HEURISTICS AND BIASES IN NARRATIVE AND NON-NARRATIVE RISK MESSAGES

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HEURISTICS AND BIASES IN NARRATIVE AND NON-NARRATIVE RISK MESSAGES

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Understanding the cognitive heuristics people use to make decisions and the biases in judgment resulting from their use has been a focus of risk communication research for nearly forty years. During that period, research has demonstrated consistent effects of these heuristics and biases across multiple contexts using fairly standardized approaches to measurement. My previous research, however, has found that people may make decisions inconsistent with the expectations of known cognitive biases when those decisions are situated within narratives. This dissertation expands on that work and examines the role narratives play in decision making, specifically in the reduction of cognitive biases caused by the use of mental heuristics when reading stories. Three experiments empirically examine three known biases: *prospect theory framing effects*, the effect to which people make different decisions depending on whether a choice is presented as a loss or as a gain (Chapter 2); *anchoring effects*, the effect to which people judge a decision based on an initial unrelated piece of information given prior to the decision (Chapter 3); and the *gambler's fallacy*, the faulty notion that the result of an independent event is related to the result of previous independent events (Chapter 4). Chapter two tests whether the influence of narratives over cognitive biases may result from goals held by readers. It found further evidence that narratives reduce the biases related to gain-loss framing effects and no evidence that this

reduction was due to goals held while reading. Chapter three explores the role of perceived realism in bias reduction and also tests the anchoring and adjustment heuristic in a narrative. It found that narratives reduce biases related to the anchoring and adjustment heuristic and no evidence that perceived realism of the narratives influenced the reduction. Chapter four examines whether the presentation of a story as either first person or third person influences a reader's decision and also tests the gambler's fallacy in a narrative. The experiment yielded inconclusive results, specifically a difference between the narrative and non-narrative conditions that did not meet the standard and acceptable level of statistical significance. This is notably different from the results presented in chapters 2 and 3, and is possibly due to the fact that unlike the non-narrative versions of the framing and anchoring experiments, narrative information is inherently contained in the non-narrative condition of the gamblers fallacy as it pertains to an ordered sequence of events.

Overall, the findings expand our understanding of narrative stories in risk communication as they relate to cognitive heuristics and biases. Specifically, the three experiments suggest that narratives reduce the biases caused by cognitive heuristics in risk decision-making.

BIOGRAPHICAL SKETCH

Joseph S. Steinhardt was born in Pennsylvania but spent the majority of his adult life in central New Jersey. He received a B.A. in Communication from Boston University (2006). Following his undergraduate studies, he spent three years working in different facets of the media and communication industry amassing 17 film and video credits ranging from location credits on feature films and network television to producer credits on reality television and documentaries. He also worked as a project coordinator and data analyst on the National Exit Poll for the 2006 congressional election at Edison Research. It was this direct experience in media and analytics that led him to want to answer larger and more meaningful communication questions. This led him to first to the master's program in Media Studies at Syracuse University, and ultimately to the PhD program at Cornell University's Department of Communication where he studied risk communication under the guidance and mentorship of Professor Katherine McComas. Joe currently lives in Ithaca, NY with his wife, Stephanie, and daughter Maeva.

DEDICATON

To Stephanie, my guiding light through a dark tunnel,

and Maeva, my smile when I reach the end.

To Mom and Dad, for always supporting me and encouraging me.

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"Finding is losing something else.
I think about, perhaps even mourn,
what I lost to find this"
-Richard Brautigan, *Loading Mercury With A Pitchfork*

"Among those whom I like or admire, I can find no common denominator, but among those whom I love, I can: all of them make me laugh." – W.H. Auden

While my name is the only one listed on the title page of this dissertation, it was not a solo journey. In fact, there are many people in my life, both personal and professional, without whom I may never have made it through the PhD program nor completed this dissertation.

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CHAPTER 1

INTRODUCTION

Understanding the mental heuristics people use to make decisions and the biases in judgment resulting from their use has been a focus of risk communication research for nearly forty years. Recent experiments, however, have found that people may make decisions inconsistent with the expectations of known cognitive biases when those decisions are situated within narratives. This dissertation research further probes the relationship between narrative risk messages and decision-making by exploring whether reading narratives can cause people to make better informed and less biased risk judgments by eliminating cognitive biases. Specifically the research will examine three known biases: *prospect theory framing effects*, the effect to which people make different decisions depending on whether a choice is presented as a loss or as a gain; *anchoring effects*, the effect to which people judge a decision based on an initial unrelated piece of information given prior to the decision; and the *gambler's fallacy*, the faulty notion that the result of an independent event is related to the result of previous independent events.

The role narratives may play in reducing cognitive biases is especially important as narrative messages are increasingly popular in risk communication. For example, narrative messages have been shown to be more effective than descriptive messages in risk communication ranging from messages focusing on radon (Golding, Krimsky, & Plough, 1992; Krimsky, 2007) to awareness of social determinants of health (Niederdeppe, Bu, Borah, Kindig, & Robert, 2008). Narratives can take many forms in risk and health communication, sometimes referred to as exemplars (Brosius, 1999), testimonial evidence (Ubel et al., 2001), case histories (Dickson, 1982), or anecdotal evidence (Slater & Rouner, 1996) as

Winterbottom, Bekker, Conner, & Mooney (2008) points out in their meta-analysis. While many of these studies tested risk messages in the form of brochures or other short descriptive information, there is increasing interest in long-form narratives (i.e., stories) as effective risk communication messages (Hinyard & Kreuter, 2006; Kreuter et al., 2007). Certain characteristics of narrative stories, such as suggested causal links, may be especially persuasive about risk as they can reduce counter-arguing and resistance (Dahlstrom, 2010; Dahlstrom, 2012).

The following research addresses an important gap at the intersection of the research on cognitive biases and narrative communication. Essentially, the research on cognitive biases is often rooted in abstraction, asking people to make decisions in formats which they never encounter elsewhere. With that in mind, it is also important to distinguish between the 'real world-ness' of the format versus the decision itself; while few people, if any, may be faced with a decision in which they must choose between a sure gain and a 50-50 gamble in the real world, people certainly make choices between varying degrees of uncertainty on a daily basis. However, rarely, if ever, are those choices presented in the form of single-item decisions. Exploring how stories, one of the most common ways to communicate information, influence the effects resulting from cognitive biases when tested in traditional experimental formats, bridges a key gap in applying our psychological understanding of decision making to risk communication.

The effect of presenting a choice in the form of a story on a person's preference is important to investigate not just to better understand our cognitive processes but also to better apply research when it comes to creating narrative risk communication campaigns. Not fully understanding how narratives may influence judgment could lead to unintended effects of

messages; attempts to avoid these unintended effects often involve work from non-narrative contexts as it is often the best available. For example, narratives are frequently cited as effective ways to communicate about health and risk (Baezconde-Garbanati et al., 2014; Golding, Krimksy, & Plough, 1992; Khangura, Bennett, Stacey, & O'Connor, 2008; Kim, Bigman, Leader, Lerman, & Capella, 2012; McQueen, Kreuter, Kalesan, & Alcaraz, 2011), and cognitive heuristics have also been suggested as ways to influence risk decisions, from gain-and-loss framing effects (O'Keefe & Jensen, 2007; Rothman, Bartels, Wlaschin, & Salovey, 2006) to anchoring and adjustment effects (Chapman & Johnson, 1999; Peters, McCaul, Stefanek, & Nelson, 2006; Senay & Kaphingst, 2009). However, it is possible that these two effective forms of risk communication when mixed together are either rendered ineffective or behave in ways not anticipated by risk communicators and message designers. This research will work toward closing the gap in understanding how these two important methods of effective risk communication interact and their influence on decision-making about risk.

To fully explore the role narratives may play in the use of cognitive heuristics, this research conducts randomized experiments using a general population sample of adults. These experiments are designed to test differences between the outcomes of traditional non-narrative methods of measuring biases compared with narrative versions of the same experiments. Participants will be randomly assigned to conditions in which they will either answer questions or read narratives based on those questions and differences between the choices will be analyzed for the effect of the narrative version on preference.

Intellectual merits and broader social impacts

This research contributes to a scientific understanding of how narratives influence decision making about risk, specifically addressing two research gaps. First, it examines heuristics and biases often tested in discrete decision formats or line-item questions in narrative contexts, which are commonly used in applied risk communication such as Public Service Announcements (PSAs) and related campaigns. In addition, it examines narratives in the form of stories. For example, most research examining narrative risk messages pit narratives against statistical messages, thus conceptualizing narratives simply as words or discrete anecdotal accounts instead of numbers (i.e. McQueen, Kreuter, Kalesan, & Alcaraz, 2011; Betsch, Ulshofer, & Renkewitz, & Betsch, 2011; etc.). However, the stories we hear in real life as well as those which are written into PSAs and edutainment programming are often far more complex. The proposed research addresses this gap by examining how narrative stories influence risk decisions.

By testing traditional theories of decision making in more applied circumstances such as narratives, the proposed research provides scientific evidence that will aid and inform risk managers, health officials, and other groups interested in health and risk campaigns.

This dissertation builds on previous literature on heuristics and biases and their role in risk communication by exploring their efficacy in a narrative context, a context suggested to be more effective in communicating risk information about health and other hazards (Harter, Japp, & Beck, 2005). In doing so, the results allow for the design of more effective and more appropriate risk and health communication campaigns, as well as a deeper understanding of prospect theory framing effects and the impact of narrative in risk information processing.

This dissertation will aid in the development of more effective risk and health communication strategies for risk managers and health officials. By examining the influence of narratives on heuristics and biases and how they can distort judgment in ways that are not predicted by previous research, my proposed research will provide deeper insight into crafting health and risk messages as well as open up important discussions on best practices for risk communicators. By establishing empirical support that the hypotheses generated from heuristic and bias related theories may not be applicable to narrative settings, this research provides a foundation for future research into better designed and more effective risk management and health campaigns.

Statement of the Research Problem

Much research over the last several decades has sought to understand why, when faced with certain choices, the cognitive shortcuts that are designed to aid people in their decision-making often lead them to make choices that are not optimal. For example, why are people risk averse in situations where they may benefit in taking risks, and risk seeking in situations where it may be better not to be (Kahneman, 2011; Taleb, 2001)? Many of the leaders in the area of risk perception and risk communication have tackled this question, providing compelling examples of the pitfalls of poor decision-making about risk as well as explanations as to why these decisions may be made (Kahneman, 2011; Loewenstein, Weber, Hsee, & Welch 2001; Reyna & Brainerd, 2011; Slovic, 1993, etc.). While scholars have offered competing theories as to why people sometimes make poor choices, many of which are explicated below, there is general agreement that more mindful decisions by individuals may lead to a safer society overall.

This dissertation examines how narratives might promote people to engage in more

mindful decisions about risk. It focuses on the impact of narratives on three specific cognitive heuristics that have been shown to bias judgment about risk: framing, anchoring, and the gambler's fallacy. These were chosen among the multitude of other heuristics for two main reasons. First, they are prominent in literature; all three of the heuristics are well understood, and their effects have been replicated in many different contexts and have a large body of research showing their effects. This allows for the research to better isolate the effect of a narrative presentation without potential confounding factors relating to whether or not the heuristic is strong enough to be measured. Second, they were chosen to represent different types of heuristics with the goal of being able to better generalize the findings. Framing relates to decision-making, whereas anchoring and adjustment relates to estimation. The gambler's fallacy provides a heuristic that is related to narrative in general as it involves an ordered sequence of events. By examining all three types of heuristics this research will allow for a more clear understanding of narratives role in their biases. Finally, these heuristics were chosen for their conceptual fit with their intersection with narrative. This dissertation will provide early, somewhat exploratory work in the area of narrative and heuristics. There are few previous studies examining their intersection; thus, I chose to test heuristics that best lend themselves to being situated in narratives.

The following research explores the impact of narrative stories on effects related to cognitive biases that have been previously shown in traditional non-narrative formats. It does so by (1) testing framing effects by examining differences in choice after reading messages framed in terms of losses or gains in a non-narrative format compared with when the question is presented in the form of a narrative story, (2) testing anchoring effects by examining differences in choice after reading messages with numerical anchors in a non-narrative format

compared with a narrative story, (3) testing the gambler's fallacy by examining differences in choice when reading stories relating to the outcome of gambling on roulette outcomes compared with being presented with a list of previous outcomes. In doing so, this research combines previous work on heuristics and biases, narratives, risk communication, and decision research.

This research focuses on stories as they are increasingly popular in risk communication campaigns, yet they may also have unintended effects due to their narrative format. For example, several previous experiments have found that framing effects that occurred when presented in a traditional non-narrative decision format did not occur when the same situation was presented as a narrative story (Steinhardt & Shapiro, 2013c; Steinhardt & Shapiro, 2015). These experiments provide evidence that narratives might affect a cognitive heuristic's influence on choice, yet they also only tested a limited number of narratives and only a single heuristic (framing). This research expands on these experiments in an attempt to further replicate, refine, and generalize the findings by testing for the role of narrative stories in amplifying or attenuating other cognitive biases and exploring the potential of narratives for leading to better decisions.

Rationale for Dissertation

This dissertation examines heuristics and biases work that permeates many facets of communication and psychological research and are formative to behavioral economics research. Our understanding of these heuristics and biases is so robust that their influence is often taken as a given rather than a dependent variable for investigation. In fact, the studies leading up to this dissertation came out of research assuming effects of heuristics. Previously, my goal was to use the influence of heuristics to manipulate a person's enjoyment of fiction

and perception of characters in narrative fiction. For example, would a character in a story acting in a way inconsistent with the expectations of theories of behavior surrounding decision-making be viewed as more of a risk taker? Would the story be viewed as being less realistic? In attempting to answer these questions I uncovered unexpected results. It turns out heuristics and biases may behave in counterintuitive ways when situated in narratives. Essentially, these well-worn and robust theories of behavior may only be robust in some circumstances. More significantly, those situations in which the theories are less robust may be those situations most relevant to communication research.

From an economic standpoint, there is significance in highlighting instances in which people make decisions that are not the most mathematically optimal. Neoclassical economics is based on the assumption that people will *always* behave in the most mathematically optimal way (Friedman & Savage, 1979; Simon, 1979; Simon, 1955). With that in mind, Kahenman and Tverksy's experimental evidence showing people behaving in non-optimal ways, due to the heuristics they used when making decisions, was groundbreaking (Kahneman & Tversky, 1979; Tversky & Kahneman, 1973; Tversky & Kahneman, 1974; Tversky & Kahneman, 1981). It led to a Nobel Prize and provided strong evidence for in support of a branch of economics based on people not always behaving optimally called behavioral economics. However, while revolutionary in the sense that their research and other similar to it destroyed the notion of the lay-person as a decision-making machine free of emotion, the ways in which people answered these questions in different frames or after being asked to make estimates after being given selective information may be less relevant to how people make real world decisions and form real world attitudes, a cornerstone of communication research.

This dissertation takes a step in the direction of marrying the research from the

discrete questions asked by Kahneman, Tversky, and their colleagues, and research related to reading narrative stories, a prime method of real world communication. Are the heuristics a decision-making version of an optical illusion (which are also caused by heuristics)? Or do they actually relate to our real world decisions and behavior? For example, that someone might mistake object size in a Delboeuf illusion or an Ebbinghaus illusion[1] does not mean that they might mistakenly walk into a tree thinking it is further than it really is or that they might not be able to catch a ball thrown to them because they mistook its size. And yet, much of the research into the cognitive heuristics around decision making seem to take precisely that implication: essentially, that people are irrational actors, incapable of making good judgments, due to their reaction to these discrete decision problems.

By joining the theories of decision-making from behavioral economics and psychology with communication work on narrative, this dissertation allows for a kinder view of the lay-person as a decision maker. It also allows for a better understanding of the boundaries of heuristics and biases research by exploring them in contexts outside those in which they have been originally tested.

Decision making in narrative messages as risk communication

While this dissertation draws from research outside communication such as decision science, cognitive psychology, and behavioral economics, at its core are questions about risk communication. Research exploring decision making and heuristics and biases in those other areas of study often focus on decision outcomes as a way to measure bias as a means rather than an end. Their experiments are often steeped in abstraction, asking people to make

[1] Both the Ebbinghaus illusion and the Delboeuf illusion deal with relative size perception. Each illusion involves two circles of equal size that appear to be different

judgments in context-free situations in order to measure the deviation in participant's answers from a mathematical expected value.

In contrast, the research in this dissertation is focused on narrative messages, a core component of risk communication and communication research in general. The goals of this research aim to understand a decision not simply to measure bias but to better understand how biases can be removed and preferences can be shifted when people are faced with context-rich narrative messages compared with abstract questions. This research is concerned with people not as a means to study biases, but rather with a person as a decision-maker, taking as background what is known from other fields of study about heuristics and biases. At the heart of this research are stories and how people react to their messages, characters, and characteristics when arriving at decisions about risk.

Numeracy and decision-making

One concept key to the rationale above is *numeracy*. Numeracy, a person's ability to reason mathematically and make sense of basic statistical and probabilistic information (Lipkus, Samsa, & Rimer, 2001), can influence decisions in almost all aspects of daily life. Matters of health are often steeped in risk analysis and probability; political arguments and decisions are often made with uses (or misuses) of quantitative information; and sports, finance, and consumer issues are frequently reported in terms of averages, rates of change, and changes in rate of change (Madison, 2003; Madison & Steen, 2003; Madison & Steen, 2007; Steen, 2001). Throughout this dissertation, I will be measuring numeracy as a potential covariate and factor in decision-making.

Numeracy can be measured objectively or subjectively. For example, Schwartz and colleagues (1997) devised a three-item scale with objective questions such as, "Imagine that

we flip a fair coin 1,000 times. What is your best guess about how many times the coin would come up heads in 1,000 flips?" The scale was later expanded to ten items with similar objective questions pertaining to other aspects of numeracy such as orders of magnitude, probability, proportions, and percentages (Lipkus et al., 2001). The objective skills tested by both Lipkus et al. and Schwartz are clearly relevant to statistical and mathematical judgments.

These objective tests raise issues, however, as they feel like exams to participants and thus may yield low cooperation rates (Fagerlin et al., 2007). These criticisms led to the development of a subjective numeracy scale (SNS) with Likert-scale questions such as "How often do you find numeric information to be useful?" The SNS has been shown to be as predictive of individual numeracy, as objective measures are without feeling like a test or causing discomfort (Zikmund-Fisher, Smith, Ubel, & Fagerlin, 2007). The SNS has been used to assess numeracy, sometimes alongside objective measures, in a range of health decision-making and risk comprehension research (Anderson et al., 2011; Clampa, Osborn, Peterson, & Rothman, 2010; McNaughton, et al., 2011; Hess, Visschers, & Siegrist, 2011; Visschers & Siegrist, 2010; Zikmund-Fisher, Mayman, & Fagerlin, 2014).

Outline of following chapters

Chapters two, three, and four describe three experimental studies aimed at answering questions posed in this chapter surrounding heuristics and biases in narrative and non-narrative risk messages. Though the chapters report on three distinct experiments, all three extend theory on the role of narrative messages on heuristics and biases. Combined, they provide evidence for the effect that narratives introduce into risk decision-making, which reshapes the role of cognitive heuristics on choice. The chapters are formatted as distinct papers with literature reviews, hypotheses and research questions, methods, results,

discussions and conclusions. Implications for future research are also discussed in these chapters.

Entitled "Do Goals influence Framing Effects in Narrative Risk Messages?," chapter two is informed by previous research related to framing effects in narrative and non-narrative risk messages which found that effects described in non-narrative messages are removed in narrative ones (Steinhardt & Shapiro, 2015; Steinhardt & Shapiro, 2013a; Steinhardt & Shapiro, 2013b; Steinhardt & Shapiro, 2013c). Based on those findings, chapter two explores how the goal held by the reader when reading a story may influence the effect of frame. Specifically, it explores whether readers prompted to read a story with the goal of making a decision will be more susceptible to framing effects than those prompted to understand the characters, likely the default goal for reading a story.

Chapter three, entitled "Anchoring and Adjustment Heuristics in Narrative vs. Non-Narrative Risk Messages," reports the results of an experiment testing the anchoring and adjustment heuristic in a narrative story. Previous research looking at narratives and heuristics has only examined framing effects. The experiment described in chapter three examines the anchoring and adjustment heuristic with the goal of extending framing research to other heuristics with the goal of generalizing the results.

Chapter four, entitled "The Gambler's Fallacy in Narrative vs. Non-Narrative Risk Messages," reports the results of an experiment testing the gambler's fallacy in a narrative story. This experiment further extends and generalizes the findings of the previous chapters to include another heuristic. In addition, this experiment also looks at differences between 1st person and 3rd person presentation of a story and how that influences heuristics and biases.

Finally, the fifth chapter provides a synthesis of the previous chapters as well as

implications for communication and best risk communication practices.

CHAPTER 2

DO GOALS INFLUENCE FRAMING EFFECTS IN NARRATIVE RISK MESSAGES?

