AT THE BOUNDARY OF RISK AND UNCERTAINTY:

BEHAVIORAL INSIGHTS INTO ENTERPRISE RISK MANAGEMENT

By

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At the Boundary of Risk and Uncertainty:

Behavioral Insights into Enterprise Risk Management

Abstract

by

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This dissertation investigates how managers assess ambiguous emerging exposures, which lie at the intersection of measurable risk and unmeasurable uncertainty. The problem is important because it has implications for organizational resilience and the efficiency and effectiveness of the risk management function.

Study 1, a qualitative interview-based exploration, suggests that risk managers assessing emerging risks in the insurance industry do not evaluate front-line business managers as critically as the "Three Lines" risk governance model recommends they should. The data indicate four potential reasons for the seeming bias: (1) the effect of framing emerging risks as opportunities; (2) shared social identity among risk managers and the business; (3) preferences for measuring ambiguous risks qualitatively instead of quantitatively; and (4) the time horizon within which a risk is expected to materialize.

Study 2, an experiment with 115 financial professionals, examines two of these reasons: shared social identity and risk framing. It finds that risk managers who identify more strongly with the business units they assess tend to be less objective and that positively framed risks are evaluated less critically. Interestingly, the relationship

between social identity and objectivity does not depend on a shared functional background.

Study 3, an experiment with 193 risk managers, investigates the remaining two reasons—risk quantification and time horizon—and the influence of a risk manager's numerical ability. The study tests how these factors affect risk assessment indirectly through subjective processing fluency and perceived reliability of risk information. Results show significant indirect effects of information presentation format on willingness to challenge risk information, moderated by time horizon and numeracy. Less numerate risk managers generally show more skepticism toward quantitative data and more confidence in qualitative data.

This research responds to calls for more behavioral studies in enterprise risk management and contributes practical insights into the perceptions and performance of risk professionals.

Keywords: enterprise risk management (ERM); sensemaking; construal level; framing; social identity; numeracy; emerging risk

CHAPTER 1: INTRODUCTION

Research Purpose and Motivation

Business leaders and their consultants assert that we live in an increasingly volatile, uncertain, complex, and ambiguous world (Marsh & McLennan & Association for Financial Professionals, 2020; McKinsey, 2022). Managers, therefore, often face extreme uncertainty when making decisions amid major emerging trends such as technology innovation, climate change, fundamental demographic shifts, and changes in the distribution of political and economic power (Allianz, 2023; COSO, 2018; Marsh & McLennan, 2016; World Economic Forum, 2023).

Along with perceptions of greater uncertainty overall, the range of uncertainties considered to be manageable has increased (Power, 2007), and many firms have adopted an enterprise-wide risk management (ERM) framework for this purpose. Such a holistic, coordinated approach to managing an organization's portfolio of significant exposures "is intended to be ongoing and iterative, embedded in everyday business processes to allow the entity to stay aware and ahead of emerging threats and opportunities" (COSO, 2018: 19). Risk executives play a central role in ERM, leading a function responsible for the scrutiny of risk-taking activities across the organization while (ideally) also offering risk advice which supports the achievement of business plans and strategic objectives (COSO, 2017; ISO, 2018). The risk management function acts as the second line of assurance in a Three Lines[1] model of risk governance, which has been universally adopted in financial services industries and is ever more common in non-financial industries (COSO, 2015; Institute of Internal Auditors, 2020).

[1] Also known as the Three Lines of Defense model.

Despite the implied benefits of integrating risk management processes with business planning and decision making, such as increased resilience contributing to increased firm value, most firms struggle to do it (Deloitte, 2013; Ittner & Michels, 2017, 2017; Marsh & McLennan, 2017, 2018). The difficulty arises partly because the ambiguous properties of emerging risks make them difficult to identify and evaluate. These exposures can develop unevenly over long periods, and there is little historical data with which to estimate their potential impact (Allan, Cantle, Godfrey, & Yin, 2013; Borsa, Frank, & Doran, 2014; IRGC, 2015). Many organizations find it convenient to simply ignore ambiguous emerging exposures in their formal business planning decisions (COSO, 2018; TCFD, 2017).

This dissertation research aims to understand how various factors affect managers' judgment and decision-making when evaluating ambiguous emerging risks. Such understanding may help management practitioners incorporate risk more fully and efficiently into their business planning decisions. In addition, the empirical evidence from this study contributes to the knowledge of ERM as a scholarly topic. There have been recent calls by regulators (De Nederlandsche Bank, 2015) and academics (Bromiley, McShane, Nair, & Rustambekov, 2015; Crawford & Jabbour, 2023; Sax & Andersen, 2020) for more behavioral research into how organizations measure and respond to risks that have long or uncertain timeframes and little history (Fehrenbacher, Sutton, & Weisner, 2022; Stoel, Ballou, & Heitger, 2017), how risk management is integrated with strategic planning (Sax & Andersen, 2018; Viscelli, Beasley, & Hermanson, 2016; Viscelli, Hermanson, & Beasley, 2017), and the effectiveness of the Three Lines model

(Andersen, Sax, & Giannozzi, 2022; Davies & Zhivitskaya, 2018; Power, Ashby, & Palermo, 2013).

Literature Overview

Risk and Uncertainty

Risk management practitioners often use the terms risk and uncertainty interchangeably. For example, ERM guidance by the International Organization for Standardization (ISO) defines risk as the "effect of uncertainty on objectives" (2018: 1). But the distinction is useful when considering emerging exposures because it allows practitioners to differentiate between quantifiable risks, which can be measured and managed with some precision, and unquantifiable uncertainties, which are less predictable and may require a more adaptive response.

Over a century ago, the economists John Maynard Keynes (1921) and Frank Knight (1921) independently articulated a fundamental distinction between risk and uncertainty. Both authors argued that risk can be measured probabilistically, whereas true uncertainties—which they saw as pervasive in business and finance—cannot. If unmeasurable uncertainty is widespread in business, how can it be effectively addressed? Recent research has examined uncertainty based on the extent to which it can be mitigated. Packard and Clark (2020) distinguish between mitigable (epistemic) uncertainty, which can be alleviated by obtaining more information, and immitigable (aleatory) uncertainty, which cannot. The authors contend that most uncertainty managers face is immitigable because it involves human stakeholders whose behavior is inherently unpredictable. Packard and Clark (2020) suggest that organizations tend to respond to

mitigable uncertainty by prediction and planning and to immitigable uncertainty by agility and adaptation.

A recent book by Kay and King (2020), summarized in a policy brief by Kay (2020), similarly categorizes unmeasurable uncertainty as either resolvable or radical. Resolvable uncertainty can be converted into risk by getting more or better information, allowing probability distributions to be deduced. In contrast, radical uncertainty cannot be resolved by analyzing mathematical properties or observing past data. In the authors' view, radical uncertainty is best addressed by narrative reasoning, which aims for outcomes that are robust and resilient to unexpected events, although "guesstimates" and "making up numbers over and over again" (Kay, 2020: 4) using techniques like Monte Carlo simulation may also be useful for illustrating the range of possible outcomes or identifying key parameters. The authors warn, however, against equating the results of these subjective techniques with objective probability distributions.

