level

of precision is reduced, with the lowest ratings given to happiness now, $M = 61.961$, $SE = 3.120$,

an intermediate rating given to happiness lately, $M = 66.016$, $SE = 3.215$, and the highest rating

given to life satisfaction, $M = 69.718$, $SE = 2.790$. No other effect was found in the raw SWB

scores.

Several predicted effects were found, however, in the second ANOVA for which

instability indices were a dependent measure. With the additional level to the *prime* factor, the

resulting design was a 3 (prime) × 2 (day) × 2 (precision) × 2 (order) design. There was overall a

main effect of *precision*, $F(1,45) = 10.804$, $p = .002$, $\eta_p^2 = .194$, in which instability was higher

for ratings of happiness now, $M = 13.790$, $SE = 1.494$, than happiness lately, $M = 9.450$, $SE =$

1.099. *Day* interacted with *order*, $F(1,45) = 7.076$, $p = .011$, $\eta_p^2 = .136$, and as well as with

prime, $F(1,45) = 4.357$, $p = .019$, $\eta_p^2 = .162$, to predict SWB instability. Regarding the

day*order interaction, this was characterized by an pattern parallel to those observed in

Experiments 1 and 2, in which adolescents responding about today produced higher instability,

$M = 15.523$, $SE = 2.184$, than the week prior, $M = 8.171$, $SE = 1.732$, if asked about the present

day first. When the week prior was presented first, instability was roughly equivalent between

days, (week ago, M = 12.423, SE = 1.840; today, M = 10.365, SE = 2.319). The *day*prime*

interaction, however, was characterized by a pattern in which there was a difference between

instability today and a week ago, but only in the condition with no prime; both primes resulted in

intermediate levels of instability. These means are depicted in Figure 5.

Discussion

In this article we have discussed an alternative theoretical perspective for describing

memory and forecasting of emotion and affect, making predictions regarding the use of

representation in judgments and recollections of subjective well-being. Specifically, we found

evidence that recollections of past well-being were based more often in global gist

representations, whether they be judgments of global life satisfaction (or, to a lesser extent,

momentary daily affect in the past). This explanation is supported by effects of what day was in

question in instability indices; greater instability--the difference between overall life satisfaction

and happiness ratings--was found for the present day than the previous week, if the participants

received questions about the present day first. Asking about the previous week first elicited

activation of global gist representations that carried through questions about the present day,

resulting in an elimination of the present-day effect. It may also be counterintuitive that

instability for happiness lately was lower than happiness now, as a judgment of one's happiness

lately could be posited to require the distillation of many timepoints of affect. As verbatim

representations of specific details and context that lead to varying levels of momentary well-

being are subject to more interference over time, simply asking questions about global gist

representation of well-being interferes with verbatim recollection, allowing gist representations

to dominate (as predicted and found in other research varying order of verbatim and gist

questions). Further evidence for this explanation is found in the priming manipulation in

Experiment 2, in which responding to a prime to recall meaningful or important things from the

day (predicted to more strongly elicit gist representations) resulted in lower instability when

asked about the present day. Though limited to the condition in which the previous week was

asked about first, it was predicted in that the activation of the global representation of well-being

reduced the influence of details in the ratings of happiness.

Although predictions regarding mere patterns of raw SWB ratings were not predicted a

priori from the theory, there were reliable effects found that warrant attention. Specifically, all

experiments found that memories for the previous week's well-being were lower than for the present day. This difference was found more strongly for more global representations of well-being, and when a prime was used to elicit meaningful and global memory representations. As these interaction effects were in the direction of gist representations raising ratings of well-being today (as opposed to the more precise representations lowering one's recollection of well-being the week prior), this may have been the result of global representations underlying an optimism bias—similar to the bias that also results from activation of nostalgic memories and emotional representations (Cheung et al., 2013). Although this may be nominally paradoxical (i.e., the present study found the past well-being to be rated less highly than the present), it is likely that a mere week-long delay would not introduce the optimism associated with nostalgia. However, the representations associated with what is meaningful and important (i.e., the gist-based memory prime), or with global life satisfaction may introduce such optimism.

These experiments also contribute to a growing body of research supporting the idea that focusing attention on verbatim details reflects detrimental effects on judgment (e.g. Lazar, 2012; Reyna & Lloyd, 2006; Reyna et al., 2011), specifically that the measures of SWB instability correlated with individual differences and sensation-seeking as well as subsequent real-world risk-taking. Sensation-seeking has been a reliable and consistent predictor of risk-taking, through a mechanism of raising the perceived benefits of risks (Maslowsky, Buvinger, Keating, Steinberg, & Cauffman, 2011). The predicted mechanism of this effect--that a greater instability index is the result of an greater relative focus on verbatim details in making judgments of well-being, and that focus on verbatim detail also underlies risk-taking--is corroborated by the correlation between instability and framing in Experiment 1, in which more instability was associated with less framing. The risky choice framing effect has been found to be based in a

focus on the categorical gist differences between the sure and risky options in the problem, as emphasizing or de-emphasizing the gist difference has the effect of increasing or decreasing the framing effect, respectively (Kühberger & Tanner, 2010). Displaying a stronger framing effect (reliance on the gists in the problem) has reflected a "protective" relationship in predicting real-world risks such as adolescent sexual initiation and number of sexual partners (Reyna et al., 2011). The present study is in parallel to this effect, in that a greater reliance on verbatim detail in happiness judgments was predictive of a decreased framing effect in Experiment 1, and greater sensation-seeking in both experiments.

It is predicted that this focus on verbatim detail would also have a detrimental effect on judgments of future well-being, as well as other real-world outcomes (Wilhelms et al., 2015). The result of the present study is consistent with research that shows that people who are distracted from details make better judgments regarding automobile purchases (Dijksterhuis, Bos, Nordgren, & van Baaren, 2006). For example, people who focus on a questions of *why*, made better decisions regarding purchases of cell phones, an effect that was entirely mediated by the gist memory for phone traits (Fukukura, Ferguson, & Fujita, 2013). This result suggests that it is the reliance on these gist representations of options that results in choosing the option that will result in the highest satisfaction. Past research has also extended this effect to domains specific to subjective well-being. Specifically, college students who focus on the physical details of housing options in a housing lottery were less accurate in predicting their future well-being than those who focused on the global and social features that would remain consistent across options (Dunn, Wilson, & Gilbert, 2003). Similarly, ratings of well-being were negatively correlated with a numeric rate of earning in a task in which people were assigned either to earn as much as possible or were given an artificial cap on earnings (Hsee, Zhang, Cai & Zhang,

2013). Those without the cap did not display this effect, suggesting that a focus on rate of earning (a verbatim detail) results in reduced happiness overall. Future research could expand this body of work by using the current instability paradigm in a longitudinal design, with the prediction that lower instability would be associated with greater accuracy in predicting future happiness.

Past work on forecasting of future emotion has interpreted the results in the context of construal level theory (Wilson & Gilbert, 2003), and this theory has had some success in explaining some affective forecasting effects (e.g., Liberman, Sagristano, & Trope, 2002; Trope, & Liberman, 2003). Although this theoretical perspective can be seen as similar to fuzzy-trace theory, in that concrete details are often stored as verbatim representations and abstractions (e.g. questions of *why*) are often stored as gist representations, construal level theory does not make any prediction regarding greater accuracy with a specific construal level (e.g., fewer details). Drawing predictions specifically from fuzzy-trace theory instead allows the prediction that the stability of gist representations over time (in comparison to verbatim representations that are subject to interference) allows more accuracy in recalling and predicting judgments that are based on those representations; judgments based on verbatim representations will be subject to more noise and interference and thus less consistency over time, resulting in many commonly observed affective forecasting effects.

Basing predictions regarding memory for subjective well-being in fuzzy-trace theory also allows developmental predictions to be made, which were tested in Experiment 3. Specifically, the theory predicts that both verbatim and gist processing develop with age, and that verbatim processing develops sooner in adolescence and can represent a unique route to risk taking (Reyna & Farley, 2006). This prediction has been borne out in studies that find that adolescents can

demonstrate reverse-framing compared to adults (Reyna et al., 2011) and that risk-taking in adolescence is predicted by a tradeoff of risk and benefits (Maslowski et al., 2011). Applied to the current paradigm of testing for memories and judgments of subjective well-being, fuzzy-trace theory would predict greater instability indices in adolescence than adulthood, driven by an increase in activation of verbatim representations in making judgments of happiness, resulting in greater variation in happiness judgments compared to those based on global representations (e.g. life satisfaction), which is what was found in the present study. Future research can extend this framework by testing if the increase in instability reflects detrimental effects on behavior, or results in more inaccuracy in forecasts.

The present study also fits into the body of research that characterizes the differential predictive ability of life satisfaction and daily affect and happiness. Specifically, past research using large datasets found that life satisfaction was associated with income and education, whereas daily affect was more strongly related to loneliness, health, and smoking (Kahneman & Deaton, 2010). Separate activation of gist and verbatim representations cued by the question can reveal not only different strengths of associations, but also opposing relationships for seemingly similar questions (e.g. Mills, Reyna, Estrada, 2008). Fuzzy-trace theory can also extend previous research on subjective well-being by applying the theoretical position that better real-world outcomes are often associated with reliance on gist representations. This means that a focus on global representations (such as life satisfaction) could predict improvements in more objectively-defined outcomes--such as education or financial state--than a focus on more ephemeral representations (such as momentary happiness).

In conclusion, the results of these experiments supported theoretical predictions that instability captures the level of verbatim detail incorporated into judgments of happiness, such

that people have lower levels of instability after a delay (resulting in less access to verbatim

details), and lower levels of instability if they were primed to think about their well-being on a

different day (for which they would be accessing gist representations of well-being). Instability

also predicted framing, such that those who incorporate more verbatim detail into judgments of

happiness also focus less on the gist in framing problems. This research also corroborated

existing research demonstrating that focus on verbatim detail (as captured in instability) results

in more risk-taking as measured by ARQ.

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Table 1

			Today		1 Week Delay	
		Overall	**Now**	**Lately**	**Now**	**Lately**
Descriptive Statistics						
	Mean Instability	8.28	10.87	7.08	7.63	7.55
	Standard Deviation	7.49	11.95	8.30	10.77	10.44
Pearson Correlations						
Framing Index		-.171	-.143	**-.241***	.022	.158
Framing Index (signed confidence)		-.120	-.107	**-.208***	.043	-.100
BIS		.155	**.194***	.054	.092	.084
BAS	Drive	.003	**.189***	-.023	-.149	-.035
	Fun-seeking	**.227***	.066	**.235***	.150	**.233***
	Reward-responsiveness	.154	**.265****	.16	-.04	.053
ARQ		**.194***	.125	**.237***	.043	.181
	Thrill-seeking	**.227***	.123	**.275****	.095	**.193***
	Rebellion	.168	.074	.182	.090	.160
	Recklessness	.011	.074	.136	-.140	-.017
	Antisocial	.124	.147	.086	-.03	.152

Table 2

		Overall	Today		1 Week Delay	
			Now	Lately	Now	Lately
Descriptive Statistics						
	Mean Instability	8.80	10.89	8.42	8.78	6.78
	Standard Deviation	7.62	11.50	9.97	10.78	8.27
Pearson Correlations						
BIS		**.164****	**.174****	**.151****	**.092***	**0.034**
BAS	Drive	-.034	.018	-.017	-0.02	-0.064
	Fun-seeking	.020	.079	.039	-0.002	0.029
	Reward-responsiveness	.086	**.132****	.064	**0.05**	-0.001
ARQ		.049	.010	.005	0.064	0.048
	Thrill-seeking	-.020	-.020	-.032	0.01	-0.011
	Rebellion	.080	.041	.022	0.077	0.067
	Recklessness	.043	-.021	-.021	**.105***	0.027
	Antisocial	.028	.017	.027	-0.005	0.052
AUDIT		.080	.009	.033	**.089***	.079
	Consumption	.067	.041	.008	**.088***	.050
	Dependence	.070	.006	.083	.055	.067
	Harm	.063	-.026	.021	.067	.085

Table 3

	Overall	Today		1 Week Delay	
		Now	**Lately**	**Now**	**Lately**
Descriptive Statistics					
Mean Instability	11.33	16.40	9.90	10.89	8.13
Standard Deviation	8.39	15.58	11.75	13.30	8.71