Several previous experiments have found that framing effects that occurred when presented in a traditional non-narrative decision format did not occur when the same situation was presented as a narrative story (Steinhardt & Shapiro, 2015; Steinhardt & Shapiro, 2013a, Steinhardt & Shapiro, 2013b, Steinhardt & Shapiro, 2013c). Steinhardt and Shapiro (2015) tested three different narrative stories involving gain-and-loss framed risk decisions and compared participant's choices with non-narrative versions of the same choice. They found that gain-loss framing effects occurred in the non-narrative versions of the decision task, where participants were more likely to take a risk when making a decision between two losses than two gains. There was no observed gain-loss framing effect in the narrative versions in two of the experiments, and in the third experiment choices were substantially different between narrative and non-narrative versions.

Steinhardt and Shapiro (2013c) examined whether a lack of framing effect in narratives may actually have been the result of a *selective attention effect*. A selective attention effect is part of fuzzy-trace theory which predicts that the deletion of a zero in a decision frame can eliminate framing effects in non-narrative formats by shifting the focus of attention to key numbers rather than the contrast between 'some' and 'none' (Reyna, 2012; Reyna, Chick, Corbin, & Hsia, 2013). Steinhardt and Shapiro (2013c) explored whether the stories were causing selective attention effects due to their wording, and found evidence to the contrary. Further, it provided another example where framing effects were eliminated after reading narratives.

One possible explanation for the differences in decision-making about risk between

narrative and non-narrative risk messages may be that people have different goals while reading stories than they do while reading questions. For example, typical framing experiments involve decisions between two choices (i.e. "Imagine that you face the following pair of concurrent decisions. First examine both decisions, then indicate the option you prefer" or sometimes more simply "Which of the following options do you prefer?"; Tversky & Kahneman, 1981). However, when looking at a question a reader may have the goal of providing the best answer, whereas while reading a narrative a person may be best trying to understand the characters or other elements of the story. This experiment will test whether a reader's goal influences their decision in a framing experiment.

This chapter begins by reviewing the literature on narratives, framing effects, and previous research examining the influence of narratives on framing effects. After introducing the hypotheses, the methodology is explained. Analyses of the results are reported, followed by a general discussion of the findings that includes limitations of the experiment and directions for future research.

Narratives

It has been argued that all communication can be conceptualized as narratives and storytelling. Defining *narrative* as "a theory of symbolic actions—words and/or deeds—that have sequence and meaning for those who live, create, or interpret them" (p. 2), Fisher (1984) describes the world as a set of ongoing stories with attitudes and beliefs being formed by which stories we decide to latch onto and which we choose to ignore. Hinyard and Kreuter's definition is perhaps more relevant to the work in this dissertation as it pertains more to characters and story elements, defining a narrative as "any cohesive and coherent story with

an identifiable beginning, middle, and end that provides information about scene, characters, and conflict," (Hinyard & Kreuter, 2007, p. 778).

Narratives can play a great role in shaping attitudes and beliefs about risk. In a dual process model of information processing, there is an affective side of decision-making tied to intuition and experience, and an analytical side linked with calculation and deliberation (Chaiken & Trope, 1999; Epstein, 1994; Slovic, Finucane, Peters, & MacGregor, 2004). There is evidence that the affective and experiential process can be influenced by narratives, especially when the narratives relate to second-hand experience (Slovic, Finucane, & Peters, 2005).

The risk-as-feelings hypothesis explains how people's affective feelings can take precedent over what they might otherwise believe is the best decision, the result of which is that people's judgment can be affected by aspects of narratives (Loewenstein et al., 2001). For example, Slovic, Finucane, Peters, and MacGregor (2004) describes research in which subjects were given problems related to risky activities such as driving while tired. They found that warnings were more effective in the form of narrative scenarios or anecdotes than they were in the form of statistical evidence (Hendrickx, Vlek, & Oppewal, 1989). Similar research has found that narratives about tanning beds were more effective than statistical evidence in promoting less risky tanning behavior (Greene & Brinn, 2003).

One of the key aspects of narrative in shaping our understanding of the world is the judgments we make about the characters in these narratives. Just as they do with real people, people make social judgments about fictional characters in media based upon their actions, including moral judgments (Zillmann and Bryant, 1975; Zillmann and Cantor, 1977; Tamborini, 2011; Zillmann, 2006), and these moral judgments affect enjoyment and

identification (Barker, 2005; Hoffner, Cantor, & Bryant, 1991; Oliver, 1993). Audiences use events in a story and a character's actions to help form an impression of the character (Zwaan, Langston, & Graesser, 1995). The way in which fictional characters handle risk decisions may tell the audience something about the characters themselves, including their attitude toward risk and sensation seeking. Additionally, the risk judgments made by fictional characters may attract the attention of the audience, which is also shown to increase enjoyment (Anderson & Kirkorian, 2006).

In addition to the audience's judgments about the characters themselves, risky actions taken by fictional characters in media have been shown to increase attention and arousal (Pechmann & Shih, 1999; Donohew, Palmgreen, & Lorch 1994), as well as enjoyment in general (Bushman & Stack, 1996). The factors leading to arousal are important to understand because they can lead to more favorable judgment of the risky actions (Pechmann & Shih, 1999). These judgments people make about the characters in stories, real or fictional, go on to affect the decisions they make about risks in the real world. Thus, narratives have become an increasingly important part of risk communication campaigns intended to influence and promote better decisions about risk.

Narratives as persuasion

Rather than using cognitive shortcuts in decision-making, people can be persuaded by information present in narratives. For example, research suggests that absorption in a narrative and engagement with characters may make viewers more likely to attend to the information present within the fiction (Papa et al., 2000; Sherry, 2002; Slater & Rouner, 2002). In fact, educators have latched on to this concept, advocating for the intentional addition of educational content into fiction to promote positive behavior (Papa & Singhal,

2009; Singhal & Rogers, 2004; Wilkin et al., 2007; Winsten, 1993). In addition to education, episodic television is one of the most common forms of entertainment for Americans, and television's narratives have been linked with being more persuasive due to reducing reactance, counter-arguing, and perceived invulnerability, which are key factors in resisting persuasion (Moyer-Gusé, 2008; Moyer-Gusé & Nabi, 2010).

Previous research has shown that engagement with a narrative can influence behavioral intention in a number of different ways such as changing the perception of social norms (Moran, Murphy, Frank, & Baezconde-Garbanati, 2013), reducing general resistance to persuasion (Moyer-Guse & Nabi, 2010), or highlighting key pieces of information in stories that provide a version that is easier to process (Reyna, 2012). As such, narratives are increasingly popular in communication about risk. Research has explored the role narrative messages can play in influencing intention to quit smoking (Kim, Bigman, Leader, Lerman, & Capella, 2012), perception of vaccination (Reyna, 2012), motivation to screen for breast cancer (Kreuter et al., 2007; McQueen, Kreuter, Kalesan, & Alcaraz, 2011), and other health and risk related contexts.

There have been many reasons why narratives may be such effective tools of communication. For example, research suggests that when people watch or read narratives, they may feel like they have been transported into the world of the story, possibly to the point where they lose track of the real world. This level of immersion is known as *transportation*, which is why narrative stories may result in different, sometimes more persuasive, perceptions than non-narrative information (Green & Brock, 2000; Moyer- Gusé & Nabi, 2010). Another reason that narratives may result in different perceptions than non-narratives is due to relationships with the characters in the stories formed by the reader or viewer.

Moyer- Gusé and Nabi (2010) describe three types of relationships, all conceptually different while being somewhat related: Perceived similarity, which is essentially how strongly a reader believes they share beliefs, attitudes and other characteristics with a character; identification, which is a process in which a reader imagines himself or herself as a character in a narrative; and parasocial interaction, which is a social relationship between a reader and a character in a narrative. All three of these concepts are emotional connections with characters in narratives wholly different than can be experienced in non-narrative information and that may also influence decisions presented in narrative contexts. In sum, research confirms that narratives play a strong role in our lives and offers compelling evidence that they may be effective tools for risk and health communication.

Framing effects

In addition to a scientific understanding of the role of narratives, our understanding of the role cognitive heuristics and biases play in decision-making has also been a powerful tool in risk and health communication. One of the most commonly used effects in risk message testing and communication is a framing effect.

Within the realm of communication research, "framing" can take on multiple meanings (each of which then has its own multiple meanings). In brief, there is a large body of research, mostly rooted in mass communication and sociology literature, examining the way that the choices journalists and politicians make in story presentation influence public attitudes (Shah, McLeod, & Lee, 2009; Goffman, 1974). There is a second, equally large body of research, mostly rooted in psychology and economics related to judgment under uncertain conditions, often related to making choices between two risks, examining the way in which presentation of the choices affects the decision being made (Tversky & Kahneman, 1981).

While Entman (1993) argues that the two are theoretically linked and can be brought together, there are also practical differences between framing as it relates to priming and aspects of a story, and framing as it relates to prospect theory and heuristics. Both are loosely related in that they offer evidence that the presentation of information affects how it is perceived, but the mechanism behind the two, and often the application of research, are largely different. When using the term "framing" in the answer to this question, I will only be discussing framing as it relates to the role of cognitive heuristics in judgment under uncertainty. While both areas of framing can be relevant to how audiences make sense of information about risk, only one is rooted in cognitive psychology, which is the area in which this research is focused.

Prospect theory framing effects

When making decisions involving differing levels of risk, a person's judgment does not always result in the most mathematically optimal outcome. For example, we may judge the probability of events that are more vivid or easier to imagine like being attacked by a shark as being greater than a likely but harder to imagine risk like heart disease; we may be more likely to take a risk to avoid a loss than we would to maximize a gain of the same likelihood; we may be more likely to think a coin will land on 'heads' if 'tails' has come up four times in a row previously; or we may be more likely to buy a $599 64GB iPad if it is placed between a $499 model and a $699 model than if it were on its own. These decisions may be the result of the mental heuristics used in the decision making process in place of more rigorous calculations.

Similar to *schema*, cognitive methods of organizing knowledge pertaining to various aspects of the world (Piaget, 1952), heuristics are used to manage the cognitive load of

complex decisions. Many judgmental biases resulting from the use of heuristics have been proposed over the years, including *prospect theory* which states that a person values losses and gains differently and will make decisions based on the expected gains rather than the expected losses (Tversky and Kahneman, 1981). One implication of prospect theory is that decisions about equivalent choices may be different based on how the options are presented: whether in terms of potential losses or potential gains. For example, Tversky and Kahneman found that when presented with the choice between either (1) a sure gain of $240, or (2) a 25% chance to gain $1000 or a 75% chance to gain nothing, an overwhelming majority (84%) took the sure gain (option 1). In comparison, when presented with a choice between either (1) a sure loss of $750, or (2) a 75% chance to lose $1000 or a 25% chance to lose nothing, an equally sizeable majority (87%) took the risk (option 2) (Tversky & Kahneman, 1986). In this sense, people tend to be risk-seeking in order to avoid losses, while risk averse when faced with choices involving gains. This notion has become known as a *framing effect*.

While framing effects have been replicated in numerous studies (Kühberger, 1998), there are alternative theories for why the effect occurs. The key proposition of the theory is that people do not view losses and gains in the same manner. The result is that people will be more risk averse when making choices in a positive frame than in a negative one. According to Tversky & Kahenman (1981), losses are perceived to be far more negative than an equivalent gain is perceived to be positive, thus resulting in the bias. A competing explanation, offered by Fuzzy Trace Theory, posits that people base their decisions on the simplest amount of meaning needed to make a choice (Reyna & Brainerd, 1991). What this means is that rather than looking at probabilities and numbers, people perceive they are deciding between a choice of “some” and “some or none” in the gain frame, and “none” and

"none or some" in the loss frame. The result is that in both cases people will pick the choice they perceive as having the best chance of "some," which is the sure thing in the gain frame and the gamble in the loss frame.

Recent research has focused on the limitations of framing effects and the factors that mediate and moderate them. Levin, Gaeth, Schreiber, and Lauriola (2002), for example, found that framing effects did not occur when both frames promoted the same action but touted either benefits or consequences depending on condition, compared with when frames related to a choice between two actions such as a gamble or a sure thing (a standard framing experiment). O'Keefe and Jensen (2009) found through meta-analysis that framing effects are somewhat limited in effect size in general and that efficacy of the messages using framing effects in risk communication has been inconsistent, with some experiments reporting statistically significant but remarkably small amounts of attitude change and others reporting results that were significant statistically as well as creating meaningful change.

In addition to limitations, research has also explored differences in framing effects due to age. In general, research has found that children are more risk-seeking than adults (Paulsen, Platt, Huettel, & Brannon, 2011). In tasks related to choosing between sure bets and gambles similar to those described earlier, children are more likely to choose riskier options than adults (Harbaugh et al., 2002; Levin & Hart, 2003). It has been argued that the biases tend to increase with age when it comes to framing effects (Kim, Goldstein, Hasher, & Zacks, 2005). Research has shown that the biases from other heuristics such as *representativeness*, the degree to which people judge small numbers of individual events as being representative of larger samples thus bearing their statistical qualities (Tversky & Kahneman, 1974) may also increase with age (Kokis, Macpherson, Toplak, West, & Stanovich, 2002). Specifically,

studies found younger children more likely to focus on quantitative differences between sure bet and gamble options resulting in no framing effect when the two have equal expected value, and older children behave more like adults basing their decision on the simplest amount of meaning rather than calculating, thus exhibiting framing effects (Reyna, 2012; Reyna & Brainerd, 2011; Reyna & Ellis, 1994; Steelandt et al., 2013). In other words, even though children get better at calculating as they get older, they also develop *gist*, a tendency to rely on bottom-line meaning to make decisions, which takes the place of the calculations that results in heuristics and biases around risk decisions (Reyna & Brainerd, 1995). While research in adults (described in more detail below) found that framing effects were eliminated when decisions were presented in the form of narrative stories, no research has examined the role that narratives play in framing effects in children. Potential differences in susceptibility due to age are also important to acknowledge when analyzing data in the proposed research across a general population. Although conducting such research is outside the purview of this dissertation, it is a fruitful area for future research to explore.

Narratives and framing effects

Above, I've argued that framing influences persuasion in risky choice decisions, and that narratives have also been shown to be persuasive in risky choice decisions, what might happen when the two are joined? How might one affect the other? Could varying framing within narratives influence our perception of characters? Or would our judgments about characters impact the influence of frame? Previous research began to answer some of these questions by examining the role narratives play in prospect theory framing effects. Specifically, Steinhardt and Shapiro (2015) found that when a traditional framing study was conducted with the questions in the form of narrative stories about characters making

decisions, framing effects were eliminated. Across three experiments, we tested different aspects of narratives and whether or not they resulted in framing effects (Steinhardt & Shapiro, 2015). We found that when reading a full story about a character faced with a decision between a sure thing and a gamble with equal expected values, traditional framing effects were eliminated. One possibility was that the narrative was providing a context for the decision which changed the response. To test whether that was the case we created a question in the context of the story, but without the narrative ("Assume that due to the stipulations of an unusual will left by a relative you are given $3,000 dollars but then have to choose between: a) A sure gain of $1,000 dollars; b) A coin flip that if it lands on heads you gain nothing and if it lands on tails you gain $2,000" in the gain frame). In these conditions, framing effects were present, providing support that it was the narrative that was causing the change in participant's decisions and not simply the new context. (See Table 2.1).

Table 2.1 Cross-tabulation of frame by respondent's decision, controlling for narrative

	Condition					
	Narrative		*Story context, no narrative*		*Original Wording*	
	Frame		*Frame*		*Frame*	
	Gain	*Loss*	*Gain*	*Loss*	*Gain*	*Loss*
Gamble	59.5 %	59.1 %	17.0 %	38.6 %	26.7 %	66.0 %
Sure Thing	40.5	40.9	83.0	61.4	73.3	34.0
	100%	100%	100%	100%	100%	100%
	(N = 46)	(N = 44)	(N = 47)	(N = 44)	(N = 45)	(N = 47)
	$\chi^2 = .00$, df = 1		$\chi^2 = 5.33$, df = 1		$\chi^2 = 14.26$, df = 1	

ns	$p < .05$	$p < .001$
Cramer's V = .00	Cramer's V = .24	Cramer's V = .39

We also tested stories in which the choices were framed in terms of survival and mortality, rather than gains and losses. We used a question from a previous study by McNeil et al. (1982) which is often cited as an exemplar of framing research, in which they tested differences in responses to whether people would choose radiation therapy or surgery as treatment for cancer, with the risks of the procedures framed as either how many out of 100 will live (survival frame) or how many people out of 100 will die (mortality frame). In the 1982 study they found preferences toward surgery were greater when the choices were framed in terms of survival. In our experiment (Steinhardt & Shapiro, 2015) we reported a preference shift towards radiation therapy when reading a story compared with a non-story regardless of frame. Potential reasons for differences between our results and the results from McNeil et al. included differences in public perception toward radiation therapy presently compared with in 1982 and that McNeil's original question contained story elements as it involved a patient in a hospital and a doctor thus resulting in no significant difference between it and the narrative version in our experiment.

Essentially, across all three experiments, the biases that were shown in the results of previous research in non-narrative formats (that people were more likely to take a risk to avoid a loss than to maximize a gain) were reduced in narrative formats. One could argue a potential reason for the bias reduction was that the narrative provided a context in which to make the decision, rather than an aspect of the narrative itself. In other words, by giving

people the context of a character trying to make a decision about his uncle's will in a law office, it allowed them to think about the decision in a new way leading to a different choice than when they were faced with the decision free of context. However, by testing the same decision as the traditional Kahneman and Tversky experiment in the same context as our narrative but without the story, we were able to rule this explanation out: when reading the single-line question in context, participants still made choices in line with prospect theory's expectations, whereas people who read the full narrative did not.

Another potential cause of the bias reduction could be due to unintended linguistic cues due to the wording of the story. For example, *selective attention framing effects* occur when terms like 'zero,' 'none,' and 'nothing,' are removed from the wording surrounding gambling decisions by shifting the focus of attention to key numbers rather than the contrast between 'some' and 'none' (Reyna, 2012). In a separate study (Steinhardt & Shapiro, 2013c), we explored selective attention framing effects in narrative stories. To test whether or not selective attention framing effects occur in narrative stories, we constructed four versions of a story with a choice framed as either a gain or a loss and with or without the word "nothing" included in the story. Participants in one set of conditions read a story in the gain frame with the line "if [the coin] lands on tails there will be no extra inheritance" and a choice between a sure gain of $1,000 and a "coin flip," while participants in another set of conditions read a story in the gain frame with that same line changed to "if [the coin] lands on tails you will get nothing," and a choice between a sure gain of $1,000 and a "coin flip with a 50% chance to gain nothing, and a 50% chance to gain $2,000."

While the responses in the non-narrative control condition with the same choice as the narratives were consistent with the predictions of prospect theory, surprisingly there was

no significant difference between the choices made in the zero and deleted zero conditions. These findings suggest that when presented in the form of a narrative, the deletion of a zero will have little, if any, effect on a person's decision.

Reader Goals and Character Goals

Reading the narrative stories resulted in decisions that don't appear to be influenced by framing effects in the same way that those made by adults in the previous experiments were. One possible explanation for this difference may be that readers have different goals when reading a narrative story compared with reading a question. For example, Green and Jenkins (2014) define *interactive narratives* as stories in which readers are given the opportunity to decide the direction of the plot at key points, essentially what readers were asked to do in previous experiments in which readers made decisions at the end of the story as if they were the protagonist. Further, they explain that interactive narratives may foster more critical thinking and that they may have a greater impact on attitudes due to the length of time readers spend with them. Other research has found that when readers read with the goal of studying or learning that they have higher rates of comprehension and critical thinking compared with when they read with the goal of entertainment (Bohn-Gettler and Kendeou, 2014).

Reading for enjoyment can often be different than reading for other purposes, and is often the goal of reading the type of narratives participants will be reading in this experiment as it involves characters and story elements rather than risk communication message elements. Reading for enjoyment is also often the least cognitively involved type (Lorch, Lorch, & Klusewitz, 1993; O'Hara, 1996), and is sometimes done quickly without thought or criticism and usually in a linear fashion without going back and re-reading. However, some types of

reading for enjoyment such as thrillers or mysteries may invoke higher levels of concentration and involvement in the text (O'Hara, 1996). This reading is still done in a linear fashion, but often slower and can involve a reader trying to anticipate what is ahead or searching for relationships between events in the story.

In contrast, reading for problem solving and decision making involves a search for information in the text which needs to be accessed and integrated before a reader makes a choice (O'Hara, 1996; Greatbatch, Luff, Heath, and Campion, 1995). Reading for problem solving focuses a reader on specific textual information and causes them to adopt general processing strategies while reading (Anderson, 1982; Anderson & Pichert, 1978; McCrudden & Schraw, 2007; van den Broek, Lorch, Linderholm, & Gustafson, 2001). Essentially, there is evidence from a wide range of studies using different methodologies suggesting that readers process text and information differently based on their goal while reading. Thus, asking readers to read with different goals in mind may influence both their comprehension of the text as well as a decision they make after reading.