Notwithstanding Kay and King's (2020) warning, leading firms in the insurance industry are experimenting with highly subjective techniques to measure and price emerging exposures when some knowledge is available but not enough for standard actuarial pricing methods due to a lack of data or mathematical models. Exposures must be measurable if they are to be transferred from an insured entity to an insurer. Sachs (2018) describes how Munich Re, one of the largest firms in the industry, is extending the boundaries of insurability from risk into uncertainty, motivated by the prospect of high premiums and growth in new business areas and fierce competition in standard risks. "What we aim to achieve is the translation of an emerging risk from the uncertainty domain into the risk domain […] by making systematic use of expert judgment and

intuition. Data and quantitative tools are replaced by experience and qualitative assessment" (Sachs, 2018: 336). The result of the process should be an insurance premium derived from a "plausible and quantifiable scenario […] based on subjective risk estimates," which are sufficiently unbiased to sustain the product line in the long run (Sachs, 2018: 336).

Since many emerging exposures straddle the boundary between Knightian risk and Knightian uncertainty, I define *risk* in this dissertation as a special category of uncertainty for which it is possible to gather observations and estimate (even if subjectively) future outcomes (see Andersen & Young, 2020).

Organizational Responses to Uncertainty

Researchers studying how organizations respond to uncertainty commonly focus on one of three perspectives: Dynamic Capabilities, Sensemaking, or Institutional Theory. Each provides a distinct but complementary lens for understanding how organizations navigate and adapt to uncertain environments.

Dynamic capabilities. The dynamic capabilities perspective has its origins in the fields of economics and strategy, particularly the resource-based view of the firm (Barney, 1991) and strategic management (Aguilar, 1967; Ansoff, 1980; Bettis & Hitt, 1995). Teece et al. (2007, 1997) define dynamic capabilities as an organization's ability to adapt, integrate, and reconfigure internal and external competencies to deal with rapidly changing environments. This perspective emphasizes the need for organizations to continually sense opportunities and threats and evolve and transform in response to emerging trends and uncertainties (Agarwal & Helfat, 2009; Teece, 2007).

The Risk and Insurance Management Society (2022: 12) promotes Strategic Risk Management (SRM) as "an elegant approach to combining enterprise risk management with forward looking strategic methodologies to support the assessment of organizational resilience and identification of organizational uncertainties." Bromiley et al. (2016) argue that SRM is implicitly a subset of ERM applied to risks that have strategic importance. ERM can, therefore, be considered a dynamic capability (Bogodistov & Wohlgemuth, 2017; Nair, Rustambekov, McShane, & Fainshmidt, 2014) since it also involves scanning for emerging threats and opportunities and reallocating resources to adapt to a changing environment.

Sensemaking. The sensemaking perspective has its roots in cognitive and social psychology (Corner, Kinicki, & Keats, 1994; Daft & Weick, 1984; Weick, Sutcliffe, & Obstfeld, 2005). This approach views organizations as interpretation systems in which individuals and groups facing ambiguity and uncertainty repeatedly scan their environment for cues. They collectively interpret these cues and use them to continually construct plausible shared understandings of their circumstances and to choose actions. Sensemaking is a search for plausibility rather than truth or accuracy because of cognitive limitations that prevent a complete evaluation of alternative actions.

Sensemaking research has also addressed the existence of high reliability organizations (HROs) (Khorsandi & Aven, 2014; Weick, Sutcliffe, & Obstfeld, 1999). Although "normal accidents" (Perrow, 1999) and crises can be expected in many highly uncertain environments because of unanticipated interactions among complex technologies and tightly coupled organizational systems, HROs thrive by systematically creating a state of awareness of, and adaptability to, changing conditions and information.

The archetypal HRO is defined by five traits: constant vigilance for potential failures, careful scrutiny of assumptions, heightened operational sensitivity, a focus on adaptability and resilience, and decision-making authority based on expertise instead of rank.

***Institutional theory*.** The institutional perspective, originating in sociology, focuses on how organizations are shaped by their social, cultural, and institutional environments (DiMaggio and Powell, 1983; Meyer & Rowan, 1977). It critically examines the circumstances in which organizations respond to uncertainty by aligning with societal norms and expectations. If risk management becomes institutionalized, formal risk management structures and processes could be less effective at managing risk than they appear (Power, 2004, 2007). Organizational actors in turbulent and unpredictable environments may thoughtlessly emulate the risk management practices of seemingly successful others, regardless of fit (Jabbour & Abdel-Kader, 2016). Aspects of formal risk management may be only loosely coupled (Meyer & Rowan, 1977; Orton & Weick, 1990) with actual business operations to maintain legitimacy and conform to institutional norms. For example, some existential risks could be subject to a rational and rigorous control process even though business insiders know they are uncontrollable. Since the effectiveness of most risk management efforts cannot be measured, loose coupling allows actual business operations to proceed without being overly constrained by ceremonial risk management activities (Power, 2007).

Bias in Individual Responses to Organizational Uncertainty

Research has identified several interrelated social and psychological factors that help to explain individual differences in risk perception and can be a source of bias in

judgment and decisions (see reviews in Raue, Lermer, & Streicher, 2018; Renn, 2008; Shefrin, 2016). COSO ERM guidance (2017: 78) briefly acknowledges a few of these influences and advises management to "identify and mitigate the effect of bias in carrying out risk assessment practices." Table 1 presents some of the sources of bias most relevant to ERM. They include demographic characteristics, personality traits, and cognitive, motivational, and social factors.

TABLE 1
Factors that Influence Individual Risk Perceptions and Decisions

Factor	Description	Representative Sources
Demographic Characteristics Gender, Ethnicity, Age, and Expertise	Males tend to perceive risk as lower than females. Ethnic majorities tend to perceive risk as lower than minorities. Risk taking tends to decrease with age. More expertise in a domain is associated with lower perceived risk.	Finucane et al. (2000); Nicholson, et al. (2005); Slovic et al. (1995)
Personality Traits Big Five personality traits	Risk propensity is directly related to Extraversion and Openness and inversely related to Neuroticism, Agreeableness, and Consciousness.	Nicholson, et al. (2005)
Cognitive Factors Excessive optimism; confirmation bias	People tend to overestimate the likelihood of positive outcomes and focus on information confirming their pre-existing beliefs about risk.	March & Shapira, (1987); Nickerson (1998); Weinstein (1980)
Illusion of control; Overconfidence	People habitually overestimate the degree to which they can control uncertain outcomes.	Durand (2003); March & Shapira, (1987); Lichtenstein & Fischhoff (1977)
Framing of information	The way risk information is presented, rather than its content, can affect how people perceive and respond to it.	Kahneman & Tversky (1979); Levin et al. (1998); Vessey (1991)
Availability of information	People tend to misjudge risks by relying too much on readily available information.	Tversky & Kahneman (1973)
Affect	Positive feelings about a risky scenario prompt people to perceive its risks as low and benefits as high. In contrast, negative feelings lead to perceptions of high risk and low benefits.	Slovic et al. (2004); Finucane et al. (2000)
Modes of thinking	Mental representations of situational cues in an uncertain environment prompt people to use either a slow, analytical mode of thinking or a faster, heuristic mode that relies on intuition, affect, and emotion. Although heuristic thinking is often efficient and effective, it misleads in some circumstances.	Kahneman (2011) Liberman et al. (2002); Mousavi & Gigerenzer (2014)
Motivational Factors Incentives	Agents will take either too much risk or not enough risk if their incentives are not aligned with the interests of the principal.	Eisenhardt (1989)
Social Factors Groupthink	Group dynamics can amplify the individual risk perceptions of group members, resulting in a polarized collective attitude to risk.	Janis (1982)
Social identification	Once individuals are psychologically attached to a group, they tend to align their attitudes and behaviors, including risk perceptions and decision-making, with the group's norms.	Brewer (1999); Tajfel & Turner (1985)
Culture	Cultural values and social structures shape individual differences in risk perceptions.	Douglas & Wildavsky (1983);