Figure 1
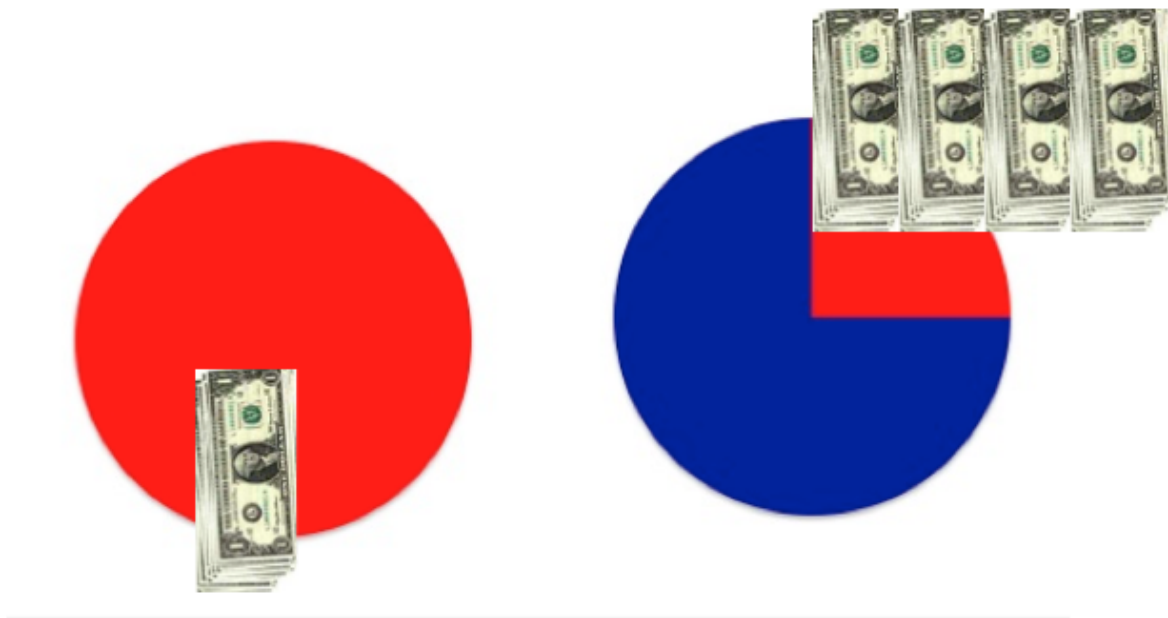
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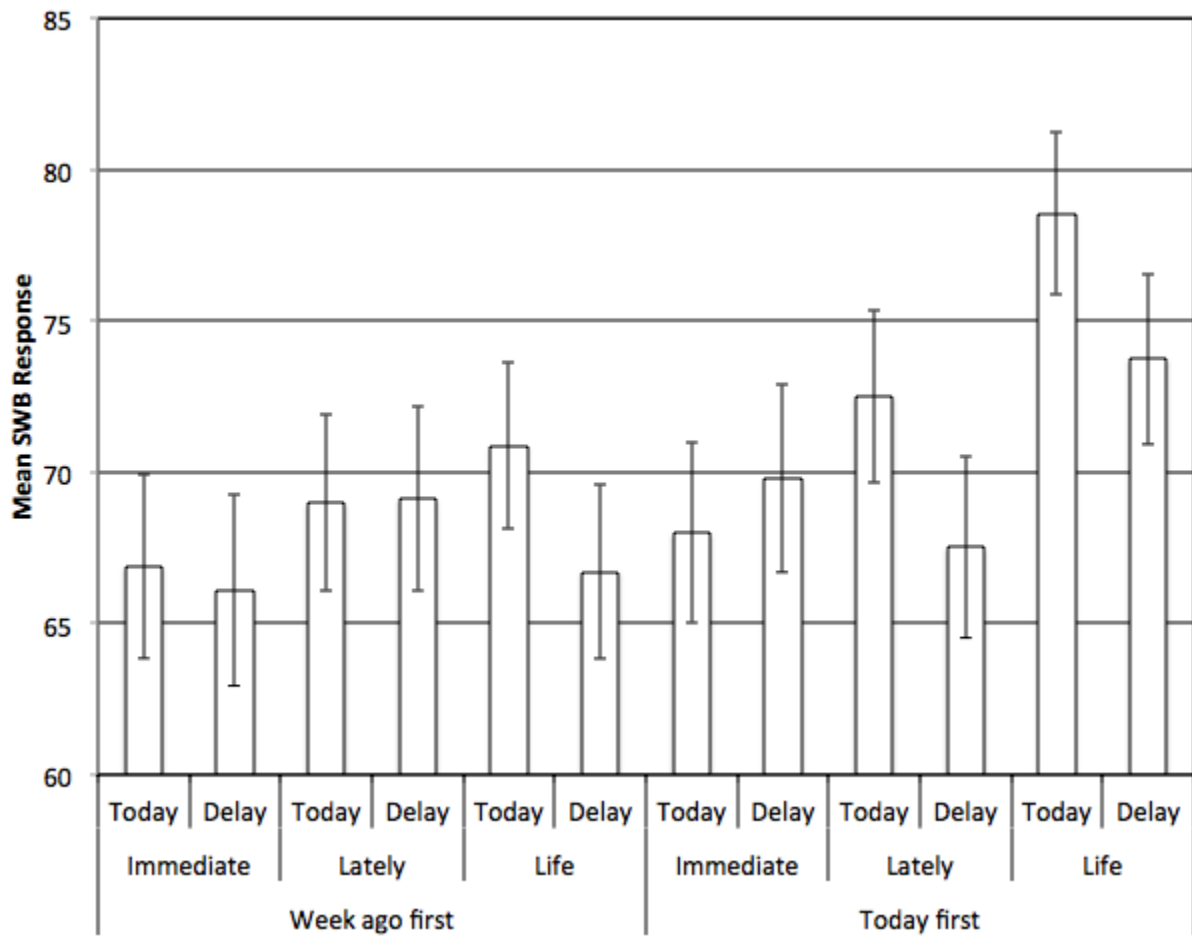
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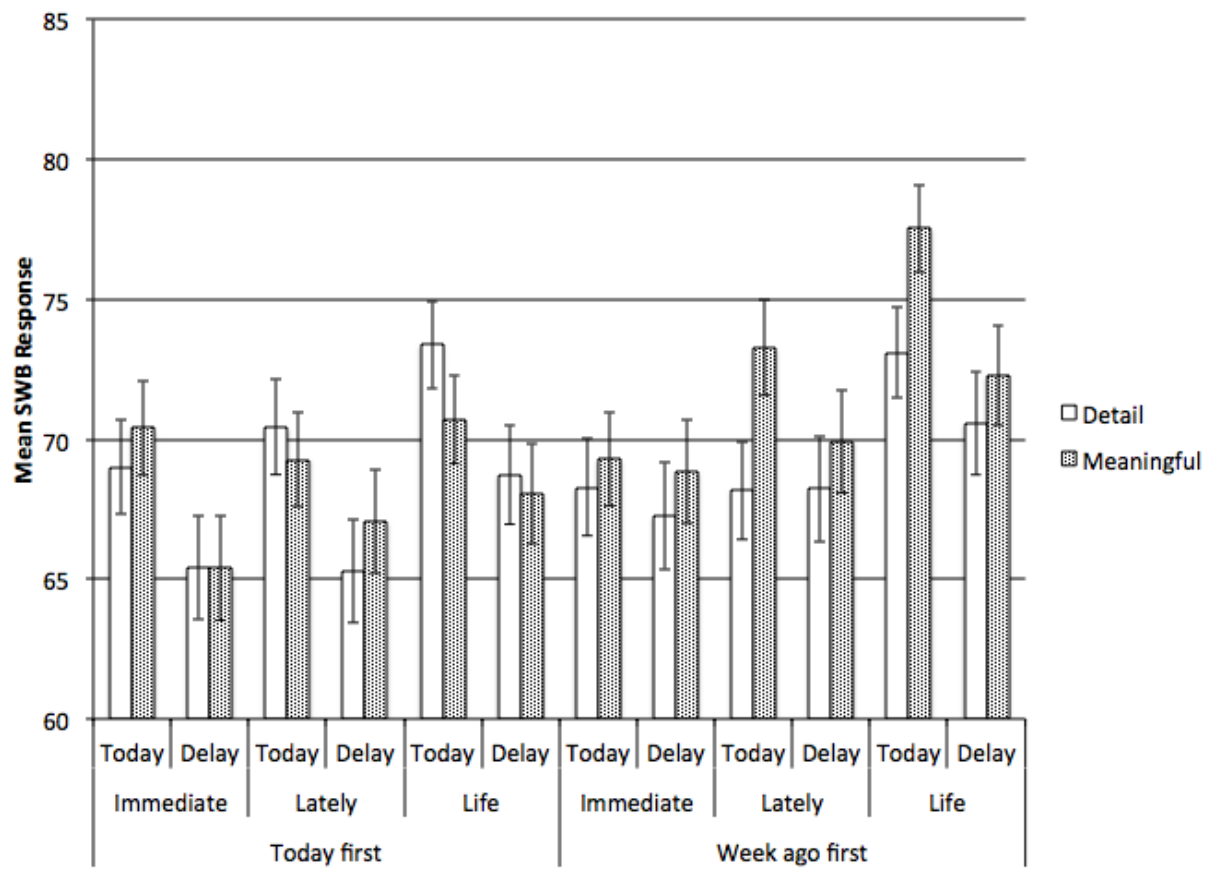
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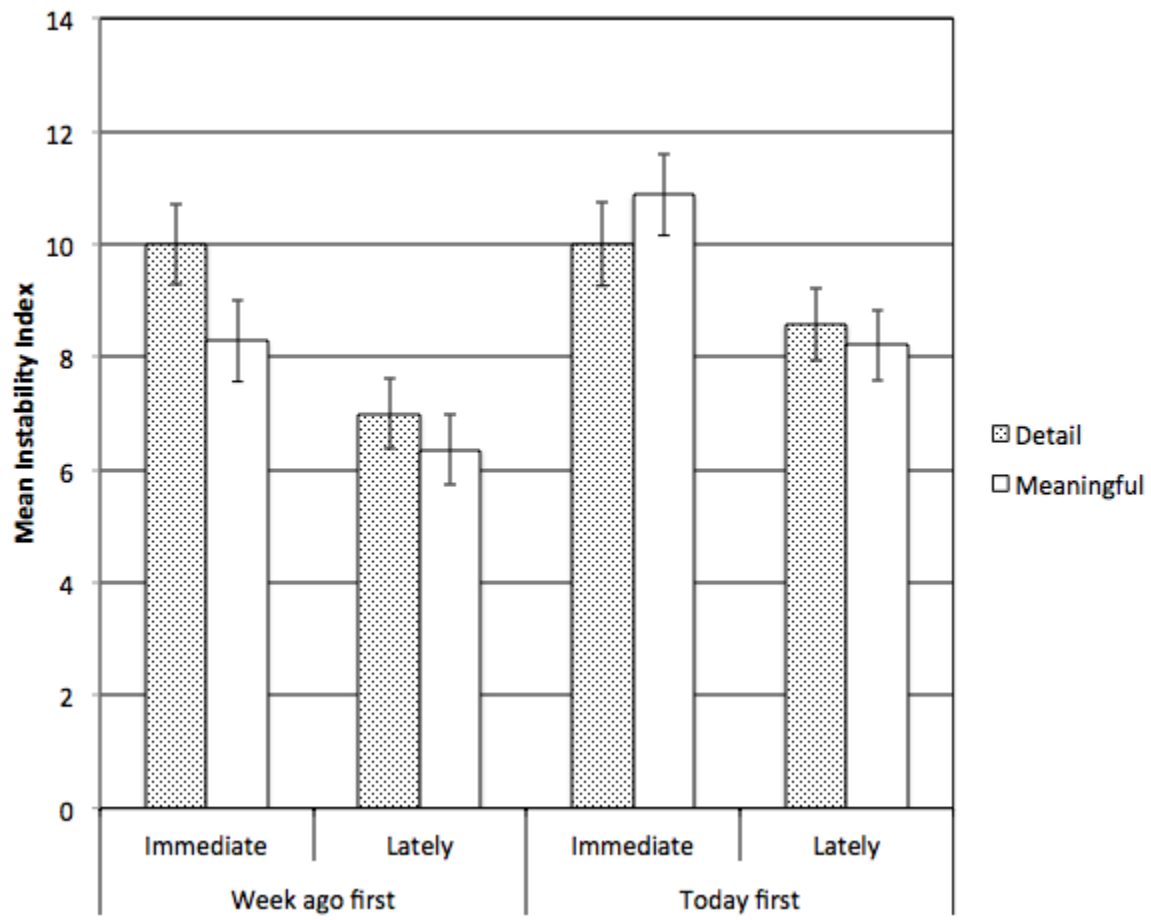
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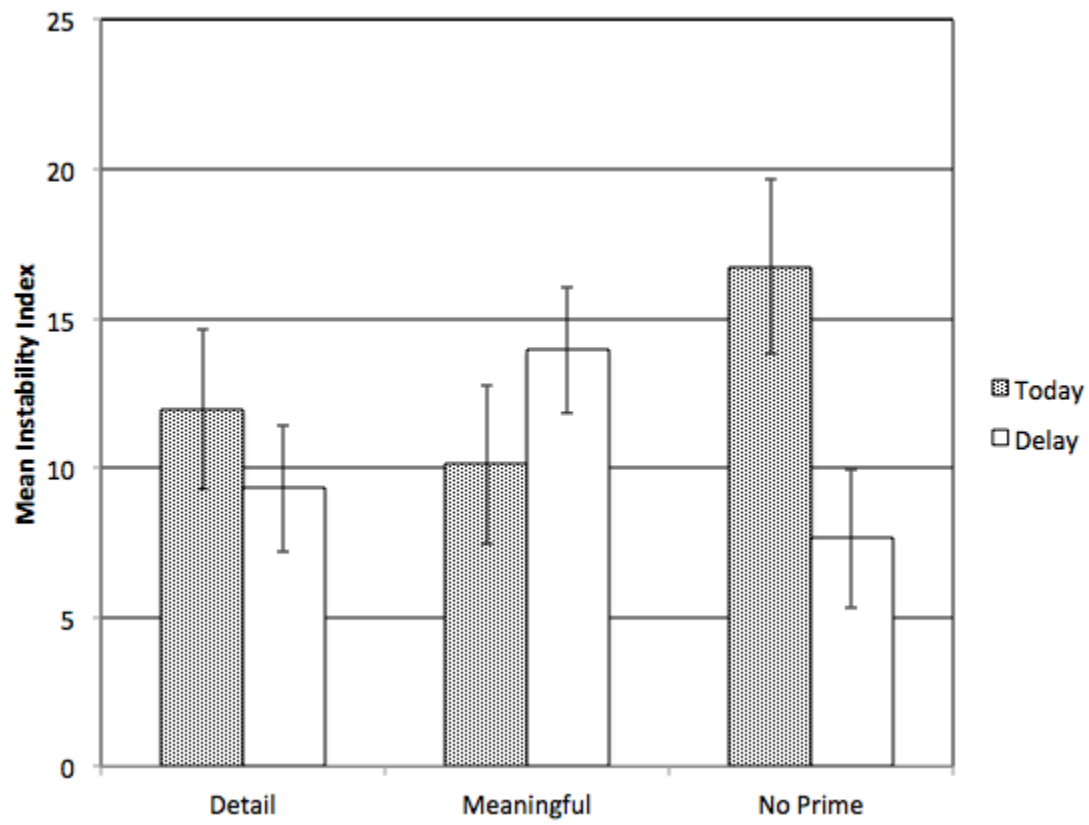
CHAPTER 5

Conclusion

The evidence reviewed above has demonstrated that decisions in a variety of contexts, including framing tasks and medical treatment choices, are based on the gists of the decision options. Furthermore, those with high cognitive reflection scores have been shown, under certain circumstances, to preferentially rely on less complex gist representations that can lead to improved outcomes. FTT accounts for findings that demonstrate independent encoding and retrieval of gist and verbatim representations, as well as their simultaneous improvement with age (though individuals increasingly rely on gist with development, they are also able to retrieve more precise verbatim representations when needed). These effects also illustrate the importance of understanding and insight.

Thus, although many people may presume that advanced reasoning is based on precise, complex representations, the evidence appears to demonstrate the opposite. The argument from standard dual process mechanisms is that "when we are evaluating important risks—such as the risk of certain activities and environments for our children—we do not want to substitute vividness for careful thought about the situation" (Evans & Stanovich, 2013, p. 236). FTT makes explicit predictions that oppose those assumptions, specifically that the advanced processing exhibited by experts in their domain of knowledge, will occur automatically and unconsciously rather than through careful thought about the situation (Reyna, in press). Although experts certainly can deliberate, in the normal course of events they rely on gist, meaning they rely on representations of meaningful, semantic connections.

Other traditional dual process accounts of have focused more on the relationship between intelligence and rationality (in determining whether or not a person will make an intuitive or

deliberate choice (Stanovich, West, & Toplak, 2012). This emphasis is in the context of a dual-systems account in which Type 1 processes are automatic, fast, and intuitive, and Type 2 processes are "slow, sequential, and correlated with measures of general intelligence" (Evans & Stanovich, 2013, p. 235). Many of these dual-systems structures are default-interventionist, meaning that the cognitive capacities found in Type 2 thinking only operate if a need for an override of Type 1 thinking is detected (as opposed to processes running in parallel as in FTT; Evans & Stanovich, 2013; Kahneman, 2011; Kahneman & Frederick, 2002). Type 2 processes not only include the cognitive capacities that tend to result in accurate judgments, but also the reflective capacities that monitor processing and determine if an override of automatic thinking is necessary, as captured in individual differences in constructs such as need for cognition (Stanovich, West, & Toplak, 2011, Figure 1).

Although there are a variety of other traditional dual process theories with varying details and theoretical differences, many common elements of these theories distinguish these two types of processes (for a summary, see Figure 1 in Kahneman, 2003). A recent review concluded that a common characteristic of dual process theories is that Type 1 processes do not require controlled attention and thus make minimal demands on working memory (Evans & Stanovich, 2013). This dual-process account allows for an association between experience and Type 1 processing by arguing that rules, principles, or tasks that have been practiced to the point of automaticity will become intuitive and automatic under Type 1 processes (Kahneman & Klein, 2009). This explanation, however, appears to be indistinct from purely associative processing (e.g., resulting from "implicit learning and conditioning," Evans & Stanovich, 2013, p.236), and does not predict a relationship between Type 1 processing and insight (Brainerd, Yang, Reyna, Howe, & Mills, 2008).

Past work on affective forecasting has placed the results in the context of construal level theory (Wilson & Gilbert, 2003). This theory has been used to explain differences in preferences between near-future events and distant-future events through differences in the levels of concrete details (Liberman, Sagristano, & Trope, 2002; Trope, & Liberman, 2003). The theory does not predict, however, any greater accuracy with higher levels of construal (i.e., fewer details). Instead, as was described above, level of detail or abstraction has an effect on choice through changes in gist memory representation, as those who focused on why people choose phones organized the information into cohesive gist memories that improved decisions. Drawing predictions from FTT also permits predictions regarding real-world outcomes. For example, it may be that focusing on global representations of well-being (such as life satisfaction or global happiness) as opposed to more ephemeral representations (such as momentary happiness) predict improvements in more objectively-defined outcomes, such as health, education, or financial state.

Global representations of well-being based on gist may have additional impact through a much more simple mechanism--people spend a great deal of time not focused on the details of their present environment. In a recent study of real-time reports of well-being from about 500 people, 46.9% of samples taken included a report of mind-wandering (Killingsworth & Gilbert, 2010). This suggests that a much of the time, people are not focused on the details of their current activities, and a good portion of this is likely to be because of reminiscing about the past or daydreaming about the future. If people spend much of their daily lives focused on the global gists that form the basis of overall happiness and life satisfaction instead of the verbatim detail of their experience, then it may be more important to focus people on enduring gist representations than judgments of specific levels of intensity of happiness when it comes to guiding people's

choices about their futures. As Daniel Kahneman summarized regarding predictions of future happiness, "nothing in life is as important as you think it is, while you are thinking about it." This may be because asking about intensity of in-the-moment happiness is the wrong question to ask—long-term happiness in retrospect, the digested gist of experience, may be what ultimately matters for well-being (Kahneman, 2011, p. 402).

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Uncorrected Effects and Means from Chapter 1

Experiment 1	df	F	p	η_p^2
EV	1	417.102	< .001	0.362
EV * CRT	3	5.486	0.001	0.022
Magnitude	1	7.465	0.006	0.01
Probability	1	194.526	< .001	0.209
Probability * BSSS * CRT	3	2.836	0.037	0.011
Product * EV	1	7.354	0.007	0.01
Product * Magnitude	1	14.166	< .001	0.019
Product * Magnitude * BSSS	1	11.805	0.001	0.016
EV * Magnitude	1	111.864	< .001	0.132
Product * EV * Magnitude	1	6.441	0.011	0.009
EV * Probability	1	5.236	0.022	0.007
Magnitude * Probability * BSSS	1	4.458	0.035	0.006
Product * Magnitude * Probability * BSSS * CRT	3	2.948	0.032	0.012
EV * Magnitude * Probability	1	11.796	0.001	0.016
CRT	3	6.718	< .001	0.027

Notes. Highest order interactions in bold. Error df = 736.

Experiment 2 – Binary Choice	df	F	p	η_p^2
Product	2	35.667	< .001	0.056
EV	1	1174.795	< .001	0.66
EV * CRT	3	23.684	< .001	0.105
Magnitude	1	50.049	< .001	0.077
Probability	1	96.057	< .001	0.137
Probability * BSSS * CRT	3	3.807	0.01	0.019
Product * EV	2	13.783	< .001	0.022
Product * Magnitude	2	15.48	< .001	0.025
Product * Magnitude * CRT	6	3.721	0.001	0.018
EV * Magnitude	1	497.664	< .001	0.452
EV * Magnitude * CRT	3	4.885	0.002	0.024
Product * EV * Magnitude	2	5.288	0.005	0.009
Product * EV * Magnitude * BSSS	2	3.341	0.036	0.006
Product * Probability	2	18.371	< .001	0.03
Product * Probability * BSSS	2	3.218	0.04	0.005
EV * Probability	1	84.608	< .001	0.123
Product * EV * Probability * BSSS * CRT	6	2.201	0.041	0.011
Magnitude * Probability	1	19.314	< .001	0.031
EV * Magnitude * Probability	1	103.598	< .001	0.146
EV * Magnitude * Probability * CRT	3	4.868	0.002	0.024

Notes. Highest order interactions in bold. Error df = 604.

Experiment 2 – Signed Confidence	df	F	p	η_p^2
Product	2	31.668	0	0.062
EV	1	928.347	0	0.661
EV * CRT	3	17.154	0	0.097
Magnitude	1	46.818	0	0.089
Probability	1	57.839	0	0.108
Product * EV	2	9.922	0	0.02
Product * Magnitude	2	15.241	0	0.031
Product * Magnitude * CRT	6	3.436	0.002	0.021
EV * Magnitude	1	482.634	0	0.503
EV * Magnitude * CRT	3	3.314	0.02	0.02
Product * EV * Magnitude	2	9.205	0	0.019
Product * Probability	2	24.063	0	0.048
EV * Probability	1	102.742	0	0.177
Magnitude * Probability	1	32.863	0	0.064
EV * Magnitude * Probability	1	115.521	0	0.195
BSSS	1	4.097	0.044	0.009

Notes. Highest order interactions in bold. Error df = 954.

BSSS	CRT	Product	EV	Magnitude	Probability	M	SE
Experiment 1 Means & SEs							
Low	0	Candy	Equal EV	1	⅓	0.248	0.062
					⅔	0.113	0.066
				6	⅓	0.186	0.057
					⅔	-0.086	0.065
			Unequal EV	1	⅓	0.034	0.066
					⅔	-0.283	0.064
				6	⅓	0.122	0.06
					⅔	-0.05	0.064
		Alcohol	Equal EV	1	⅓	0.293	0.063
					⅔	0.086	0.067
				6	⅓	0.213	0.06
					⅔	0.001	0.07
			Unequal EV	1	⅓	0.049	0.067
					⅔	-0.217	0.067
				6	⅓	0.051	0.065
					⅔	-0.09	0.066
	1	Candy	Equal EV	1	⅓	0.224	0.062
					⅔	0.066	0.066
				6	⅓	0.202	0.058
					⅔	-0.108	0.066
			Unequal EV	1	⅓	0.067	0.067
					⅔	-0.364	0.065
				6	⅓	0.051	0.06
					⅔	-0.123	0.064
		Alcohol	Equal EV	1	⅓	0.244	0.063
					⅔	0.051	0.067
				6	⅓	0.213	0.06
					⅔	0.036	0.071
			Unequal EV	1	⅓	-0.018	0.067
					⅔	-0.393	0.067
				6	⅓	0.069	0.065
					⅔	-0.196	0.067
	2	Candy	Equal EV	1	⅓	0.369	0.069
					⅔	0.054	0.074
				6	⅓	0.184	0.064
					⅔	0.116	0.073
			Unequal EV	1	⅓	0.068	0.074
					⅔	-0.37	0.072
				6	⅓	0.014	0.067
					⅔	-0.166	0.072
		Alcohol	Equal EV	1	⅓	0.353	0.071

					⅔	0.117	0.075
				6	⅓	0.274	0.068
					⅔	-0.078	0.079
			Unequal EV	1	⅓	-0.055	0.075
					⅔	-0.342	0.075
				6	⅓	0.058	0.073
					⅔	-0.274	0.074
	3	Candy	Equal EV	1	⅓	0.17	0.069
					⅔	0.01	0.074
				6	⅓	0.124	0.064
					⅔	-0.056	0.073
			Unequal EV	1	⅓	-0.174	0.074
					⅔	-0.465	0.072
				6	⅓	-0.083	0.067
					⅔	-0.188	0.072
		Alcohol	Equal EV	1	⅓	0.26	0.071
					⅔	-0.137	0.075
				6	⅓	0.169	0.068
					⅔	-0.024	0.079
			Unequal EV	1	⅓	-0.205	0.075
					⅔	-0.438	0.075
				6	⅓	-0.151	0.073
					⅔	-0.356	0.074
High	0	Candy	Equal EV	1	⅓	0.292	0.055
					⅔	0.057	0.058
				6	⅓	0.304	0.051
					⅔	-0.105	0.058
			Unequal EV	1	⅓	0.116	0.059
					⅔	-0.486	0.057
				6	⅓	0.263	0.053
					⅔	-0.144	0.056
		Alcohol	Equal EV	1	⅓	0.342	0.055
					⅔	0.102	0.059
				6	⅓	0.331	0.053
					⅔	-0.087	0.062
			Unequal EV	1	⅓	0.089	0.059
					⅔	-0.373	0.059
				6	⅓	0.142	0.057
					⅔	-0.259	0.058
	1	Candy	Equal EV	1	⅓	0.207	0.061
					⅔	-0.018	0.064
				6	⅓	0.212	0.056
					⅔	-0.049	0.064