Character goals, and how readers interpret and internalize them can also influence a reader's goal while reading a story. This can happen both consciously and unconsciously. For example, research has suggested that people may adopt the observed goals of a character automatically as the observation can trigger goal-related mental representations (Aarts, Dijksterhuis, & Dik, 2008; Aarts, Gollwitzer, & Hassin, 2004). Aarts, Gollwitzer, & Hassin found that that participants who read a story about a character with the goal of earning money performed better at a money-earning task than those who read a story with no goal. Essentially, readers adopted the characters goal unconsciously and internalized it when performing the task. Similarly, McCulloch, Fitzsimons, Chua, and Albarracín (2011) provide

evidence for vicarious goal satiation. Here, not only do readers pursue a goal along with a character who is also pursuing it, but they also stop pursuing that goal once the character achieves it. In other words, readers will only internalize the goal if the character is still working toward that goal at the end of the story.

These unconscious goal internalizations have been used in health and risk related contexts. For example, Lee and Shapiro (2013) asked participants to read about a character who was pursuing a diet and found them more likely to have an active diet goal when the character continued to pursue the goal at the end of the story than when they achieved their goal. Lee and Shapiro (2014) elaborated on this by also asking participants to read stories where the characters failed to reach the goals and found evidence that suggests that people internalize the character's goals because they continue to pursue them at the end of the story, regardless of why they stopped pursuing their goal.

In addition to unconscious goal internalization, readers can also consciously pursue the goal of a character in a story. Social Cognitive Theory (SCT) suggests that people make their own goals, and control their own actions, but that those goals and actions are influenced by observing other people (Bandura, 2005; Bandura, 1986). This can include fictional characters or non-fictional characters portrayed in media and research has suggested that readers and viewers can adopt a characters health and risk behaviors and goals (Bandura, 2004; Nabi, 2009; Singhal, Cody, Rogers, & Sabido, 2004). This is especially true when a reader perceives a similarity with the character performing the behavior (Bandura, 1997).

When it comes to decision making in narratives then, it is not just important to think about the goal held by the reader, but also the goal held by the characters. While this study does not directly explore the goals held by the character making the decision, the potential

influence of those goals on the findings is considered in the discussion section.

Hypotheses

Based on the above rationale, this experiment tests how reader goals when reading narratives influence framing effects by modifying a decision problem discussed by Tversky & Kahneman (1974). In their 1974 experiment, participants were asked to make a choice between the following options:

> Assume yourself richer by $300 than you are today. You have to choose between:
>
> a) a sure gain of $100
>
> b) 50% chance to gain $200 and 50% chance to gain nothing

When presented with a choice between two gains, 72% of participants ($N = 126$) chose the sure gain of $100. A second group was then asked to make a similar choice between potential losses:

> Assume yourself richer by $500 than you are today. You have to choose between:
>
> a) a sure loss of $100
>
> b) 50% chance to lose nothing and 50% chance to lose $200

In this scenario, 64% of participants ($N = 128$) chose to take the gamble. This is consistent with the typical framing experiment finding that people are more risk averse when choosing between potential gains than potential losses.

The narrative conditions are adapted from research by Steinhardt and Shapiro (2015). Their research used narratives based on Kahenman and Tversky's framing experiments and reported a lack of framing effect in the narrative conditions. This experiment adapts these stories to include instructions about what goal the reader should have in mind while reading, with the belief that readers with goals more in line with problem solving will be more likely to

result in framing effects than those with goals related to understanding the characters in the story. Based on the above rationale, when reading with the goal of solving a problem, readers will focus their attention on the choice to be made and away from other elements of the story. A focus on those other elements has been shown to remove biases in past research. They will also be more likely to be aware they will be asked to make a decision, and thus may act more in accordance with the expectations of reading for problem solving and decision making. When reading with the goal of understanding the characters however, participants will act more as though they are reading for enjoyment and thus be less cognitively involved and more likely to be influenced by other elements of the story when making their decision.

Specifically the experiment will test the following hypotheses:

H1: When given a goal of making the best decision at the end of a story, readers will be more likely to exhibit traditional framing effects: to choose a risk when deciding between two losses and to choose a sure thing when deciding between two gains.

H2: When given a goal of understanding the characters in a story, traditional framing effects will be eliminated, and readers will be equally likely to choose a sure thing as they are a risk regardless of whether a decision is framed in terms of losses or gains.

H3: When making a choice after reading a narrative, readers will be more likely to be biased by the framing of the decision (consistent with prospect theory) if they are told they will be making a decision, rather than when they are told to try to understand the characters in the story.

Method

Participants

Participants in the experiment were recruited through Amazon's Mechanical Turk

(MTurk).[2] Participants received $0.10 in return for participation. In order to participate, participants had to be native speakers of English, living in the U.S., who have completed 95% or more of the jobs they started on MTurk. In total, 203 people participated in the experiment (103 female, 100 male; ages between 18 and 69; $M = 34.73$, $SD = 12.99$). Only participants who correctly answered a manipulation check question (explained below) were used in the reported results. The reported sample consisted of 182 people (94 female, 88 male; ages between 18 and 69; $M = 35.86$, $SD = 13.02$).

Materials

In this experiment I implement a 2x2 between-subjects factorial design in which participants were randomly assigned to one of two versions of the task—a full story version with the goal of making the best decision and a full story version with the goal of best understanding the characters, and within each version, either a gain framed story or a loss framed story. The story versions used the same story from Steinhardt and Shapiro (2015). Based on Hinyard and Kreuter (2007)'s definition of a story as "any cohesive and coherent story with an identifiable beginning, middle, and end that provides information about scene, characters, and conflict," (p. 778) the stories modified the decision problem from Tversky and Kahneman (1974), turning their question into a story about a character needing to make a choice about a bequest under the stipulations of a will left to him by his uncle. In order to make our story more realistic, I multiplied the dollar amounts in the original experiment by 10

[2] There is evidence that the data obtained from MTurk is at least as reliable as data obtained through more conventional methods and is more demographically diverse than other Internet samples. The amount paid seems to influence the speed of data gathering, but not the quality (Burhmester, Kwang, & Gosling, 2011). Berinsky and colleagues (Berinksy, Huber, & Lenz, 2012) found MTurk samples more representative of the US population than other convenience samples, but less representative than Internet panels or national probability samples. They were also able to replicate published work using MTurk samples.

($500 became $5,000, etc.). The full stories for all four conditions can be found in Appendix A.

In the version with the goal of making the best decision, before reading the story participants were given the instructions to "please read the following story with the goal of being able to make the decision that the main character is faced with." In the version with the goal of understanding the characters, before reading the story participants were given the instructions to "please read the following story with the goal of understanding the main character." Instructions were bolded in in a font twice as large as the story text.

For each story version, participants were also randomly assigned to either a gain frame or a loss frame condition. Thus, participants were randomly assigned to one of four possible conditions, one of two stimulus versions, each in either the gain frame or loss frame.

Procedure

After agreeing to informed consent, participants were randomly assigned to one of the four conditions. After, reading the story with the goal of understanding characters, or making a decision, they were asked to choose between either a sure gain or loss depending on condition, or a coin flip with a 50% change of a sure thing (gain or loss depending on condition) and a 50% chance of nothing, which is described in the story (See Appendix A).

Manipulation check

In order to ensure that participants in either condition internalized and understood their assigned reading goal, participants were asked "What goal were you given while reading the previous story?" and given three options: understanding the main character, being able to make the decision that the main character is faced with, or enjoying the story. The question was asked after making their decision and before reporting their demographic variables and

numeracy. Twenty-one participants, roughly 10% of the sample, got this question wrong and were removed from the final sample reported below.

Measures

In this experiment the dependent variable was the participant's *decision*, which was assessed through a single item asking them to choose between two options; either a gamble (coin flip), or a sure loss or gain.

Results

Decision Goal

The first hypothesis (H1), that readers who were given the goal of making the best decision at the end of a story will be more likely to act in line with the predictions of prospect theory framing, was rejected. I tested H1 using a binary logistic regression model to predict participant's decision (gamble vs. sure thing), for the participants who read the instructions about making a decision at the end of reading the story, that included frame (gain vs. loss; using the loss condition as a reference category). There was no effect of frame on participant's decision in the 'decision goal' version (OR = .91, p = .82).

Character Goal

The second hypothesis (H2), that readers who were given the goal of understanding the characters at the end of a story will be unaffected by decision framing when making a choice, was supported. I tested H2 using a binary logistic regression model to predict participant's decision (gamble vs. sure thing), for the participants who read the instructions about understanding the main character in the story, that included frame (gain vs. loss; using the loss condition as a reference category). There was no effect of frame on a participant's

decision in the 'character goal' version, which was the predicted outcome (OR = .72, p = .46).

Decision Goal vs. Character Goal

The third hypothesis (H3), that readers given the goal of making a decision at the end of a story will be more biased by decision framing when making a choice than readers given the goal of understanding the main character, was rejected. I tested H3 using a binary logistic regression model to predict participant's decision (gamble vs. sure thing) that included variables for version (decision goal vs. character goal; using decision goal as a reference category), frame (gain vs. loss; using the loss condition as a reference category), and their interaction terms.

There was no significant main effect of frame on a participant's decision (OR = .91 , p = .82). Nor was there a significant main effect of version on a participant's decision (OR = 1.17, p = .72). Participants reading stories were more likely to take a sure thing regardless of the goal they were given or how the decision was framed (M = 66.4 percent; See Table 2.2). There was no significant interaction between the effects of the framing manipulation and the goal given to the reader on participant's decision (OR = .80, p = .72). Thus while the participants were reluctant to gamble in any condition, framing did not affect their decision when reading the narrative regardless of what goal was given to them when reading.

Table 2.2 Cross-tabulation of frame by respondent's decision, controlling for narrative

	Decision Goal Narrative		*Character Goal Narrative*	
	Frame		*Frame*	
	Gain	*Loss*	*Gain*	*Loss*
Gamble	31.9 %	34.1 %	30.4 %	37.8 %
Sure Thing	68.1 %	65.9 %	69.6 %	62.2 %
	100 %	100 %	100 %	100 %
	(N = 47)	(N = 44)	(N = 46)	(N = 45)

Discussion

The results of this experiment indicate that framing did not influence decisions when the question was worded in the form of a narrative story, regardless of what goal the reader was given for reading the story. This is consistent with previous research examining framing and narratives (Steinhardt & Shapiro, 2013a; Steinhardt & Shapiro, 2013b; Steinhardt & Shapiro, 2013c; Steinhardt & Shapiro, 2015). Less expected was the lack of influence of readers' goal on their decision. Therefore, reader goals are an unlikely explanation for narrative's influence on framing effects.

While it is a possibility that participants simply did not internalize the instructions, and future research would benefit from questions specifically addressing that concern, the findings are consistent with similar research (including some conducted after this experiment reported later in this dissertation). Additionally, based on the length of the story and the size of the instructions relative to the rest of the story, there are more likely explanations for the

lack of influence of goal. For example, one plausible explanation is that reading the narrative over-rides any influence the given goal may have had at the beginning of the story. There may also be elements of the story leading readers to be more risk averse. In all four story conditions, regardless of goal or frame, readers were more likely to choose the sure thing over a gamble. In previous experiments with these same stories, Steinhardt and Shapiro (2015) also reported a similar bias toward risk aversion from participants, with 59.5% choosing the 'sure thing' when gain-framed and 59.1% choosing the sure thing when loss-framed.

Elements of the narrative may be drawing participants away from gambling (risking money on a coin flip). For example, readers may find it less appropriate to gamble or be risky with money left to them by a deceased relative and thus more likely to choose the sure thing regardless of frame. If this were the case, it would also imply that despite being given instructions otherwise, readers have trouble interacting with a narrative in any way other than thinking about the characters.

Combined with previous research in the area, these findings add to a body of work around the power narratives have in overcoming the biases of framing on choice. Steinhardt and Shapiro (2013a) provided evidence that it was more than just the context of the story that was shaping reader judgment by testing questions with the same context as the story. Steinhardt and Shapiro (2013b) examined whether the lack of framing effect was actually the result of a selective attention effect and provided another example where framing effects were eliminated after reading narratives.

The results of this current experiment build on that work by first providing more evidence that narratives may reduce the biases of framing, and further that the bias reduction is not due to the goals held by the reader while reading.

Limitations

This experiment had both advantages and disadvantages. I report a modification of framing effects after reading a narrative. This was measured through a population recruited through MTurk. However, previous work along these lines used both MTurk and student populations with similar findings. In this particular study, there was no replication of Kahneman and Tversky (1979)'s original experiment within the population as a control. In four previous experiments, three of which were recruited through these same means within the last two years (Steinhardt & Shapiro, 2013a; Steinhardt & Shapiro, 2013b; Steinhardt & Shapiro, 2013c; Steinhardt & Shapiro, 2015) these original studies were replicated with the same framing effect described by Kahneman and Tversky. As such, there was no reason to believe anything would have changed in this population within such a short period of time, and it felt unnecessary to replicate it yet again. There is no reason to believe the addition of a control group would alter the results or their meaning in any way.

This research used a story which has been tested before in previous studies described above. This had the advantage of not having to worry about whether changes in the story were affecting judgment and allowed the experiment to further isolate the influence of reader goal. However, it also means that the majority of research into the effect of framing in narratives have relied on a single story. Future research should examine other narratives and their influence on framing as to build a broader body of literature and make the findings even more generalizable.

While this experiment explored the role of the goals held by the readers, it did not look at the goal held by the character nor the reader's perception of that goal. It is possible that the reader internalized what they perceived to be the character's goal in the story and this biased

their final decision. Future research could explore this further by measuring and manipulating the goal of the main character in the story.

The following chapter will expand on the findings of this experiment by examining anchoring and adjustment in narrative and non-narrative messages. In doing so it will attempt to further generalize the role of narratives on cognitive heuristics. This will allow for a more clear understanding of whether there is something about the specific interaction of framing effects and narrative risk messages, or rather if the influence pertains to something that affects other biases as well.

CHAPTER 3

ANCHORING AND ADJUSTMENT HEURISTICS IN NARRATIVE AND NON-NARRATIVE RISK MESSAGES

The previous chapter expanded on the findings of several previous experiments that found that framing effects that occurred when presented in a traditional non-narrative decision format did not occur when the same situation was presented as a narrative story (Steinhardt & Shapiro, 2013a; Steinhardt & Shapiro, 2015). The previous chapter provided evidence that reader goals may not influence decisions in a framing experiment. It also provided further support that reading narratives change the influence of framing effects and may even remove the biases of framing effects.

Framing effects are just one out of a number of biases caused by cognitive heuristics used in decision making that have been detected. While framing effects deal primarily with decision-making about risk, others deal with different elements of risk analysis. For example, anchoring and adjustment primarily concerns estimation. Like framing it is also used in risk communication practice.

As with the research on framing effects, the work measuring and documenting the anchoring and adjustment is currently only being done in non-narrative contexts. This section will expand the previous work on framing effects and narratives by looking at how the anchoring and adjustment heuristic is influenced by narrative contexts.

Anchoring and adjustment effects

When making decisions, people can be biased toward an initially presented value. This value is known as an anchor, and this effect is known as an *anchoring effect*. The effect is the result of a bias due to poor adjustment away from an initial anchor resulting in

judgments that gravitate toward that starting point (Kahneman, 2011; Tversky & Kanheman, 1974). In their benchmark experiment, Tversky and Kahneman had participants watch researchers randomly select a number between 1 and 100 by spinning a wheel, asked them to estimate whether the number of African nations in the United Nations was more or less than that number, and then asked them to estimate the actual answer. Even though participants watched the wheel spin, and thus saw that number was randomly selected from the wheel, the answers that participants gave in their estimate were significantly clustered around whatever number came up. This clustering became known as anchoring.

Over the past 40 years, anchoring effects have been shown in a variety of settings. For example, Ariely, Loewenstein, and Prelec (2003) showed students common products and asked first if they wanted to buy the product for a dollar amount equal to the last two digits of their social security number and then asked the most they would pay for the product. Students with social security numbers above the median gave values 57% to 107% higher than subjects with below-median numbers. An even stronger effect of the random anchor was seen when the group was broken up into quintiles such that students' willingness-to-pay correlated significantly with the last two digits of their social security number, with the average estimate for each quintile being higher than the one before it. Other experiments described the effect of anchoring on legal decisions (Englich and Soder, 2009), forecasting the sales of a product (Critcher and Gilovich, 2008; Epley & Gilovich, 2010), and even an individual's own efficacy at problem solving (Cervone and Peake, 1986).

While Tversky and Kahenman (1974) explain the effect as resulting from insufficient adjustments away from the anchor, more recent research has suggested alternative explanations. A more nuanced understanding indicates that the anchor may be a reference

point for shifting the boundary of the range of plausible values and that the notion of adjustment would only explain the effect when the anchor is outside that boundary (Mussweiler, Englich, and Strack, 2005; Strack and Mussweiler, 1997). Instead, under normal circumstances, the anchoring effect is believed to be the result of confirmatory hypothesis testing (Chapman and Johnson, 1999; Mussweiler and Strack, 1999; Mussweiler and Strack, 2000; Wegener et al., 2010). That is, the decision makers consider the anchor to be a plausible answer (when it is inside the boundary of plausible values) and test their hypothesis against it, thus explaining gravitation toward that point.

While anchoring effects have been reported in a wide range of studies, Furnham and Boo (2011) illustrate psychological factors that may moderate the effect of an anchor. For example, research has found that participants in a sad mood are more likely to be affected by an anchor than those in a happy or neutral mood (Bodenhausen et al., 2000; Englich and Soder, 2009). The role that narratives play in eliciting emotions may thus be a potential influence on anchoring processes. In addition, people with less knowledge and experience related to the target task or decision are also more likely to be affected by an anchor (Wilson et al., 1996; Englich Mussweiler, & Strack, 2006). Similar decreases in anchoring effects have been reported among people with higher cognitive ability (Bergman, Ellingsen, Johannesson, & Svensson, 2010).

Anchoring and adjustment has also been shown to cause biases related to health and risk communication efforts. For example, research suggests that anchoring and adjustment causes people to misinterpret their personal disease risk relative to the objective risk given to them by their healthcare providers (Linnenbringer, Roberts, Hiraki, Cupples, & Green, 2010; Senay and Kaphingst, 2009). Other research has shown anchoring effects related to consumer

choice of sugary sweetened beverage size (Sharpe & Staelin, 2010) or popcorn size (Wansink & Park, 2001) leading to over consumption and misinterpretation of the risk.

Narratives and anchoring effects

Like frames, anchors lend themselves to being used in narratives both intentionally and unintentionally. For example, numerical information in a story, even if irrelevant, can provide readers and anchor to subconsciously adjust to similar to the random number on the wheel of fortune in Tversky & Kanheman (1974)'s experiment. Narrative communication about risk can also introduce anchors intentionally, such as describing the environmental impact of climate change in terms of the melting of polar ice caps people are often presented with narratives of what used to exist compared with what exists today. Health campaigns aimed at curbing consumption of cigarettes, sugary sweetened beverages, or other unhealthy food could include low anchors with the intent of reducing consumption as people adjust toward the anchor. However, to date, no known research has explored the impact that situating an anchor within a narrative context may have on the anchor's strength.

In this experiment, I modify the Tversky & Kahneman (1974) experiment by testing it in a narrative and non-narrative context. The non-narrative context will present participants with the estimation problem described above after being given the results of a simulated wheel spin to pick a number with the wheel either landing on '65' or '25.' In the narrative version, participants will read a story about a character who is at the mall shopping for a gift and who gets recruited to participate in the anchoring experiment. Participants are then asked to make the same estimation decision as that character is faced with.

Previous research, including that reported in the previous chapter, provides evidence that narrative contexts may limit the biases of framing, if not remove them entirely. This

experiment explores whether or not the biases of anchoring and adjustment may also be reduced by a narrative context. It is possible that story elements such as characters and settings will also distract from the information present in non-story anchoring experiments resulting in bias distortion or reduction relative to traditional anchoring experiments. In order to test, I first verify that anchoring effects occur in an online version of the originally designed experiment:

> **H1:** Participants' estimates of the percent of African nations in the United Nations will be higher when given the random anchor of '65' than when given the random anchor of '25' in a non-narrative context.

Next I compare the results of the non-narrative version to the narrative version and also test whether the anchor had any effect on decisions in the narrative version:

> **H2a:** There will be less variance in participants' estimates of the percent of African nations in the United Nations in the narrative version than the non-narrative version.

> **H2:** There will be no difference between participants' estimates of the percent of African nations in the United Nations when given the random anchor of '65' compared with when they are given the random anchor of '25' in a narrative version.