The Three Lines Model of Organizing Risk Governance

In many industries, such as banking, insurance, energy, utilities, healthcare, and mining, firms employ a chief risk officer (CRO) to oversee a centralized risk management function responsible for independent monitoring of risk-taking activities across the organization (Mikes, 2010; Pagach & Warr, 2011). This function acts as the second line of assurance in a Three Lines model of risk governance. The first line of assurance is the business manager, who owns the risk and related controls. The second line is the central risk management function and the third is internal audit (COSO, 2015; Deloitte, 2018; Lim, Woods, Humphrey, & Seow, 2017).

One of the main strengths of the Three Lines model is its clear definition of roles and responsibilities across the business with respect to the management of risks (CRO Forum, 2021). COSO (2017, Appendix C: 9) endorses the model, explaining that it "offers an organization a balanced approach to managing risk and seizing opportunities, all while enabling risk-based decision-making that is free of bias." According to COSO (2017, see Appendix C), the second line should have sufficient independence from the first line in order to provide unbiased oversight and objective challenge to risk-taking activities and performance. Insurance regulators specifically reference the Three Lines model as best practice, requiring risk managers to be sufficiently independent of business managers and other functions so as to provide an objective perspective on strategies and potential risk issues (IAIS, 2019, 2021a).

Despite widespread acceptance, the Three Lines model is a subject of intense debate, particularly around the ideal configuration of business management and risk management roles. At issue is how to improve the integration of ERM and business

decision-making while preserving appropriate amounts of independence and objectivity among risk managers (Chambers, 2013; COSO, 2020; IAIS, 2021b; Institute of Internal Auditors, 2019; Lim et al., 2017; McCafferty, 2019; Mont, 2015; Parliamentary Commission on Banking Standards, 2013). There is little research evidence on which to make a case (Sax & Andersen, 2020). Arguably, risk managers can never be fully independent from business management regardless of reporting lines and accountabilities (Institute of Internal Auditors, 2020). To be most effective, they may need to understand the business well beyond their immediate span of responsibility (e.g., through internal rotation and ad hoc training) and be at the table as business partners and advisors when significant business decisions are made (CRO Forum, 2021).

Three Complementary Studies

This dissertation comprises three complementary studies investigating how risk managers assess ambiguous emerging exposures at the intersection of measurable risk and unmeasurable uncertainty. I designed an exploratory qualitative study to provide insights into poorly understood behavioral aspects of the risk management process, such as risk judgments in groups, the level of quantification in ERM, and how managers attempt to link ERM to strategy (Bromiley et al., 2015; Viscelli et al., 2017). The results of the qualitative study inform two subsequent quantitative experimental studies, which I designed to probe deeper into insights from the qualitative study, specifically concerning the effects on a risk manager's judgment of the following factors: risk framing; how closely risk managers identify with the front line; risk quantification; and the time-horizon of risk. Although experimental research designs do not capture the complexities

of the real world, they allow for precise control and excel in isolating and testing specific cause-and-effect relationships (Kadous & Zhou, 2017).

A combination of quantitative and qualitative research methods (Johnson & Onwuegbuzie, 2004) is appropriate for this dissertation because a single method alone is inadequate to explain the complex interaction of external factors and human psychological processes that underlie the assessment of ambiguous emerging risks (Allan et al., 2013). The synthesized results of these three studies provide a more complete understanding.

Chapter 2 of this dissertation contains the qualitative study. Chapters 3 and Four contain the two experimental studies. Chapter 5 draws general conclusions. Since each study is written as a standalone manuscript, readers may notice some repetition across those chapters and this introductory chapter.

The following paragraphs summarize each study and describe how they are related. They also summarize the dissertation's overall contribution.

Summary of Study 1

Study 1 examines the broad research question:

> *How do risk managers in the insurance industry evaluate and respond to the potential effects of emerging organizational risks?*

I used an exploratory qualitative method in Study 1 because the inductive and interpretive nature of such methods is considered most suitable for studying poorly understood phenomena: it helps to find patterns that explain the data (Edmondson & McManus, 2007).

I conducted 22 semi-structured interviews with risk executives (mostly CROs) in the non-life insurance industry in 2019[2] and adopted a constructivist grounded theory approach (Charmaz, 2014) for data collection and analysis. I interpreted the data primarily through a collective sensemaking lens (Maitlis & Christianson, 2014; Weick et al., 2005). Table 2 displays the summary results of Study 1.

TABLE 2
Summary Qualitative Findings

1. ***Emerging risks are strategic risks*** *for the insurance industry.*
2. *There is* ***less evidence than expected of constructive professional tension*** *between front-line executives and risk managers regarding emerging risks.*
3. ***Some risk managers self-censor their communication*** *if it conflicts with the risk perceptions of front-line business managers.*
4. *Interviewees' organizations* ***attempt to measure the unmeasurable*** *by* ***using judgment-based qualitative measurement scales*** *and, if there is enough commercial incentive, by applying an art of quantification.*
5. *Taking action to address emerging risks is constrained by a* ***short business planning horizon*** *and commercial realities.*

Summarizing the five main findings: The data indicate that emerging risks present potential strategic opportunities (to offer new types of coverage) and strategic threats (not adapting quickly enough to a changing business environment) to companies in the insurance industry. Because of the importance and ambiguity of these risks, risk managers encourage the inclusion of diverse viewpoints and sources of information in a collective process of identifying, measuring, and prioritizing emerging risks. Various channels of communication help to educate, motivate, and build consensus among the people evaluating them. However, within this inclusive evaluation process, there is less

[2] I conducted all interviews before the COVID-19 pandemic struck, so it did not feature in the results.

evidence of constructive professional tension between risk and front-line managers than expected. In addition, some risk managers filter their communication in order to emphasize emerging risks that business decision-makers (i.e., underwriting managers) perceive to be "real," that is, within a timeframe and level of certainty that is relevant to the business, even if the risk managers are worrying about longer-term risks. Further filtering and prioritizing of emerging risks is achieved by collective risk rankings using judgmental qualitative measurement scales because there is little data and no credible method of quantifying the risks. However, in the case of emerging risks that have partially emerged (e.g., cyber, autonomous cars) and pose a material present-day commercial threat or opportunity, management often considers them "real" enough to attempt to quantify them and take some kind of action, using quantification methods that are more art than science.

Beyond the formal findings, it was notable that many participants seemed to view their role in managing emerging risks primarily as a "risk conductor" (IRGC, 2015: 5) focusing on coordinating internal and external parties in assessing, managing, and communicating emerging issues. This perception differs markedly from the conventional second-line risk management role, which emphasizes oversight and constructive challenge.