		Unequal EV	1	⅓	-0.071	0.065
				⅔	-0.358	0.063
			6	⅓	0.166	0.058
				⅔	-0.185	0.062
	Alcohol	Equal EV	1	⅓	0.344	0.062
				⅔	0.008	0.066
			6	⅓	0.227	0.059
				⅔	-0.18	0.069
		Unequal EV	1	⅓	0.025	0.065
				⅔	-0.325	0.065
			6	⅓	-0.001	0.063
				⅔	-0.388	0.065
2	Candy	Equal EV	1	⅓	0.192	0.058
				⅔	0.077	0.061
			6	⅓	0.208	0.054
				⅔	-0.025	0.061
		Unequal EV	1	⅓	-0.262	0.062
				⅔	-0.424	0.06
			6	⅓	0.027	0.056
				⅔	-0.109	0.06
	Alcohol	Equal EV	1	⅓	0.308	0.059
				⅔	0.08	0.063
			6	⅓	0.067	0.056
				⅔	-0.112	0.066
		Unequal EV	1	⅓	-0.159	0.062
				⅔	-0.386	0.063
			6	⅓	-0.073	0.06
				⅔	-0.241	0.062
3	Candy	Equal EV	1	⅓	0.175	0.061
				⅔	0.042	0.064
			6	⅓	0.239	0.056
				⅔	0.058	0.064
		Unequal EV	1	⅓	-0.233	0.065
				⅔	-0.46	0.063
			6	⅓	0.016	0.058
				⅔	-0.184	0.062
	Alcohol	Equal EV	1	⅓	0.219	0.062
				⅔	0.024	0.066
			6	⅓	0.208	0.059
				⅔	0.03	0.069
		Unequal EV	1	⅓	-0.197	0.065
				⅔	-0.417	0.065
			6	⅓	-0.147	0.063

| | ⅔ | -0.271 | 0.065 |

BSSS	CRT	Product	EV	Magnitude	Probability	M	SE
Experiment 2 Binary Choice Means & SEs							
Low	0	Candy	Equal EV	1	⅓	0.47	0.07
					⅔	0.145	0.07
				6	⅓	0.301	0.071
					⅔	-0.024	0.074
			Unequal EV	1	⅓	0.036	0.077
					⅔	-0.253	0.068
				6	⅓	0.084	0.075
					⅔	-0.277	0.073
		Alcohol	Equal EV	1	⅓	0.349	0.066
					⅔	0.193	0.067
				6	⅓	0.241	0.071
					⅔	-0.108	0.079
			Unequal EV	1	⅓	-0.048	0.076
					⅔	-0.41	0.07
				6	⅓	0.157	0.076
					⅔	-0.325	0.074
		Money	Equal EV	1	⅓	0.373	0.074
					⅔	0.398	0.068
				6	⅓	0.133	0.077
					⅔	-0.12	0.079
			Unequal EV	1	⅓	-0.12	0.078
					⅔	-0.373	0.066
				6	⅓	0	0.077
					⅔	-0.205	0.072
	1	Candy	Equal EV	1	⅓	0.362	0.076
					⅔	0.29	0.077
				6	⅓	0.377	0.078
					⅔	0.014	0.081
			Unequal EV	1	⅓	0.101	0.085
					⅔	-0.536	0.075
				6	⅓	0.188	0.083
					⅔	-0.377	0.08
		Alcohol	Equal EV	1	⅓	0.435	0.072
					⅔	0.333	0.074
				6	⅓	0.304	0.078
					⅔	-0.159	0.087
			Unequal EV	1	⅓	0.087	0.084
					⅔	-0.478	0.076
				6	⅓	0.145	0.083
					⅔	-0.275	0.081
		Money	Equal EV	1	⅓	0.333	0.081

				⅔	0.348	0.074
			6	⅓	0.159	0.084
				⅔	-0.014	0.087
		Unequal EV	1	⅓	-0.203	0.086
				⅔	-0.449	0.072
			6	⅓	-0.087	0.084
				⅔	-0.319	0.079
2	Candy	Equal EV	1	⅓	0.439	0.078
				⅔	0.424	0.079
			6	⅓	0.424	0.08
				⅔	0.273	0.083
		Unequal EV	1	⅓	0.061	0.087
				⅔	-0.273	0.076
			6	⅓	0.242	0.085
				⅔	-0.076	0.081
	Alcohol	Equal EV	1	⅓	0.485	0.074
				⅔	0.545	0.076
			6	⅓	0.242	0.079
				⅔	-0.061	0.089
		Unequal EV	1	⅓	-0.03	0.086
				⅔	-0.227	0.078
			6	⅓	0.061	0.085
				⅔	-0.136	0.083
	Money	Equal EV	1	⅓	0.318	0.083
				⅔	0.545	0.076
			6	⅓	$1.00\text{E-}13$	0.086
				⅔	-0.045	0.089
		Unequal EV	1	⅓	-0.333	0.088
				⅔	-0.303	0.074
			6	⅓	-0.258	0.086
				⅔	-0.258	0.08
3	Candy	Equal EV	1	⅓	0.366	0.07
				⅔	0.439	0.071
			6	⅓	0.329	0.072
				⅔	0.024	0.074
		Unequal EV	1	⅓	-0.085	0.078
				⅔	-0.512	0.069
			6	⅓	$-1.00\text{E-}13$	0.076
				⅔	-0.183	0.073

		Alcohol	Equal EV	1	⅓	0.585	0.066
					⅔	0.537	0.068
				6	⅓	0.28	0.071
					⅔	0.049	0.079
			Unequal EV	1	⅓	0.024	0.077
					⅔	-0.415	0.07
				6	⅓	-0.11	0.077
					⅔	-0.28	0.075
		Money	Equal EV	1	⅓	0.402	0.075
					⅔	0.573	0.068
				6	⅓	0.207	0.077
					⅔	0.049	0.08
			Unequal EV	1	⅓	-0.317	0.079
					⅔	-0.634	0.066
				6	⅓	-0.183	0.077
					⅔	-0.354	0.072
High	0	Candy	Equal EV	1	⅓	0.455	0.072
					⅔	0.351	0.073
				6	⅓	0.234	0.074
					⅔	0.052	0.077
			Unequal EV	1	⅓	0.091	0.08
					⅔	-0.299	0.071
				6	⅓	0.117	0.078
					⅔	-0.143	0.075
		Alcohol	Equal EV	1	⅓	0.299	0.069
					⅔	0.13	0.07
				6	⅓	0.208	0.074
					⅔	-0.039	0.082
			Unequal EV	1	⅓	0.078	0.079
					⅔	-0.208	0.072
				6	⅓	0.182	0.079
					⅔	-0.156	0.077
		Money	Equal EV	1	⅓	0.273	0.077
					⅔	0.351	0.07
				6	⅓	0.13	0.08
					⅔	-0.234	0.082
			Unequal EV	1	⅓	-0.091	0.081
					⅔	-0.26	0.068
				6	⅓	-0.078	0.08
					⅔	-0.325	0.074
	1	Candy	Equal EV	1	⅓	0.342	0.074
					⅔	0.411	0.075
				6	⅓	0.205	0.076

				⅔	-0.014	0.079
		Unequal EV	1	⅓	-0.014	0.083
				⅔	-0.356	0.073
			6	⅓	-0.041	0.08
				⅔	-0.11	0.077
	Alcohol	Equal EV	1	⅓	0.452	0.07
				⅔	0.452	0.072
			6	⅓	0.219	0.076
				⅔	-0.014	0.084
		Unequal EV	1	⅓	-0.055	0.081
				⅔	-0.37	0.074
			6	⅓	-0.096	0.081
				⅔	-0.301	0.079
	Money	Equal EV	1	⅓	0.247	0.079
				⅔	0.616	0.072
			6	⅓	0.027	0.082
				⅔	-0.096	0.085
		Unequal EV	1	⅓	-0.233	0.083
				⅔	-0.452	0.07
			6	⅓	-0.233	0.082
				⅔	-0.384	0.076
2	Candy	Equal EV	1	⅓	0.417	0.069
				⅔	0.369	0.07
			6	⅓	0.274	0.071
				⅔	-0.012	0.074
		Unequal EV	1	⅓	-0.083	0.077
				⅔	-0.524	0.068
			6	⅓	0.143	0.075
				⅔	-0.214	0.072
	Alcohol	Equal EV	1	⅓	0.536	0.066
				⅔	0.417	0.067
			6	⅓	0.381	0.07
				⅔	-0.107	0.078
		Unequal EV	1	⅓	-0.012	0.076
				⅔	-0.488	0.069
			6	⅓	0.167	0.076
				⅔	-0.369	0.074
	Money	Equal EV	1	⅓	0.429	0.074
				⅔	0.429	0.067
			6	⅓	0.012	0.076
				⅔	-0.19	0.079
		Unequal EV	1	⅓	-0.226	0.078
				⅔	-0.631	0.065

			6	⅓	-0.25	0.076
				⅔	-0.452	0.071
3	Candy	Equal EV	1	⅓	0.333	0.072
				⅔	0.436	0.073
			6	⅓	0.295	0.074
				⅔	0.128	0.076
		Unequal EV	1	⅓	-0.333	0.08
				⅔	-0.615	0.07
			6	⅓	-0.103	0.078
				⅔	-0.192	0.075
	Alcohol	Equal EV	1	⅓	0.487	0.068
				⅔	0.577	0.069
			6	⅓	0.192	0.073
				⅔	0.051	0.081
		Unequal EV	1	⅓	-0.359	0.079
				⅔	-0.538	0.072
			6	⅓	-0.179	0.078
				⅔	-0.269	0.077
	Money	Equal EV	1	⅓	0.346	0.077
				⅔	0.397	0.07
			6	⅓	0.179	0.079
				⅔	-0.026	0.082
		Unequal EV	1	⅓	-0.41	0.081
				⅔	-0.705	0.068
			6	⅓	-0.372	0.079
				⅔	-0.385	0.074

BSSS	CRT	Product	EV	Magnitude	Probability	M	SE
Experiment 2 Signed Confidence Means & SEs							
Low	0	Candy	Equal EV	1	⅓	3.969	0.576
					⅔	1.446	0.626
				6	⅓	2.615	0.577
					⅔	0.031	0.616
			Unequal EV	1	⅓	0.185	0.663
					⅔	-2.123	0.573
				6	⅓	1	0.625
					⅔	-1.723	0.615
		Alcohol	Equal EV	1	⅓	2.954	0.572
					⅔	1.877	0.605
				6	⅓	1.831	0.575
					⅔	-0.877	0.66
			Unequal EV	1	⅓	-0.2	0.664
					⅔	-3.154	0.616
				6	⅓	1.677	0.638
					⅔	-2.354	0.621
		Money	Equal EV	1	⅓	2.954	0.615
					⅔	3.538	0.605
				6	⅓	1.231	0.614
					⅔	-0.723	0.649
			Unequal EV	1	⅓	-1.185	0.664
					⅔	-3.062	0.57
				6	⅓	-0.031	0.639
					⅔	-1.031	0.597
	1	Candy	Equal EV	1	⅓	3.164	0.626
					⅔	2.582	0.68
				6	⅓	2.891	0.627
					⅔	-0.164	0.67
			Unequal EV	1	⅓	1.145	0.72
					⅔	-3.727	0.622
				6	⅓	1.273	0.679
					⅔	-2.873	0.668
		Alcohol	Equal EV	1	⅓	3.509	0.622
					⅔	2.873	0.658
				6	⅓	2.782	0.625
					⅔	-0.909	0.717
			Unequal EV	1	⅓	0.891	0.722
					⅔	-3.218	0.67
				6	⅓	1.982	0.694

				⅔	-1.418	0.675
	Money	Equal EV	1	⅓	2.636	0.669
				⅔	3.2	0.657
			6	⅓	1.036	0.667
				⅔	-0.127	0.705
		Unequal EV	1	⅓	-1.891	0.722
				⅔	-2.673	0.619
			6	⅓	-0.8	0.695
				⅔	-2.218	0.649
2	Candy	Equal EV	1	⅓	3.49	0.65
				⅔	3.961	0.707
			6	⅓	3.176	0.651
				⅔	2.275	0.696
		Unequal EV	1	⅓	0.98	0.748
				⅔	-1.588	0.646
			6	⅓	2.078	0.705
				⅔	-0.059	0.694
	Alcohol	Equal EV	1	⅓	3.902	0.646
				⅔	5.137	0.683
			6	⅓	2.02	0.649
				⅔	-0.392	0.745
		Unequal EV	1	⅓	0.412	0.75
				⅔	-1.706	0.696
			6	⅓	0.51	0.72
				⅔	-1.353	0.701
	Money	Equal EV	1	⅓	3.294	0.695
				⅔	4.961	0.683
			6	⅓	-0.039	0.693
				⅔	-0.196	0.733
		Unequal EV	1	⅓	-1.843	0.749
				⅔	-1.451	0.643
			6	⅓	-1.196	0.722
				⅔	-1.569	0.674
3	Candy	Equal EV	1	⅓	2.406	0.559
				⅔	3.783	0.607
			6	⅓	2.725	0.56
				⅔	0.71	0.598
		Unequal EV	1	⅓	-0.899	0.643
				⅔	-3.87	0.556
			6	⅓	0.246	0.606
				⅔	-0.899	0.597
	Alcoho	Equal EV	1	⅓	4.42	0.555

				1			
					⅔	4.551	0.587
				6	⅓	2	0.558
					⅔	0.406	0.641
			Unequal EV	1	⅓	-0.261	0.645
					⅔	-3.101	0.598
				6	⅓	-0.899	0.619
					⅔	-2	0.603
		Money	Equal EV	1	⅓	3.029	0.597
					⅔	4.913	0.587
				6	⅓	1.232	0.596
					⅔	0.652	0.63
			Unequal EV	1	⅓	-2.536	0.644
					⅔	-4.928	0.553
				6	⅓	-1.377	0.62
					⅔	-2.42	0.58
High	0	Candy	Equal EV	1	⅓	3.058	0.644
					⅔	3.231	0.7
				6	⅓	2.462	0.645
					⅔	0.058	0.689
			Unequal EV	1	⅓	0.558	0.741
					⅔	-2.135	0.64
				6	⅓	1.385	0.698
					⅔	-1.173	0.687
		Alcohol	Equal EV	1	⅓	2.423	0.64
					⅔	1.712	0.676
				6	⅓	2.558	0.643
					⅔	-0.077	0.738
			Unequal EV	1	⅓	1.212	0.743
					⅔	-2.154	0.689
				6	⅓	2.058	0.713
					⅔	-1.423	0.695
		Money	Equal EV	1	⅓	2.558	0.688
					⅔	3.192	0.676
				6	⅓	0.904	0.686
					⅔	-1.904	0.725
			Unequal EV	1	⅓	-0.096	0.742
					⅔	-1.942	0.637
				6	⅓	-0.462	0.715
					⅔	-2.019	0.668
	1	Candy	Equal EV	1	⅓	2.371	0.59
					⅔	3.79	0.641

			6	⅓	1.5	0.59
				⅔	0.113	0.631
		Unequal EV	1	⅓	-0.581	0.678
				⅔	-2.758	0.586
			6	⅓	-0.452	0.639
				⅔	-1.016	0.63
	Alcohol	Equal EV	1	⅓	3.661	0.586
				⅔	4.161	0.62
			6	⅓	1.968	0.589
				⅔	0.097	0.676
		Unequal EV	1	⅓	-0.532	0.68
				⅔	-2.903	0.631
			6	⅓	-0.887	0.653
				⅔	-2.226	0.636
	Money	Equal EV	1	⅓	1.984	0.63
				⅔	5.532	0.619
			6	⅓	-0.258	0.629
				⅔	-0.694	0.664
		Unequal EV	1	⅓	-2.274	0.68
				⅔	-3.339	0.583
			6	⅓	-2.032	0.655
				⅔	-3.016	0.611
2	Candy	Equal EV	1	⅓	2.906	0.58
				⅔	3.531	0.631
			6	⅓	2.125	0.581
				⅔	0.406	0.621
		Unequal EV	1	⅓	-0.469	0.668
				⅔	-3.281	0.577
			6	⅓	0.828	0.629
				⅔	-1.609	0.62
	Alcohol	Equal EV	1	⅓	3.484	0.577
				⅔	3.578	0.61
			6	⅓	3.703	0.58
				⅔	0.297	0.665
		Unequal EV	1	⅓	-0.438	0.67
				⅔	-3.188	0.621
			6	⅓	1.578	0.643
				⅔	-1.781	0.626
	Money	Equal EV	1	⅓	2.766	0.62
				⅔	4.188	0.609
			6	⅓	-0.203	0.619

				⅔	-0.656	0.654
		Unequal EV	1	⅓	-2.031	0.669
				⅔	-4.844	0.574
			6	⅓	-1.875	0.644
				⅔	-2.734	0.602
3	Candy	Equal EV	1	⅓	2.761	0.567
				⅔	3.716	0.616
			6	⅓	2.134	0.568
				⅔	0.94	0.607
		Unequal EV	1	⅓	-2.791	0.653
				⅔	-4.672	0.564
			6	⅓	-0.746	0.615
				⅔	-1.388	0.606
	Alcohol	Equal EV	1	⅓	3.746	0.564
				⅔	4.806	0.596
			6	⅓	1.507	0.567
				⅔	-0.045	0.65
		Unequal EV	1	⅓	-2.567	0.654
				⅔	-4.179	0.607
			6	⅓	-1.179	0.628
				⅔	-2.597	0.612
	Money	Equal EV	1	⅓	2.343	0.606
				⅔	3.522	0.596
			6	⅓	0.866	0.605
				⅔	-0.313	0.639
		Unequal EV	1	⅓	-3.149	0.654
				⅔	-5.582	0.561
			6	⅓	-2.925	0.63
				⅔	-2.806	0.588

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APPENDIX B

Original Survey Items

You are invited to participate in a research study of risk and decision making. You were selected as a possible participant because you are 18 years of age or older and can understand and respond to a questionnaire written in English. Please read this form carefully and ask any questions you may have before agreeing to take part in the study. What the study is about:The purpose of this study is to understand how people make decisions that involve risks. What we will ask you to do: If you agree to be in this study, we will ask you to do the following: Respond to a written questionnaire about how you view various risks and decisions (as well as provide background information). The questionnaire usually takes about 30 minutes to complete(although some people may take longer). Risks and Benefits: We do not anticipate any risks for you participating in this study other than those encountered in day-to-day life. There are no direct benefits to participating other than the possibility that some people may gain greater insight into their own thinking and decision making. Indirect benefits to participation include contribution to scientific knowledge, which the investigator hopes will ultimately improve risk communication and healthy decision making. Compensation: You may earn extra credit if you are taking a class that offers credit for research studies. The class instructor will assign credit according to class policy. Taking part is voluntary:Taking part in this study is completely voluntary. You may skip any questions that you do not want to answer. If you decide not to take part or to skip some of the questions, it will not affect your current or future relationship with Cornell University. If you decide to take part, you are free to withdraw at anytime. You are free to stop at any time for any reason. Your answers will be confidential: The records of this study will be kept private. In any sort of report we make public, we will not include any information that will make it reasonably possible to identify you. Research records will be kept in a locked file or office, and on computers used for data storage and analysis; only the researchers or other authorized individuals will have access to the records. Your data may also be used for educational purposes such as teaching, publications,and/or presentations and may be viewed by students, other trainees, and professional colleagues. If you have questions:The researcher(s) conducting this study is Dr. Valerie Reyna. Please ask any questions you have now. If you have questions later, you may contact the investigator by telephone at (607) 254-1172;by email at vr53@cornell.edu; and by mail at Department of Human Development, MVR B44, Cornell University, Ithaca, NY 14853. If you have any questions or concerns regarding your rights as a subject in this study, you may contact the Institutional Review Board at 607-255-5138, or access their website at http://www.irb.cornell.edu/. You may also report your concerns or complaints anonymously through Ethicspoint or by calling toll free at 1-866-293-3077. Ethicspoint is an independent organization that serves as a liaison between the University and the person bringing the complaint so that anonymity can be ensured. Statement of Consent:I have read the above information, and have received answers to any questions I asked. I consent to take part in the study. Please select an option below:

❍ I am 18 years or older and I agree to participate in this study.