Potential covariates

Higher levels of perceived realism has been linked with greater amounts of transportation into narratives (Green, 2004) which can elicit critical thinking. Additionally, research has suggested that when stories violate a person's view of reality, either through coherence within the narrative (narrative realism), or with the real world (external realism), that they can negatively affect readers judgments and the narratives persuasive power

(Busselle & Bilandzic, 2008). Thus, it is possible that participants who believe the narrative is more realistic will make decisions closer to how would in real life and may be more likely to be anchored. In other words, if people think what they are reading is realistic, they may behave similarly to when they make the decision in a non-narrative setting, however if they think the story is not realistic it is possible their estimate will be biased due to attempting to adjust to the rules of an environment they perceive as different. Based on this rationale, I explore the possibility of perceived realism as a covariate.

It is also possible that participants with greater confidence in their estimate will be less likely to be anchored regardless of whether the question is presented in a narrative or in a non-narrative format. Previous research has suggested that higher levels of self-reported confidence in an answer are associated with lower levels of anchoring (Jacowitz & Kahneman, 1995; Mussweiler & Strack, 2000). This is likely due to people with higher levels of confidence being able to generate more anchor-inconsistent information (Epley, 2004). Jacowitz & Kahneman (1995) also report that people are more confident in their answer to an estimation task when given an anchor compared with when they do not receive one, likely due to a belief that an anchor is a useful piece of information (even when randomly generated). Research has also suggested that regardless of whether or not they are given an anchor that people are generally over-confident in their ability to estimate (Block & Harper, 1991; Cesarini, Sandewall, & Johannesson, 2006). Thus, I will also explore the possibility of confidence as a covariate.

The ability to estimate is considered a key component of numeracy (Edwards, 1984; Huizinga et al., 2009; Paulos, 1988) including health and risk related numeracy (Låg, Bauger, Linberg, & Friborg, 2013; Steen, 1999). As the participants will be asked to make an

estimation of a percentage, I will also be measuring numeracy as a potential covariate in order to ensure that the results of the analysis are related to the manipulation of the anchor and narrative and not to differences in participant's numeracy.

Method

Participants

Participants in the experiment were recruited through Amazon's Mechanical Turk (MTurk).[3] Participants received $0.10 in return for participation. In order to participate, participants had to be native speakers of English, living in the U.S., who have completed 95% or more of the jobs they started on MTurk. In total, 191 people participated in the experiment (85 female, 105 male; ages between 19 and 70; $M = 35.42$, $SD = 12.50$).

Materials

In this experiment I implement a 2x2 between-subjects factorial design in which participants were randomly assigned to one of two versions of the task—a narrative version or a non-narrative version, and within each version, either a high anchor (65) or a low anchor (25). Based on Hinyard and Kreuter's definition of a story as "any cohesive and coherent story with an identifiable beginning, middle, and end that provides information about scene, characters, and conflict," (Hinyard & Kreuter, 2007, p. 778), in this experiment I modified the anchoring and adjustment experiment described in Tversky and Kahneman (1974), turning their experiment into a story about a character participating in their experiment after being

[3] There is evidence that the data obtained from MTurk is at least as reliable as data obtained through more conventional methods and is more demographically diverse than other Internet samples. The amount paid seems to influence the speed of data gathering, but not the quality (Burhmester, Kwang, & Gosling, 2011). Berinsky and colleagues (Berinksy, Huber, & Lenz, 2012) found MTurk samples more representative of the US population than other convenience samples, but less representative than Internet panels or national probability samples. They were also able to replicate published work using MTurk samples.

recruited at the mall while shopping for a gift (See Appendix 3).

In this experiment participants were randomly assigned to one of two versions of the task—a non-narrative version that replicated online the original experiment described by Tversky and Kahneman, and a narrative story version.

For each version, participants were also randomly assigned to either a "65 anchor" or a "25 anchor" condition. Thus, participants were randomly assigned to one of four possible conditions, one of two stimulus versions, each with either 65 as an anchor or with 25 as an anchor.

Procedure

After agreeing to informed consent, participants were randomly assigned to one of the four conditions. After, reading the story or question in which a number is randomly assigned (as either 25 or 65), they were asked to estimate whether the percentage of African nations in the United Nations was more or less than that number and then to estimate the actual percentage.

Measures

In this experiment the dependent variable was the participant's *estimate*, which was assessed through a single item asking them to estimate the percentage of African nations in the United Nations.

After answering participants were asked to rate their certainty and confidence in their answer on an 11-point scale ranging from "Not At All Certain/Confident" to "Extremely Certain/Confident." The two were average together to create a variable for *confidence* (Cronbach's α=.95, M = 5.26, SD = 2.49).

After reading the messages, participants were given the eight question Subjective

Numeracy Scale (SNS) to assess numeracy (Fagerlin et al., 2007). While the scale was reliable (Cronbach's α = .83), one question ("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") loaded poorly on the same factor as the other seven questions and was not included in the averaged SNS score. Results were more or less equivalent whether or not this item was included (Cronbach's α=.86, *M* = 3.80, *SD* = .75).

Perceived realism was measured with an 8-item scale adapted from Shapiro and Kim (2012). Students were asked after reading the story to respond on a 5-point semantic differential between "Strongly Disagree" and "Strongly Agree" to the following statements: If this were to happen to me it would happen this way; If this were to happen to me it would look this way; If this were to happen to me it would make sense; If this were to happen to the typical person it would look this way; If this were to happen to the typical person it would make sense; This story describes a situation that could really happen to a typical person; I do not understand people in situations like the one described; The story just seemed illogical to me. The eight items were compiled into a mean index (Cronbach's α=.88, *M* = 3.35, *SD* = .79).

Results

In order to test both parts of the second hypothesis (H2a and H2b), participants' estimates were subjected to a 2x2 analysis of variance having two levels of wording (narrative, non-narrative) and two levels of anchor (25, 65) that included numeracy, perceived realism, and confidence as covariates.

The main effect of anchor yielded an *F* ratio of $F(1,1) = 6.7$, $p < .01$ (See Table 3.2),

indicating that the mean estimate was significantly higher when 65 was used as an anchor (M = 42.25, SD = 23.23; See Table 3.1) than when 25 was used as an anchor (M = 36.37, SD = 20.96; See Table 3.1). The main effect of wording yielded an F ratio of $F(1,1) = 6.30$, $p < .05$ (See Table 3.2), indicating that the mean estimate was significantly higher in narrative versions (M = 43.02, SD = 23.47; See Table 3.1) than in non-narrative versions (M = 35.07, SD = 20.09; See Table 3.1). There was a significant interaction effect between wording and anchor, $F(1,1) = 7.63$, $p < .01$ (See Table 3.2), indicating that that the anchor had a significant effect in the non-narrative condition but not the narrative condition (See Figure 3.1).

Anchoring in non-narrative online experiments

The first hypothesis (H1), that participants' estimates of the percent of African nations in the United Nations will be higher when given the random anchor of '65' than when given the random anchor of '25' in a non-narrative context in an online experiment, was supported. When estimating the amount of African Nations in the United Nations after being shown an anchor of '25' participant's estimate of the percentage was M = 27.21, SD = 2.59 (See Table 3.1). When estimating the amount of African Nations in the United Nations after being shown an anchor of '65' participant's estimate of the percentage was M = 43.65, SD = 2.57. This was a significant difference (F (1,1) = 17.89, $p < .001$).

Anchoring effects in narrative messages compared with non-narrative messages

The results of the analysis of variance provide support for the first part of the second hypothesis (H2a), that the variance in participant's estimates of the percent of African Nations in the United Nations in the narrative version is less than the non-narrative version. Using a t-test, I report that in the narrative version of the experiment's estimates were not significantly higher when '65' was used as an anchor (M = 41.02, SD = 25.20) than when '25' was used as

an anchor (M = 44.98, SD = 21.72), $t(99) = .84$, $p = .26$, two-tailed. This supports the second part of the second hypothesis (H2b), that there is a difference between participants' estimates of the percent of African nations in the United Nations when given the random anchor of '65' compared with when they are given the random anchor of '25' in a narrative version.

Numeracy, realism, and confidence

Participants in the study had an average SNS score of 3.80 out of 5 (SD = .75); however, numeracy was not related to a person's estimate in either the narrative or non-narrative condition ($F(1,1) = .30$, $p = .59$).

Regarding the first research question (RQ1), there was no link reported between participants' perceived realism of the story in the narrative conditions and their estimates ($F(1,1) = 1.77$, $p = .19$). Participants in the study reported an average perceived realism score of 3.35 out of 5 (SD = .79). Their perceived realism was independent of the anchor (26 vs. 65), $t(191) = .86$, $p = .16$, and did not influence their estimates as entering perceived as a covariate did not weaken the effect of anchor on estimate.

The second research question (RQ2) regarded the role of confidence in participants' estimates. Participants in the study reported an average confidence score of 5.26 out of 10 (SD = 2.49). Their reported confidence was independent of the question wording (narrative vs. non-narrative), $t(191) = .07$, $p = .22$, and anchor (26 vs. 65), $t(191) = .60$, $p = .18$, and did not influence participants' estimates as entering confidence as a covariate did not weaken the effect of wording or anchor on estimate.

Table 3.1 Parameter estimates with significance for Narrative vs. Non-narrative wording in Anchoring Experiments

	Wording	
Anchor	*Narrative*	*Non-Narrative*
		Wording
25	41.02 (21.72)	27.21 (15.73)**
65	44.98 (21.72)	43.65 (20.96)**
	(N = 99)	(N = 92)
		**Significant at
		$p < .05$ level

Table 3.2 General Linear Model parameter estimates and significant interactions for reduced models predicting estimate across all conditions and estimates in the narrative conditions only

	Estimate		Estimate (Narrative conditions only)	
	Est. (η_p^2)	Sig.	Est. (η_p^2)	Sig.
Intercept	2.78 (.02)		4.08 (.05)	*
Wording (Narrative vs. Non-Narrative)	5.85 (.04)	*		
Anchor	6.20 (.04)	*	.00 (.00)	
Female	3.85 (.03)		2.08 (.03)	
Age	.12 (.00)		.32 (.00)	
Perceived Realism			3.32 (.04)	
Confidence	1.77 (.01)		1.29 (.02)	
Numeracy	.08 (.00)		.33 (.00)	
Wording*Anchor	7.74 (.05)	**		
Adjusted r^2	*.25***		*.14***	
N = (listwise deletion)	191		99	

Notes: * $p < .05$, ** $p < .01$ (one-tailed). Variables included in the reduced model based on F-scores from between subject effects (not shown).

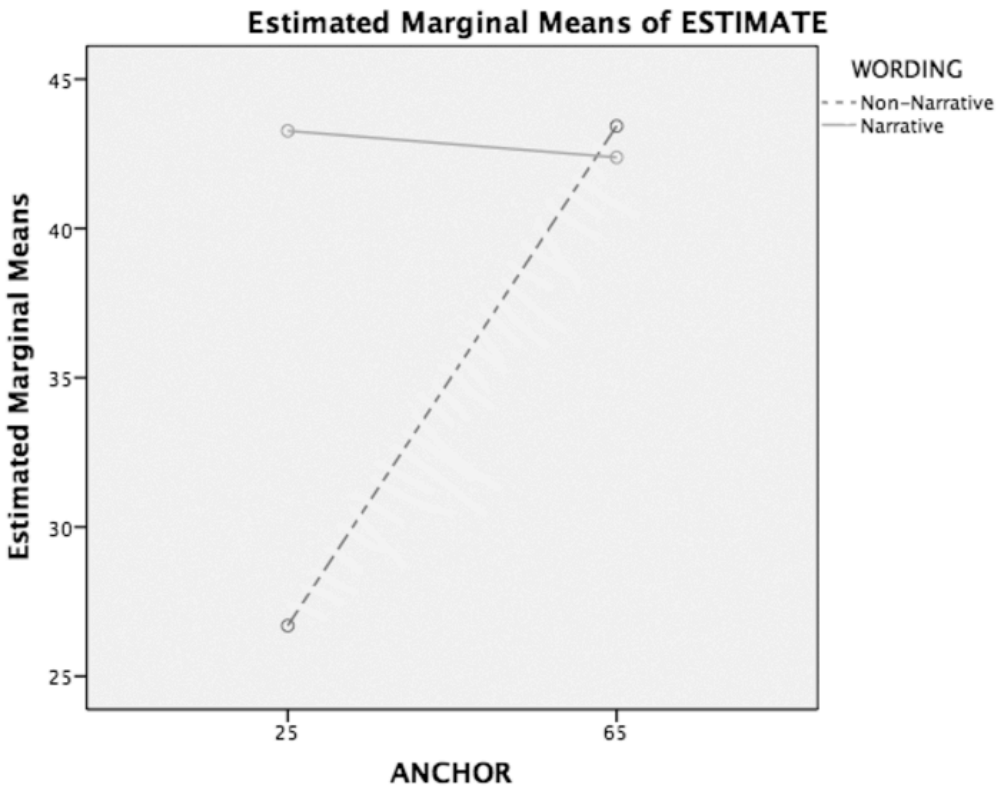

Figure 3.1.
Participant estimates by anchor and wording (N=191)

Discussion

The results of this experiment indicate that while a random anchor influenced the estimate in the originally worded online version of the experiment, it did not in a narrative version of the same experiment. In the online non-narrative version of the original experiment described by Kahneman and Tversky (1974) I report that participants' estimates were anchored to the random numbers provided to them. In the version in which participants read a

narrative story about a character, however, the estimates were not linked with the anchor number. The interaction between the two versions shows that the narrative presentation of the problem influenced estimation.

I was able to rule out numeracy as a potential cause of the estimation bias by testing for it as a covariate in the analysis and finding no effect of its influence. I also measured the effect of participant confidence and perceived realism as covariates and found no effect of their influence. In the case of perceived realism, which was only able to be measured in the narrative conditions, this implies that the anchor influenced their estimate regardless of how realistic a participant believed the story to be, and that the story didn't seem any more or less realistic whether the wheel landed on '25' or '65.' Numeracy and confidence were able to be measured in both the narrative and non-narrative conditions. The lack of effect of influence as covariates in the analysis implies that the wording (narrative vs. non-narrative) influenced participants estimates regardless of their level of numeracy or confidence in their answer.

Combined with the results of the previous chapter, this experiment provides further evidence that narratives may influence the biases caused by cognitive heuristics. However, the experiment still does not provide evidence for mechanism. It is possible that other elements of the story simply drew reader's attention away from the anchor and thus it was less present in their mind at the time of the decision. However, research suggests that people who are more cognitively busy or have more stored in their memory are likely to be more prone to anchoring effects, not less (Epley & Gilovich, 2006; Kruger, 1999), although I did not measure cognitive load during this experiment. Similarly, while transportation was also not measured, it is possible that readers were transported into the story and this also led to them ignoring the anchor. Future research could measure transportation and cognitive load as

potential causes for the bias removal.

Limitations

This experiment had both advantages and disadvantages. I report a modification of anchoring and adjustment effects after reading a narrative. This was measured through a population recruited through MTurk. However, in this particular study, there was also a successful replication of Kahneman and Tversky (1979)'s original experiment within the same MTurk population as a control.

This research used a new story which has never been tested before in previous research. This had the advantage of allowing for a new story to be tested. However, it also means that there could be factors related to the story itself that caused differences in participants' responses. This story was generated in the same way as the stories used in previous experiments (Steinhardt, and Shapiro, 2015, etc.) and future chapters of this research and used similar character names and demographics. Future research should examine other narratives and their influence on anchoring and adjustment as to build a broader body of literature and make the findings even more generalizable. Future research should also replicate this research with the same story as occurred with the previous narratives on framing.

It is also possible that participants simply did not see the anchor in the stories. In Kahneman and Tverksy (1979)'s original experiment as well as in the online replication in this chapter, the anchor number was made very clear to participants. In the narrative version it is possible that readers skimming the story or even one's reading it more closely glossed over the anchor number as seemingly irrelevant information and processed it as "a random number" rather than '65' or '25.' It would be difficult to control for this in future research

without introducing other confounding factors. For example, a manipulation check asking participants to recall the anchor, o summarize the story, may ignore any unconscious influence of the anchor. Further highlighting the anchor in the narrative or reminding participants of the anchor before making their estimate however may introduce factors into their decision not present in the original experiment with which the results are being compared. Future research would be best to attempt a manipulation check, while being cautious of potential confounding factors.

The following chapter will expand on the findings of this experiment and the previous chapter related to framing by examining the gambler's fallacy in narrative and non-narrative messages. In doing so it will attempt to further understand the role of narratives on cognitive heuristics by exploring one which is narrative in nature. This will allow for a more clear understanding of whether there is something about the specific interaction of framing effects or anchoring and adjustment and narrative risk messages, or rather if the influence pertains to something that affects other biases as well.

CHAPTER 4

THE GAMBLER'S FALLACY IN NARRATIVE AND NON-NARRATIVE RISK MESSAGES

Just as anchors and frames may provide information that unconsciously shapes the way people make decisions, people may also be influenced by the outcomes of events that are perceived to be related to a given judgment (but actually are not). For example, there is a common belief that for random sequences of independent events, there should be systematic reversals to even out the sequence. For example, people may believe that when flipping a fair coin, if 'heads' comes up nine times in a row that the odds of 'tails' coming up on the next subsequent flip is greater than 50%. This mistaken belief is known as the *gambler's fallacy*. The fallacy is likely the result of a related bias known as the representative bias marked by what Tversky and Kahneman (1971) jokingly refer to as the "law of small numbers." Essentially, people believe that small samples are representative of the traits of larger samples or systems of which they are a part, such that if a coin will land on heads 50% of an infinite series of flips, it should land on heads 50% of 10 flips.

The effect of the gambler's fallacy has been discussed in studies dating back to the 1950's (Jarvik, 1951) and was first described in the late 18th century (Laplace, 1796). The fallacy has been tested in a number of different settings, from standard lab settings (Bar-Hillel and Wagenaar, 1991; Huber, Kirchler, & Stöckl, 2010) to surveys. For example, Dohmen et al. (2009) gave respondents the outcome of eight coin flips with the last three being heads and asked them to predict the next and found that participants believed tails was more likely to come up than heads. Interestingly, while it has been argued that the type of people who choose to gamble may not the same type of people who participate in experiments, the

gambler's fallacy has also been shown in real world studies of lottery players (Clotfelter & Cook, 1993; Terrell, 1994) and roulette players (Croson & Sundali, 2005; Sundali & Croson, 2006). A study of Danish lottery players also reported that men were slightly more susceptible to the bias than women (Suetens & Tyran, 2012).

Narratives and the gambler's fallacy

Unlike framing effects and anchoring and adjustment effects, the gambler's fallacy pertains to an ordered sequence of outcomes; essentially a story. This makes the gambler's fallacy a unique heuristic to explore in a narrative as the non-narrative version is still a story; one free of all but the most basic story elements (i.e. sequential events). Thus, how the gambler's fallacy is affected, or not, by adding additional narrative elements making it into the type of story studied in previous chapters, may illuminate why the biases from heuristics are influenced by narratives. Essentially, exploring the gambler's fallacy and comparing it with anchoring and adjustment or framing allows for the comparison of heuristics which are already narrative to ones which are not. Thus allowing to begin to categorize the types of heuristics along with how prone they are to being affected by narrative presentation.

One influence on the strength of the gambler's fallacy is the way in which people acquire information related to their decision. For example, Barron and Leider (2010) reported that the gambler's fallacy was stronger when outcomes were experienced (essentially unfolded one at a time), compared to when they were presented all at once (e.g. THTHTTTT). Similar results suggesting that the fallacy was stronger when outcomes were observed one at a time compared with being told to participants all at once were reported in research related to predicting the outcome of a die where four sides are one color and the other two are another color (Newell and Rakow, 2007). Barron and Leider (2010) note that there are no studies they

were aware of "based solely on fully described sequences of past outcomes (as in the example where a gambler approaches a roulette table and observes the table's history of outcomes)," (p. 119) a concept which is somewhat narrative in nature. The following research conceptualizes the unfolding of a sequence of events as a narrative and measures the way in which adding other details of a story may alter the expected outcome.

Barron and Leider (2010) emphasize the importance of a "fully realized sequence" in their research on experience and describe how the effect will be stronger than experiments which only give the final part of a sequence. For example, Burns and Corpus (2004) asked participants to imagine they had observed 100 spins of a roulette wheel and that the last four spins in a row were red, which resulted in a gambler's fallacy effect in which participants believed the chances of the next spin landing on red were significantly lower than 50%. Barron and Leider (2010) however, suggest that the results may have been different had the experiment described the outcome of each of the 100 spins rather than asking participants to imagine the spins. In their experiment, they replicated Burns and Corpus (2004) but instead listed all 100 outcomes as either R or B (Red or Black), with the last four being RRRR. When replicated as such, they did not see evidence of a gambler's fallacy as half the participants selected red and the other half selected black. It should be noted however that their study had a relatively small sample size (36 participants) and that the dependent variable was a binary choice rather than an estimation of probability as Burns and Corpus tested.