The study's main practical contribution is the observation that, when evaluating and making decisions about complex emerging risks, organizations must strike a balance between the contributions of front-line business experts and the contributions of other participants who have less market expertise but also have fewer direct commercial incentives. Paradoxically, in attempting to diversify risk committees by seeking

representation from multiple business units, some organizations may end up with less diverse risk information and fewer decision options because too many group members share a similar mental model (that of an underwriting executive) or because the balance of power is tipped too far toward front-line group members. As facilitators of the risk assessment process, risk managers act as gatekeepers and perform some initial screening to distill data gathered during the scanning phase. To a large extent, they determine which risk information is attended to by risk committees and other executive teams, where it is then further filtered by the group consensus frame. If risk managers pre-filter risk information—either to conform with the risk perceptions of front-line executives out of weakness or because they already share the same mental model of emerging risks—then the range of potential risks attended to may be narrowed considerably. This filtering can also limit the interpretation of these risks and reduce the variety of alternative responses considered.

The study contributes to the literature on ERM by applying a broad analytical perspective, sensemaking, to a topic that has so far been studied primarily by accounting and finance scholars through the lenses of agency theory and institutional theory (Bromiley et al., 2015). It also contributes to the sensemaking literature by responding to Maitlis and Christianson's (2014) call for more research on the relationship between sensemaking and key team processes such as strategic decision-making.

Connections Between Study 1, Study 2, and Study 3

Two of the findings from Study 1 (less professional tension than expected and self-censorship) suggest that, in the context of assessing emerging risks in the insurance industry, some risk managers do not challenge the opinions of front-line business

managers as vigorously as the Three Lines risk governance model recommends. Since all of the findings appear to offer clues about factors that could be influencing this behavior, I chose to examine these clues more closely in Study 2 and Study 3. Specifically, the interview data point to four potential explanations for the seemingly biased judgment:

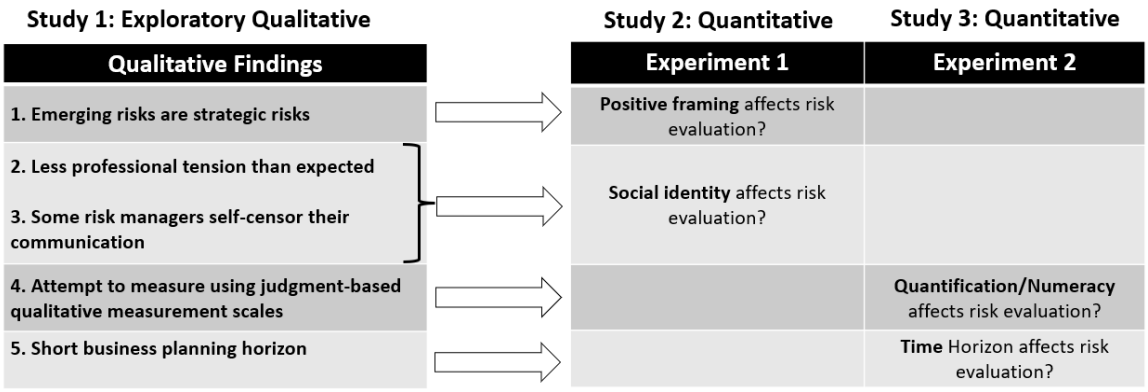
1. ***The effect of framing emerging risks as strategic opportunities (see Finding 1 in Table 1)***: Framing biases are well established in psychology research (Levin et al., 1998). Study participants consistently described emerging risks as commercial opportunities or sources of competitive advantage. Several participants even described the downside of emerging risks as the risk of missing a potential business opportunity;
2. ***Shared social identity among risk managers and the front-line business (see Findings 2 and 3)***: Shared meanings and mental models among risk managers and front-line executives can be expected to reduce tension and encourage conformity (Ashforth & Mael, 1989; Corner et al., 1994). Some participants held concurrent quasi-front-line responsibilities such as strategic planning and product development. In addition, many were either former underwriters or had previously held an underwriting support role, such as pricing actuary;
3. ***Preferences for measuring ambiguous risks qualitatively instead of quantitatively (see Finding 4)***: Research on the psychology of information processing indicates that presentation format, including the amount of quantification, can influence user judgment (Eilifsen, Hamilton, & Messier, 2021; Kelton, Pennington, & Tuttle, 2010; Vessey, 1991). Participants were generally skeptical of numbers produced when trying to measure a risk that

may not be measurable. Many noted that speculative quantification of emerging risks is inefficient and potentially misleading. Instead, almost all participants described a collective process of ranking emerging risks for management attention using judgmental methods, which ranged from a simple color scheme representing high, medium, and low importance to a complicated database-driven algorithm with dozens of numerically weighted criteria.

4. ***The time horizon within which a risk is expected to materialize (see Finding 5)***: Psychology research shows that people tend to be more optimistic about outcomes in the distant future than the near future (Kahneman & Lovallo, 1993; Nussbaum, Liberman, & Trope, 2006). Participants indicated that their organizations look ahead three to five years when making business plans. Such a planning horizon is too short to include the potential effects of many emerging risks.

Figure 1 illustrates how these potential explanations for behavior observed in Study 1 are tested using experiments in Study 2 and Study 3.

FIGURE 1
Connections Between Study 1 (Exploratory Qualitative), Study 2 (Experiment) and Study 3 (Experiment)



Summary of Study 2

In Study 2, I evaluated the first two potential explanations (framing and shared social identity) for behavior observed in Study 1. Study 2 is a between-subjects experiment with 115 financial professionals, which relies on information framing (Levin et al., 1998) and social identity (Ashforth & Mael, 1989; Tajfel & Turner, 1985) literature. In this study, I tested hypotheses that risk managers with functional backgrounds similar to personnel in the business units they evaluate will be less objective (i.e., more biased) in their assessments of emerging risks because of higher shared social identity and that the degree to which objectivity is compromised will be higher for a positively framed risk.

Consistent with my expectations, participants evaluated a positively framed risk less objectively, and higher shared social identity was associated with lower objectivity. However, contrary to my expectations, the relationship between social identity and objectivity was not dependent on a shared functional background.

The finding that positive framing compromises the objectivity of experienced practitioners suggests that organizations should be cautious about proposals to modernize the Three Lines model by assigning risk managers responsibility for assessing the strategic opportunities inherent in emerging risks (Deloitte, 2021; PwC, 2018a). Organizations should be alert to the apparent negative influence of group affiliation on a risk manager's judgment. However, the results also imply that organizations may benefit from staffing their risk management units with former business unit managers who have the knowledge and experience to form competent judgments about complex strategic

risks. This is supported by the finding that a shared functional background does not directly or indirectly impair objectivity through group affiliation.

The study responds to calls for more research on the extent to which risk is a downside-only concept and the tenuous link between ERM and strategy (Bromiley et al., 2015; Viscelli et al., 2017). It provides evidence that the biasing effects of frame and social identity which have been observed in professional auditors (Mock & Fukukawa, 2016; Stefaniak, Houston, & Cornell, 2012) carry over to a risk management context.