❍ I do not agree to participate in this study.

Thank you so much for volunteering to be in our study, helping us to better understand how people make decisions. It is important that you respond to all items by circling only one

choice. We are interested only in your likes or feelings, not in how others feel about these things or how one is supposed to feel. There are no right or wrong answers as in other kinds of tests. Do not put your name anywhere on the survey. Please be honest (we won't know who you are). It is much better to give your best guess than to skip a question. Base your answers on what you would really do in real life. You can withdraw at any time without causing bad feelings. Feel free to ask questions if anything is unclear. Treat each decision separately, as though you were making only that one decision.

Thank you so much for volunteering to be in our study, helping us to better understand how people make decisions. It is important that you respond to all items by circling only one choice. We are interested only in your likes or feelings, not in how others feel about these things or how one is supposed to feel. There are no right or wrong answers as in other kinds of tests. Do not put your name anywhere on the survey. Please be honest (we won't know who you are). It is much better to give your best guess than to skip a question. Base your answers on what you would really do in real life. You can withdraw at any time without causing bad feelings. Feel free to ask questions if anything is unclear. Treat each decision separately, as though you were making only that one decision.

DGDECISIONS: Assume that a "drink" means one small alcoholic drink of your choice (beer, wine or liquor). If you do not drink alcohol, imagine another type of beverage you enjoy. You do not have to drink everything in one sitting; assume that you can take it with you in unopened containers. Remember, we won't know who you are, so answer honestly. Treat each decision separately, as though you were making only that one decision. Please answer every question; better to guess than to leave it blank.

Which would you choose?		How confident are you in your decision?				
6 drinks for sure.	A 2/3 chance of getting 9 drinks and a 1/3 chance of getting nothing.	Not at all 1	Low 2	Medium 3	High 4	Completely5
○	○	○	○	○	○	○

	Which would you choose?		How confident are you in your decision?				
1 drink for sure. ○	A 2/3 chance of getting 3 drinks and a 1/3 chance of getting nothing. ○	Not at all 1 ○	Low 2 ○	Medium 3 ○	High 4 ○	Completely5 ○	

	Which would you choose?		How confident are you in your decision?				
1 drink for sure. ○	A 1/3 chance of getting 6 drinks and a 2/3 chance of getting nothing. ○	Not at all 1 ○	Low 2 ○	Medium 3 ○	High 4 ○	Completely5 ○	

Which would you choose?		How confident are you in your decision?				
6 drinks for sure.	A 2/3 chance of getting 10 and a half drinks and a 1/3 chance of getting nothing.	Not at all 1	Low 2	Medium 3	High 4	Completely5
○	○	○	○	○	○	○

Which would you choose?		How confident are you in your decision?				
6 drinks for sure.	A 1/3 chance of getting 18 drinks and a 2/3 chance of getting nothing.	Not at all 1	Low 2	Medium 3	High 4	Completely5
○	○	○	○	○	○	○

	Which would you choose?		How confident are you in your decision?				
	1 drink for sure.	A 1/3 chance of getting 3 drinks and a 2/3 chance of getting nothing.	Not at all 1	Low 2	Medium	High	Completely
	○	○	○	○	○	○	○

	Which would you choose?		How confident are you in your decision?				
	1 drink for sure.	A 2/3 chance of getting 1 and a half drinks and a 1/3 chance of getting nothing.	Not at all 1	Low 2	Medium 3	High 4	Completely5
	○	○	○	○	○	○	○

	Which would you choose?		How confident are you in your decision?				
6 drinks for sure.	A 1/3 chance of getting 21 drinks and a 2/3 chance of getting nothing.	Not at all 1	Low 2	Medium 3	High 4	Completely5
❍	❍	❍	❍	❍	❍	❍

DLDECISIONS: Assume that a "drink" means one small alcoholic drink of your choice (beer, wine or liquor). If you do not drink alcohol, imagine another type of beverage you enjoy. You do not have to drink everything in one sitting; assume that you can take it with you in unopened containers. Remember, we won't know who you are, so answer honestly. Treat each decision separately, as though you were making only that one decision. Please answer every question; better to guess than to leave it blank.

	Which would you choose?		How confident are you in your decision?				
Lose 1 drink for sure.	A 2/3 chance of losing 1 and a half drinks and a 1/3 chance of losing nothing.	Not at all 1	Low 2	Medium 3	High 4	Completely5
❍	❍	❍	❍	❍	❍	❍

	Which would you choose?		How confident are you in your decision?				
	Lose 1 drink for sure.	A 1/3 chance of losing 3 drinks and a 2/3 chance of losing nothing.	Not at all 1	Low 2	Medium 3	High 4	Completely 5
	❍	❍	❍	❍	❍	❍	❍

	Which would you choose?		How confident are you in your decision?				
	Lose 6 drinks for sure.	A 1/3 chance of losing 18 drinks and a 2/3 chance of losing nothing.	Not at all 1	Low 2	Medium 3	High 4	Completely 5
	❍	❍	❍	❍	❍	❍	❍

	Which would you choose?		How confident are you in your decision?				
	Lose 1 drink for sure.	A 1/3 chance of losing 6 drinks and a 2/3 chance of losing nothing.	Not at all 1	Low 2	Medium 3	High 4	Completely 5
	❍	❍	❍	❍	❍	❍	❍

	Which would you choose?		How confident are you in your decision?				
	Lose 6 drinks for sure.	A 2/3 chance of losing 10 and a half drinks and a 1/3 chance of losing nothing.	Not at all 1	Low 2	Medium 3	High 4	Completely5
	❍	❍	❍	❍	❍	❍	❍

	Which would you choose?		How confident are you in your decision?				
	Lose 6 drinks for sure.	A 1/3 chance of losing 21 drinks and a 2/3 chance of losing nothing.	Not at all 1	Low 2	Medium 3	High 4	Completely5
	❍	❍	❍	❍	❍	❍	❍

	Which would you choose?		How confident are you in your decision?				
	Lose 1 drink for sure.	A 2/3 chance of losing 3 drinks and a 1/3 chance of losing nothing.	Not at all 1	Low 2	Medium 3	High 4	Completely 5
	❍	❍	❍	❍	❍	❍	❍

	Which would you choose?		How confident are you in your decision?				
	Lose 6 drinks for sure.	A 2/3 chance of losing 9 drinks and a 1/3 chance of losing nothing.	Not at all 1	Low 2	Medium 3	High 4	Completely 5
	❍	❍	❍	❍	❍	❍	❍

CG DECISIONS: Assume that a "candy bar" means one small (fun size, treat size, or snack size) candy bar of your choice. You do not have to eat everything in one sitting; assume that you can take it with you in unopened containers. Treat each decision separately, as though you were making only that one decision. Remember, we won't know who you are, so answer honestly. Please answer every question; better to guess than to leave it blank.

	Which would you choose?		How confident are you in your decision?				
	1 candy bar for sure.	A 1/3 chance of getting 3 candy bars and a 2/3 chance of getting nothing.	Not at all 1	Low 2	Medium 3	High 4	Completely5
	❍	❍	❍	❍	❍	❍	❍

	Which would you choose?		How confident are you in your decision?				
	1 candy bar for sure.	A 1/3 chance of getting 6 candy bars and a 2/3 chance of getting nothing.	Not at all 1	Low 2	Medium 3	High 4	Completely5
	❍	❍	❍	❍	❍	❍	❍

	Which would you choose?		How confident are you in your decision?				
	1 candy bar for sure.	A 2/3 chance of getting 1 and a half candy bars and a 1/3 chance of getting nothing.	Not at all 1	Low 2	Medium 3	High 4	Completely5
	❍	❍	❍	❍	❍	❍	❍

	Which would you choose?		How confident are you in your decision?				
	1 candy bar for sure.	A 2/3 chance of getting 3 candy bars and a 1/3 chance of getting	Not at all 1	Low 2	Medium 3	High 4	Completely5
	❍	❍	❍	❍	❍	❍	❍

	Which would you choose?		How confident are you in your decision?				
	6 candy bars for sure.	A 1/3 chance of getting 18 candy bars and a 2/3 chance of getting nothing.	Not at all 1	Low 2	Medium 3	High 4	Completely5
	❍	❍	❍	❍	❍	❍	❍

	Which would you choose?		How confident are you in your decision?				
	6 candy bars for sure.	A 1/3 chance of getting 21 candy bars and a 2/3 chance of getting nothing.	Not at all 1	Low 2	Medium 3	High 4	Completely5
	❍	❍	❍	❍	❍	❍	❍

	Which would you choose?	How confident are you in your decision?				
6 candy bars for sure.	A 2/3 chance of getting 9 candy bars and a 1/3 chance of getting nothing.	Not at all 1	Low 2	Medium 3	High 4	Completely5
○	○	○	○	○	○	○

	Which would you choose?	How confident are you in your decision?				
6 candy bars for sure.	A 2/3 chance of getting 10 and a half candy bars and a 1/3 chance of getting nothing.	Not at all 1	Low 2	Medium 3	High 4	Completely5
○	○	○	○	○	○	○

CL DECISIONS: Assume that a "candy bar" means one small (fun size, treat size, or snack size) candy bar of your choice. You do not have to eat everything in one sitting; assume that you can take it with you in unopened containers. Treat each decision separately, as though you were making only that one decision. Remember, we won't know who you are, so answer honestly. Please answer every question; better to guess than to leave it blank.

	Which would you choose?		How confident are you in your decision?				
	Lose 1 candy bar for sure.	A 1/3 chance of losing 6 candy bars and a 2/3 chance of losing nothing.	Not at all 1	Low 2	Medium 3	High 4	Completely5
	❍	❍	❍	❍	❍	❍	❍

	Which would you choose?		How confident are you in your decision?				
	Lose 6 candy bars for sure.	A 2/3 chance of losing 9 candy bars and a 1/3 chance of losing nothing.	Not at all 1	Low 2	Medium 3	High 4	Completely5
	❍	❍	❍	❍	❍	❍	❍

Which would you choose?		How confident are you in your decision?				
Lose 1 candy bar for sure.	A 2/3 chance of losing 1 and a half candy bars and a 1/3 chance of losing nothing.	Not at all 1	Low 2	Medium 3	High 4	Completely5
❍	❍	❍	❍	❍	❍	❍

Which would you choose?		How confident are you in your decision?				
Lose 1 candy bar for sure.	A 1/3 chance of losing 3 candy bars and a 2/3 chance of losing nothing.	Not at all 1	Low 2	Medium 3	High 4	Completely5
❍	❍	❍	❍	❍	❍	❍

	Which would you choose?		How confident are you in your decision?				
Lose 6 candy bars for sure.	A 2/3 chance of losing 10 and a half candy bars and a 1/3 chance of losing nothing.	Not at all 1	Low 2	Medium 3	High 4	Completely5
❍	❍	❍	❍	❍	❍	❍

	Which would you choose?		How confident are you in your decision?				
Lose 6 candy bars for sure.	A 1/3 chance of losing 18 candy bars and a 2/3 chance of losing nothing.	Not at all 1	Low 2	Medium 3	High 4	Completely5
❍	❍	❍	❍	❍	❍	❍

Which would you choose?		How confident are you in your decision?				
Lose 6 candy bars for sure.	A 1/3 chance of losing 21 candy bars and a 2/3 chance of losing nothing.	Not at all 1	Low 2	Medium 3	High 4	Completely5
○	○	○	○	○	○	○

Which would you choose?		How confident are you in your decision?				
Lose 1 candy bar for sure.	A 2/3 chance of losing 3 candy bars and a 1/3 chance of losing nothing.	Not at all 1	Low 2	Medium 3	High 4	Completely5
○	○	○	○	○	○	○

MGDECISIONS: Assume that dollar values represent exact values in cash and that you can take it with you. Treat each decision separately, as though you were making only that one decision. Remember, we won't know who you are, so answer honestly. Please answer every question; better to guess than to leave it blank.

Which would you choose?		How confident are you in your decision?				
$1 for sure.	A 1/3 chance of getting $3 and a 2/3 chance of getting nothing.	Not at all 1	Low 2	Medium 3	High 4	Completely5
❍	❍	❍	❍	❍	❍	❍

Which would you choose?		How confident are you in your decision?				
$6 for sure.	A 2/3 chance of getting $10.50 and a 1/3 chance of getting nothing.	Not at all 1	Low 2	Medium 3	High 4	Completely5
❍	❍	❍	❍	❍	❍	❍

	Which would you choose?		How confident are you in your decision?				
$1 for sure.	A 2/3 chance of getting $3 and a 1/3 chance of getting nothing.	Not at all 1	Low 2	Medium 3	High 4	Completely5
○	○	○	○	○	○	○

	Which would you choose?		How confident are you in your decision?				
$1 for sure.	A 1/3 chance of getting $6 and a 2/3 chance of getting nothing.	Not at all 1	Low 2	Medium 3	High 4	Completely5
○	○	○	○	○	○	○

	Which would you choose?	How confident are you in your decision?				
$1 for sure. ○	A 2/3 chance of getting $1.50 and a 1/3 chance of getting nothing. ○	Not at all 1 ○	Low 2 ○	Medium 3 ○	High 4 ○	Completely 5 ○

	Which would you choose?	How confident are you in your decision?				
$6 for sure. ○	A 1/3 chance of getting $21 and a 2/3 chance of getting nothing. ○	Not at all 1 ○	Low 2 ○	Medium 3 ○	High 4 ○	Completely 5 ○

Which would you choose?		How confident are you in your decision?				
$6 for sure.	A 1/3 chance of getting $18 and a 2/3 chance of getting nothing.	Not at all 1	Low 2	Medium 3	High 4	Completely5
○	○	○	○	○	○	○

Which would you choose?		How confident are you in your decision?				
$6 for sure.	A 2/3 chance of getting $9 and a 1/3 chance of getting nothing.	Not at all 1	Low 2	Medium 3	High 4	Completely5
○	○	○	○	○	○	○

MLDECISIONS: Assume that dollar values represent exact values in cash and that you can take it with you. Treat each decision separately, as though you were making only that one decision. Remember, we won't know who you are, so answer honestly. Please answer every question; better to guess than to leave it blank.

Which would you choose?		How confident are you in your decision?				
Lose $1 for sure.	A 1/3 chance of losing $6 and a 2/3 chance of losing nothing.	Not at all 1	Low 2	Medium 3	High 4	Completely5
○	○	○	○	○	○	○

Which would you choose?		How confident are you in your decision?				
Lose $1 for sure.	A 1/3 chance of losing $3 and a 2/3 chance of losing nothing.	Not at all 1	Low 2	Medium 3	High 4	Completely5
○	○	○	○	○	○	○

Which would you choose?		How confident are you in your decision?				
Lose $6 for sure.	A 1/3 chance of losing $18 and a 2/3 chance of losing nothing.	Not at all 1	Low 2	Medium 3	High 4	Completely5
○	○	○	○	○	○	○

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	Which would you choose?		How confident are you in your decision?				
	Lose $6 for sure.	A 2/3 chance of losing $9 and a 1/3 chance of losing nothing.	Not at all 1	Low 2	Medium 3	High 4	Completely5
	❍	❍	❍	❍	❍	❍	❍

	Which would you choose?		How confident are you in your decision?				
	Lose $6 for sure.	A 2/3 chance of losing $10.50 and a 1/3 chance of losing nothing.	Not at all 1	Low 2	Medium 3	High 4	Completely5
	❍	❍	❍	❍	❍	❍	❍

	Which would you choose?		How confident are you in your decision?				
	Lose $6 for sure.	A 1/3 chance of losing $21 and a 2/3 chance of losing nothing.	Not at all 1	Low 2	Medium 3	High 4	Completely5
	❍	❍	❍	❍	❍	❍	❍

	Which would you choose?		How confident are you in your decision?				
	Lose $1 for sure.	A 2/3 chance of losing $3 and a 1/3 chance of losing nothing.	Not at all 1	Low 2	Medium 3	High 4	Completely5
	❍	❍	❍	❍	❍	❍	❍

	Which would you choose?		How confident are you in your decision?				
	Lose $1 for sure.	A 2/3 chance of losing $1.50 and a 1/3 chance of losing nothing.	Not at all 1	Low 2	Medium 3	High 4	Completely5
	❍	❍	❍	❍	❍	❍	❍

DTDECISIONS: Assume that a "drink" means one small alcoholic drink of your choice (beer, wine or liquor). If you do not drink alcohol, imagine another type of beverage you enjoy. You do not have to drink everything in one sitting; assume that you can take it with you in unopened containers. Remember, we won't know who you are, so answer honestly. Treat each decision separately, as though you were making only that one decision. Please answer every question; better to guess than to leave it blank.

	Which would you choose?		How confident are you in your decision?				
	1 drink right now.	Getting 3 drinks in a month.	Not at all 1	Low 2	Medium 3	High 4	Completely5
	○	○	○	○	○	○	○

	Which would you choose?		How confident are you in your decision?				
	6 drinks right now.	Getting 10 and a half drinks in a month.	Not at all 1	Low 2	Medium 3	High 4	Completely5
	○	○	○	○	○	○	○

	Which would you choose?		How confident are you in your decision?				
	6 drinks right now.	Getting 18 drinks in a month.	Not at all 1	Low 2	Medium 3	High 4	Completely5
	○	○	○	○	○	○	○

	Which would you choose?		How confident are you in your decision?				
	6 drinks right now.	Getting 21 drinks in a month.	Not at all 1	Low 2	Medium 3	High 4	Completely5
	○	○	○	○	○	○	○

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	Which would you choose?		How confident are you in your decision?				
	1 drink right now.	Getting 3 drinks in a month.	Not at all 1	Low 2	Medium 3	High 4	Completely5
	○	○	○	○	○	○	○

	Which would you choose?		How confident are you in your decision?				
	1 drink right now.	Getting 6 drinks in a month.	Not at all 1	Low 2	Medium 3	High 4	Completely5
	○	○	○	○	○	○	○

	Which would you choose?		How confident are you in your decision?				
	1 drink right now.	Getting 1 and a half drinks in a month.	Not at all 1	Low 2	Medium 3	High 4	Completely5
	○	○	○	○	○	○	○

	Which would you choose?		How confident are you in your decision?				
	6 drinks right now.	Getting 9 drinks in a month.	Not at all 1	Low 2	Medium 3	High 4	Completely5
	○	○	○	○	○	○	○

For YOU, what is the GIST of these choices about drinks now versus in a month?
- ❍ Now is always better than later.
- ❍ Now is mostly better than later.
- ❍ Later is always better than now.
- ❍ Later is mostly better than now.
- ❍ The amount of waiting time and the number of drinks both matter.

CTDECISIONS: Assume that a "candy bar" means one small (fun size, treat size, or snack size) candy bar of your choice. You do not have to eat everything in one sitting. Treat each decision separately, as though you were making only that one decision. Remember, we won't know who you are, so answer honestly. Please answer every question; better to guess than to leave it blank.