The proposed research will explore the intersection of narrative stories and the gambler's fallacy. Presently, there is little research that explores the gambler's fallacy in a story format and none that I found that explores it with the aim of examining the role of story. Burns and Corpus (2004), use short narratives (i.e. "You watch 100 spins of the wheel, and

exactly 50 of those times ended up black and the other 50 red. As you approach the wheel, you are going over those last 100 spins in your head and you realize that the last 4 spins in a row came up red. (Assume that all spins come up either red or black)," p. 184) in order to test differences between the participants being told a streak occurred at the very end of a sequence of 100 or sometime in the middle or that events were random like a roulette wheel or 'under a person's control' like making a basket. However, there was no non-narrative control and the influence of story was not explored.

The research in this chapter, specifically explores whether narratives will affect the strength of the gambler's fallacy and whether the influence of narrative may be different than the influence reported in previous chapters due to the fallacy's built-in story elements. As it is unclear whether the gambler's fallacy will behave like the other heuristics in previous chapters (framing and anchoring) and will have its biases reduced in a narrative context, or whether it will behave in a similar manner to the non-narrative version due to the story elements present within a sequence of roulette spins, I will explore the gambler's fallacy in a narrative story with the following research question:

> **RQ1:** How will a person's susceptibility to the gambler's fallacy be affected by narratives related to gambling outcomes compared with non-narrative information about gambling outcomes.

Spin observation

Previous research found that when the results of previous gambling outcomes are presented to a person in a full sequence one at a time (Barron & Leider, 2010), which is closer to being a story, compared with when they are told the outcome of the entire sequence all at once as statistics, that the fallacy was stronger. Lejarraga & Gonzalez (2011) also suggest that

people may be more prone to biases including the gambler's fallacy when the related information is experienced rather than described with probabilities. Lejarraga (2010), for example, found people preferred to sample a lottery rather than look at descriptive information about the outcomes before making a decision, and that it is more valuable to people in decision making. This is likely why Barron & Leider (2010) found a stronger bias when participants observed spins compared with when they were given information about the results of all the spins. The results reported in Chapters 2 and 3 of this dissertation as well as in previous studies looking at narrative stories found that the stories have effects on the biases from cognitive heuristics that are often counter-intuitive, often removing the biases entirely. Based on that rationale, I explore the intersection of spin observation and narrative on the strength of the gambler's fallacy with the following research question:

> **RQ2:** How does the presentation of previous outcomes within a story, either unfolding slowly or presented at once, influence the gambler's fallacy?

First-person vs. third-person voice

The crux of the gambler's fallacy, as well as the research testing the fallacy, involves the observation of previous gambling outcomes. However, there is no known research or theory related to differences related to whether a person is experiencing the spins directly, or watching someone else experience the spins. A narrative setting will allow for the exploration of potential differences between observing outcomes directly compared with observing a character's observation of the outcomes.

One way to explore this difference is by testing narratives written in different voices. Narratives written in the first-person may feel as though they are being experienced directly as the reader is the protagonist, whereas narratives written in third-person involve observing

the protagonist. In both cases, they are interactive narratives in which readers get to decide the direction of the plot at key points and may foster more critical thinking and have a greater impact on attitudes due to the length of time readers spend with them (Green & Jenkins, 2014). However, both may also have different patterns of participant estimates than non-narrative versions.

Differences between the first-person and third-person voice have been observed in a variety of contexts. For example, a first-person narrative may be more persuasive than a third-person narrative. Winterbottom, Bekker, Conner, & Mooney (2008) found that health interventions relying on first-person narratives were twice as influential on decision making as those employing third-person narratives, although in their meta-analysis also found that the majority of health interventions (59%) used third-person narratives. Segal et al. (1997) found that while a first-person voice to a story may lead to great identification with the main character than a third-person voice, that story elements and individual differences related to the reader were ultimately more important to a reader's interaction with a narrative. Kaufman & Libby (2012) also reported that first-person narratives elicited higher levels of experience taking, a similar concept to identification in which readers mentally simulate and take on the thoughts, goals, and behaviors of characters as if they were their own, compared with third-person narratives.

Voice has also been shown to influence risk perception in narratives. For example Nan, Dahlstrom, Richards, & Rangarajan (2015) reported that first-person narratives resulted in greater risk perception related to HPV and behavioral intention to get vaccinated compared with third-person narratives. Banerjee & Greene (2012) also explored the differences between first-person and third-person narratives related to cocaine use and the influence of voice on

transportation into the narrative. While they found that greater levels of transportation led to greater levels of anti-cocaine related beliefs, however, voice (first-person compared with third-person) did not influence transportation.

With no specific research related to how voice may influence the role of narratives on the biases from cognitive heuristics, I pose the following research question:

RQ3: How does the voice of a story, first-person compared with third-person, affect the influence of the gambler's fallacy on decision making?

Other variables

With the same rationale as the analysis in the previous chapter, I will be measuring perceived realism, confidence, and numeracy as potential covariates. I also measured experience with gambling as a control as greater experience with gambling has been suggested to increase the strength of the fallacy (Roney & Sansone, 2015).

Method

Participants

Participants in the experiment were recruited through Amazon's Mechanical Turk (MTurk).[4] Participants received $0.10 in return for participation. In order to participate, participants had to be native speakers of English, living in the U.S., who have completed 95% or more of the jobs they started on MTurk. In total, 320 people participated in the experiment (127 female, 193 male; ages between 18 and 69; $M = 35.78$, $SD = 11.41$).

[4] There is evidence that the data obtained from MTurk is at least as reliable as data obtained through more conventional methods and is more demographically diverse than other Internet samples. The amount paid seems to influence the speed of data gathering, but not the quality (Burhmester, Kwang, & Gosling, 2011). Berinsky and colleagues (Berinksy, Huber, & Lenz, 2012) found MTurk samples more representative of the US population than other convenience samples, but less representative than Internet panels or national probability samples. They were also able to replicate published work using MTurk samples.

Materials

In this experiment I implement two 2x2 between-subjects factorial designs which each share a comparison group in which participants were randomly assigned to one of three versions of the task—a first person narrative version, a third-person narrative version, or a non-narrative version, and within each version, one of two different 'spin observation' conditions: either a condition in which all the spins are shown at once, or one where they are given one at a time. Both 2x2 designs share the third-person narrative version as a comparison group. Thus, participants were randomly assigned to one of six possible conditions. The stories and questions were based on the findings and design of Barron and Lieder (2010)'s gambler's fallacy experiments.

Survey stimulus

The impact of narrative stories on the effect of the gambler's fallacy was tested through two different types of stories, written in two different persons. In one type, the story involves a character in a casino at a roulette wheel observing a series of spins one at a time, with the last four spins of the series coming up "red." After reading the story, participants are asked to make estimations of the probability of red coming up on the next spin. In the other type of story the main character will come up to the roulette table and immediately be informed by another character of the results of the last 10 spins (which will be the same outcomes as the ones in the other type). Each type of story will also be written in both first-person and third-person voices[5]. After reading the story, participants will be asked to make

[5] A first-person narrative, is technically written in the second person using the pronoun 'you,' in order to make the reader feel as though they are in the first-person when reading. The third person version uses the proper noun of the main character. For both full stories see Appendix.

estimations of the probability of red coming up on the next spin.

A final set of two conditions will replicate Barron and Lieder (2010)'s original experiment as a control group, with no narrative and participants presented the outcome of 10 spins either one at a time or all at once, before being asked to make a probability estimate.

Measures

In this experiment the dependent variable was the participant's *estimate*, which was assessed through a single item asking them to estimate the probability that the outcome of the next roulette spin is Red.

After answering, participants were asked to rate their certainty and confidence in their answer on an 11-point scale ranging from "Not At All Certain/Confident" to "Extremely Certain/Confident." The two were average together to create a variable for *confidence*. (Cronbach's α=.98, M = 7.39, SD = 2.49).

After reading the messages, respondents were given the eight question SNS to asses numeracy. While the scale was reliable (Cronbach's α = .82), one question ("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?") loaded poorly on the same factor as the other seven questions and was not included in the averaged SNS score. Results were more or less equivalent whether or not this item was included (Cronbach's α=.82, M = 3.89, SD = .76).

Perceived realism was measured with an 8-item scale adapted from Shapiro & Kim (2012). Students were asked after reading the story to respond on a 5-point semantic differential between "Strongly Disagree" and "Strongly Agree" to the following statements: If this were to happen to me it would happen this way; If this were to happen to me it would look this

way; If this were to happen to me it would make sense; If this were to happen to the typical person it would look this way; If this were to happen to the typical person it would make sense; This story describes a situation that could really happen to a typical person; I do not understand people in situations like the one described; The story just seemed illogical to me. The eight items were compiled into a mean index (Cronbach's α=.83, M = 3.62, SD = .77).

Familiarity with casino gambling and roulette

Either two or three questions were asked to participants to assess their familiarity with casino gambling and roulette. First, all participants were asked "Have you ever been to a casino before?" Participants who answered yes to that question, were then asked "Have you ever gambled in a casino before?" while those who answered no skipped the question. Then all participants were asked "Have you ever played roulette before?" All questions were either yes or no, with the amount of yes answers being added together to create a 'casino familiarity' variable. It was not appropriate to apply Cronbach's alpha to this scale as it involves more than two unordered categories, not to mention a 'skip question' (M = 1.47, SD = 1.22).

Procedure

After agreeing to informed consent, participants were randomly assigned to one of the six conditions. After, reading the story or question, they were asked to estimate the probability that the outcome of the next spin is Red.

Results

Narrative vs. Non-narrative messages

When comparing narrative and non-narrative versions of the experiment I only used the third-person narratives. This was done to first ensure that there were not twice as many participants in the narrative conditions as the non-narrative conditions, and second to allow

the results to be more easily compared to the results of the previous chapters in which there was no first person version of the stories. There is also no reason to believe from looking at the results that merging the two narrative versions to together would change any of the findings, and instead just introduce an unnecessary confounding factor into the analysis. The results of the first person narrative versions are reported in Table 4.2 and are used in the analysis comparing first person and third person versions.

The first research question relates to how the gambler's fallacy is affected by narratives related to gambling outcomes compared with non-narrative information about gambling outcomes. This was explored using a logistic regression model to predict a participant's estimate of the probability of red coming up on the next wheel spin, that included format (narrative vs. non-narrative; using the non-narrative condition as a reference category) and spin observation (yes, meaning that the reader read the spins one at a time, or no, meaning that they read the results of all previous spins at once), and that included a participant's confidence, numeracy, and perceived realism as covariates.

There was no significant main effect of wording on a participant's estimate (OR = 1.82 , p = .18). There was also no significant main effect of spin observation on a participant's estimate (OR = 1.20, p = .27). Familiarity with gambling and roulette also did not influence participant's estimates (OR = 1.01, p = .32).

Participants believed the odds of red coming up was higher in the narrative version with spin observation than the non-narrative version with spin observation (M = 48.1 percent compared with M = 46.6 percent; See Table 4.1). They also believed the odds of red coming up were higher in the narrative version without spin observation than the non-narrative version without spin observation (M = 51.2 percent compared with M = 45.7 percent; See

Table 4.1). Regardless of spin observation participants believed the odds of red coming up were closer to 50 percent in the narrative conditions than the non-narrative conditions where they underestimated the probability; however, these differences were not statistically significant and may have been due to chance.

There was no significant interaction between the effects of the wording manipulation (narrative vs. non-narrative) and whether the spins were observed by the reader on their decision ($OR = .01$, $p = .92$).

Spin observation and previous outcomes

With regard to the second research question (RQ2), as to how the presentation of previous outcomes within a story, either unfolding slowly or presented all at once, influence the gambler's fallacy, the results of the previously described analysis also provide an answer. The presentation of previous outcomes was operationalized as whether the reader observed the previous spins before making his or her decision (or in the non-narrative version, whether the spins results were presented one at a time or all at once). As reported, there was no significant main effect of spin observation, nor was there a significant interaction between observation and wording. The difference between estimates was small between the conditions where readers observed the spins, and those differences were greater in the narrative conditions compared with the non-narrative conditions (3.06% compared with -.98%), but the differences were not statistically significant.

First Person vs. Third Person

The third research question (RQ3) was explored using a logistic regression model to predict participant's estimate of the probability of red coming up on the next wheel spin, that included person (first person vs. third person; using the third person condition as a reference

category) and spin observation (yes, meaning that the reader saw the spins one at a time, or no, meaning that they saw the results of all previous spins at once; using no as a reference category), and that included a participant's confidence, numeracy, and perceived realism as reference categories.

There was no significant main effect of person on a participant's estimate (OR = .11 , p = .74). There was a significant main effect of spin observation on a participant's estimate (OR = 5.4, p < .05). Participants believed the odds of red coming up was higher in the third-person version with spin observation than the first-person version with spin observation (M = 48.1 percent compared with M = 46.2 percent; See Table 4.2), but they believed the odds of red coming up were lower in the narrative version without spin observation than the non-narrative version without spin observation (M = 51.2 percent compared with M = 54.3 percent; See Table 4.1). Regardless of spin observation, participants believed the odds of red coming up were closer to 50 percent in the third-person conditions than the first-person conditions. There was no significant interaction between the effects of the person manipulation and whether the spins were observed by the reader on their decision (OR = 1.60, p = .21). Familiarity with gambling and roulette was included in the analysis as a covariate and did not influence a participant's estimates (OR = 1.57, p = .21).

Table 4.1 **Cross-tabulation of spin observation by respondent's estimate, controlling for narrative.**

	Narrative		*Non Narrative*	
	Spin Observation		*Spin Observation*	
	Yes	*No*	*Yes*	*No*
Estimate	48.14 %	51.20 %	46.65 %	45.67 %
	(16.01)	(17.9)	(22.21)	(18.01)
	(N = 54)	(N = 53)	(N = 52)	(N = 52)

Table 4.2 **Cross-tabulation of spin observation by respondent's estimate, controlling for tense.**

	First Person		*Third Person*	
	Spin Observation		*Spin Observation*	
	Yes	*No*	*Yes*	*No*
Estimate	46.25 %	54.31 %	48.14 %	51.20 %
	(14.87)	(20.80)	(16.01)	(17.9)
	(N = 55)	(N = 54)	(N = 54)	(N = 53)

Discussion

While not at the generally accepted level of significance, narrative wording seemed to influence participants' estimations. Participants reading narratives tended to believe the odds of 'red' coming up on the next spin after a string of spins landing on 'red' were closer to 50% than participants reading non-narrative spin outcomes. In other words, there was a non-significant gambler's fallacy effect in the non-narrative versions with participants believing the odds of 'red' coming up on the next spin were below 50%, but this was not the case in the narrative versions. However, I did not find any evidence that whether the spin outcomes were observed one at a time, or all at once, influenced a participant's estimation. The estimates reported in the non-narrative conditions with and without spin observation (M = 46.6%, SD = 22.2 and M = 45.7%, SD = 18.0, respectively) are very close to previously reported work on the gambler's fallacy looking at random events like the roulette spins I described in this research. Burns and Corpus (2004), for example, reported a mean of M = 44.8% (SD = 13.3) when participants believed a streak was random (such as a spin of a roulette wheel). While not at the normally accepted level of significance, it seemed that for participants in either story version, the story seemed to result in estimates closer to 50% (M = 48.1%, SD = 16.0 with spin observation and M = 51.2%, SD = 17.9 without).

The differences between probability estimates from participants did not seem to be largely effected by whether the story was told in the first-person ("You approach the table just as the wheel finishes spinning") or the third-person ("Andy approaches the table just as the wheel finishes spinning"). However, the influence of spin observation was stronger in the first-person version (M = 46.2 percent with spin observation compared with M = 54.3 percent

without; See Table 4.2) compared with the third-person versions (M = 48.1 percent with spin observation compared with M = 51.2 percent without; See Table 4.2). It is possible this is the result of the level of interactivity caused by the wording. As discussed by Greene & Jenkins (2014), interactivity in a narrative promotes more critical thinking. It is possible then that higher levels of interactivity may result in higher levels of critical thinking. In other words, the higher levels of interactivity promoted by the first-person presentation of the story may result in more critical thinking which may draw more attention to key decision elements of the story causing a reader to treat it more like a decision-problem than a narrative resulting in answers more in line with expectations of the gambler's fallacy. In the third-person versions, then, the narratives may be slightly less interactive (though still more interactive than the non-narrative versions) resulting in the largest reduction in bias. The results of this experiment do not lend themselves to definitive answers regarding how point-of-view in storytelling may influence decision-making. Future research should further explore this relationship specifically aiming to focus on how point-of-view may manipulate interactivity or decision outcomes in general.

Limitations

This experiment had both advantages and disadvantages. I report a non-significant modification of the gambler's fallacy after reading a narrative. This was measured through a population recruited through MTurk. However, in this particular study, there was also a successful replication of a gambler's fallacy experiment within the same MTurk population as a control. Additionally, similar samples have been recruited through MTurk successfully in other parts of this dissertation and previous research in the same area. There is no reason to believe that the findings reported in this study would be different were the sample recruited

through a different method.

This research used a new story which has not been tested in previous research. This had the advantage of allowing for a new story to be tested. However, it also means that there could be factors related to the story itself that caused differences in participants' responses. This story was generated in the same way as the stories used in previous experiments (Steinhardt, and Shapiro, 2015, etc.) and previous chapters of this research and used similar character names and demographics. Future research, however, should examine other narratives and their influence on the gambler's fallacy as to build a broader body of literature and make the findings even more generalizable. Future research should also replicate this research with the same story as occurred with the previous narratives on framing.

The research in this chapter involved casino gambling, specifically roulette. This created a number of potential limitations and confounding factors. First, it is possible that participants more familiar with roulette or casino gambling in general may have been biased by their experience. In order to avoid this potential conflict, in addition to random assignment which should have distributed the experienced gamblers evenly across the different conditions, I also asked three questions about familiarity and experience with casinos and roulette. Their reported experience with casinos and roulette was independent of the question wording (narrative vs. non-narrative and did not influence participants' estimates.

Another problem created by using a red vs. black roulette paradigm as a proxy for a 50/50 gamble, compared with a coin flip, is that in most casinos there are also green spaces. To further complicate things, some casinos use a European style layout with one green space (0) where the true odds of landing on 'red' are 48.6%, and others use an American style layout with two green spaces (0, and 00) and the true odds of landing on 'red' are 47.4%.

Some casinos, including many online casinos use layouts with no green spaces where the odds of 'red' are 50%. This study, however, makes no mention of the green spaces. By using a casino roulette table, this experiment had the advantage of greater realism in the narrative; however, that also may have resulted in less realism in the play of the game for those familiar with its nuances. Previous research related to the fallacy using roulette also ignored the green element of the table when using colors, or the 0 and 00 elements of the table when using numbers. In addition, the question specifically related to experience with roulette did not influence participant's estimates.

Finally, this experiment gathered twice as much narrative data as non-narrative data in order to be able to test first person against third person narrative presentation. Rather than group all the narrative data together when comparing between the two formats, I made the conscious decision to only use the third person narratives when comparing them against the non-narrative versions. The primary reason for this was in order to offer more external validity with the previous research presented in this dissertation and from other similar studies (Steinhardt & Shapiro, 2015, etc.) which only tested third-person narratives. While there is no reason to believe that combining the two narrative conditions into one group would have changed the findings and conclusions from this study, it would have added an additional confounding factor and limitation.

In general, the findings of this chapter were the least conclusive. The results of the experiment showed effects, but they were not significant. The gambler's fallacy has always been a difficult study to test, and while it is clear from the body of work on the topic that it is a real phenomenon, much of the research is also focused on its many limitations and stipulations and its small effect size. The conditions testing whether the biases are stronger in

the first-person or third-person were also inconclusive. Again, it seemed like there was an effect, but it was not significant. Future research should further probe that, as it shows promise.

Compared with the other two heuristics tested in this dissertation, the gambler's fallacy may be the most difficult to test as narrative against a non-narrative. This may be because there is something inherently narrative about the gambler's fallacy, even when distilled to just the outcomes of previous actions. These outcomes tell a story, whether of wheel spins, coin flips, or in the case of the hot-hand fallacy, made baskets. Time sequence plays a role in this heuristic, as do reality, two elements of narrative. While anchoring and adjustment exists in abstraction, and non-narrative framing effects exist in the realm of problem solving, the gambler's fallacy relies on a person's heuristic belief of how reality should function and how their judgments changes as that belief strays further from how reality is operating. This real-world-ness inherent in the gambler's fallacy that does not exist in the other two heuristics tested is both a reason why it was important to test in this dissertation, but it may also be why the results are the least conclusive, as it introduces a number of limitations and confounding factors to the research.

The following chapter will synthesize the findings from the previous three chapters into a broader discussion of how heuristics and biases are influenced by narratives. It will draw conclusions and pose directions for future research.