Summary of Study 3

In Study 3, I evaluated the remaining two potential explanations (risk quantification and time horizon) for behavior observed in Study 1. I also evaluated the potential role of a risk manager's numerical ability in this behavior. Using a between-subjects experiment with 193 risk managers and drawing on construal level theory and cognitive psychology's concept of processing fluency, I hypothesized that quantification, time horizon, and numeracy jointly affect a risk manager's judgment, operating indirectly through subjective feelings of processing fluency and perceptions of the information's reliability.

In the experiment, professional risk managers were asked to evaluate a set of highly uncertain potential events that were intended to trigger an abstract construal (i.e., abstract mental representation). I hypothesized that when other central aspects of the risk assessment task were also construed abstractly, the alignment of abstract construal cues would cause risk managers to be less critical in their assessment than when construal levels were misaligned (i.e., some aspects of the risk assessment task construed concretely and some abstractly). Specifically, I hypothesized that an alignment of abstract

construal cues triggered by (1) high uncertainty in the risk itself, (2) a qualitative report presentation format in which qualitative risk information is more salient than quantitative risk information, and (3) a distant time horizon, should lead risk managers to experience feelings of processing fluency, thereby eliciting positive affect (which signals that the reported risk information can be relied upon), and in turn reducing their inclination to challenge the risk information. Furthermore, when a quantitative (i.e., concrete) presentation format is the only thing preventing abstract construal alignment during the risk assessment task, less numerate risk managers should experience relatively stronger feelings of processing disfluency. They, therefore, should be more critical in their evaluations relative to more numerate risk managers.

Consistent with my expectations, I found significant indirect effects of the information presentation format on participants' willingness to challenge risk information through processing fluency and perceptions of reliability. These indirect effects were moderated by time horizon and numeracy. Specifically, controlling for numeracy, participants who were considering the distant future along with a quantitative presentation experienced greater difficulty processing the risk information, which they then perceived as less reliable. Additionally, controlling for time horizon, less numerate participants perceived quantitative risk information to be less reliable than more numerate participants.

Contrary to my expectations, I did not find any significant differences in propensity to challenge the risk information between participants exposed to the combination of report presentation format and time horizon intended to activate a more abstract mindset (aligned abstract construals) and those exposed to combinations intended

to activate a more concrete mindset (misaligned construals). However, a second experiment designed specifically to measure construal levels in the treatment groups provided modest evidence that my experimental manipulations did influence construal levels (although not in the way I expected) and that construal levels were indeed related to processing fluency, which indirectly affected propensity to challenge the risk information as expected. This lack of evidence for the hypothesized effects of construal cues may be attributable to well-documented challenges in predicting and measuring the combined effects of multiple construal cues (Benschop et al., 2021; Soderberg, Callahan, Kochersberger, Amit, & Ledgerwood, 2015; Trautmann, 2019). It is also possible that other, more powerful, cognitive processes were at work.

Supplemental analysis uncovered some interesting relationships. First, less numerate risk managers reacted more intensely to presentation format than their more numerate peers, expressing significantly more skepticism toward a quantitative format and significantly more confidence in a qualitative format. Second, participants overall were more inclined to challenge risk information involving the distant future than the near future. Third, I found notable differences in the behavior of participants from financial and non-financial industries. Controlling for numeracy, participants from non-financial industries perceived a quantitative risk presentation to be less reliable than a qualitative presentation. They were, therefore, more prone to challenge it regardless of the time horizon. In comparison, participants from financial industries exhibited this behavior only when risk was in the distant future. Controlling for numeracy and time horizon, participants from non-financial industries experienced greater difficulty

processing a quantitative presentation, which they then perceived as less reliable and were more likely to challenge.

The results highlight the need to integrate both qualitative descriptions and quantitative measures in internal risk communication (where feasible) to accommodate varying levels of numeracy among employees across different departments and reduce the potential for bias in risk-related decisions. Furthermore, the results underscore the potential importance of numerical ability as an aspect of cognitive diversity in organizational decisions about ambiguous risks. Since numerical ability is distinct from general intelligence, which is a broad and multifaceted concept, including people with differing numerical abilities may improve decisions through the constructive disagreement of diverse viewpoints. The findings also suggest that organizations may benefit from training programs and decision aids to help corporate managers become more comfortable assessing ambiguous risks with distant time frames. Additionally, the findings related to industry type may reflect a lack of familiarity in non-financial industries with advanced risk management practices, which are well understood in regulated financial industries.

This study builds directly upon the ERM research of Fehrenbacher et al. (2022) and Stoel et al. (2017) by establishing that numeracy and time frame are additional factors that influence the judgment of professional risk managers. Additionally, the study combines less salient quantitative risk information with more salient qualitative risk information to reflect common practice in the field, in contrast to previous studies that focused on the effect of either one or the other.

Overall Contribution

The three complementary studies in this dissertation provide insights into the thoughts and actions of risk managers assessing ambiguous emerging exposures that straddle the boundary between measurable risk and unmeasurable uncertainty. Based on interviews, the first study revealed a tendency for risk managers to be less critical than recommended by the Three Lines risk governance model when evaluating the opinions of front-line business managers regarding emerging risks. To examine potential reasons for this reluctance, two experimental studies tested the influence of framing, shared social identity, risk quantification and time horizon. Results from the experiments indicated that these factors do indeed affect risk judgment.

However, it is important to acknowledge that the qualitative findings, even though derived from rigorous analysis, are based on my interpretation of the data. The passive behavior of risk managers observed in the first study might not indicate bias but could instead reflect their perceived role as a 'risk conductor' orchestrating information and activity flow while leaving scrutiny and conflict to risk committees. Such committees were prevalent in the organizations of interview participants. Regardless, the studies collectively have an important implication for diversity in decision-making: To be most effective, risk decision-making bodies should not only have representation from various business units (as evident in the organizations from the first study) but should also have diversity in members' mental models (as evidenced by the biasing effects of shared social identity in the second study) and diversity in numerical aptitude (as evidenced by the difference in skepticism of low and high numeracy participants toward quantitative risk information in the third study).

This dissertation research contributes to ERM as a scholarly topic by responding to calls by regulators (De Nederlandsche Bank, 2015) and academics (Bromiley et al., 2015; Crawford & Jabbour, 2023; Sax & Andersen, 2020) for more behavioral research into how organizations measure and respond to risks that have long or uncertain timeframes and little history, how risk management is integrated with strategic planning, and the effectiveness of the Three Lines model in which risk managers constitute the crucial second line.

CHAPTER 2: STUDY 1: CONTENDING WITH EMERGING RISKS – A SENSEMAKING PERSPECTIVE

Introduction

Most firms struggle to integrate their risk management processes with their business planning and decision making (Deloitte, 2013; Ittner & Michels, 2017; Marsh & McLennan, 2017, 2018) even though such integration is thought to increase a firm's resilience and contribute to its value (COSO, 2017; Fox, 2018; Ittner & Michels, 2017; McKinsey, 2018). One reason for the difficulty is the problem of assessing the severity and likelihood of "emerging risks" that arise from societal, technological, and environmental trends or conditions such as extreme weather, cyber-attacks, changes to legislation and regulations, resource scarcity, and social instability (Allianz, 2018; CRO Forum, 2018; World Economic Forum, 2018). Traditional enterprise-wide risk management (ERM) programs do not capture these risks well because they manifest over long or uncertain timeframes, and their lack of historical precedent makes it difficult to estimate their impact (Allan et al., 2013; Borsa et al., 2014). As a result, many organizations simply ignore the implications of these risks in their formal business planning decisions (COSO, 2018; TCFD, 2017).