	Which would you choose?		How confident are you in your decision?				
	6 candy bars right now.	Getting 9 candy bars in a month.	Not at all 1	Low 2	Medium 3	High 4	Completely5
	❍	❍	❍	❍	❍	❍	❍

	Which would you choose?		How confident are you in your decision?				
	1 candy bar right now.	Getting 6 candy bars in a month.	Not at all 1	Low 2	Medium 3	High 4	Completely5
	❍	❍	❍	❍	❍	❍	❍

	Which would you choose?		How confident are you in your decision?				
	6 candy bars right now.	Getting 10 and a half candy bars in a month.	Not at all 1	Low 2	Medium 3	High 4	Completely5
	❍	❍	❍	❍	❍	❍	❍

	Which would you choose?		How confident are you in your decision?				
	1 candy bar right now.	Getting 1 and a half candy bars in a month.	Not at all 1	Low 2	Medium 3	High 4	Completely5
	○	○	○	○	○	○	○

	Which would you choose?		How confident are you in your decision?				
	6 candy bars right now.	Getting 18 candy bars in a month.	Not at all 1	Low 2	Medium 3	High 4	Completely5
	○	○	○	○	○	○	○

	Which would you choose?		How confident are you in your decision?				
	1 candy bar right now.	Getting 3 candy bars in a month.	Not at all 1	Low 2	Medium 3	High 4	Completely5
	○	○	○	○	○	○	○

	Which would you choose?		How confident are you in your decision?				
	6 candy bars right now.	Getting 21 candy bars in a month.	Not at all 1	Low 2	Medium 3	High 4	Completely5
	○	○	○	○	○	○	○

	Which would you choose?		How confident are you in your decision?				
	1 candy bar right now.	Getting 3 candy bars in a month.	Not at all 1	Low 2	Medium 3	High 4	Completely5
	○	○	○	○	○	○	○

For YOU, what is the GIST of these choices about candy bars now versus in a month?
○ Now is always better than later.
○ Now is mostly better than later.
○ Later is always better than now.
○ Later is mostly better than now.
○ The amount of waiting time and the amount of candy both matter.

MTDECISIONS: Assume that dollar values represent exact values in cash and that you can take it with you. Treat each decision separately, as though you were making only that one decision. Remember, we won't know who you are, so answer honestly. Please answer every question; better to guess than to leave it blank.

	Which would you choose?		How confident are you in your decision?				
	$1 right now.	Getting $1.50 in a month.	Not at all 1	Low 2	Medium 3	High 4	Completely5
	○	○	○	○	○	○	○

	Which would you choose?		How confident are you in your decision?				
	$6 right now.	Getting $10.50 in a month.	Not at all 1	Low 2	Medium 3	High 4	Completely5
	○	○	○	○	○	○	○

	Which would you choose?		How confident are you in your decision?				
	$1 right now.	Getting $3 in a month.	Not at all 1	Low 2	Medium 3	High 4	Completely5
	○	○	○	○	○	○	○

	Which would you choose?		How confident are you in your decision?				
	$6 right now.	Getting $21 in a month.	Not at all 1	Low 2	Medium 3	High 4	Completely5
	○	○	○	○	○	○	○

	Which would you choose?		How confident are you in your decision?				
	$6 right now.	Getting $18 in a month.	Not at all 1	Low 2	Medium 3	High 4	Completely5
	○	○	○	○	○	○	○

	Which would you choose?		How confident are you in your decision?				
	$6 right now.	Getting $9 in a month.	Not at all 1	Low 2	Medium 3	High 4	Completely5
	○	○	○	○	○	○	○

	Which would you choose?		How confident are you in your decision?				
	$1 right now.	Getting $6 in a month.	Not at all 1	Low 2	Medium 3	High 4	Completely5
	○	○	○	○	○	○	○

	Which would you choose?		How confident are you in your decision?				
	$1 right now.	Getting $3 in a month.	Not at all 1	Low 2	Medium 3	High 4	Completely5
	○	○	○	○	○	○	○

For YOU, what is the GIST of these choices about money now versus in a month?
○ Now is always better than later.
○ Now is mostly better than later.
○ Later is always better than now.
○ Later is mostly better than now.
○ The amount of waiting time and the amount of money both matter.

Remember that all answers are anonymous (we will not know who you are). Please answer every question; better to guess than to leave it blank.

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Remember that all answers are anonymous (we will not know who you are). Please answer every question; better to guess than to leave it blank.

Remember that all answers are anonymous (we will not know who you are). Please answer every question; better to guess than to leave it blank.

If you do NOT drink alcohol at all, CHECK HERE:
❍ I do not drink alcohol

What type of drink did you imagine during the earlier questions?
❍ beer
❍ wine
❍ hard alcohol shots (i.e. vodka, whiskey, rum, tequila)
❍ mixed drinks (i.e. martinis, whiskey sour, Tom Collins)
❍ Other: _____

How many ounces was that drink? (remember that a bottle/can of beer is 12oz, a glass of wine is 4oz and a shot of alcohol is 1oz)

What candy did you imagine during the earlier questions?

How large was that candy bar/package?
❍ king size
❍ fun/snack size
❍ miniature
❍ normal size
❍ other: _____

How would you rate your hunger on the following scale at the present moment?
❍ ExtremelyHungry1
❍   2
❍   3
❍   4
❍   5
❍   6
❍   7
❍   8
❍   9
❍ Not at allHungry10

How would you rate your thirst on the following scale at the present moment?

- ○ ExtremelyThirsty1
- ○ 2
- ○ 3
- ○ 4
- ○ 5
- ○ 6
- ○ 7
- ○ 8
- ○ 9
- ○ Not at allThirsty10

The purpose of the present study is to compare your preferences for different amounts of money. In this experiment you will be asked to make a series of decisions about hypothetical monetary alternatives. One monetary choice will be available immediately (now), while the other monetary alternative will be available after a certain time delay. Please keep in mind, that there are no "correct" answers. We are only interested in which option you would prefer. Please answer every question as truthfully as possible.

What would you prefer?
- ○ $54 now
- ○ $55, 117 days from now

What would you prefer?
- ○ $55 now
- ○ $75, 61 days from now

What would you prefer?
- ○ $19 now
- ○ $25, 53 days from now

What would you prefer?
- ○ $31 now
- ○ $85, 7 days from now

What would you prefer?
- ○ $14 now
- ○ $25, 19 days from now

What would you prefer?
- ○ $47 now
- ○ $50, 160 days from now

What would you prefer?
❍ $15 now
❍ $35, 13 days from now

What would you prefer?
❍ $25 now
❍ $60, 14 days from now

What would you prefer?
❍ $78 now
❍ $80, 162 days from now

What would you prefer?
❍ $40 now
❍ $55, 62 days from now

What would you prefer?
❍ $11 now
❍ $30, 7 days from now

What would you prefer?
❍ $67 now
❍ $75, 119 days from now

What would you prefer?
❍ $34 now
❍ $35, 186 days from now

What would you prefer?
❍ $27 now
❍ $50, 21 days from now

What would you prefer?
❍ $69 now
❍ $85, 91 days from now

What would you prefer?
❍ $49 now
❍ $60, 89 days from now

What would you prefer?
○ $80 now
○ $85, 157 days from now

What would you prefer?
○ $24 now
○ $35, 29 days from now

What would you prefer?
○ $33 now
○ $80, 14 days from now

What would you prefer?
○ $28 now
○ $30, 179 days from now

What would you prefer?
○ $34 now
○ $50, 30 days from now

What would you prefer?
○ $25 now
○ $30, 80 days from now

What would you prefer?
○ $41 now
○ $75, 20 days from now

What would you prefer?
○ $54 now
○ $60, 111 days from now

What would you prefer?
○ $54 now
○ $80, 30 days from now

What would you prefer?
○ $22 now
○ $25, 136 days from now

What would you prefer?
- ○ $20 now
- ○ $55, 7 days from now

Please indicate your agreement or disagreement with the following statements. Choose one:

I cannot seem to save money.
- ○ strongly disagree
- ○ Disagree
- ○ Neither Agree nor Disagree
- ○ Agree
- ○ Strongly Agree

I spend more than I can afford to spend.
- ○ strongly disagree
- ○ Disagree
- ○ Neither Agree nor Disagree
- ○ Agree
- ○ Strongly Agree

I borrow money to buy things I enjoy.
- ○ strongly disagree
- ○ Disagree
- ○ Neither Agree nor Disagree
- ○ Agree
- ○ Strongly Agree

I am worried about the amount of money that I owe.
- ○ strongly disagree
- ○ Disagree
- ○ Neither Agree nor Disagree
- ○ Agree
- ○ Strongly Agree

I think it is better to spend now and worry later.
- ○ strongly disagree
- ○ Disagree
- ○ Neither Agree nor Disagree
- ○ Agree
- ○ Strongly Agree

I think it is better to save money for the future.
- ❍ strongly disagree
- ❍ Disagree
- ❍ Neither Agree nor Disagree
- ❍ Agree
- ❍ Strongly Agree

I never borrow money.
- ❍ strongly disagree
- ❍ Disagree
- ❍ Neither Agree nor Disagree
- ❍ Agree
- ❍ Strongly Agree

I think it is better to go without something I want until I can afford to pay for it.
- ❍ strongly disagree
- ❍ Disagree
- ❍ Neither Agree nor Disagree
- ❍ Agree
- ❍ Strongly Agree

I save up money to buy things I enjoy.
- ❍ strongly disagree
- ❍ Disagree
- ❍ Neither Agree nor Disagree
- ❍ Agree
- ❍ Strongly Agree

I spend money on having fun today and don't worry about tomorrow.
- ❍ strongly disagree
- ❍ Disagree
- ❍ Neither Agree nor Disagree
- ❍ Agree
- ❍ Strongly Agree

I wait to buy what I want until I have enough money.
- ❍ strongly disagree
- ❍ Disagree
- ❍ Neither Agree nor Disagree
- ❍ Agree
- ❍ Strongly Agree

I believe in sacrifice now, enjoy later.
- ○ strongly disagree
- ○ Disagree
- ○ Neither Agree nor Disagree
- ○ Agree
- ○ Strongly Agree

Please indicate your agreement or disagreement with the following statements. Choose one:

I would like to explore strange places.
- ❍ strongly disagree
- ❍ Disagree
- ❍ Neither Agree nor Disagree
- ❍ Agree
- ❍ Strongly Agree

I get restless when I spend too much time at home.
- ❍ strongly disagree
- ❍ Disagree
- ❍ Neither Agree nor Disagree
- ❍ Agree
- ❍ Strongly Agree

I like to do frightening things.
- ❍ strongly disagree
- ❍ Disagree
- ❍ Neither Agree nor Disagree
- ❍ Agree
- ❍ Strongly Agree

I like wild parties
- ❍ strongly disagree
- ❍ Disagree
- ❍ Neither Agree nor Disagree
- ❍ Agree
- ❍ Strongly Agree

I would like to take off on a trip with no pre-planned routes or timetables.
- ❍ strongly disagree
- ❍ Disagree
- ❍ Neither Agree nor Disagree
- ❍ Agree
- ❍ Strongly Agree

I prefer friends who are excitingly unpredictable.
- ❍ strongly disagree
- ❍ Disagree
- ❍ Neither Agree nor Disagree
- ❍ Agree
- ❍ Strongly Agree

I would like to try bungee jumping.
- ❍ strongly disagree
- ❍ Disagree
- ❍ Neither Agree nor Disagree
- ❍ Agree
- ❍ Strongly Agree

I would love to have new and exciting experiences, even if they are illegal.
- ❍ strongly disagree
- ❍ Disagree
- ❍ Neither Agree nor Disagree
- ❍ Agree
- ❍ Strongly Agree

Answer these questions according to how often you have done the following: Choose one.

Smoking (tobacco)
- ❍ Never
- ❍ Hardly Never
- ❍ Sometimes
- ❍ Often
- ❍ Very Often

Roller Blading
- ❍ Never
- ❍ Hardly Never
- ❍ Sometimes
- ❍ Often
- ❍ Very Often

Drinking and driving
- ○ Never
- ○ Hardly Never
- ○ Sometimes
- ○ Often
- ○ Very Often

Parachuting
- ○ Never
- ○ Hardly Never
- ○ Sometimes
- ○ Often
- ○ Very Often

Speeding
- ○ Never
- ○ Hardly Never
- ○ Sometimes
- ○ Often
- ○ Very Often

Stealing cars and going for joy rides
- ○ Never
- ○ Hardly Never
- ○ Sometimes
- ○ Often
- ○ Very Often

Tao Kwon Do fighting
- ○ Never
- ○ Hardly Never
- ○ Sometimes
- ○ Often
- ○ Very Often

Underage drinking
- ○ Never
- ○ Hardly Never
- ○ Sometimes
- ○ Often
- ○ Very Often

Staying out late
○ Never
○ Hardly Never
○ Sometimes
○ Often
○ Very Often

Driving without a license
○ Never
○ Hardly Never
○ Sometimes
○ Often
○ Very Often

Talking to strangers
○ Never
○ Hardly Never
○ Sometimes
○ Often
○ Very Often

Flying in a plane
○ Never
○ Hardly Never
○ Sometimes
○ Often
○ Very Often

Cheating
○ Never
○ Hardly Never
○ Sometimes
○ Often
○ Very Often

Getting drunk
○ Never
○ Hardly Never
○ Sometimes
○ Often
○ Very Often

Sniffing gas or glue
○ Never
○ Hardly Never
○ Sometimes
○ Often
○ Very Often

Having unprotected sex
○ Never
○ Hardly Never
○ Sometimes
○ Often
○ Very Often

Leaving school
○ Never
○ Hardly Never
○ Sometimes
○ Often
○ Very Often

Teasing and picking on people
○ Never
○ Hardly Never
○ Sometimes
○ Often
○ Very Often

Snow skiing
○ Never
○ Hardly Never
○ Sometimes
○ Often
○ Very Often

Snow boarding
○ Never
○ Hardly Never
○ Sometimes
○ Often
○ Very Often

Taking drugs (including marijuana)
○ Never
○ Hardly Never
○ Sometimes
○ Often
○ Very Often

Overeating
○ Never
○ Hardly Never
○ Sometimes
○ Often
○ Very Often

Entering a competition
○ Never
○ Hardly Never
○ Sometimes
○ Often
○ Very Often

Give your best answer to the following 3 questions. It is better to guess than to leave them blank:

A bat and a ball cost $1.10 in total. The bat costs $1.00 more than the ball. How much does the ball cost? (in cents)

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

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

Your height:in feet and inches

Your weightin lbs

Remember that all answers are completely anonymous. Please answer the following questions to the best of your ability.

How often do you have a drink containing alcohol?
- ○ Never
- ○ Monthly or less
- ○ 2 to 4 times a month
- ○ 2 to 3 times a week
- ○ 4 or more times a week

How many drinks containing alcohol do you have on a typical day when you are drinking?
- ○ 1 or 2
- ○ 3 or 4
- ○ 5 or 6
- ○ 7, 8 or 9
- ○ 10 or more

How often do you consume 6 or more drinks on one occasion?
- ○ Never
- ○ Less than monthly
- ○ Monthly
- ○ Twice a Month
- ○ Weekly
- ○ Daily or almost daily

How often do you consume 4 or more drinks on one occasion (within about two hours)?
- ○ Never
- ○ Less than monthly
- ○ Monthly
- ○ Twice a Month
- ○ Weekly
- ○ Daily or almost daily

How often do you consume 5 or more drinks on one occasion (within about two hours)?
- ○ Never
- ○ Less than monthly
- ○ Monthly
- ○ Twice a Month
- ○ Weekly
- ○ Daily or almost daily

How often during the last year have you found that you were not able to stop drinking once you had started?
❍ Never
❍ Less than monthly
❍ Monthly
❍ Twice a Month
❍ Weekly
❍ Daily or almost daily

How often during the last year have you failed to do what was normally expected from you because of drinking?
❍ Never
❍ Less than monthly
❍ Monthly
❍ Twice a month
❍ Weekly
❍ Daily or almost daily

How often during the last year have you needed a first drink in the morning to get yourself going after a heavy drinking session?
❍ Never
❍ Less than monthly
❍ Monthly
❍ Twice a Month
❍ Weekly
❍ Daily or almost daily

How often during the last year have you had a feeling of guilt or remorse after drinking?
❍ Never
❍ Less than monthly
❍ Monthly
❍ Twice a Month
❍ Weekly
❍ Daily or almost daily

How often during the last year have you been unable to remember what happened the night before because you had been drinking?
❍ Never
❍ Less than monthly
❍ Monthly
❍ Twice a Month
❍ Weekly
❍ Daily or almost daily

Have you or someone else been injured as a result of your drinking?
❍ No
❍ Yes, but not in the last year
❍ Yes, during the last year

Has a relative or friend or a doctor or another health worker been concerned about your drinking or suggested you cut down?
❍ No
❍ Yes, but not in the last year
❍ Yes, during the last year

Now some basic information about you.

Your age is (in years):

You are:
❍ Male
❍ Female

Are you of Hispanic, Latino, or Spanish origin?
❍ No, not of Hispanic, Latino or Spanish origin
❍ Yes, Mexican, Mexican American, Chicano
❍ Yes, Puerto Rican
❍ Yes, Cuban
❍ Yes, Central American (FILL IN): _____
❍ Yes, South American (FILL IN): _____
❍ Yes, Spanish (Spain)

You are:
- ❍ White
- ❍ Black/ African American
- ❍ Asian Indian
- ❍ Chinese
- ❍ Filipino
- ❍ Japanese
- ❍ Korean
- ❍ Vietnamese
- ❍ Other Asian (FILL IN): _____
- ❍ Native American/ American Indian/ Alaskan Native (FILL IN Tribe): _____
- ❍ Native Hawaiian or Other Pacific Islander
- ❍ Mixed Ethnicity (example: Chicano and Native American, FILL IN): _____
- ❍ Other (FILL IN): _____

You are invited to participate in a research study of risk and decision making. You were selected as a possible participant because you are 18 years of age or older and can understand and respond to a questionnaire written in English. Please read this form carefully and ask any questions you may have before agreeing to take part in the study.   What the study is about:The purpose of this study is to understand how people make decisions that involve risks.   What we will ask you to do: If you agree to be in this study, we will ask you to do the following: Respond to a written questionnaire about how you view various risks and decisions (as well as provide background information). The questionnaire usually takes about 30 minutes to complete(although some people may take longer).   Risks and Benefits: We do not anticipate any risks for you participating in this study other than those encountered in day-to-day life. There are no direct benefits to participating other than the possibility that some people may gain greater insight into their own thinking and decision making. Indirect benefits to participation include contribution to scientific knowledge, which the investigator hopes will ultimately improve risk communication and healthy decision making.   Compensation: You may earn extra credit if you are taking a class that offers credit for research studies. The class instructor will assign credit according to class policy.   Taking part is voluntary: Taking part in this study is completely voluntary. You may skip any questions that you do not want to answer. If you decide not to take part or to skip some of the questions, it will not affect your current or future relationship with Cornell University. If you decide to take part, you are free to withdraw at anytime. You are free to stop at any time for any reason.   Your answers will be confidential: The records of this study will be kept private. In any sort of report we make public, we will not include any information that will make it reasonably possible to identify you. Research records will be kept in a locked file or office, and on computers used for data storage and analysis; only the researchers or other authorized individuals will have access to the records. Your data may also be used for educational purposes such as teaching, publications,and/or presentations and may be viewed by students, other trainees, and professional colleagues.   If you have questions: The researcher conducting this study is Dr. Valerie Reyna. You can reach the study research assistant, Evan Wilhelms, at eaw97@cornell.edu or 440-941-3826. Please ask any questions that you have now. If you have any questions later, you may contact Dr. Reyna at vr53@cornell.edu or at 607-254-1504. If you have any questions or concerns regarding your rights as a subject in this study, you may contact the Institutional Review Board at 607-255-5138, or access their website at http://www.irb.cornell.edu/. You may also report your concerns or complaints anonymously through Ethicspoint or by calling toll free at 1-866-293-3077. Ethicspoint is an independent organization that serves as a liaison between the University and the person bringing the complaint so that anonymity can be ensured.   Statement of Consent: I have read the above information, and have received answers to any questions I asked. I consent to take part in the study. Please select an option below:
❍ I am 18 years or older and I agree to participate in this study.
❍ I do not agree to participate in this study.