CHAPTER 5

CONCLUSION AND FUTURE RESEARCH

The three experiments in this dissertation investigated the role narratives play in decision-making about risk. More specifically, the experiments investigated how our previous understanding surrounding decision-making related to heuristics and biases is altered when the decisions are situated in narratives. In this regard, the dissertation explored heuristics and biases in a way which, to the best of my knowledge has never previously been explored. Primarily, the dissertation situated previous foundational and well-replicated heuristic experiments into narrative contexts in an effort to understand how their biases may be altered. In the case of heuristic and biases research, to the best of my knowledge no previous research into heuristics and biases (other than my own which informed this dissertation) was directed at narrative risk messages. Yet, understanding how these effects are altered in narrative message is significant. First, there is increasing interest in narratives as effective health and risk messages (De Wit, Das, & Vet, 2008; Kim, Bigman, Leader, Lerman, & Cappella, 2012; Nyhan et al., 2014; etc.). Second, our understanding of the world is in many ways due to the judgments we make about narratives and the actions made by characters within them. Certain characteristics of narratives, such as suggested links between cause and effect present within a narrative, may be especially persuasive about risk by reducing counter-arguing and resistance (Appel & Richter, 2007; Banerjee & Greene, 2012; Green & Jenkins, 2014; Slater, 2002). As a result narratives are increasingly popular in communicating risk, and understanding how they may influence decision making, including how they may change our current understanding of decision making in applied contexts, is crucial.

In addition to looking at heuristics and biases in a new way, this dissertation also takes a more holistic view of narratives than other research into narrative and non-narrative risk messages. Some previous research conceptualizes narrative as simply non-statistical, often personal or anecdotal, information. For example, Greene and Brinn (2003) presented college students with either statistical evidence about skin cancer and tanning (i.e. ‘‘The myth regarding tanning bed use is that the UVA rays they emit are safer than the sun, but this is not true’’) or a personal anecdote about skin cancer and tanning (i.e. ‘‘Alicia liked the convenience, and she thought that the UVA rays emitted by the tanning bed were safer than UVB rays from the sun’’). Similar research examined differences in survey responses after newspapers placed either a factual article about radon, or a ‘human interest’ story based on personal experience with radon (Golding, Krimksy, & Plough, 1992).

While the research in this dissertation is informed by the type of narrative research focused on personal experience with risk, it also expands upon it by conceptualizing narrative as a story, closer to fiction than news or information as in much previous risk research related to narrative messages, not to mention research suggesting edutainment (Carey, et. al, 2014; Espinoza, 2013; Hamilton-Wray, 1992) or entertainment-education (Literat & Chen, 2014; Moyer-Gusé, Mahood, & Brookes, 2011; Moyer-Gusé, 2008; Singhal, Wang, & Rogers, 2012; Slater & Rouner, 2002) formats may be most persuasive about risk. Despite being closer to fiction, however, it is not clear that responses would be any different whether participants were told this was a story vs. a ‘real’ thing that happened or is happening. Instead this dissertation takes a more holistic view of narrative and poses that it may not be any single element of the narrative that is influencing judgments. Rather, that the introduction of narrative, especially one as rich as a fictional story, may result in new patterns of behavior

related to decision making.

For some, it may seem like a frustrating answer (or non-answer) that a narrative is changing behavior in itself and that tweaking elements of the narrative such as realness, characters, settings, etc. may not necessarily alter behavior in additional measurable ways. However, through the three experiments in this dissertation as well as previously conducted experiments along similar lines, it has been shown that narratives create measurable and consistent patterns when interacting with heuristics on behavior. And further, that these new patterns are related to the introduction of narrative, and not concepts related to the narrative or reading such as perceived realism and voice, nor concepts related to an individual decision maker such as numeracy or confidence in their answer. At the same time, it is important to acknowledge that many possibilities for why narratives are influencing the biases of cognitive heuristics are still unexplored, many of which were discussed in the limitations and discussion sections of the three experiments in this dissertation. Despite a clear answer for the mechanism behind the bias reduction, the findings from the three experiments suggest something about how narratives interact with heuristics.

Overall, the studies show that narrative stories weaken the biases of cognitive heuristics used in decision-making. In chapter 2, it was hypothesized that giving readers different goals when reading stories in different frames (making the best decision compared with understanding the characters in the story) would change how strongly their decisions would be biased by heuristics. The hypothesis received no support, however. Regardless of the goal given to readers, their decisions were not in line with the expectations of non-narrative framing literature. Rather, their decisions were in line with previous experiments I conducted examining framing effects in narrative risk messages (Steinhardt & Shapiro,

2013a; Steinhardt & Shapiro, 2013b; Steinhardt & Shapiro, 2013c; Steinhardt & Shapiro, 2015). In other words, while a readers goal did not influence their preference after reading a narrative, the narrative reduced the biases related to gain-loss framing of the decision regardless of the goal they held.

In the third chapter I hypothesized that anchoring and adjustment effects that have been observed in previous experiments would be weaker in narrative contexts than in non-narrative contexts. The hypothesis received full support as estimates in the non-narrative conditions were anchored to the numbers where estimates for the percentage of African nations in the United Nations were significantly higher in groups where participants were randomly assigned the number '65' than groups where they were assigned the number '25.' However, when the same experiment was conducted in a narrative setting, essentially where a character was participating in the same experiment that participants in the non-narrative groups were, estimates were not significantly different whether they were assigned '65' or '25.' In other words, an anchoring effect was observed in a non-narrative context that was not observed in a narrative context. Interestingly, the estimates and the related anchoring effects were not related to a participant's confidence in his or her answer nor their level of self-assessed numeracy. While the findings from chapter two related to preference, the findings from the anchoring and adjustment chapter relate to analysis of risk and estimation. Together, these findings suggest that narratives may not only affect choice but also analysis in ways previously not understood from the results of experiments performed in non-narrative situations only.

Put together, the conclusions from chapters two and three paint a picture of decision making and risk analysis that is far less bleak than some previous research into heuristics and

biases. For example, some decision making research, especially when written for a popular or general audience, portrays the lay person as 'dumb,' frequently behaving irrationally and not in their own best interest, and pointing to the results of experiments as evidence of people's poor reasoning and behavior (Fischoff, Slovic, & Lichtenstein, 1982; Huff, 1954; Paulos, 1988; Slovic, Fischoff, & Lichtenstein, 1985; Taleb, 2004). The decisions they describe are usually referred to as 'irrational' are often the product of biases due to the heuristics used in judgment. This dissertation allows for an alternative explanation, where judgments may be biased in some contexts but not others, where the richer and more real-life-like the context, the less biased and more 'rational' the decisions are. Similar research using virtual reality to provide for a more real-world context also found that judgments were less biased by heuristics (Fiore, Harrison, Hughes, & Rutström, 2009; Harrison, Haruvy, & Rutström, 2011). This is not to say that the previous research is invalid, rather, that its reach may have been over-extended to include all decisions in any context, rather than decisions and judgments in discrete 'problem' based contexts. In fact, more recent research examining the difference between expert and lay risk judgments and perceptions have found that the differences may be more marginal than originally thought (Hansen, et. al, 2003; Wright, Bolger, & Rowe, 2002).

The fourth chapter related to the gamblers fallacy and the experiment did not produce any significant effects, which suggests that the gambler's fallacy may behave differently from the other heuristics tested in chapters two and three. This is likely due to the fact that the gambler's fallacy relates to the processing of narrative information in decision making, while framing and anchoring do not. Thus, adding narrative information to framing and anchoring problems altered the patterns of responses from decision-makers, whereas simply increasing the amount of narrative information in gamblers fallacy problems did not. This interpretation

may also shed light on the results of previous experiments conducted before this dissertation began. For example, similar null results were reported when testing narrative versions of McNeil and colleagues (1982) experiment in which people were faced with a choice between radiation therapy and surgery to treat colorectal cancer. Again, in the original version of the experiment, narrative information was present, and our manipulation (Shapiro & Steinhardt, 2015) simply increased the amount. Unfortunately, the findings in the fourth chapter do not validate that notion, rather the results raise questions and provide groundwork for future research that may one day explain why the gambler's fallacy behaves differently than framing and anchoring.

It is a well-worn topic at this point that the way in which key information is presented can influence a person's decision (see framing effects, etc.). However, the findings from the three chapters suggest a more nuanced approach to understanding this influence by demonstrating that it is not just how information is presented that matters, but also the context in which the information is presented. This is especially true when the context is narrative in nature

Communication implications/challenges of risk communication

The findings from this dissertation extend research related to heuristics and biases as well as narrative and non-narrative risk communication. In doing so, the findings also highlight the challenges of effective communication about science, health, environment, and risk. For example, it was observed in two experiments in this dissertation that heuristics and biases did not operate the same way in narrative settings as they did in non-narrative settings and that their effects were weakened in narrative settings. However, risk communicators continue to point to heuristics and biases when crafting messages, and those messages are

often narrative in nature.

There has long been a disconnect in the research being done by scholars in non-narrative contexts and the practice of risk communicators using that research in narrative contexts. An understanding of the framing effects that occur in non-narrative research may lead to a focus on how messages are framed in risk communication campaigns and an overly optimistic goal of attitude change. The anchoring and adjustment results showed that while the bias has been observed in numerous non-narrative studies, when situated in a narrative people may be less biased by anchor numbers. It has been proposed that anchoring and adjustment is one reason people may judge risks as being more dangerous when their morality rates are expressed with larger rote frequencies regardless of base-rate, such as rating a cancer that kills 1,286 out of 10,000 people as riskier than one which kills 24.14 out of 100 (Yamagishi, 1997). While a 12.86% risk is almost half of a 24.14% risk, one reason for the incorrect judgment may be an anchoring effect to the larger rote frequency. Senay & Kaphingst (2009) also suggest that patients may make misunderstand their personal risk of a disease due to anchoring to information about objective risk presented to them by healthcare provides. While one possible takeaway from these studies would be to pay closer attention to rote frequency when presenting risk information, the findings from this dissertation suggest that people may also be less biased simply by situating the risk information within a narrative. Likewise, these findings suggest that when using narratives to present health information, one should not necessarily expect readers to be biased by base-rate and frequency information the same way they would in a non-narrative format. Future research should explore this further, specifically exploring how people judge risks with different base-rates and frequencies in narrative and non-narrative settings. By situating key information within narratives, it may aid

people in making more informed decisions.

While the gambler's fallacy may have less of a direct application to risk communication research, understanding its relationship with narrative plays a key role in bridging the gap between our understanding of heuristics and narratives. A look at how the gambler's fallacy may behave differently in a narrative setting than a non-narrative setting, allows for a broader understanding of cognitive heuristics used in decision-making about risk, and narratives. Unlike framing and anchoring effects, in which the key information is numerical, with the gambler's fallacy the key information is a story; an ordered sequence of events. Had the gambler's fallacy experiment shown similar results to the anchoring and framing experiments, it would have suggested that it is story elements such as characters, settings, and language that cause bias reduction. However, the results of the gambler's fallacy research in this dissertation were inconclusive suggesting that further research needs to be done to allow for this understanding, paying more attention to the nuances and limitations of studying the gambler's fallacy. It is a positive sign that while not at the generally accepted level of significance, the results of the gambler's fallacy experiment did not show obvious support for an alternative theory.

Future Research

This dissertation provides early evidence that the cognitive biases caused by heuristics in decision-making may be reduced or otherwise altered when making decisions after reading narratives. However, there are both research gaps to address, and further evidence to gather in order to gain a complete understanding of the relationship between heuristics and narratives. First, the findings from the first two experiments can only be generalized to two different heuristics – framing effects and anchoring effects – and with only one narrative tested for

each heuristic. Other heuristics may elicit different patterns of behavior when situated in a narrative that are more consistent with the expectations from non-narrative research. Future research could explore different heuristics and different narratives in order to better identify the boundaries of a narrative's influence.

Future research could also further probe the gambler's fallacy and it's relation to the other heuristics tested in this dissertation as well as those not tested. The gambler's fallacy experiment in this dissertation was inconclusive, however, as it was designed similar to the other experiments in this dissertation, may suggest that the gambler's fallacy behaves differently than framing and anchoring heuristics. If this is the case, it is possible that the gambler's fallacy is not the only heuristic that behaves this way, as other heuristics such as availability – the overestimation of the likelihood of events that are easier to imagine (Tversky & Kahneman, 1973). Thus, future research could investigate different types of cognitive biases with the aim of building a typology of heuristics along with their relation to influence from narrative.

While this dissertation provides a starting point for a general understanding of the relationship between narratives and cognitive biases, it leaves many questions unanswered pertaining to mechanism and how specific elements of narratives influence the role of cognitive biases in decision-making. While I report no significant findings related to reader goals, perceived realism, and voice, I recognize that different choices could have been made in operationalization of those concepts that may have yielded different results. Future research could further probe the relationship between these concepts and their role in narrative's influence. Additionally, while this dissertation explored the goal of the reader, it ignored the role of the goal of the main character in a story, which has been shown to influence reader

behavior. Future research could also explore how character goals may influence the strength of cognitive heuristics on a reader's decision. For instance, would cognitive biases be affected different when participants are faced with decisions related to earning money after reading a narrative where the main character has a goal of earning a lot of money compared with a goal of finding love or losing weight.

Finally, future research could examine the role of length and richness of language in a narrative. For example, there may be a threshold at which a story becomes rich enough that it influences cognitive biases. This richness could simply be related to length or word count, but could also pertain to more nuanced elements of the story such as how much is known about the characters and their motivations. It may be that certain elements of a story are the cause for the bias reduction reported in this dissertation.

Conclusion

Evidence from the studies in this dissertation suggests that cognitive biases are reduced when the choices are introduced using narratives rather than discrete questions. Narratives may provide power in communicating information about risk, not just persuasive messages about risk as they are generally used for in risk communication. Additionally, when crafting persuasive messages, or health and risk campaigns relying on narratives such as entertainment-education or messages employing anecdotal stories, risk communicators must be careful not to rely on an expected influence of heuristics when designing narrative messages. In this sense, the dissertation both offers potential solutions to non-persuasive risk communication, while elucidating new challenges in persuasive risk communication; both key to helping inform the public about risk issues and aid in their decision making.

APPENDIX

Appendix 1. IRB exemption approval form

Cornell University
Office of
Research Integrity and Assurance

East Hill Office Building, Suite 320
395 Pine Tree Road
Ithaca, NY 14850
p. 607-254-5162
f. 607-255-0758
www.irb.cornell.edu

Institutional Review Board for Human Participants

Concurrence of Exemption

To:	Joseph Steinhardt
From:	Amita Verma, Director, ORIA
Approval Date:	June 06, 2014
Protocol ID#:	1406004740
Protocol Title:	Heuristics and Biases in Narrative vs. Non-Narrative risk messages

Your above referenced request for **Exemption from IRB Review** has been approved according to Cornell IRB Policy #2 and under paragraph 2 of the Department of Health and Human Services Code of Federal Regulations 45CFR 46.101(b).

Please note the following:

- Investigators are responsible for ensuring that the welfare of research subjects is protected and that methods used and information provided to gain participant consent are appropriate to the activity. Please familiarize yourself with and conduct the research in accordance with the ethical standards of the Belmont Report (http://www.hhs.gov/ohrp/policy/belmont.html).
- Investigators are responsible for notifying the IRB office of change or amendments to the protocol and acquiring approval or concurrence **BEFORE** their implementation.
- Progress reports or requests for continuation of approval are not required for thie study.

For questions related to this application or for IRB review procedures, please contact the IRB office at irbexemptions@cornell.edu or 254-5162. Visit the IRB website at www.irb.cornell.edu for policies, procedures, FAQs, forms, and other helpful information about Cornell's Human Participant Research Program.

Please download the latest forms from the IRB website www.irb.cornell.edu/forms/ for each submission.

Cc: Katherine McComas

Appendix 2A. Chapter 2 stimulus materials (Decision goal, gain frame)

Please read the following story with the goal of <u>being able to make the decision that the main character is faced with</u>:

Andy's uncle recently passed away. Andy and his wife are sitting in the lawyer's office across from his desk to discuss the details of *his uncle's will.*

"It was a bit non-standard to say the least," joked the lawyer. "Your uncle was a bit of an eccentric."
"The man loved games." Andy said.
He looked over at his wife. "I can't wait to see what he thought up this time." She held his hand and smiled nervously.
A pause filled the room, and then the lawyer spoke. "Are you guys ready to talk about the will?"
When Andy nodded yes, the lawyer handed him a piece of paper.
Andy looked it over with his wife, a bit confused.
"Basically, here is what this means" said the lawyer. Andy looked up.
"First, here's a check for $3,000 dollars. No matter what, you keep that."
"But then you need to make a choice. You inherit $1,000 more dollars right now, and that is it."
The lawyer reached into his desk. "Or I can flip this coin. If it lands on heads you inherit $2,000 dollars instead of the $1,000, but if it lands on tails there will be no extra inheritance."
Andy scratched his head and looked at his wife.
Andy turned away from his wife and looked at the lawyer.

If you were Andy, which would you choose?

•A sure gain of $1000
•Coin flip

Appendix 2B. Chapter 2 stimulus materials (Decision goal, loss frame)

Please read the following story with the goal of <u>being able to make the decision that the main character is faced with</u>:

Andy's uncle Alfred recently passed away. He and his wife are sitting in the lawyer's office across from his desk to discuss the details of his *uncle's will.*

"It was a bit non-standard to say the least," joked the lawyer. "Your uncle was a bit of an eccentric."
"The man loved games." Andy said.
He looked over at his wife. "I can't wait to see what he thought up this time." She held his hand and smiled nervously.
A pause filled the room, and then the lawyer spoke. "Are you guys ready to talk about the will?"
When Andy nodded yes, the lawyer handed him a piece of paper.
Andy looked it over with his wife, a bit confused.
"Basically, here is what this means" said the lawyer. Andy looked up.
"First, here's a check for $5,000 dollars. No matter what, you keep that."
"But then you need to make a choice. You lose $1,000 of those dollars right now, and that is it."
The lawyer reached into his desk. "Or I can flip this coin. If it lands on heads you lose $2,000 dollars instead of the $1,000, but if it lands on tails you keep the whole check."
Andy scratched his head and looked at his wife.
Andy turned away from his wife and looked at the lawyer.

If you were Andy, which would you choose?

•A sure gain of $1000
•Coin flip

Appendix 2C. Chapter 2 stimulus materials (Character goal, gain frame)

Please read the following story with the goal of <u>understanding the main character</u>:

Andy's uncle recently passed away. Andy and his wife are sitting in the lawyer's office across from his desk to discuss the details of *his uncle's will.*

"It was a bit non-standard to say the least," joked the lawyer. "Your uncle was a bit of an eccentric."
"The man loved games." Andy said.
He looked over at his wife. "I can't wait to see what he thought up this time." She held his hand and smiled nervously.
A pause filled the room, and then the lawyer spoke. "Are you guys ready to talk about the will?"
When Andy nodded yes, the lawyer handed him a piece of paper.
Andy looked it over with his wife, a bit confused.
"Basically, here is what this means" said the lawyer. Andy looked up.
"First, here's a check for $3,000 dollars. No matter what, you keep that."
"But then you need to make a choice. You inherit $1,000 more dollars right now, and that is it."
The lawyer reached into his desk. "Or I can flip this coin. If it lands on heads you inherit $2,000 dollars instead of the $1,000, but if it lands on tails there will be no extra inheritance."
Andy scratched his head and looked at his wife.
Andy turned away from his wife and looked at the lawyer.

If you were Andy, which would you choose?

•A sure gain of $1000
•Coin flip

Appendix 2D. Chapter 2 stimulus materials (Character goal, loss frame)

Please read the following story with the goal of <u>understanding the main character</u>:

Andy's uncle Alfred recently passed away. He and his wife are sitting in the lawyer's office across from his desk to discuss the details of his *uncle's will.*

"It was a bit non-standard to say the least," joked the lawyer. "Your uncle was a bit of an eccentric."
"The man loved games." Andy said.
He looked over at his wife. "I can't wait to see what he thought up this time." She held his hand and smiled nervously.
A pause filled the room, and then the lawyer spoke. "Are you guys ready to talk about the will?"
When Andy nodded yes, the lawyer handed him a piece of paper.
Andy looked it over with his wife, a bit confused.
"Basically, here is what this means" said the lawyer. Andy looked up.
"First, here's a check for $5,000 dollars. No matter what, you keep that."
"But then you need to make a choice. You lose $1,000 of those dollars right now, and that is it."
The lawyer reached into his desk. "Or I can flip this coin. If it lands on heads you lose $2,000 dollars instead of the $1,000, but if it lands on tails you keep the whole check."
Andy scratched his head and looked at his wife.
Andy turned away from his wife and looked at the lawyer.

If you were Andy, which would you choose?

•A sure gain of $1000
•Coin flip

Appendix 3A. Chapter 3 stimulus materials (Narrative version, 65 anchor)

Please read the following story:

Andy is at the mall shopping for a Valentine's Day gift for his girlfriend Emily. As he is walking through the food court he is approached by a man in a suit.

"Hi, do you have a few minutes to participate in an experiment?" said the man.

"How long will it take?" said Andy, curious about what the experiment was.

"Just a few minutes" the man replied as he pointed over to a wheel of fortune behind a table.

"Hmm…okay." Andy loved watching Wheel of Fortune as a kid and liked game shows in general, and wondered what the purpose of the wheel was.

The two of them walked over to the able and Andy looked at the wheel. It was almost like a giant roulette wheel with numbers ranging from one to one hundred.