ERM is still an evolving topic in management scholarship, and there remains much to be discovered, including how organizations measure and respond to risks with ambiguous time horizons and little history (Bromiley et al., 2015), as well as how risk management is integrated (or not) with business planning (Van der Stede, 2011; Viscelli et al., 2017, 2016). Furthermore, since most ERM studies have been by finance and accounting scholars using a narrow range of theories (mainly agency theory and institutional theory) as the analytical lenses (Beasley, Branson, & Pagach, 2015; Cohen,

Krishnamoorthy, & Wright, 2017; Ittner & Keusch, 2016), there have been calls for research on ERM using a wider selection of management theories (Bromiley et al., 2015).

I conducted a qualitative study using semi-structured interviews with participants in the insurance industry to answer the following research question: *How do managers evaluate and respond to the potential effects of emerging organizational risks?* The insurance industry is an appropriate context for this study because of its relatively mature risk management processes and because insurance companies are in the business of measuring and warehousing risk (Nair et al., 2014).

The results of this study indicate that emerging risks present potential strategic opportunities and strategic threats to companies in the insurance industry. Because of the importance and ambiguity of these risks, risk managers encourage the inclusion of diverse viewpoints and sources of information in a collective process of identifying, measuring, and prioritizing emerging risks. Various channels of communication help to educate, motivate, and build consensus among the people evaluating the risks. However, within this inclusive evaluation process, there is less constructive professional tension between risk and front-line managers than expected. In addition, some risk managers filter their communication in order to emphasize emerging risks that business decision-makers (i.e., underwriting managers) perceive to be "real," that is, within a timeframe and level of certainty that is relevant to the business, even if the risk managers are worrying about longer-term risks. Further filtering and prioritizing of emerging risks is achieved by collective risk rankings using judgmental qualitative measurement scales because there is little data and no credible method of quantifying the risks. However, in the case of emerging risks that have partially emerged (e.g., cyber-crime, autonomous cars) and pose

a material present-day commercial threat or opportunity, business decision makers often consider them "real" enough to attempt to quantify them and take some kind of action, using quantification methods that are more art than science.

Literature Review

To inform the research question, I first refer to practitioner and academic literature to help situate interviewees in the context of their roles. I then shift to streams of academic literature on sensemaking and bounded rationality, two areas of management theory that shed light on the research question.

The Risk Officer in Context

ERM is a holistic, coordinated approach to managing all of the significant risk exposures that an organization faces. By managing the enterprise's risks as a portfolio rather than individually, managers attempt to optimize risk-return trade-offs (Nocco & Stulz, 2006) and thereby make the achievement of business objectives more likely (COSO, 2017). Interest in implementing ERM as a form of risk governance has grown rapidly since the U.S. Sarbanes-Oxley Act of 2002 and the subsequent global financial crises, with regulators, rating agencies, stock exchanges, professional associations, international standards organizations, and consulting firms promoting ERM adoption (Arena, Arnaboldi, & Azzone, 2010; Lundqvist, 2015; Bromiley et al., 2015).

In many industries, such as banking, insurance, energy, utilities, healthcare, and mining, the centralization of an organization's risk management processes often results in the appointment of a Chief Risk Officer (CRO) to oversee ERM (Mikes, 2010; Pagach & Warr, 2011). The prototypical CRO role in a financial services company leads a risk management function that is mainly responsible for independent scrutiny of risk-taking

activities across the organization. The function acts as the second line of defense in a Three Lines of Defense model of risk governance which has become orthodoxy in the thinking of financial services regulators and advisors. The first line of defense is the business line manager, who owns the risk and related controls. The second line of defense is the central risk management function that monitors exposure and advises on risk policy, and the third is internal audit (COSO, 2015; Deloitte, 2018; Lim et al., 2017). In the insurance industry, practitioner literature suggests that the extent to which the risk officer role is defined and functional boundaries drawn is contingent on the organization's regulatory domicile, its size, and the maturity of its risk management function (EY, 2018; Power et al., 2013; St. John's University & Protiviti, 2015). In any case, apart from having a robust risk management infrastructure to support the business and meet the risk governance requirements of credit rating agencies and regulators, most insurance companies today at least have a designated CRO-like role for regulatory reporting purposes, although the role need not be a standalone full-time one (EIOPA, 2017; Pooser & Walker, 2015).

Part of a risk officer's remit is to evaluate emerging risks and trends that might impact the company in the future (Mikes, 2010). Standard & Poor's specifically reviews the management of emerging risks and trends as part of its insurer creditworthiness ratings (2019), as do regulators in their supervisory roles (EIOPA, 2017; National Association of Insurance Commissioners, 2017).

Academic research on organizational and behavioral aspects of the risk management process is still developing, and there is consensus that much work is needed (Bromiley et al., 2015; Crawford & Jabbour, 2023; Van der Stede, 2011). Recent

qualitative studies on risk management have examined the experience of organizational actors as they adopt or adapt ERM programs (Arena et al., 2010; Giovannoni, Quarchioni, & Riccaboni, 2016; Jabbour & Abdel-Kader, 2015, 2016; Jemaa, 2022; Tekathen & Dechow, 2013); develop organizational risk culture and legitimacy for the risk management function (Gendron, Brivot, & Guénin-Paracini, 2016; Meidell & Kaarbøe, 2017; Mikes, 2009, 2011); navigate the tension between business opportunity and formal risk controls (Lim et al., 2017; Palermo, Power, & Ashby, 2017); and attempt to integrate ERM with strategy (Viscelli et al., 2017) or the financial reporting process (Cohen et al., 2017).

From the perspective of risk officers in the insurance industry, this study attempts to peer into the "black box" (Cohen et al., 2017) of how organizations grapple to assess complex emerging risks and make business decisions based on the assessment. To my knowledge, this is the first study to explore the lived experience of risk officers in the process of assessing emerging risks facing the insurance industry.

Emerging Risks Defined

Emerging risks can be regarded as the unintended consequences of "complex interactions between strategic objectives, existing risks, risk management interventions, business and regulatory environment, markets, and people's behavior" (Allan et al., 2013: 189). A broader view considers emerging risks to be those born from the intersection of global megatrends, such as demographic shifts, climate change, innovative technology, and changes in the distribution of global economic and political power (Marsh & McLennan, 2016). These risks are difficult to define and predict, with uncertain

trajectories due to their extensive interactions with other phenomena, including the systems designed to manage risk (Allan et al., 2013; Marsh & McLennan, 2016).

Emerging risks embody general principles of complexity like interconnectedness, path dependence, context specificity, and emergence (Boulton, Allen, & Bowman, 2015). An emerging risk has attributes of a "wicked" (Rittel & Webber, 1973) problem: competing views on the issue and its causes, rapidly changing circumstances contingent on individual organizations, and the difficulty of long-term planning under high uncertainty where committing to a decision can lead an organization even further down the wrong path (Lee & Green, 2015; McShane, 2018).