Treat each of the following decisions separately, as though you were making only that one decision. Remember, we won't know who you are, so answer honestly. Please answer every question; better to guess than to leave it blank.

Rheumatoid arthritis is a serious condition that causes joint pain and swelling in your hands, wrists, knees and feet. The pain can be bad enough that it interferes with your ability to do normal activities like use a knife and fork. Imagine that you were diagnosed with rheumatoid arthritis about 6 months ago. You responded well to medications in the beginning but now your arthritis has not been well controlled for the past 2 months. You have more joint pain and stiffness. You are feeling worse, but you are not to the point that something has to change.   Your doctor tells you about a different medication that he/she thinks may help you. The medication is taken as a pill twice a day and is covered by your insurance.   Recent studies show that this new medication helps about 65% of people who take it. The only serious side effect is the risk of a lung infection or pneumonia. This complication happens in 1 per 100 people taking the medication.

How likely would you be to start this medication?
○ Very Likely
○ Likely
○ Somewhat likely
○ Slightly likely
○ Not likely at all

Select the statement that best reflects how you feel about the risk of 1 per 100 people developing pneumonia:

❍ This is a serious side effect…but the probability is so small that there is basically no risk to worry about.
❍ This is a serious side effect…but the probability is small (acceptable).
❍ This is a serious side effect…and the probability is too large (unacceptable).
❍ Even though the probability is small – this side effect is unacceptable.
❍ It doesn't matter how small the probability is – the only thing that matters is that I can get this side effect.
❍ If none of these statements reflect how you feel, please tell us what your feelings are:
    _____

How risky do you think this side effect is?
❍ Very risky
❍ Risky
❍ Somewhat risky
❍ A little risky
❍ Not risky at all

How worried would you feel after hearing that 1 per 100 people develop pneumonia?
❍ Very worried
❍ Worried
❍ Somewhat worried
❍ A little worried
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    _____

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Select the statement that best reflects how you feel about the risk of 1 per 10,000 people developing pneumonia:
❍ This is a serious side effect…but the probability is so small that there is basically no risk to worry about.
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Select the statement that best reflects how you feel about the risk of 1 per 100,000 people developing pneumonia:
- ❍ This is a serious side effect…but the probability is so small that there is basically no risk to worry about.
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How likely would you be to start this medication?
- ○ Very Likely
- ○ Likely
- ○ Somewhat likely
- ○ Slightly likely
- ○ Not likely at all

Select the statement that best reflects how you feel about the risk of 1 per 100 people developing cancer:
- ❍ This is a serious side effect…but the probability is so small that there is basically no risk to worry about.
- ❍ This is a serious side effect…but the probability is small (acceptable).
- ❍ This is a serious side effect…and the probability is too large (unacceptable).
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    _____

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How likely would you be to start this medication?
- ⭘ Very Likely
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Select the statement that best reflects how you feel about the risk of 1 per 1000 people developing cancer:

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Select the statement that best reflects how you feel about the risk of 1 per 100,000 people developing cancer:

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How likely would you be to start this medication?
- ⭕ Very Likely
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Select the statement that best reflects how you feel about the risk of 1 per 100 people developing pneumonia:

❍ This is a serious side effect…but the probability is so small that there is basically no risk to worry about.
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How worried would you feel after hearing that 1 per 100 people develop pneumonia?
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Rheumatoid arthritis is a serious condition that causes joint pain and swelling in your hands, wrists, knees and feet. The pain can be bad enough that it interferes with your ability to do normal activities like use a knife and fork. Imagine that you were diagnosed with rheumatoid arthritis about 6 months ago. You responded well to medications in the beginning but now your arthritis has not been well controlled for the past 2 months. You have more joint pain and stiffness. You are feeling worse, and you are to the point that something has to change.   Your doctor tells you about a different medication that he/she thinks may help you. The medication is taken as a pill twice a day and is covered by your insurance.   Recent studies show that this new medication helps about 65% of people who take it. The only serious side effect is the risk of a lung infection or pneumonia. This complication happens in 1 per 1000 people taking the medication.

How likely would you be to start this medication?
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Select the statement that best reflects how you feel about the risk of 1 per 1000 people developing pneumonia:
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Select the statement that best reflects how you feel about the risk of 1 per 10,000 people developing pneumonia:

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Select the statement that best reflects how you feel about the risk of 1 per 100,000 people developing pneumonia:

❍ This is a serious side effect…but the probability is so small that there is basically no risk to worry about.
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- ❍ Very Likely
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- ❍ Slightly likely
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Select the statement that best reflects how you feel about the risk of 1 per 100 people developing cancer:

❍ This is a serious side effect…but the probability is so small that there is basically no risk to worry about.

❍ This is a serious side effect…but the probability is small (acceptable).

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❍ Even though the probability is small – this side effect is unacceptable.

❍ It doesn't matter how small the probability is – the only thing that matters is that I can get this side effect.

❍ If none of these statements reflect how you feel, please tell us what your feelings are:

_____

How risky do you think this side effect is?

❍ Very risky

❍ Risky

❍ Somewhat risky

❍ A little risky

❍ Not risky at all

How worried would you feel after hearing that 1 per 100 people develop cancer?

❍ Very worried

❍ Worried

❍ Somewhat worried

❍ A little worried

❍ Not worried at all

Rheumatoid arthritis is a serious condition that causes joint pain and swelling in your hands, wrists, knees and feet. The pain can be bad enough that it interferes with your ability to do normal activities like use a knife and fork. Imagine that you were diagnosed with rheumatoid arthritis about 6 months ago. You responded well to medications in the beginning but now your arthritis has not been well controlled for the past 2 months. You have more joint pain and stiffness. You are feeling worse, and you are to the point that something has to change.   Your doctor tells you about a different medication that he/she thinks may help you. The medication is taken as a pill twice a day and is covered by your insurance.   Recent studies show that this new medication helps about 65% of people who take it. The only serious side effect is the risk of cancer. This complication happens in 1 per 1000 people taking the medication.

How likely would you be to start this medication?
- ○ Very Likely
- ○ Likely
- ○ Somewhat likely
- ○ Slightly likely
- ○ Not likely at all

Select the statement that best reflects how you feel about the risk of 1 per 1000 people developing cancer:
- ❍ This is a serious side effect…but the probability is so small that there is basically no risk to worry about.
- ❍ This is a serious side effect…but the probability is small (acceptable).
- ❍ This is a serious side effect…and the probability is too large (unacceptable).
- ❍ Even though the probability is small – this side effect is unacceptable.
- ❍ It doesn't matter how small the probability is – the only thing that matters is that I can get this side effect.
- ❍ If none of these statements reflect how you feel, please tell us what your feelings are:

  _____

How risky do you think this side effect is?
- ❍ Very risky
- ❍ Risky
- ❍ Somewhat risky
- ❍ A little risky
- ❍ Not risky at all

How worried would you feel after hearing that 1 per 1000 people develop cancer?
- ❍ Very worried
- ❍ Worried
- ❍ Somewhat worried
- ❍ A little worried
- ❍ Not worried at all

Rheumatoid arthritis is a serious condition that causes joint pain and swelling in your hands, wrists, knees and feet. The pain can be bad enough that it interferes with your ability to do normal activities like use a knife and fork. Imagine that you were diagnosed with rheumatoid arthritis about 6 months ago. You responded well to medications in the beginning but now your arthritis has not been well controlled for the past 2 months. You have more joint pain and stiffness. You are feeling worse, and you are to the point that something has to change.   Your doctor tells you about a different medication that he/she thinks may help you. The medication is taken as a pill twice a day and is covered by your insurance.   Recent studies show that this new medication helps about 65% of people who take it. The only serious side effect is the risk of cancer. This complication happens in 1 per 10,000 people taking the medication.

How likely would you be to start this medication?
- ○ Very Likely
- ○ Likely
- ○ Somewhat likely
- ○ Slightly likely
- ○ Not likely at all

Select the statement that best reflects how you feel about the risk of 1 per 10,000 people developing cancer:
❍ This is a serious side effect…but the probability is so small that there is basically no risk to worry about.
❍ This is a serious side effect…but the probability is small (acceptable).
❍ This is a serious side effect…and the probability is too large (unacceptable).
❍ Even though the probability is small – this side effect is unacceptable.
❍ It doesn't matter how small the probability is – the only thing that matters is that I can get this side effect.
❍ If none of these statements reflect how you feel, please tell us what your feelings are:

_____

How risky do you think this side effect is?
❍ Very risky
❍ Risky
❍ Somewhat risky
❍ A little risky
❍ Not risky at all

How worried would you feel after hearing that 1 per 10,000 people develop cancer?
❍ Very worried
❍ Worried
❍ Somewhat worried
❍ A little worried
❍ Not worried at all

Rheumatoid arthritis is a serious condition that causes joint pain and swelling in your hands, wrists, knees and feet. The pain can be bad enough that it interferes with your ability to do normal activities like use a knife and fork. Imagine that you were diagnosed with rheumatoid arthritis about 6 months ago. You responded well to medications in the beginning but now your arthritis has not been well controlled for the past 2 months. You have more joint pain and stiffness. You are feeling worse, and you are to the point that something has to change.   Your doctor tells you about a different medication that he/she thinks may help you. The medication is taken as a pill twice a day and is covered by your insurance.   Recent studies show that this new medication helps about 65% of people who take it. The only serious side effect is the risk of cancer. This complication happens in 1 per 100,000 people taking the medication.

How likely would you be to start this medication?
- ❍ Very Likely
- ❍ Likely
- ❍ Somewhat likely
- ❍ Slightly likely
- ❍ Not likely at all

Select the statement that best reflects how you feel about the risk of 1 per 100,000 people developing cancer:
- ○ This is a serious side effect…but the probability is so small that there is basically no risk to worry about.
- ○ This is a serious side effect…but the probability is small (acceptable).
- ○ This is a serious side effect…and the probability is too large (unacceptable).
- ○ Even though the probability is small – this side effect is unacceptable.
- ○ It doesn't matter how small the probability is – the only thing that matters is that I can get this side effect.
- ○ If none of these statements reflect how you feel, please tell us what your feelings are:

  _____

How risky do you think this side effect is?
- ○ Very risky
- ○ Risky
- ○ Somewhat risky
- ○ A little risky
- ○ Not risky at all

How worried would you feel after hearing that 1 per 100,000 people develop cancer?
- ○ Very worried
- ○ Worried
- ○ Somewhat worried
- ○ A little worried
- ○ Not worried at all

Based on the description you just saw, how physically sick are you in the story?
- ○ Extremely sick
- ○ Very sick
- ○ Somewhat sick
- ○ Slightly sick
- ○ Not at all sick

Have you, or someone close to you, ever had pneumonia?
- ○ Yes
- ○ No

Have you, or someone close to you, ever had arthritis?
- ○ Yes
- ○ No

Have you, or someone close to you, ever had cancer?
○ Yes
○ No

Remember, we won't know who you are, so answer honestly. Please answer every question; better to guess than to leave it blank.

The following statements reflect values or principles about medications with a risk of side effects. Please choose the response that best represents your position.

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
Avoid risk.	○	○	○	○	○
Better to be safe than sorry.	○	○	○	○	○
I have a responsibility to my family to not take risks.	○	○	○	○	○
I have a responsibility to not put people I love at risk.	○	○	○	○	○
I have a responsibility to my family to not end up in the hospital needlessly.	○	○	○	○	○
There are always some measures you can take to reduce risk.	○	○	○	○	○
Some risks are worth the cost.	○	○	○	○	○
Known risks are manageable risks.	○	○	○	○	○
Less risk is better than more risk.	○	○	○	○	○
Being aware of risks is a better way of making	○	○	○	○	○

decisions.					

Remember, we won't know who you are, so answer honestly. Please answer every question; better to guess than to leave it blank.

Please choose the response that best represents your position about medications with a risk of side effects.

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
Even low risk events happen to someone.	○	○	○	○	○
Even low risks add up to 100% eventually.	○	○	○	○	○
It only takes one bad decision to die.	○	○	○	○	○
It only takes one risky decision to get the worst consequences.	○	○	○	○	○
Putting yourself in risky situations is never a good idea.	○	○	○	○	○
Once you get a fatal outcome, there is no way back.	○	○	○	○	○
Even if you get tested, you can still get a negative outcome.	○	○	○	○	○
If you can't handle taking precautions, you are not ready to take risks.	○	○	○	○	○
When I get	○	○	○	○	○

tested, I can control the consequences. It only takes one bad decision for my life to be different forever.	○	○	○	○	○

Remember, we won't know who you are, so answer honestly. Please answer every question; better to guess than to leave it blank.

Please choose the response that best represents your position.

	None	Low	Medium	High
Overall, for YOU, which of the following best represents the RISKS of taking medication with a risk of side effects?	○	○	○	○
Overall, for YOU, which of the following best represents the BENEFITS taking medication with a risk of side effects	○	○	○	○

Remember, we won't know who you are, so answer honestly. Please answer every question; better to guess than to leave it blank.

Please choose the response that best represents your position.

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
It is important to accept the risk of side effects now in order to improve my chances of being healthy in the future.	○	○	○	○	○
It is important to reduce my chances of becoming disabled, even if it means taking medications with a risk of serious side effects.	○	○	○	○	○
It is okay to ignore the risk of a serious side effect if it is extremely rare.	○	○	○	○	○
It is wrong to take medications for my arthritis that could cause serious side effects.	○	○	○	○	○
It is better to continue with the pain I know than to change my medications.	○	○	○	○	○
It is okay to delay treating	○	○	○	○	○

my arthritis in order to take care of my family responsibilities.					
It is important to take care of my disease so that I can be as productive as possible.	○	○	○	○	○
It is better to take natural remedies than prescription medications for my arthritis	○	○	○	○	○
Even if my medications are not working well, it is better to stay on them than to try a new mediation that could cause cancer.	○	○	○	○	○
It is important to take the strongest possible medications now to improve my chances of being able to function in the future.	○	○	○	○	○

Remember, we won't know who you are, so answer honestly. Please answer every question; better to guess than to leave it blank.

Click to write the question text

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I would like to explore strange places.	○	○	○	○	○
I get restless when I spend too much time at home.	○	○	○	○	○
I like to do frightening things.	○	○	○	○	○
I like wild parties.	○	○	○	○	○
I would like to take o on a trip with no pre-planned routes or timetables.	○	○	○	○	○
I prefer friends who are excitingly unpredictable.	○	○	○	○	○
I would like to try bungee jumping.	○	○	○	○	○
I would love to have new and exciting experiences, even if they are illegal.	○	○	○	○	○

For each of the following statements, please indicate the likelihood that you would engage in the described activity or behavior if you were to find yourself in that situation. Provide a rating from Extremely Unlikely to Extremely Likely, using the following scale. Remember, we won't know who you are, so answer honestly. Please answer every question; better to guess than to leave it blank.

	Extremely Unlikely	Moderately Unlikely	Somewhat Unlikely	Not Sure	Somewhat Likely	Moderately Likely	Extremely Likely
Admitting that your tastes are different from those of a friend.	○	○	○	○	○	○	○
Going camping in the wilderness.	○	○	○	○	○	○	○
Betting a day's income at the horse races.	○	○	○	○	○	○	○
Investing 10% of your annual income in a moderate growth mutual fund.	○	○	○	○	○	○	○
Drinking heavily at a social function.	○	○	○	○	○	○	○
Taking some questionable deductions on your income tax return.	○	○	○	○	○	○	○
Disagreeing with an authority figure on a	○	○	○	○	○	○	○

major issue.							
Betting a day's income at a high-stake poker game.	○	○	○	○	○	○	○
Having an affair with a married man/woman.	○	○	○	○	○	○	○
Passing off somebody else's work as your own.	○	○	○	○	○	○	○
Going down a ski run that is beyond your ability.	○	○	○	○	○	○	○
Investing 5% of your annual income in a very speculative stock.	○	○	○	○	○	○	○
Going whitewater rafting at high water in the spring.	○	○	○	○	○	○	○
Betting a day's income on the outcome of a sporting event.	○	○	○	○	○	○	○
Engaging in unprotected sex.	○	○	○	○	○	○	○
Revealing a friend's	○	○	○	○	○	○	○

secret to someone else.							
Driving a car without wearing a seat belt.	❍	❍	❍	❍	❍	❍	❍
Investing 10% of your annual income in a new business venture.	❍	❍	❍	❍	❍	❍	❍
Taking a skydiving class.	❍	❍	❍	❍	❍	❍	❍
Riding a motorcycle without a helmet.	❍	❍	❍	❍	❍	❍	❍
Choosing a career that you truly enjoy over a more secure one.	❍	❍	❍	❍	❍	❍	❍
Speaking your mind about an unpopular issue in a meeting at work.	❍	❍	❍	❍	❍	❍	❍
Sunbathing without sunscreen.	❍	❍	❍	❍	❍	❍	❍
Bungee jumping off a tall bridge.	❍	❍	❍	❍	❍	❍	❍
Piloting a small plane.	❍	❍	❍	❍	❍	❍	❍
Walking	❍	❍	❍	❍	❍	❍	❍

home alone at night in an unsafe area of town.						
Moving to a city far away from your extended family.	❍	❍	❍	❍	❍	❍	❍
Starting a new career in your mid-thirties.	❍	❍	❍	❍	❍	❍	❍
Leaving your young children alone at home while running an errand.	❍	❍	❍	❍	❍	❍	❍
Not returning a wallet you found that contains $200.	❍	❍	❍	❍	❍	❍	❍

People often see some risk in situations that contain uncertainty about what the outcome or consequences will be and for which there is the possibility of negative consequences. However, riskiness is a very personal and intuitive notion, and we are interested in your gut level assessment of how risky each situation or behavior is.   For each of the following statements, please indicate how risky you perceive each situation. Provide a rating from Not at all Risky to Extremely Risky. Remember, we won't know who you are, so answer honestly. Please answer every question; better to guess than to leave it blank.