"You're probably wondering what this is," said the man. "I'm going to use this wheel to randomly pick a number between one and one hundred. Whatever it lands on, that is your number."

"Okay," said Andy, "so are some numbers better for me than others?"

"No, we just want you to see that this is a randomly picked number."

"Okay"

"Ready?" The man spun the wheel. Andy watched it as it spun, and listening to the clicking of the wheel as it slowed down until finally it stopped.

"65. That's you're number."

"65" said Andy. "Now what?"

"Okay," Said the man. "First, decide if you think the percentage of African countries in the United Nations is higher or lower than that number."

"Okay"

"Now, please do your best to estimate the percentage of African countries in the United Nations by moving upward or downward from the given number accordingly"

If you were Andy, what would you <u>estimate as the percentage of African countries in the United Nations</u>?

Appendix 3B. Chapter 3 stimulus materials (Narrative version, 25 anchor)

Please read the following story:

Andy is at the mall shopping for a Valentine's Day gift for his girlfriend Emily. As he is walking through the food court he is approached by a man in a suit.

"Hi, do you have a few minutes to participate in an experiment?" said the man.

"How long will it take?" said Andy, curious about what the experiment was.

"Just a few minutes" the man replied as he pointed over to a wheel of fortune behind a table.

"Hmm…okay." Andy loved watching Wheel of Fortune as a kid and liked game shows in general, and wondered what the purpose of the wheel was.

The two of them walked over to the able and Andy looked at the wheel. It was almost like a giant roulette wheel with numbers ranging from one to one hundred.

"You're probably wondering what this is," said the man. "I'm going to use this wheel to randomly pick a number between one and one hundred. Whatever it lands on, that is your number."

"Okay," said Andy, "so are some numbers better for me than others?"

"No, we just want you to see that this is a randomly picked number."

"Okay"

"Ready?" The man spun the wheel. Andy watched it as it spun, and listening to the clicking of the wheel as it slowed down until finally it stopped.

"65. That's you're number."

"65" said Andy. "Now what?"

"Okay," Said the man. "First, decide if you think the percentage of African countries in the United Nations is higher or lower than that number."

"Okay"

"Now, please do your best to estimate the percentage of African countries in the United Nations by moving upward or downward from the given number accordingly"

If you were Andy, what would you <u>estimate as the percentage of African countries in the United Nations</u>?

Appendix 3C. Chapter 3 stimulus materials (Non-narrative version, 65 anchor)

The following number has been randomly generated:

65

Please decide if you think the percentage of African countries in the United Nations is higher or lower than that number.

When you are finished, please do your best to estimate the percentage of African countries in the United Nations by moving upward or downward from the given number accordingly.

Record your estimate in the following box:

Appendix 3D. Chapter 3 stimulus materials (Non-narrative version, 25 anchor)

The following number has been randomly generated:

25

Please decide if you think the percentage of African countries in the United Nations is higher or lower than that number.

When you are finished, please do your best to estimate the percentage of African countries in the United Nations by moving upward or downward from the given number accordingly.

Record your estimate in the following box:

Appendix 4A. Chapter 4 stimulus materials (First person narrative version, without spin observation)

Please read the following story:

You are in Atlantic City for your brother's bachelor party. It is only your third time in a casino, the first time you won 100 dollars playing blackjack, the second time you lost 200 dollars at the same game. Tonight you decide you want to try a new game.

"Hi, can you point me to the Roulette tables?" you ask the floor manager.

"Walk down toward the bathrooms over there and make a right, then you should see them."

"Thanks!" you say.

You walk through the casino listening to the sounds of the slot machines. You have never played roulette before but it always seemed like a lot of fun so you're excited to play tonight. You never gambled more than the money you allot yourself to spend. Tonight you have $200 and decide you will play until you lose it all, or your brother comes to get you.

You approach the table. You decided you are only going to bet on the outside tonight, and only bet on the color the ball landed on, which is either black or red.

You look up at the board that lists the most recent colors and numbers that came up.

The last six spins landed as follows: Red, Black, Black, Black, Black, Black.

What do you estimate the odds to be of Black coming up on the next spin (as a percentage between 0% and 100%)?

Appendix 4B. Chapter 4 stimulus materials (First person narrative version, with spin observation)

Please read the following story:

You are in Atlantic City for your brother's bachelor party. It is only your third time in a casino, the first time you won 100 dollars playing blackjack, the second time you lost 200 dollars at the same game. Tonight you decide you want to try a new game.

"Hi, can you point me to the Roulette tables?" you ask the floor manager.

"Walk down toward the bathrooms over there and make a right, then you should see them"

"Thanks!" you say.

You walk through the casino listening to the sounds of the slot machines. You have never played roulette before but it always seemed like a lot of fun so you're excited to play tonight. You never gambled more than the money you allotted yourself to spend. Tonight you have $200 and decide you will play until you lose it all, or your brother comes to get you.

You approach the table just as the wheel finishes spinning.

"12. Red" says the dealer.

The dealer resets the table and spins again.

"28. Black" says the dealer.

You decide you are only going to bet on the outside tonight, and only bet on the color the ball lands on, which is either black or red. You also want to watch a few more spins before you make your bet.

The next spin also lands on black, this time 33.

You wait, and the following spin also lands on black.

Another spin, and again the ball stops on black.

You decide to watch one more spin and then make a $50 bet.

"8" says the dealer, "Black."

The dealer resets the board giving money to the winners.

"Place your bets."

What do you estimate the odds to be of Black coming up on the next spin (as a percentage between 0% and 100%)?

Appendix 4C. Chapter 4 stimulus materials (Third person narrative version, without spin observation)

Please read the following story:

Andy is in Atlantic City for his brother's bachelor party. It is only his third time in a casino, the first time he won 100 dollars playing blackjack, the second time he lost 200 dollars at the same game. Tonight he decides he wants to try a new game.

"Hi, can you point me to the Roulette tables?" Andy asks the floor manager.

"Walk down toward the bathrooms over there and make a right, then you should see them"

"Thanks!" said Andy.

Andy walks through the casino listening to the sounds of the slot machines. He has never played roulette before but it always seemed like a lot of fun to him so he was excited to play tonight. He never gambled more than the money he allotted himself to spend. Tonight he has $200 and figures he will play until he loses, or his brother comes to get him.

Andy approaches the table. He decides he is only going to bet on the outside tonight, and only bet on the color the ball landed on, which is either black or red.

He looks up at the board that lists the most recent colors and numbers that came up.

The last six spins landed as follows: Red, Black, Black, Black, Black, Black.

It is time for Andy to place his bet.

What do you estimate the odds to be of Black coming up on the next spin (as a percentage between 0% and 100%)?

Appendix 4D. Chapter 4 stimulus materials (Third person narrative version, with spin observation)

Please read the following story:

Andy is in Atlantic City for his brother's bachelor party. It is only his third time in a casino, the first time he won 100 dollars playing blackjack, the second time he lost 200 dollars at the same game. Tonight he decides he wants to try a new game.

"Hi, can you point me to the Roulette tables?" Andy asks the floor manager.

"Walk down toward the bathrooms over there and make a right, then you should see them"

"Thanks!" said Andy.

Andy walks through the casino listening to the sounds of the slot machines. He has never played roulette before but it always seemed like a lot of fun to him so he was excited to play tonight. He never gambled more than the money he allotted himself to spend. Tonight he has $200 and figures he will play until he loses, or his brother comes to get him.
Andy approaches the table just as the wheel finishes spinning.

"12. Red" says the dealer.

The dealer resets the table and spins again.

"28. Black" says the dealer.

Andy decides he is going to bet on the outside tonight, and only bet on the color the ball lands on, which is either black or red. He also wants to watch a few more spins before he makes his bet.

The next spin also lands on black, this time 33.

Andy waits and the following spin also lands on black.

Another spin, and again the ball stops on black.

Andy decides he will watch one more spin and then make a $50 bet.

"8" says the dealer, "Black."

The dealer resets the board and gives money to the winners.

"Place your bets."

What do you estimate the odds to be of Black coming up on the next spin (as a percentage between 0% and 100%)?

Appendix 4E. Chapter 4 stimulus materials (Non-narrative version, without spin observation)

Imagine a roulette wheel being spun where the results are random and the wheel has a **50% chance of landing on either red or black**.

The most recent six spins resulted in the following pattern:

RED, BLACK, BLACK, BLACK, BLACK, BLACK

What do you estimate the odds to be of Black coming up on the next spin (as a percentage between 0% and 100%)?

Appendix 4F. Chapter 4 stimulus materials (Non-narrative version, without spin observation)

Imagine a roulette wheel being spun where the results are random and the wheel has a **50% chance of landing on either red or black**.

The most recent six spins resulted in the following pattern[6]:

RED

BLACK

BLACK

BLACK

BLACK

BLACK

What do you estimate the odds to be of Black coming up on the next spin (as a percentage between 0% and 100%)?

[6] The online experiment used spacing that forced the participant to scroll down to in order to see the results of the next spin.

REFERENCES

Aarts, D., & Dijksterhuis, A. (86). Dik (2008). Goal contagion: Inferring goals from others' actions–and what it leads to. *Shah & Gardner (Eds.), Handbook of Motivation,* 265-280.

Aarts, H., Gollwitzer, P. M., & Hassin, R. R. (2004). Goal contagion: Perceiving is for pursuing. *Journal of Personality and Social Psychology, 87*(1), 23.

Anderson, B. L., Obrecht, N. A., Chapman, G. B., Driscoll, D. A., & Schulkin, J. (2011). Physicians' communication of down syndrome screening test results: The influence of physician numeracy. *Genetics in Medicine, 13*(8), 744-749.

Anderson, D. R., & Kirkorian, H. L. (2006). Attention and television. *The Psychology of Entertainment,* 35-54.

Anderson, R. C. (1982). Allocation of attention during reading. *Advances in Psychology, 8*, 292-305.

Anderson, R. C., & Pichert, J. W. (1978). Recall of previously unrecallable information following a shift in perspective. *Journal of Verbal Learning and Verbal Behavior, 17*(1), 1-12.

Appel, M., & Richter, T. (2007). Persuasive effects of fictional narratives increase over time. *Media Psychology, 10*(1), 113-134.

Ariely, D., Loewenstein, G., & Prelec, D. (2006). Tom sawyer and the construction of value. *Journal of Economic Behavior & Organization, 60*(1), 1-10.

Baezconde-Garbanati, L. A., Chatterjee, J. S., Frank, L. B., Murphy, S. T., Moran, M. B., Werth, L. N., Kagan, J. (2014). Tamale lesson: A case study of a narrative health communication intervention. *Journal of Communication in Healthcare, 7*(2), 82-92.

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory.* Prentice-Hall, Inc.

Bandura, A. (1997). *Self-efficacy: The exercise of control* Macmillan.

Bandura, A. (2004). Social cognitive theory for personal and social change by enabling media. *Entertainment-Education and Social Change: History, Research, and Practice,* 75-96.

Bandura, A. (2005). The primacy of self-regulation in health promotion. *Applied Psychology, 54*(2), 245-254.

Banerjee, S. C., & Greene, K. (2012). Role of transportation in the persuasion process: Cognitive and affective responses to antidrug narratives. *Journal of Health Communication, 17*(5), 564-581.

Bar-Hillel, M., & Wagenaar, W. A. (1991). The perception of randomness. *Advances in Applied Mathematics, 12*(4), 428-454.

Barker, M. J. (2005). The lord of the rings and 'Identification' A critical encounter. *European Journal of Communication, 20*(3), 353-378.

Barron, G., & Leider, S. (2010). The role of experience in the gambler's fallacy. *Journal of Behavioral Decision Making, 23*(1), 117-129.

Bergman, O., Ellingsen, T., Johannesson, M., & Svensson, C. (2010). Anchoring and cognitive ability. *Economics Letters, 107*(1), 66-68.

Berinsky, A. J., Huber, G. A., & Lenz, G. S. (2012). Evaluating online labor markets for experimental research: Amazon.com's mechanical turk. *Political Analysis, 20*(3), 351-368.

Betsch, C., Ulshofer, C., Renkewitz, F., & Betsch, T. (2011). The influence of narrative v. statistical information on perceiving vaccination risks. *Medical Decision Making: An International Journal of the Society for Medical Decision Making, 31*(5), 742-753.

Bodenhausen, G. V., Gabriel, S., & Lineberger, M. (2000). Sadness and susceptibility to judgmental bias: The case of anchoring. *Psychological Science, 11*(4), 320-323.

Bohn-Gettler, C. M., & Kendeou, P. (2014). The interplay of reader goals, working memory, and text structure during reading. *Contemporary Educational Psychology, 39*(3), 206-219.

Brosius, H. (1999). Research note: The influence of exemplars on recipients' judgments the part played by similarity between exemplar and recipient. *European Journal of Communication, 14*(2), 213-224.

Buhrmester, M., Kwang, T., & Gosling, S. D. (2011). Amazon's mechanical turk a new source of inexpensive, yet high-quality, data? *Perspectives on Psychological Science, 6*(1), 3-5.

Burns, B. D., & Corpus, B. (2004). Randomness and inductions from streaks: "Gambler's fallacy" versus" hot hand ". *Psychonomic Bulletin & Review, 11*(1), 179-184.

Bushman, B. J., & Stack, A. D. (1996). Forbidden fruit versus tainted fruit: Effects of warning labels on attraction to television violence. *Journal of Experimental Psychology: Applied, 2*(3), 207.

Busselle, R., & Bilandzic, H. (2008). Fictionality and perceived realism in experiencing stories: A model of narrative comprehension and engagement. *Communication Theory, 18*(2), 255-280.

Carey, M. P., Senn, T. E., Walsh, J. L., Coury-Doniger, P., Urban, M. A., Fortune, T., Carey, K. B. (2014). Evaluating a brief, video-based sexual risk reduction intervention and assessment reactivity with STI clinic patients: Results from a randomized controlled trial. *AIDS and Behavior,* 1-19.

Cervone, D., & Peake, P. K. (1986). Anchoring, efficacy, and action: The influence of judgmental heuristics on self-efficacy judgments and behavior. *Journal of Personality and Social Psychology, 50*(3), 492.

Cesarini, D., Sandewall, Ö., & Johannesson, M. (2006). Confidence interval estimation tasks and the economics of overconfidence. *Journal of Economic Behavior & Organization, 61*(3), 453-470.

Chaiken, S., & Trope, Y. (1999). *Dual-process theories in social psychology* Guilford Press.

Chapman, G. B., & Johnson, E. J. (1999). Anchoring, activation, and the construction of values. *Organizational Behavior and Human Decision Processes, 79*(2), 115-153.

Ciampa, P. J., Osborn, C. Y., Peterson, N. B., & Rothman, R. L. (2010). Patient numeracy, perceptions of provider communication, and colorectal cancer screening utilization. *Journal of Health Communication, 15*(sup3), 157-168.

Clotfelter, C. T., & Cook, P. J. (1993). Notes: The "Gambler's fallacy" in lottery play. *Management Science, 39*(12), 1521-1525.

Critcher, C. R., & Gilovich, T. (2008). Incidental environmental anchors. *Journal of Behavioral Decision Making, 21*(3), 241-251.

Croson, R., & Sundali, J. (2005). The gambler's fallacy and the hot hand: Empirical data from casinos. *Journal of Risk and Uncertainty, 30*(3), 195-209.

Dahlstrom, M. F. (2010). The role of causality in information acceptance in narratives: An example from science communication. *Communication Research,*

Dahlstrom, M. F. (2012). The persuasive influence of narrative causality: Psychological mechanism, strength in overcoming resistance, and persistence over time. *Media Psychology, 15*(3), 303-326.

De Wit, J. B., Das, E., & Vet, R. (2008). What works best: Objective statistics or a personal testimonial? An assessment of the persuasive effects of different types of message evidence on risk perception. *Health Psychology, 27*(1), 110.

Dickson, P. R. (1982). The impact of enriching case and statistical information on consumer judgments. *Journal of Consumer Research,* 398-406.

Dohmen, T., Falk, A., Huffman, D., Marklein, F., & Sunde, U. (2009). Biased probability judgment: Evidence of incidence and relationship to economic outcomes from a representative sample. *Journal of Economic Behavior & Organization, 72*(3), 903-915.

Donohew, L., Palmgreen, P., & Lorch, E. P. (1994). Attention, need for sensation, and health communication campaigns. *American Behavioral Scientist, 38*(2), 310-322.

Edwards, A. (1984). Computational estimation for numeracy. *Educational Studies in Mathematics, 15*(1), 59-73.

Englich, B., & Soder, K. (2009). Moody experts—how mood and expertise influence judgmental anchoring. *Judgment and Decision Making, 4*(1), 41-50.

Englich, B., Mussweiler, T., & Strack, F. (2006). Playing dice with criminal sentences: The influence of irrelevant anchors on experts' judicial decision making. *Personality & Social Psychology Bulletin, 32*(2), 188-200.

Entman, R. M. (1993). Framing: Toward clarification of a fractured paradigm. *Journal of Communication, 43*(4), 51-58.

Epley, N.A tale of tuned decks? Anchoring as accessibility and anchoring as adjustment. *The Blackwell Handbook of Judgment and Decision Making*, 240-256.

Epley, N., & Gilovich, T. (2010). Anchoring unbound. *Journal of Consumer Psychology, 20*(1), 20-24.

Epley, N., & Gilovich, T. (2006). The anchoring-and-adjustment heuristic: Why the adjustments are insufficient. *Psychological Science, 17*(4), 311-318.

Epstein, S. (1994). Integration of the cognitive and the psychodynamic unconscious. *American Psychologist, 49*(8), 709.

Espinoza, H. (2013). Using edutainment and social activities to challenge machismo in Nicaragua. *Sexual Health Exchange,* (2), 9-10.

Fagerlin, A., Zikmund-Fisher, B. J., Ubel, P. A., Jankovic, A., Derry, H. A., & Smith, D. M. (2007). Measuring numeracy without a math test: Development of the subjective numeracy scale. *Medical Decision Making: An International Journal of the Society for Medical Decision Making, 27*(5), 672-680.

Fiore, S. M., Harrison, G. W., Hughes, C. E., & Rutström, E. E. (2009). Virtual experiments and environmental policy. *Journal of Environmental Economics and Management, 57*(1), 65-86.

Fischhoff, B., Slovic, P., & Lichtenstein, S. (1982). Lay foibles and expert fables in judgments about risk. *The American Statistician, 36*(3b), 240-255.

Fisher, W. R. (1984). Narration as a human communication paradigm: The case of public moral argument. *Communications Monographs, 51*(1), 1-22.

Friedman, M., & Savage, L. J. (1948). The utility analysis of choices involving risk. *The Journal of Political Economy,* 279-304.

Furnham, A., & Boo, H. C. (2011). A literature review of the anchoring effect. *The Journal of Socio-Economics, 40*(1), 35-42.

Goffman, E. (1974). *Frame analysis: An essay on the organization of experience.* Harvard University Press.

Golding, D., Krimsky, S., & Plough, A. (1992). Evaluating risk communication: Narrative vs. technical presentations of information about radon. *Risk Analysis, 12*(1), 27-35.

Gray, J. B., & Harrington, N. G. (2011). Narrative and framing: A test of an integrated message strategy in the exercise context. *Journal of Health Communication, 16*(3), 264-281.

Greatbatch, D., Heath, C., Campion, P., & Luff, P. (1995). How do desk-top computers affect the doctor-patient interaction? *Family Practice, 12*(1), 32-36.

Green, M. C. (2004). Transportation into narrative worlds: The role of prior knowledge and perceived realism. *Discourse Processes, 38*(2), 247-266.

Green, M. C., & Brock, T. C. (2000). The role of transportation in the persuasiveness of public narratives. *Journal of Personality and Social Psychology, 79*(5), 701.

Green, M. C., & Jenkins, K. M. (2014). Interactive narratives: Processes and outcomes in User-Directed stories. *Journal of Communication, 64*(3), 479-500.

Greene, K., & Brinn, L. S. (2003). Messages influencing college women's tanning bed use: Statistical versus narrative evidence format and a self-assessment to increase perceived susceptibility. *Journal of Health Communication, 8*(5), 443-461.

Hamilton-Wray, T. L. (1992). *The cultural shareability of edutainment media in global Africa: An exploratory study* Available from Media for Development International.

Hansen, J., Holm, L., Frewer, L., Robinson, P., & Sandøe, P. (2003). Beyond the knowledge deficit: Recent research into lay and expert attitudes to food risks. *Appetite, 41*(2), 111-121.

Harbaugh, R. (2002). *Skill Reputation, Prospect Theory, and Regret Theory,*

Harrison, G. W., Haruvy, E., & Rutström, E. E. (2011). Remarks on virtual world and virtual reality experiments. *Southern Economic Journal, 78*(1), 87-94.

Harter, L. M., Japp, P. M., & Beck, C. S. (2006). *Narratives, health, and healing: Communication theory, research, and practice* Routledge.