Risk Managers as Sensemakers

Khorsandi and Aven (2014) apply the concept of a high reliability organization (HRO) (Weick et al., 1999) to risk management and suggest that firms facing highly uncertain circumstances should shift their approach from trying to accurately estimate and prepare for potential events to instead creating a state of awareness of, and adaptability to, changing conditions and information. A prototypical HRO has five traits (Khorsandi & Aven, 2014): (1) it is preoccupied with failure and always looking for warning signals of things that could potentially go wrong regardless of history; (2) it is explicit about strong assumptions or arbitrary quantifications and is reluctant to simplify its models; (3) it is sensitive to operations, fostering in its front-line operators a heightened awareness of weak cues in the environment and an understanding of the big picture; (4) it is committed to resilience, putting more emphasis on adaptability to potential surprises than on predicting outcomes; (5) it is deferent to expertise, transferring

decision-making authority to whoever is best qualified to make critical decisions about risk exposure regardless of their formal authority.

Insurance companies should exhibit many of the traits of HROs because they are in the business of aggregating and warehousing risk. Maitlis and Christianson (2014: 73) note that the five HRO practices are part of an organizational culture that encourages sensemaking and "are especially important because of the prevalence and potential impact of contradictions and ambiguities in HROs, where sensemaking may be triggered repeatedly, almost on a continual basis." Maitlis and Christianson (2014) point out the need for more revealing, descriptive qualitative data (including interviews) to illustrate the process of sensemaking as it unfolds over time. In particular, they call for more research into future-oriented sensemaking, the link between sensemaking and attention, and the relationship between sensemaking and key team processes such as strategic decision-making.

If insurance companies are HROs, then their risk managers are the real people doing real work to make sense of ambiguous emerging risks and, as Maitlis and Christianson (2014) suggest, it would be enlightening to see how concepts from the sensemaking literature map onto risk managers as they go about their work.

Sensemaking and Its Connection to Bounded Rationality

Since there is no single theory of sensemaking, Maitlis and Christianson (2014: 67) synthesize the sensemaking literature to produce an integrated definition of sensemaking as "a process, prompted by violated expectations, that involves attending to and bracketing cues in the environment, creating intersubjective meaning through cycles of interpretation and action, and thereby enacting a more ordered environment from

which further cues can be drawn." Sensemaking is a search for plausibility rather than truth or accuracy because real managers in real organizations have cognitive limitations and cannot accurately evaluate alternative actions while facing multiple issues simultaneously (Weick et al., 2005). Managerial decision makers are actors operating in a complex organizational context and coping with their bounded rationality which arises from their limited individual knowledge and limited attention (Gavetti, Levinthal, & Ocasio, 2007; Simon, 1947). As a result of these cognitive limitations, decision makers search for alternative choices but stop searching when an alternative satisfies their performance criteria even though they have not exhausted the full set of alternatives (Cyert & March, 1963; Gavetti et al., 2007). Organizations are the context in which these cognitively limited individuals can achieve a collective intelligence, but their collective time and energy must be allocated across the broad range of possible issues that could be relevant to the organization at any time (Gavetti et al., 2007).

Events must first catch our attention in order to trigger sensemaking (Ocasio, 1997; Weick et al., 2005). Updating the work of Simon (1947), Ocasio (1997) highlights the importance of procedural and communication channels in directing the attention of decision makers to certain environmental cues, thereby shaping their mental models of the situation and their resulting plans and actions. Who participates in the decision process affects which issues (problems, opportunities, and threats) and answers (proposals, projects, etc.) are attended to because participants each bring different interests and situational knowledge (Ocasio, 1997). Rerup (2009) extends the attention-based perspective by demonstrating empirically that firms may be better able to prevent unexpected rare events when they combine attentional stability (sustained attention to an

issue), attentional vividness (complex representations of an issue), and attentional coherence (the deliberate involvement and coordination of multiple individuals and teams in interpreting cues).

Collective Sensemaking and Strategic Decisions

Daft and Weick (1984) describe three stages of the sensemaking process in organizations: scanning, interpretation, and action. Interpretation is the process by which information is given meaning and actions are chosen. These three stages seem to mirror the identification, evaluation, and response stages of the risk management cycle codified in popular risk management standards (COSO, 2017; ISO, 2018). Daft and Weick (1984) use two key dimensions to explain differences in how organizations interpret their environment: (1) management's belief about the analyzability of the environment and (2) the extent to which an organization actively searches its environment in order to understand it. "Discovering organizations," which they classify as analytical sensemakers that actively and formally search for data, seem to characterize an insurance company that is attuned to the possibility of emerging risks.

Emerging risks can affect a firm's continued existence or prosperity and are, therefore, strategically significant (Bromiley et al., 2016). So, perhaps the most appropriate sensemaking model to apply to the evaluation of emerging risks is Corner, Kinicki, and Keats's (1994) parallel process model of strategic decision making. The parallel processing model is a model of collective sensemaking that integrates individual and organizational information processing. Decisions are characterized as emergent outcomes of a complex sensemaking system rather than the rationally or consciously constructed deductions suggested by traditional rational decision making models (Corner

et al., 1994). The parallel processing model has five stages which occur at both individual and organizational levels and are linked by mechanisms of shared consensus: (1) Attention – the focus on information available for interpretation, for which the linking mechanism is shared meaning among the top management team; (2) Encoding – interpretation (i.e., sensemaking), for which the linking mechanism is frame construction (building congruent mental models) among the top management team; (3) Storage/Retrieval – accessing memory and experience, for which the linking mechanism is socialization of new individuals so that they learn the collectively accepted way of doing things; (4) Decision – decisions are not made rationally but instead emerge as the outcome of previous stages. There is no linking mechanism because strategic decisions are not made individually in most organizations; (5) Action – implementation of decisions. The linking mechanism here is the management team members' roles which promote coordinated behavior. The model also accounts for individual power differences within the top management team, the demographic makeup of the team, and the organizational type.

Corner et al. (1994) make several propositions based on the model, which seem to fit well with my research question about how managers in the insurance industry evaluate and respond to emerging risks. One interesting proposition is that the consensus frame generated by a management team is likely to be grounded in the functional background of the most powerful team member. Another is that top management teams that share few meanings will collect and discuss a greater variety of decision-making information than teams that share many meanings. Yet another is that top management teams whose members have heterogenous functional backgrounds will share fewer beliefs (and mental

models) than teams with homogeneous functional backgrounds. I will be alert in this study to how these propositions bear out in my interviews with risk management executives.

Research Design

Methodology

Exploratory qualitative methods are considered most suitable for studying poorly understood phenomena because the inductive and interpretive nature of these methods helps to find patterns that explain the data (Edmondson & McManus, 2007). A qualitative approach fits my research objective of understanding how managers evaluate and respond to emerging risks because little management scholarship exists in areas such as the complexity of risk judgments in groups, the level of quantification in ERM, and the difficulty of linking ERM to strategy (Bromiley et al., 2015; Viscelli et al., 2017). I adopted a constructivist grounded theory approach (Charmaz, 2014) for data collection and analysis. This approach seeks to develop a more nuanced, deeper, and more abstract understanding of a phenomenon by engaging with qualitative data. I gathered the data though semi-structured interviews by asking open-ended questions (Appendix A) and encouraging respondents to narrate their lived experiences. The process was intended to be reflexive and iterative, requiring constant interaction with the data and recursive movement between it and the literature (Corbin & Strauss, 2015).