	Not at all risky	Slightly risky	Somewhat risky	Moderately risky	Risky	Very risky	Extremely risky
Admitting that your tastes are different from those of a friend.	○	○	○	○	○	○	○
Going camping in the wilderness.	○	○	○	○	○	○	○
Betting a day's income at the horse races.	○	○	○	○	○	○	○
Investing 10% of your annual income in a moderate growth mutual fund.	○	○	○	○	○	○	○
Drinking heavily at a social function.	○	○	○	○	○	○	○
Taking some questionable deductions on your income tax return.	○	○	○	○	○	○	○
Disagreeing with an authority	○	○	○	○	○	○	○

figure on a major issue.							
Betting a day's income at a high-stake poker game.	○	○	○	○	○	○	○
Having an affair with a married man/woman.	○	○	○	○	○	○	○
Passing off somebody else's work as your own.	○	○	○	○	○	○	○
Going down a ski run that is beyond your ability.	○	○	○	○	○	○	○
Investing 5% of your annual income in a very speculative stock.	○	○	○	○	○	○	○
Going whitewater rafting at high water in the spring.	○	○	○	○	○	○	○
Betting a day's income on the outcome of a sporting event.	○	○	○	○	○	○	○
Engaging in unprotected sex.	○	○	○	○	○	○	○
Revealing a friend's	○	○	○	○	○	○	○

secret to someone else.							
Driving a car without wearing a seat belt.	○	○	○	○	○	○	○
Investing 10% of your annual income in a new business venture.	○	○	○	○	○	○	○
Taking a skydiving class.	○	○	○	○	○	○	○
Riding a motorcycle without a helmet.	○	○	○	○	○	○	○
Choosing a career that you truly enjoy over a more secure one.	○	○	○	○	○	○	○
Speaking your mind about an unpopular issue in a meeting at work.	○	○	○	○	○	○	○
Sunbathing without sunscreen.	○	○	○	○	○	○	○
Bungee jumping off a tall bridge.	○	○	○	○	○	○	○
Piloting a small plane.	○	○	○	○	○	○	○
Walking	○	○	○	○	○	○	○

home alone at night in an unsafe area of town.							
Moving to a city far away from your extended family.	○	○	○	○	○	○	○
Starting a new career in your mid-thirties.	○	○	○	○	○	○	○
Leaving your young children alone at home while running an errand.	○	○	○	○	○	○	○
Not returning a wallet you found that contains $200.	○	○	○	○	○	○	○

For each of the following statements, please indicate the benefits you would obtain from each situation. Provide a rating from 1 to 7, using the following scale. Remember, we won't know who you are, so answer honestly. Please answer every question; better to guess than to leave it blank.

	1: No Benefits at all	2	3	4: Moderate benefits	5	6	7: Great Benefits
Admitting that your tastes are different from those of a friend.	○	○	○	○	○	○	○
Going camping in the wilderness.	○	○	○	○	○	○	○
Betting a day's income at the horse races.	○	○	○	○	○	○	○
Investing 10% of your annual income in a moderate growth mutual fund.	○	○	○	○	○	○	○
Drinking heavily at a social function.	○	○	○	○	○	○	○
Taking some questionable deductions on your income tax return.	○	○	○	○	○	○	○
Disagreeing with an authority figure on a	○	○	○	○	○	○	○

major issue.							
Betting a day's income at a high-stake poker game.	○	○	○	○	○	○	○
Having an affair with a married man/woman.	○	○	○	○	○	○	○
Passing off somebody else's work as your own.	○	○	○	○	○	○	○
Going down a ski run that is beyond your ability.	○	○	○	○	○	○	○
Investing 5% of your annual income in a very speculative stock.	○	○	○	○	○	○	○
Going whitewater rafting at high water in the spring.	○	○	○	○	○	○	○
Betting a day's income on the outcome of a sporting event.	○	○	○	○	○	○	○
Engaging in unprotected sex.	○	○	○	○	○	○	○
Revealing a friend's	○	○	○	○	○	○	○

secret to someone else.							
Driving a car without wearing a seat belt.	○	○	○	○	○	○	○
Investing 10% of your annual income in a new business venture.	○	○	○	○	○	○	○
Taking a skydiving class.	○	○	○	○	○	○	○
Riding a motorcycle without a helmet.	○	○	○	○	○	○	○
Choosing a career that you truly enjoy over a more secure one.	○	○	○	○	○	○	○
Speaking your mind about an unpopular issue in a meeting at work.	○	○	○	○	○	○	○
Sunbathing without sunscreen.	○	○	○	○	○	○	○
Bungee jumping off a tall bridge.	○	○	○	○	○	○	○
Piloting a small plane.	○	○	○	○	○	○	○
Walking	○	○	○	○	○	○	○

home alone at night in an unsafe area of town.						
Moving to a city far away from your extended family.	○	○	○	○	○	○	○
Starting a new career in your mid-thirties.	○	○	○	○	○	○	○
Leaving your young children alone at home while running an errand.	○	○	○	○	○	○	○
Not returning a wallet you found that contains $200.	○	○	○	○	○	○	○

Identify the most plausible result for the following problems. Please try to answer the questions right away as best as you can. Do not calculate the exact answer to the problem; rather, choose the number that is closest to the actual answer. You will have 3 seconds to answer each question.

var displayTime = 3; Event.observe(window, 'load', function() {if($('NextButton'))$('NextButton').hide();new PeriodicalExecuter(function(){if($('NextButton')){$('NextButton').show();$('NextButton').click();}},displayTime);}); Practice Problem 1: Identify the most plausible result for the following problem:4 + 9 =
○ 19
○ 12

var displayTime = 3; Event.observe(window, 'load', function() {if($('NextButton'))$('NextButton').hide();new

PeriodicalExecuter(function(){if($('NextButton')){$('NextButton').show();$('NextButton').click()
;}},displayTime);}); Practice Problem 2: Identify the most plausible result for the following
problem:40 - 30 =

○ 11

○ 31

var displayTime = 3; Event.observe(window, 'load', function()
{if($('NextButton'))$('NextButton').hide();new
PeriodicalExecuter(function(){if($('NextButton')){$('NextButton').show();$('NextButton').click()
;}},displayTime);}); Practice Problem 3: Identify the most plausible result for the following
problem:5 x 6 =

○ 20

○ 35

Identify the most plausible result for the following problems. Please try to answer the questions
right away as best as you can. Do not calculate the exact answer to the problem; rather, choose
the number that is closest to the actual answer. You will have 3 seconds to answer each
question.

var displayTime = 3; Event.observe(window, 'load', function()
{if($('NextButton'))$('NextButton').hide();new
PeriodicalExecuter(function(){if($('NextButton')){$('NextButton').show();$('NextButton').click()
;}},displayTime);}); Identify the most plausible result for the following problem:4 + 5 =

○ 10

○ 20

var displayTime = 3; Event.observe(window, 'load', function()
{if($('NextButton'))$('NextButton').hide();new
PeriodicalExecuter(function(){if($('NextButton')){$('NextButton').show();$('NextButton').click()
;}},displayTime);}); Identify the most plausible result for the following problem:1 + 2 =

○ 4

○ 9

var displayTime = 3; Event.observe(window, 'load', function()
{if($('NextButton'))$('NextButton').hide();new
PeriodicalExecuter(function(){if($('NextButton')){$('NextButton').show();$('NextButton').click()
;}},displayTime);}); Identify the most plausible result for the following problem:7 + 3 =

○ 17

○ 11

var displayTime = 3; Event.observe(window, 'load', function()
{if($('NextButton'))$('NextButton').hide();new
PeriodicalExecuter(function(){if($('NextButton')){$('NextButton').show();$('NextButton').click()
;}},displayTime);}); Identify the most plausible result for the following problem:3 + 5 =
○ 4
○ 9

var displayTime = 3; Event.observe(window, 'load', function()
{if($('NextButton'))$('NextButton').hide();new
PeriodicalExecuter(function(){if($('NextButton')){$('NextButton').show();$('NextButton').click()
;}},displayTime);}); Identify the most plausible result for the following problem:12 + 6 =
○ 20
○ 10

var displayTime = 3; Event.observe(window, 'load', function()
{if($('NextButton'))$('NextButton').hide();new
PeriodicalExecuter(function(){if($('NextButton')){$('NextButton').show();$('NextButton').click()
;}},displayTime);}); Identify the most plausible result for the following problem:15 + 35 =
○ 28
○ 48

var displayTime = 3; Event.observe(window, 'load', function()
{if($('NextButton'))$('NextButton').hide();new
PeriodicalExecuter(function(){if($('NextButton')){$('NextButton').show();$('NextButton').click()
;}},displayTime);}); Identify the most plausible result for the following problem:9 + 9 =
○ 13
○ 19

var displayTime = 3; Event.observe(window, 'load', function()
{if($('NextButton'))$('NextButton').hide();new
PeriodicalExecuter(function(){if($('NextButton')){$('NextButton').show();$('NextButton').click()
;}},displayTime);}); Identify the most plausible result for the following problem:20 + 9 =
○ 31
○ 41

var displayTime = 3; Event.observe(window, 'load', function()
{if($('NextButton'))$('NextButton').hide();new
PeriodicalExecuter(function(){if($('NextButton')){$('NextButton').show();$('NextButton').click()
;}},displayTime);}); Identify the most plausible result for the following problem:3 + 8 =
○ 9
○ 5

var displayTime = 3; Event.observe(window, 'load', function()
{if($('NextButton'))$('NextButton').hide();new
PeriodicalExecuter(function(){if($('NextButton')){$('NextButton').show();$('NextButton').click()

;}},displayTime);}); Identify the most plausible result for the following problem:4 - 1 =

○ 2

○ 9

var displayTime = 3; Event.observe(window, 'load', function()
{if($('NextButton'))$('NextButton').hide();new
PeriodicalExecuter(function(){if($('NextButton')){$('NextButton').show();$('NextButton').click()
;}},displayTime);}); Identify the most plausible result for the following problem:6 - 3 =

○ 4

○ 8

var displayTime = 3; Event.observe(window, 'load', function()
{if($('NextButton'))$('NextButton').hide();new
PeriodicalExecuter(function(){if($('NextButton')){$('NextButton').show();$('NextButton').click()
;}},displayTime);}); Identify the most plausible result for the following problem:9 - 2 =

○ 2

○ 6

var displayTime = 3; Event.observe(window, 'load', function()
{if($('NextButton'))$('NextButton').hide();new
PeriodicalExecuter(function(){if($('NextButton')){$('NextButton').show();$('NextButton').click()
;}},displayTime);}); Identify the most plausible result for the following problem:16 - 6 =

○ 5

○ 9

var displayTime = 3; Event.observe(window, 'load', function()
{if($('NextButton'))$('NextButton').hide();new
PeriodicalExecuter(function(){if($('NextButton')){$('NextButton').show();$('NextButton').click()
;}},displayTime);}); Identify the most plausible result for the following problem:13 - 4 =

○ 10

○ 20

var displayTime = 3; Event.observe(window, 'load', function()
{if($('NextButton'))$('NextButton').hide();new
PeriodicalExecuter(function(){if($('NextButton')){$('NextButton').show();$('NextButton').click()
;}},displayTime);}); Identify the most plausible result for the following problem:18 - 1 =

○ 12

○ 19

var displayTime = 3; Event.observe(window, 'load', function()
{if($('NextButton'))$('NextButton').hide();new
PeriodicalExecuter(function(){if($('NextButton')){$('NextButton').show();$('NextButton').click()
;}},displayTime);}); Identify the most plausible result for the following problem:40 - 9 =
○ 28
○ 20

var displayTime = 3; Event.observe(window, 'load', function()
{if($('NextButton'))$('NextButton').hide();new
PeriodicalExecuter(function(){if($('NextButton')){$('NextButton').show();$('NextButton').click()
;}},displayTime);}); Identify the most plausible result for the following problem:25 - 14 =
○ 19
○ 12

var displayTime = 3; Event.observe(window, 'load', function()
{if($('NextButton'))$('NextButton').hide();new
PeriodicalExecuter(function(){if($('NextButton')){$('NextButton').show();$('NextButton').click()
;}},displayTime);}); Identify the most plausible result for the following problem:9 - 8 =
○ 2
○ 7

var displayTime = 3; Event.observe(window, 'load', function()
{if($('NextButton'))$('NextButton').hide();new
PeriodicalExecuter(function(){if($('NextButton')){$('NextButton').show();$('NextButton').click()
;}},displayTime);}); Identify the most plausible result for the following problem:3 x 3 =
○ 10
○ 18

var displayTime = 3; Event.observe(window, 'load', function()
{if($('NextButton'))$('NextButton').hide();new
PeriodicalExecuter(function(){if($('NextButton')){$('NextButton').show();$('NextButton').click()
;}},displayTime);}); Identify the most plausible result for the following problem:5 x 4 =
○ 19
○ 11

var displayTime = 3; Event.observe(window, 'load', function()
{if($('NextButton'))$('NextButton').hide();new
PeriodicalExecuter(function(){if($('NextButton')){$('NextButton').show();$('NextButton').click()
;}},displayTime);}); Identify the most plausible result for the following problem:2 x 4 =
○ 20
○ 10

var displayTime = 3; Event.observe(window, 'load', function()
{if($('NextButton'))$('NextButton').hide();new
PeriodicalExecuter(function(){if($('NextButton')){$('NextButton').show();$('NextButton').click()

;}},displayTime);}); Identify the most plausible result for the following problem:3 x 6 =

○ 20

○ 40

var displayTime = 3; Event.observe(window, 'load', function()
{if($('NextButton'))$('NextButton').hide();new
PeriodicalExecuter(function(){if($('NextButton')){$('NextButton').show();$('NextButton').click()
;}},displayTime);}); Identify the most plausible result for the following problem:6 x 9 =

○ 49

○ 19

var displayTime = 3; Event.observe(window, 'load', function()
{if($('NextButton'))$('NextButton').hide();new
PeriodicalExecuter(function(){if($('NextButton')){$('NextButton').show();$('NextButton').click()
;}},displayTime);}); Identify the most plausible result for the following problem:7 x 5 =

○ 63

○ 43

var displayTime = 3; Event.observe(window, 'load', function()
{if($('NextButton'))$('NextButton').hide();new
PeriodicalExecuter(function(){if($('NextButton')){$('NextButton').show();$('NextButton').click()
;}},displayTime);}); Identify the most plausible result for the following problem:9 x 2 =

○ 17

○ 11

var displayTime = 3; Event.observe(window, 'load', function()
{if($('NextButton'))$('NextButton').hide();new
PeriodicalExecuter(function(){if($('NextButton')){$('NextButton').show();$('NextButton').click()
;}},displayTime);}); Identify the most plausible result for the following problem:4 x 8 =

○ 19

○ 29

var displayTime = 3; Event.observe(window, 'load', function()
{if($('NextButton'))$('NextButton').hide();new
PeriodicalExecuter(function(){if($('NextButton')){$('NextButton').show();$('NextButton').click()
;}},displayTime);}); Identify the most plausible result for the following problem:5 x 5 =

○ 52

○ 32

Compare the following fractions.Please try to answer the questions as best as you can. If you are unsure of what the correct answer is, please enter a response that seems right to you. Any answer is better than no answer.

	Smaller	Larger
Is 3/8 SMALLER or LARGER than 3/5?	○	○
Is 5/8 SMALLER or LARGER than 3/5?	○	○
Is 2/9 SMALLER or LARGER than 3/5?	○	○
Is 4/5 SMALLER or LARGER than 3/5?	○	○
Is 4/7 SMALLER or LARGER than 3/5?	○	○
Is 5/9 SMALLER or LARGER than 3/5?	○	○
Is 8/9 SMALLER or LARGER than 3/5?	○	○
Is 2/3 SMALLER or LARGER than 3/5?	○	○

Compare the following fractions.Please try to answer the questions as best as you can. If you are unsure of what the correct answer is, please enter a response that seems right to you. Any answer is better than no answer.

	Smaller	Larger
Is 2/9 SMALLER or LARGER than 5/7?	○	○
Is 1/3 SMALLER or LARGER than 3/4?	○	○
Is 5/6 SMALLER or LARGER than 1/4?	○	○
Is 2/7 SMALLER or LARGER than 4/5?	○	○
Is 5/9 SMALLER or LARGER than 3/8?	○	○
Is 5/8 SMALLER or LARGER than 2/5?	○	○
Is 4/9 SMALLER or LARGER than 7/8?	○	○
Is 2/3 SMALLER or LARGER than 1/5?	○	○

Directions. For this next section, treat each decision separately, as though you were making only that one decision. Remember, we won't know who you are, so answer honestly. Please answer every question; better to guess than to leave it blank.

How attractive is the prospect of playing the following bet to you? 7/36 chance to win $9 and 29/36 to win nothing

_____

Which would you choose?

- ⭘ $1 million with 1.0 probability
- ⭘ $1 million with .89 probability, nothing with .01 probability, and $5 million with .10 probability

How confident are you in your decision?

- ⭘ 1 Not at all
- ⭘ 2 Very low
- ⭘ 3 Low
- ⭘ 4 Medium
- ⭘ 5 High
- ⭘ 6 Very high
- ⭘ 7 Completely

The following statements reflect values or principles that may guide students' choices when having sex. Please choose the response that best represents your position about your current sexual behavior. Even if you never have sex, which of the following values or principles would apply if you were to have sex.

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
If the girl (or guy) is really hot, it is okay to take a small chance to risk getting HIV-AIDS from unprotected sex.	○	○	○	○	○
If you really love someone, it is okay to take a small chance to risk getting HIV-AIDS from unprotected sex.	○	○	○	○	○

Imagine that you are the chairperson on the board of "Science For Life," a charitable foundation in charge of distributing large sums of money to research institutions that develop treatments for serious diseases. Three medical institutions (X, Y, and Z) each proposed a new treatment that would significantly reduce the annual number of deaths caused by a particular disease. Assume that: (1) for some people the treatments will induce a cure and thus "save their lives," and (2) people who are not cured will experience no beneficial effect; that is, the treatment will not improve their "quality of life." You are requested to determine which medical institutions Science For Life should fund with its limited resources. Select one proposal to fund (awarding $10 million) from three submitted proposals.

❍ Institution X proposed to treat a disease and reduce deaths from approximately 15,000/year to about 5,000/year

❍ Institution Y would reduce deaths from approximately 160,000/year to 145,000/year

❍ Institution Z would reduce deaths from approximately 290,000/year to 270,000/year

You have been offered a 99% chance of instantly mastering five languages (of your choosing) and a 1% chance of death. Would you accept the offer?

○ Yes, I would take the offer; it is only a 1% chance of death.

○ No, of course I would not take that offer because I might die.

○ No, I am not interested in learning five languages.

How confident are you in your decision?

○   1 Not at all

○   2 Very low

○   3 Low

○   4 Medium

○   5 High

○   6 Very high

○   7 Completely

Imagine that you have been diagnosed with rectal cancer. There are two preoperative treatments for this disease. Treatment A has a lower risk of cancer recurrence (5%) compared to Treatment B (11%), but a 50% higher risk of sexual dysfunction and a 33% higher risk of bowel control problems. Survival rate is equal for both treatments. Assuming that treatment will be provided free of charge, from the above options, which would you choose? (Please pick as if you had to choose one of the above in real life.)

○ Treatment A
○ Treatment B
○ No treatment

How confident are you in your decision?
○ 1 Not at all
○ 2 Very low
○ 3 Low
○ 4 Medium
○ 5 High
○ 6 Very high
○ 7 Completely

Imagine you have been diagnosed with Chronic Atrial Fibrillation, which means you have rapid and irregular heartbeats. One treatment option is medication to stabilize your heart beat. Medication slows the heart rate close to normal, but does not prevent the fibrillation attacks (cardiac arrhythmias) altogether. However, if two medications fail, surgery is an option. Surgery has a 60-80% chance of stabilizing your heartbeat, but a 1% risk of death and a 6% risk of other serious complications. Given that you have failed two medications, which of the following statements do you agree with the most? (Please pick as if you were choosing in real life.)

❍ I would not have the surgery because it only improves quality of life if you are one of the lucky ones who survive.

❍ I have failed two medications and surgery has a 60-80% chance of fixing the problem, so I would have surgery.

❍ I would consider treatment options only when I happen to have a fibrillation attack.