Hendrickx, L., Vlek, C., & Oppewal, H. (1989). Relative importance of scenario information and frequency information in the judgment of risk. *Acta Psychologica, 72*(1), 41-63.

Hess, R., Visschers, V. H., & Siegrist, M. (2011). Risk communication with pictographs: The role of numeracy and graph processing. *Judgment and Decision Making, 6*(3), 263-274.

Hinyard, L. J., & Kreuter, M. W. (2007). Using narrative communication as a tool for health behavior change: A conceptual, theoretical, and empirical overview. *Health Education & Behavior: The Official Publication of the Society for Public Health Education, 34*(5), 777-792.

Hoffner, C., Cantor, J., & Bryant, J. (1991). Perceiving and responding to mass media characters. *Responding to the Screen: Reception and Reaction Processes,* 63-101.

Huber, J., Kirchler, M., & Stöckl, T. (2010). The hot hand belief and the gambler's fallacy in investment decisions under risk. *Theory and Decision, 68*(4), 445-462.

Huff, D. (1954). *How to lie with statistics* WW Norton & Company.

Huizinga, M. M., Carlisle, A. J., Cavanaugh, K. L., Davis, D. L., Gregory, R. P., Schlundt, D. G., & Rothman, R. L. (2009). Literacy, numeracy, and portion-size estimation skills. *American Journal of Preventive Medicine, 36*(4), 324-328.

Jacowitz, K. E., & Kahneman, D. (1995). Measures of anchoring in estimation tasks. *Personality and Social Psychology Bulletin, 21*, 1161-1166.

Jarvik, M. E. (1951). Probability learning and a negative recency effect in the serial anticipation of alternative symbols. *Journal of Experimental Psychology, 41*(4), 291.

Kahneman, D. (2011). *Thinking, fast and slow* Macmillan.

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

Kaufman, G. F., & Libby, L. K. (2012). Changing beliefs and behavior through experience-taking. *Journal of Personality and Social Psychology, 103*(1), 1.

Khangura, S., Bennett, C., Stacey, D., & O'Connor, A. M. (2008). Personal stories in publicly available patient decision aids. *Patient Education and Counseling, 73*(3), 456-464.

Kim, H. S., Bigman, C. A., Leader, A. E., Lerman, C., & Cappella, J. N. (2012). Narrative health communication and behavior change: The influence of exemplars in the news on intention to quit smoking. *Journal of Communication, 62*(3), 473-492.

Kim, S., Goldstein, D., Hasher, L., & Zacks, R. T. (2005). Framing effects in younger and older adults. *The Journals of Gerontology. Series B, Psychological Sciences and Social Sciences, 60*(4), P215-8.

Kokis, J. V., Macpherson, R., Toplak, M. E., West, R. F., & Stanovich, K. E. (2002). Heuristic and analytic processing: Age trends and associations with cognitive ability and cognitive styles. *Journal of Experimental Child Psychology, 83*(1), 26-52.

Kreuter, M. W., Green, M. C., Cappella, J. N., Slater, M. D., Wise, M. E., Storey, D., . . . Holmes, K. (2007). Narrative communication in cancer prevention and control: A framework to guide research and application. *Annals of Behavioral Medicine, 33*(3), 221-235.

Krimsky, S. (2007). Risk communication in the internet age: The rise of disorganized skepticism. *Environmental Hazards, 7*(2), 157-164.

Kruger, J. (1999). Lake Wobegon be gone! The" below-average effect" and the egocentric nature of comparative ability judgments. *Journal of Personality and Social Psychology, 77*(2), 221.

Kühberger, A. (1998). The influence of framing on risky decisions: A meta-analysis. *Organizational Behavior and Human Decision Processes, 75*(1), 23-55.

Låg, T., Bauger, L., Lindberg, M., & Friborg, O. (2014). The role of numeracy and intelligence in Health‐Risk estimation and medical data interpretation. *Journal of Behavioral Decision Making, 27*(2), 95-108.

Laplace, P., & arquis De, M. (1796). Exposition of the system of the world. *Paris: Cercie-Social,*

Lee, T. K., & Shapiro, M. A. (2013). Audience goal motivation and narrative character success: I'm motivated when you have not succeeded. Paper presented at the annual conference of *National Communication Association,* Washington, D.C.

Lee, T. K., & Shapiro, M. A. (2014). Story character's goal achievement and goal pursuit on readers' implicit and explicit goal. Paper presented at the annual conference of *International Communication Association,* Seattle, WA.

Lejarraga, T. (2010). When experience is better than description: Time delays and complexity. *Journal of Behavioral Decision Making, 23*(1), 100-116.

Levin, I. P., Gaeth, G. J., Schreiber, J., & Lauriola, M. (2002). A new look at framing effects: Distribution of effect sizes, individual differences, and independence of types of effects. *Organizational Behavior and Human Decision Processes, 88*(1), 411-429.

Levin, I. P., & Hart, S. S. (2003). Risk preferences in young children: Early evidence of individual differences in reaction to potential gains and losses. *Journal of Behavioral Decision Making, 16*(5), 397-413.

Linnenbringer, E., Roberts, J. S., Hiraki, S., Cupples, L. A., & Green, R. C. (2010). "I know what you told me, but this is what I think:" perceived risk of alzheimer disease among individuals who accurately recall their genetics-based risk estimate. *Genetics in Medicine, 12*(4), 219-227.

Lipkus, I. M., Samsa, G., & Rimer, B. K. (2001). General performance on a numeracy scale among highly educated samples. *Medical Decision Making: An International Journal of the Society for Medical Decision Making, 21*(1), 37-44.

Literat, I., & Chen, N. N. (2014). Communication infrastructure theory and Entertainment-Education: An integrative model for health communication. *Communication Theory, 24*(1), 83-103.

Loewenstein, G. F., Weber, E. U., Hsee, C. K., & Welch, N. (2001). Risk as feelings. *Psychological Bulletin, 127*(2), 267.

Lorch, R. F., Lorch, E. P., & Klusewitz, M. A. (1993). College students' conditional knowledge about reading. *Journal of Educational Psychology, 85*(2), 239.

Luenberger, D. G. (1979). *Introduction to dynamic systems* John Wiley & Sons New York.

Madison, B. L. (2003). The many faces of quantitative literacy. *Quantitative Literacy: Why Numeracy Matters for Schools and Colleges,*

Madison, B. L., & Steen, L. A. (2007). Evolution of numeracy and the national numeracy network. *Numeracy, 1*(1), 2.

McCrudden, M. T., & Schraw, G. (2007). Relevance and goal-focusing in text processing. *Educational Psychology Review, 19*(2), 113-139.

McCulloch, K. C., Fitzsimons, G. M., Chua, S. N., & Albarracín, D. (2011). Vicarious goal satiation. *Journal of Experimental Social Psychology, 47*(3), 685-688.

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

McQueen, A., Kreuter, M. W., Kalesan, B., & Alcaraz, K. I. (2011). Understanding narrative effects: The impact of breast cancer survivor stories on message processing, attitudes, and beliefs among African American women. *Health Psychology, 30*(6), 674.

Moran, M. B., Murphy, S. T., Frank, L., & Baezconde-Garbanati, L. (2013). The ability of narrative communication to address health-related social norms. *International Review of Social Research, 3*(2), 131.

Moyer-Gusé, E. (2008). Toward a theory of entertainment persuasion: Explaining the persuasive effects of Entertainment-Education messages. *Communication Theory, 18*(3), 407-425.

Moyer-Gusé, E., Mahood, C., & Brookes, S. (2011). Entertainment-education in the context of humor: Effects on safer sex intentions and risk perceptions. *Health Communication, 26*(8), 765-774.

Moyer-Gusé, E., & Nabi, R. L. (2010). Explaining the effects of narrative in an entertainment television program: Overcoming resistance to persuasion. *Human Communication Research, 36*(1), 26-52.

Murphy, S. T., Frank, L. B., Chatterjee, J. S., & Baezconde-Garbanati, L. (2013). Narrative versus nonnarrative: The role of identification, transportation, and emotion in reducing health disparities. *Journal of Communication, 63*(1), 116-137.

Mussweiler, T., & Strack, F. (1999). Hypothesis-consistent testing and semantic priming in the anchoring paradigm: A selective accessibility model. *Journal of Experimental Social Psychology, 35*(2), 136-164.

Mussweiler, T., & Strack, F. (2000). Numeric judgments under uncertainty: The role of knowledge in anchoring. *Journal of Experimental Social Psychology, 36*(5), 495-518.

Nabi, R. L. (2009). Cosmetic surgery makeover programs and intentions to undergo cosmetic enhancements: A consideration of three models of media effects. *Human Communication Research, 35*(1), 1-27.

Nan, X., Dahlstrom, M. F., Richards, A., & Rangarajan, S. (2015). Influence of evidence type and narrative type on HPV risk perception and intention to obtain the HPV vaccine. *Health Communication, 30*(3), 301-308.

Newell, B. R., & Rakow, T. (2007). The role of experience in decisions from description. *Psychonomic Bulletin & Review, 14*(6), 1133-1139.

Niederdeppe, J., Bu, Q., Borah, P., Kindig, D. A., & Robert, S. A. (2008). Message design strategies to raise public awareness of social determinants of health and population health disparities. *Milbank Quarterly, 86*(3), 481-513.

Nyhan, B., Reifler, J., Richey, S., & Freed, G. L. (2014). Effective messages in vaccine promotion: A randomized trial. *Pediatrics, 133*(4), e835-42.

O'Hara, K. (1996). Towards a typology of reading goals.

O'Keefe, D. J., & Jensen, J. D. (2007). The relative persuasiveness of gain-framed loss-framed messages for encouraging disease prevention behaviors: A meta-analytic review. *Journal of Health Communication, 12*(7), 623-644.

Oliver, M. B. (1993). Exploring the paradox of the enjoyment of sad films. *Human Communication Research, 19*(3), 315-342.

Ozenbas, D., Pagano, M. S., & Schwartz, R. A. (2011). Accentuated intraday stock price volatility. *Volatility* (pp. 111-126) Springer.

Papa, M. J., & Singhal, A. (2009). How entertainment-education programmes promote dialogue in support of social change. *Journal of Creative Communications, 4*(3), 185-208.

Papa, M. J., Singhal, A., Law, S., Pant, S., Sood, S., Rogers, E. M., & Shefner-Rogers, C. L. (2000). Entertainment-education and social change: An analysis of parasocial interaction, social learning, collective efficacy, and paradoxical communication. *Journal of Communication, 50*(4), 31-55.

Paulos, J. A. (1991). Beyond innumeracy.

Paulsen, D., Platt, M., Huettel, S. A., & Brannon, E. M. (2011). Decision-making under risk in children, adolescents, and young adults. *Frontiers in Psychology, 2*, 72.

Pechmann, C., & Shih, C. (1999). Smoking scenes in movies and antismoking advertisements before movies: Effects on youth. *The Journal of Marketing,* 1-13.

Peters, E., McCaul, K. D., Stefanek, M., & Nelson, W. (2006). A heuristics approach to understanding cancer risk perception: Contributions from judgment and decision-making research. *Annals of Behavioral Medicine, 31*(1), 45-52.

Piaget, J., Cook, M., & Norton, W. (1952). *The origins of intelligence in children* International Universities Press New York.

Reyna, V. F. (2012). A new intuitionism: Meaning, memory, and development in fuzzy-trace theory. *Judgment and Decision Making, 7*(3), 332.

Reyna, V. F., & Brainerd, C. J. (1991). Fuzzy-trace theory and framing effects in choice: Gist extraction, truncation, and conversion. *Journal of Behavioral Decision Making, 4*(4), 249-262.

Reyna, V. F., & Brainerd, C. J. (1995). Fuzzy-trace theory: An interim synthesis. *Learning and Individual Differences, 7*(1), 1-75.

Reyna, V. F., & Brainerd, C. J. (2011). Dual processes in decision making and developmental neuroscience: A fuzzy-trace model. *Developmental Review, 31*(2), 180-206.

Reyna, V. F., & Ellis, S. C. (1994). Fuzzy-trace theory and framing effects in children's risky decision making. *Psychological Science, 5*(5), 275-279.

Reyna, V. F., Chick, C. F., Corbin, J. C., & Hsia, A. N. (2014). Developmental reversals in risky decision making: Intelligence agents show larger decision biases than college students. *Psychological Science, 25*(1), 76-84.

Roney, C. J., & Sansone, N. (2015). Explaining the gambler's fallacy: Testing a gestalt explanation versus the “law of small numbers”. *Thinking & Reasoning, 21*(2), 193-205.

Rothman, A. J., Bartels, R. D., Wlaschin, J., & Salovey, P. (2006). The strategic use of Gain- and Loss-Framed messages to promote healthy behavior: How theory can inform practice. *Journal of Communication, 56*(s1), S202-S220.

Schwartz, L. M., Woloshin, S., Black, W. C., & Welch, H. G. (1997). The role of numeracy in understanding the benefit of screening mammography. *Annals of Internal Medicine, 127*(11), 966-972.

Segal, E. M., Miller, G., Hosenfeld, C., Mendelsohn, A., Russell, W., Julian, J., Delphonse, J. (1997). Person and tense in narrative interpretation. *Discourse Processes, 24*(2-3), 271-307.

Senay, I., & Kaphingst, K. A. (2009). Anchoring-and-adjustment bias in communication of disease risk. *Medical Decision Making: An International Journal of the Society for Medical Decision Making, 29*(2), 193-201.

Shah, D. V., McLeod, J. M., & Lee, N. (2009). Communication competence as a foundation for civic competence: Processes of socialization into citizenship. *Political Communication, 26*(1), 102-117.

Shapiro, M. A., & Kim, H. (2012). Realism judgments and mental resources: A cue processing model of media narrative realism. *Media Psychology, 15*(1), 93-119.

Sharpe, K. M., & Staelin, R. (2010). Consumption effects of bundling: Consumer perceptions, firm actions, and public policy implications. *Journal of Public Policy & Marketing, 29*(2), 170-188.

Sherry, J. L. (2002). Media saturation and entertainment—Education. *Communication Theory, 12*(2), 206-224.

Simon, H. A. (1955). A behavioral model of rational choice. *The Quarterly Journal of Economics,* 99-118.

Simon, H. A. (1979). Rational decision making in business organizations. *The American Economic Review,* 493-513.

Singhal, A., Cody, M. J., Rogers, E. M., & Sabido, M. (2003). *Entertainment-education and social change: History, research, and practice* Routledge.

Singhal, A., & Rogers, E. M. (2004). The status of entertainment-education worldwide. *Entertainment-Education and Social Change: History, Research, and Practice,* 3-20.

Singhal, A., Wang, H., & Rogers, E. M. (2012). The rising tide of entertainment-education in communication campaigns. *Public Communication Campaigns,* 323-336.

Slater, M. D., & Rouner, D. (1996). Value-affirmative and value-protective processing of alcohol education messages that include statistical evidence or anecdotes. *Communication Research, 23*(2), 210-235.

Slater, M. D., & Rouner, D. (2002). Entertainment—education and elaboration likelihood: Understanding the processing of narrative persuasion. *Communication Theory, 12*(2), 173-191.

Slovic, P. (1993). Perceived risk, trust, and democracy. *Risk Analysis, 13*(6), 675-682.

Slovic, P., Finucane, M. L., Peters, E., & MacGregor, D. G. (2004). Risk as analysis and risk as feelings: Some thoughts about affect, reason, risk, and rationality. *Risk Analysis, 24*(2), 311-322.

Slovic, P., Fischhoff, B., & Lichtenstein, S. (1985). Characterizing perceived risk. *Perilous Progress: Managing the Hazards of Technology,* 91-125.

Slovic, P., Peters, E., Finucane, M. L., & MacGregor, D. G. (2005). Affect, risk, and decision making. *Health Psychology, 24*(4S), S35.

Steelandt, S., Broihanne, M., Romain, A., Thierry, B., & Dufour, V. (2013). Decision-making under risk of loss in children. *PloS One, 8*(1), e52316.

Steen, L. A. (1999). Numeracy: The new literacy for a data-drenched society. *Educational Leadership, 57*, 8-13.

Steen, L. A. (2001). Mathematics and democracy: The case for quantitative literacy. *Princeton NJ,*

Steinhardt, J., & Shapiro, M. A. (2013). Framing effects in narrative and non-narrative contexts. *International Communication Association,* London, UK.

Steinhardt, J., & Shapiro, M. A. (2013). The impact of narrative messages on prospect theory framing effects. *Society for Risk Analysis,* Baltimore, MD.

Steinhardt, J., & Shapiro, M. A. (2013). Selective attention framing effects in narrative and non-narrative contexts. *Society for Judgment and Decision Making,* Toronto, ON.

Steinhardt, J., & Shapiro, M. A. (2015). Framing effects in narrative and Non-Narrative risk messages. *Risk Analysis,*

Strack, F., & Mussweiler, T. (1997). Explaining the enigmatic anchoring effect: Mechanisms of selective accessibility. *Journal of Personality and Social Psychology, 73*(3), 437.

Suetens, S., & Tyran, J. (2012). The gambler's fallacy and gender. *Journal of Economic Behavior & Organization, 83*(1), 118-124.

Sundali, J., & Croson, R. (2006). Biases in casino betting: The hot hand and the gambler's fallacy. *Judgment and Decision Making, 1*(1), 1-12.

Taleb, N. N. (2001). Fooled by randomness: The hidden role of chance in the markets and in life. *Texere, New York NY,*

Tamborini, R. (2011). Moral intuition and media entertainment. *Journal of Media Psychology: Theories, Methods, and Applications, 23*(1), 39.

Terrell, D. (1994). A test of the gambler's fallacy: Evidence from pari-mutuel games. *Journal of Risk and Uncertainty, 8*(3), 309-317.

Tversky, A., & Kahneman, D. (1973). Availability: A heuristic for judging frequency and probability. *Cognitive Psychology, 5*(2), 207-232.

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

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

Tversky, A., & Kahneman, D. (1981). The framing of decisions and the psychology of choice. *Science (New York, N.Y.), 211*(4481), 453-458.

Ubel, P. A., Jepson, C., & Baron, J. (2001). The inclusion of patient testimonials in decision aids: Effects on treatment choices. *Medical Decision Making: An International Journal of the Society for Medical Decision Making, 21*(1), 60-68.

Van den Broek, P., Lorch, R. F., Linderholm, T., & Gustafson, M. (2001). The effects of readers' goals on inference generation and memory for texts. *Memory & Cognition, 29*(8), 1081-1087.

Visschers, V. H., & Siegrist, M. (2010). When reduced fat increases preference. how fat reduction in nutrition tables and numeracy skills affect food choices. *Appetite, 55*(3), 730-733.

Wansink, B., & Park, S. (2001). At the movies: How external cues and perceived taste impact consumption volume. *Food Quality and Preference, 12*(1), 69-74.

Wegener, D. T., Petty, R. E., Blankenship, K. L., & Detweiler-Bedell, B. (2010). Elaboration and numerical anchoring: Implications of attitude theories for consumer judgment and decision making. *Journal of Consumer Psychology, 20*(1), 5-16.

Wilkin, H. A., Valente, T. W., Murphy, S., Cody, M. J., Huang, G., & Beck, V. (2007). Does entertainment-education work with Latinos in the United States? Identification and the effects of a telenovela breast cancer storyline. *Journal of Health Communication, 12*(5), 455-469.

Wilson, T. D., Houston, C. E., Etling, K. M., & Brekke, N. (1996). A new look at anchoring effects: Basic anchoring and its antecedents. *Journal of Experimental Psychology: General, 125*(4), 387.

Winsten, J. A. (1994). Promoting designated drivers: The Harvard alcohol project. *American Journal of Preventive Medicine, 10*(3 Suppl), 11-14.

Wright, G., Bolger, F., & Rowe, G. (2002). An empirical test of the relative validity of expert and lay judgments of risk. *Risk Analysis, 22*(6), 1107-1122.

Yamagishi, K. (1997). When a 12.86% mortality is more dangerous than 24.14%: Implications for risk communication. *Applied Cognitive Psychology, 11*(6), 495-506.

Zikmund-Fisher, B. J., Smith, D. M., Ubel, P. A., & Fagerlin, A. (2007). Validation of the subjective numeracy scale: Effects of low numeracy on comprehension of risk communications and utility elicitations. *Medical Decision Making: An International Journal of the Society for Medical Decision Making, 27*(5), 663-671.

Zillman, D., & Cantor, J. R. (1977). Affective responses to the emotions of a protagonist. *Journal of Experimental Social Psychology, 13*(2), 155-165.

Zillmann, D. (2006). Empathy: Affective reactivity to others' emotional experiences. *Psychology of Entertainment,* 151-181.

Zillmann, D., & Bryant, J. (1975). Viewer's moral sanction of retribution in the appreciation of dramatic presentations. *Journal of Experimental Social Psychology, 11*(6), 572-582.

Zwaan, R. A., Langston, M. C., & Graesser, A. C. (1995). The construction of situation models in narrative comprehension: An event-indexing model. *Psychological Science,* 292-297.