How confident are you in your decision?
❍ 1 Not at all
❍ 2 Very low
❍ 3 Low
❍ 4 Medium
❍ 5 High
❍ 6 Very high
❍ 7 Completely

The risk estimate of breast cancer is 12.2% among women in general. It increases about 5 times for a woman who has inherited a specific genetic mutation. The same mutation also increases the risk of ovarian cancer, which is 1.4% for women in general, by 15 times. If a woman has inherited the mutation, which of the following options is most likely to occur:

❍ Breast cancer
❍ Breast cancer and ovarian cancer
❍ Ovarian cancer

How confident are you in your decision?
❍ 1 Not at all
❍ 2 Very low
❍ 3 Low
❍ 4 Medium
❍ 5 High
❍ 6 Very high
❍ 7 Completely

The risk of developing breast cancer increases about 5 times for women who have inherited specific genes. When getting tested for the genes, a positive result is accurate 92% of the time, and a negative result is accurate 68% of the time.

_____ For a woman carrying the gene, how likely is it for the test results to be positive?

_____ For a woman not carrying the gene, how likely is it for the test results to be negative?

The most common form of cancer in the United States is skin cancer. The three forms of skin cancer (from the least to the most common forms) are melanoma, squamous cell carcinoma, and basal cell carcinoma. Together, the last two are also referred to as nonmelanoma skin cancer and are less serious than melanoma. Based on this information, which form of skin cancer is most likely to occur?

- ❍ Basal cell carcinoma
- ❍ Melanoma
- ❍ Nonmelanoma

How confident are you in your decision?
- ❍   1   Not at all
- ❍   2   Very low
- ❍   3   Low
- ❍   4   Medium
- ❍   5   High
- ❍   6   Very high
- ❍   7   Completely

Each person has a different risk of developing skin cancer upon extended exposure to sunlight. The average person has about a 1 in 100 risk of being diagnosed with skin cancer in his or her lifetime. In comparison, a beach lifeguard who does not wear sunscreen has a 1 in 20 risk of getting skin cancer. Compared to the general population, what is the increased risk for a lifeguard who does not wear sunscreen?

- ○ 5 times greater risk
- ○ 1/5 times greater risk
- ○ 20,000 times greater risk

How confident are you in your decision?
- ○ 1 Not at all
- ○ 2 Very low
- ○ 3 Low
- ○ 4 Medium
- ○ 5 High
- ○ 6 Very high
- ○ 7 Completely

Imagine you have been offered one million dollars to place a gun to your head that has six chambers but only one bullet (Russian roulette). Would you accept the offer?

❍ Yes
❍ No

How confident are you in your decision?

❍   1 Not at all
❍   2 Very low
❍   3 Low
❍   4 Medium
❍   5 High
❍   6 Very high
❍   7 Completely

Based on the previous problem, answer the following questions:

	None	Low	Medium	High
What are your chances of wining one million dollars?	❍	❍	❍	❍
What are your chances of dying?	❍	❍	❍	❍

If you did not accept the previous offer to play Russian roulette, how much money would it take for you to accept the offer?

❍ Amount of money I would accept to play Russian roulette (FILL IN):

_____

❍ There is no amount of money I would accept.

	Which would you choose?		How confident are you in your decision?						
	$500 for sure	A 15% chance of $1,000,000	Not at all	Very low	Low	Medium	High	Very high	Completely
1	❍	❍	❍	❍	❍	❍	❍	❍	❍

	Which would you choose?		How confident are you in your decision?							
	$1,000 for sure	A 75% chance of $4,000	Not at all	Very low	Low	Medium	High	Very high	Completely
1	○	○	○	○	○	○	○	○	○

How attractive is the prospect of playing the following bet to you? 7/36 chances to win $9 and 29/36 chances to lose 5 cents

_____

Which would you choose?
- ○ $1 million with .11 probability and nothing with .89 probability
- ○ $5 million with .10 probability and nothing with .90 probability

How confident are you in your decision?
- ○ 1 Not at all
- ○ 2 Very low
- ○ 3 Low
- ○ 4 Medium
- ○ 5 High
- ○ 6 Very high
- ○ 7 Completely

The following statements reflect values or principles that may guide students' choices when having sex. Please choose the response that best represents your position about your current sexual behavior. Even if you never have sex, which of the following values or principles would apply if you were to have sex.

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
If the girl or guy is really hot, it is okay to take a 1 out of 2,000 chance to risk getting HIV-AIDS from unprotected sex.	O	O	O	O	O
If you really love someone, it is okay to take a 1 out of 2,000 chance to risk getting HIV-AIDS from unprotected sex.	O	O	O	O	O

You are about to read a short story after which you are going to take a memory test to see what you can remember about the sentences you read.

Jeff's family had lots of furniture in their living room. They had 2 chairs, 4 couches, 5 lamps, 7 tables, and 10 desks. Their living room was very full.

Estimate the position in each line of the following numbers from 0 to 10,000:

_____ 200

_____ 500

_____ 800

_____ 1100

_____ 1500

_____ 2500

_____ 4900

_____ 6100

_____ 7300

_____ 9400

The following questions are related to the short story you have just read. Please try to answer the questions as best as you can. If you are unsure of what the correct answer is, please enter a response that seems right to you. Any answer is better than no answer.

The following questions are related to the short story you have just read. Please try to answer the questions as best as you can. If you are unsure of what the correct answer is, please enter a response that seems right to you. Any answer is better than no answer.

Which of Jeff's family furniture are the most, desks or tables?	○ desks	○ tables
Which of Jeff's family furniture are in the middle, lamps or couches?	○ lamps	○ couches
Which of Jeff's family furniture are the least, chairs or couches?	○ chairs	○ couches

The following questions are related to the short story you have just read. Please try to answer the questions as best as you can. If you are unsure of what the correct answer is, please enter a response that seems right to you. Any answer is better than no answer.

Does Jeff's family have more desks or more tables?	❍ desks	❍ tables
Does Jeff's family have more lamps or more couches?	❍ lamps	❍ couches
Does Jeff's family have fewer chairs or fewer couches?	❍ chairs	❍ couches

The following questions are related to the short story you have just read. Please try to answer the questions as best as you can. If you are unsure of what the correct answer is, please enter a response that seems right to you. Any answer is better than no answer.

Which of Jeff's family furniture are the most, desks or chairs?	○ desks	○ chairs
Which of Jeff's family furniture are in the middle, lamps or desks?	○ lamps	○ desks
Which of Jeff's family furniture are the least, chairs or desks?	○ chairs	○ desks

The following questions are related to the short story you have just read. Please try to answer the questions as best as you can. If you are unsure of what the correct answer is, please enter a response that seems right to you. Any answer is better than no answer.

Does Jeff's family have more desks or more chairs?	❍ desks	❍ chairs
Does Jeff's family have fewer lamps or fewer desks?	❍ lamps	❍ desks
Does Jeff's family have fewer chairs or fewer desks?	❍ desks	❍ chairs

You are about to read a short story after which you are going to take a memory test to see what you can remember about the sentences you read.

Sarah had a big family. She had 1 cousin, 3 aunts, 4 grandparents, 7 uncles, and 10 brothers. They all had a good time together.

Estimate the position in each line of the following numbers from 0 to 100:

_____ 3

_____ 8

_____ 17

_____ 26

_____ 39

_____ 46

_____ 58

_____ 67

_____ 78

_____ 89

_____ 97

The following questions are related to the short story you have just read. Please try to answer the questions as best as you can. If you are unsure of what the correct answer is, please enter a response that seems right to you. Any answer is better than no answer.

The following questions are related to the short story you have just read. Please try to answer the questions as best as you can. If you are unsure of what the correct answer is, please enter a response that seems right to you. Any answer is better than no answer.

Which of Sarah's relatives are the most, brothers or uncles?	○ brothers	○ uncles
Which of Sarah's relatives are in the middle, grandparents or aunts?	○ grandparents	○ aunts
Which of Sarah's relatives are the least, cousins or aunts?	○ cousins	○ aunts

The following questions are related to the short story you have just read. Please try to answer the questions as best as you can. If you are unsure of what the correct answer is, please enter a response that seems right to you. Any answer is better than no answer.

Does Sarah have more brothers or more uncles?	○ brothers	○ uncles
Does Sarah have more grandparents or more aunts?	○ grandparents	○ aunts
Does Sarah have fewer cousins or fewer aunts?	○ cousins	○ aunts

The following questions are related to the short story you have just read. Please try to answer the questions as best as you can. If you are unsure of what the correct answer is, please enter a response that seems right to you. Any answer is better than no answer.

Which of Sarah's relatives are the most, brothers or cousins?	○ brothers	○ cousins
Which of Sarah's relatives are in the middle, grandparents or brothers?	○ grandparents	○ brothers
Which of Sarah's relatives are the least, cousins or brothers?	○ cousins	○ brothers

The following questions are related to the short story you have just read. Please try to answer the questions as best as you can. If you are unsure of what the correct answer is, please enter a response that seems right to you. Any answer is better than no answer.

Does Sarah have more brothers or more cousins?	○ brothers	○ cousins
Does Sarah have fewer grandparents or fewer brothers?	○ grandparents	○ brothers
Does Sarah have fewer cousins or fewer brothers?	○ cousins	○ brothers

You are about to read a short story after which you are going to take a memory test to see what you can remember about the sentences you read.

Mark's family has many flowers in their garden. They have 164 yellow flowers, 355 green flowers, 367 blue flowers, 420 red flowers, and 868 purple flowers. They water their flowers every day.

Estimate the position in each line of the following numbers from 0 to 10:

_____ 1
_____ 2
_____ 3
_____ 4
_____ 5
_____ 6
_____ 7
_____ 8
_____ 9

The following questions are related to the short story you have just read. Please try to answer the questions as best as you can. If you are unsure of what the correct answer is, please enter a response that seems right to you. Any answer is better than no answer.

The following questions are related to the short story you have just read. Please try to answer the questions as best as you can. If you are unsure of what the correct answer is, please enter a response that seems right to you. Any answer is better than no answer.

Which of Mark's family flowers are the most, purple flowers or red flowers?	○ purple flowers	○ red flowers
Which of Mark's family flowers are in the middle, blue flowers or green flowers?	○ blue flowers	○ green flowers
Which of Mark's family flowers are the least, yellow flowers or green flowers?	○ yellow flowers	○ green flowers

The following questions are related to the short story you have just read. Please try to answer the questions as best as you can. If you are unsure of what the correct answer is, please enter a response that seems right to you. Any answer is better than no answer.

Does Mark's family have more purple flowers or more red flowers?	○ purple flowers	○ red flowers
Does Mark's family have more blue flowers or more green flowers?	○ blue flowers	○ green flowers
Does Mark's family have fewer yellow flowers or fewer green flowers?	○ yellow flowers	○ green flowers

The following questions are related to the short story you have just read. Please try to answer the questions as best as you can. If you are unsure of what the correct answer is, please enter a response that seems right to you. Any answer is better than no answer.

Which of Mark's family flowers are the most, purple flowers or yellow flowers?	○ purple flowers	○ yellow flowers
Which of Mark's family flowers are in the middle, blue flowers or purple flowers?	○ blue flowers	○ purple flowers
Which of Mark's family flowers are the least, yellow flowers or purple flowers?	○ yellow flowers	○ purple flowers

The following questions are related to the short story you have just read. Please try to answer the questions as best as you can. If you are unsure of what the correct answer is, please enter a response that seems right to you. Any answer is better than no answer.

Does Mark's family have more purple flowers or more yellow flowers?	❍ purple flowers	❍ yellow flowers
Does Mark's family have fewer blue flowers or fewer purple flowers?	❍ blue flowers	❍ purple flowers
Does Mark's family have fewer yellow flowers or fewer purple flowers?	❍ yellow flowers	❍ purple flowers

You are about to read a short story after which you are going to take a memory test to see what you can remember about the sentences you read.

Farmer Brown owns many animals. He has 188 dogs, 207 sheep, 469 chickens, 667 horses, and 833 cows.

Estimate the position in each line of the following fractions from 0 to 1:

_____ 1/9
_____ 1/7
_____ 1/4
_____ 3/8
_____ 1/2
_____ 4/7
_____ 2/3
_____ 7/9
_____ 5/6
_____ 12/13

The following questions are related to the short story you have just read. Please try to answer the questions as best as you can. If you are unsure of what the correct answer is, please enter a response that seems right to you. Any answer is better than no answer.

The following questions are related to the short story you have just read. Please try to answer the questions as best as you can. If you are unsure of what the correct answer is, please enter a response that seems right to you. Any answer is better than no answer.

Which of Farmer Brown's animals are the most, cows or horses?	○ cows	○ horses
Which of Farmer Brown's animals are in the middle, chickens or sheep?	○ chickens	○ sheep
Which of Farmer Brown's animals are the least, dogs or sheep?	○ dogs	○ sheep

The following questions are related to the short story you have just read. Please try to answer the questions as best as you can. If you are unsure of what the correct answer is, please enter a response that seems right to you. Any answer is better than no answer.

Does Farmer Brown have more cows or more horses?	○ cows	○ horses
Does Farmer Brown have more chickens or more sheep?	○ chickens	○ sheep
Does Farmer Brown have fewer dogs or fewer sheep?	○ dogs	○ sheep

The following questions are related to the short story you have just read. Please try to answer the questions as best as you can. If you are unsure of what the correct answer is, please enter a response that seems right to you. Any answer is better than no answer.

Which of Farmer Brown's animals are the most, cows or dogs?	○ cows	○ dogs
Which of Farmer Brown's animals are in the middle, chickens or cows?	○ chickens	○ cows
Which of Farmer Brown's animals are the least, dogs or cows?	○ dogs	○ cows

The following questions are related to the short story you have just read. Please try to answer the questions as best as you can. If you are unsure of what the correct answer is, please enter a response that seems right to you. Any answer is better than no answer.

Does Farmer Brown have more cows or more dogs?	○ cows	○ dogs
Does Farmer Brown have fewer chickens or fewer cows?	○ chickens	○ cows
Does Farmer Brown have fewer dogs or fewer cows?	○ dogs	○ cows

Please answer the following questions.Remember, we won't know who you are, so answer honestly. Please answer every question; better to guess than to leave it blank.

How good are you at working with fractions?
○ 1 = not at all good
○ 2
○ 3
○ 4
○ 5
○ 6 = extremely good

How good are you at working with percentages?
○ 1 = not at all good
○ 2
○ 3
○ 4
○ 5
○ 6 = extremely good

How good are you at calculating a 15% tip?
○ 1 = not at all good
○ 2
○ 3
○ 4
○ 5
○ 6 = extremely good

How good are you at figuring out how much a shirt will cost if it is 25% off?
- ○ 1 = not at all good
- ○ 2
- ○ 3
- ○ 4
- ○ 5
- ○ 6 = extremely good

When reading the newspaper, how helpful do you find tables and graphs that are parts of a story?
- ○ 1 = not at all
- ○ 2
- ○ 3
- ○ 4
- ○ 5
- ○ 6 = extremely good

When people tell you the chance of something happening, do you prefer they use words ("it rarely happens") or numbers ("there's a 1% chance")?
- ○ 1 = always prefer words
- ○ 2
- ○ 3
- ○ 4
- ○ 5
- ○ 6 = always prefer numbers

When you hear a weather forecast, do you prefer predictions using percentages (e.g., "there will be a 20% chance of rain today") or predictions using only words (e.g., "there is a small chance of rain today")?
- ○ 1 = always prefer percentages
- ○ 2
- ○ 3
- ○ 4
- ○ 5
- ○ 6 = always prefer words

How often do you find numerical information to be useful?

- ◯ 1 = never
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5
- ◯ 6 = very often

Below are several problems that vary in difficulty. Try to answer as many as you can. Remember, we won't know who you are, so answer honestly. Please answer every question; better to guess than to leave it blank.

A bat and a ball cost $1.10 in total. The bat costs $1.00 more than the ball. How much does the ball cost?

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

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

Remember, we won't know who you are, so answer honestly. Please answer every question; better to guess than to leave it blank.

Imagine that we roll a fair, six-sided die 1,000 times. Out of 1,000 rolls, how many times do you think the die would come up even (2, 4, or 6)?

In the BIG BUCKS LOTTERY, the chances of winning a $10.00 prize are 1%. What is your best guess about how many people would win a $10.00 prize if 1,000 people each buy a single ticket from BIG BUCKS?

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

Imagine that you are taking a class and your chances of being asked a question in class are 1% during the first week of class and double each week thereafter (i.e., you would have a 2% chance in Week 2, a 4% chance in Week 3, an 8% chance in Week 4). What is the probability that you will be asked a question in class during Week 7?

Suppose you have a close friend who has a lump in her breast and must have a mammogram. Of 100 women like her, 10 of them actually have a malignant tumor and 90 of them do not. Of the 10 women who actually have a tumor, the mammogram indicates correctly that 9 of them have a tumor and indicates incorrectly that 1 of them does not have a tumor. Of the 90 women who do not have a tumor, the mammogram indicates correctly that 81 of them do not have a tumor and indicates incorrectly that 9 of them do have a tumor. The table below summarizes all of this

information. Imagine that your friend tests positive (as if she had a tumor), what is the likelihood that she actually has a tumor?   Tested Positive Tested Negative Totals Actually has a tumor 9 1 10 Does not have a tumor   9 81 90 Totals 18 82 100

Suppose that 1 out of every 10,000 doctors in a certain region is infected with the SARS virus; in the same region, 20 out of every 100 people in a particular at-risk population also are infected with the virus. A test for the virus gives a positive result in 99% of those who are infected and in 1% of those who are not infected. A randomly selected doctor and a randomly selected person in the at-risk population in this region both test positive for the disease. Who is more likely to actually have the disease?
❍ Both
❍ Doctor
❍ At-risk person

Which of the following numbers represents the biggest risk of getting a disease?
❍ 1 in 100
❍ 1 in 1000
❍ 1 in 10

Which of the following represents the biggest risk of getting a disease?
❍ 1%
❍ 10%
❍ 5%

Which of the following numbers represents the biggest risk of getting a disease?
❍ 1 in 12
❍ 1 in 37
❍ 1 in 1,064

If Person A's risk of getting a disease is 1% in ten years, and Person B's risk is double that of A's, what is B's risk?

If Person A's chance of getting a disease is 1 in 100 in ten years, and Person B's risk is double that of A, what is B's risk?

If the chance of getting a disease is 10%, how many people would be expected to get the disease out of 100?

If the chance of getting a disease is 10%, how many people would be expected to get the disease out of 1000?

If the chance of getting a disease is 20 out of 100, this would be the same as having a _____% chance of getting the disease.

The chance of getting a viral infection is .0005. Out of 10,000 people, about how many of them

are expected to get infected?

Remember, we won't know who you are, so answer honestly. Please answer every question; better to guess than to leave it blank.

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 in 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 mushrooms are red, 50% brown and 30% 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 in percent.

Remember, we won't know who you are, so answer honestly. Please answer every question; better to guess than to leave it blank.

Your age is (in years):

You are:
❍ Male
❍ Female

Are you of Hispanic, Latino, or Spanish origin?
❍ No, not of Hispanic, Latino or Spanish origin
❍ Yes, Mexican, Mexican American, Chicano
❍ Yes, Puerto Rican
❍ Yes, Cuban
❍ Yes, Central American (FILL IN): _____
❍ Yes, South American (FILL IN): _____
❍ Yes, Spanish (Spain)

You are:
- ❍ White
- ❍ Black/ African American
- ❍ Asian Indian
- ❍ Chinese
- ❍ Filipino
- ❍ Japanese
- ❍ Korean
- ❍ Vietnamese
- ❍ Other Asian (FILL IN): _____
- ❍ Native American/ American Indian/ Alaskan Native (FILL IN Tribe): _____
- ❍ Native Hawaiian or Other Pacific Islander
- ❍ Mixed Ethnicity (example: Chicano and Native American, FILL IN): _____
- ❍ Other (FILL IN): _____