Sample

I conducted 22 semi-structured interviews with managerial decision-makers in the non-life insurance industry who were directly involved in evaluating emerging risks (Table 3). Most of the managers were risk officers. Although I initially intended to have

half of the participants directly involved in the business planning process, I chose to limit the sample to risk managers because of the project's time constraints. I recruited the participants through personal and professional networks. The insurance industry is an appropriate context for this study because of its relatively mature risk management processes. Firms in the industry should be among the best at measuring risk and integrating risk management with business planning because of their business model and because their regulators and credit rating agencies reward formal, sophisticated ERM programs (Nair et al., 2014).

TABLE 3
Participants

Interview #	Title	Company Domicile
1	VP Enterprise Risk Management	Multi-national
2	SVP Enterprise Risk Management	Multi-national
3	Head of Internal Audit	Multi-national
4	Chief Risk Officer	US only
5	Head of ESG Risks	Multi-national
6	Chief Risk Officer	Multi-national
7	Chief Risk Officer	Multi-national
8	Former Head of Strategy and Risk	Multi-national
9	Chief Risk Officer	US only
10	Chief Risk Officer	Lloyd's only*
11	Chief Risk Officer	Multi-national
12	Head of Strategy and Risk Management	Multi-national
14	Chief Risk Officer	Asia only*
15	Chief Risk Officer	Multi-national
16	Senior Risk Manager, Group Risk	Multi-national
17	Chief Risk Officer	Multi-national
18	Chief Risk Officer	Multi-national
19	Senior Manager, Head of Enterprise Risk Management	US only
20	Former Chief Risk Officer	Multi-national
21	Chief Risk Officer	US only
22	VP Enterprise Risk Management	Multi-national
23	Managing Director - Chief Risk Officer	Multi-national

* with multi-national policy coverage
Note: Interview reference #13 was not a risk manager and was therefore excluded from the sample

Data Collection

I collected the interview data for this research during the spring, summer, and fall of 2019. Interview lengths ranged from approximately forty minutes to one-hour. One participant's interview was split into two sessions on different days. Most sessions were conducted by telephone and were recorded and transcribed for analysis. My handwritten notes replaced a recording whenever a participant did not agree to be recorded. Immediately after each interview, I wrote a memo to capture any salient observations or other contextual information that would not be obvious from the interview transcript.

Data Analysis

I analyzed the interview data using manual techniques aided by specialized software. Data analysis began concurrently with data collection and included line-by-line readings of interview transcripts and repeated reviews of original audio recordings, using the continuous comparative approach (Corbin & Strauss, 2015). Formal coding began after 14 interviews had been conducted. Based on readings of the transcripts and post-interview memos, I selected the three most promising transcripts for full-detail open coding, yielding 225 initial codes. Based on the research question, I then selected the most relevant codes to focus my coding of the remaining transcripts and narrow my interview protocol for interviews that had yet to be conducted. The selected codes captured the struggle to measure emerging risks, attributes of group communication processes, and potential tensions between risk managers and business line managers when evaluating emerging risks. During focused coding of the remaining interview transcripts and interviews, I remained open to ideas and patterns that were not obvious when developing my focused codes from the initial set of interviews. Memos at various

stages of coding and analysis helped me selectively narrow my observations further to key categories and themes, while remaining mindful of emergent ideas and direction (Saldaña, 2016). Figure 2 is a representation of my data structure. Continual reference to the relevant literature helped to ensure that this research has theoretical rigor and is informed by contemporary research.

FIGURE 2
Data Structure

Themes	**Second-level categories**
Strategic risks	
	Fundamental impact on business model
	Risk as opportunity and innovation as self defense
	Scope of uncertainty and complexity
Inclusiveness	
	Aligning with the front line
	Counter-balancing the front line
	Diversifying sources and diversifying imagination
	Having the resources for a more inclusive process
Communicating	
	Consensus-building
	Educating
	Motivating
	Filtering and holding back
Qualitative risk rankings provide focus	
	Applying qualitative judgment
	Prioritizing attention
	Scaling enthusiastically
	Scaling reluctantly
Quantitative measurement is more art than science	
	Applying quantitative judgment
	Imagining extreme events
	Quantifying partially emerged risks
	Quantifying skeptically
Constrained Action	
	Relevance of planning horizon
	Responding to market pressure
	Stage in risk life cycle
	It's just plain hard

Findings

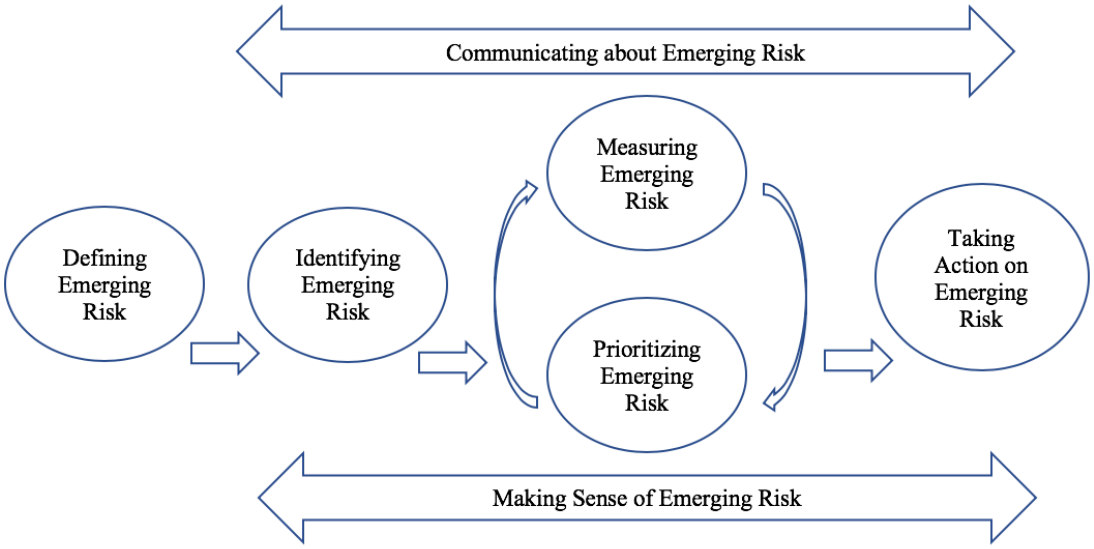
The data indicate that emerging risks present potential strategic opportunities and threats to companies in the insurance industry. Because of the importance and ambiguity of these risks, risk managers encourage the inclusion of diverse viewpoints and sources of information in a collective process of identifying, measuring, and prioritizing emerging risks. Various channels of communication help to educate, motivate, and build consensus among the people evaluating the risks. However, within this inclusive evaluation process, there is less evidence of constructive professional tension than expected between risk managers and front-line managers regarding assumptions about emerging risks. In addition, some risk managers filter their communication in order to emphasize emerging risks that business decision-makers (i.e., underwriting managers) perceive to be "real," that is, within a timeframe and level of certainty that is relevant to the business, even if the risk managers are worrying about longer-term risks. Further filtering and prioritizing of emerging risks is achieved by collective risk rankings using judgmental qualitative measurement scales because there is little data and no credible method of quantifying the risks. However, in the case of emerging risks that have partially emerged (e.g., cyber, autonomous cars) and pose a material present-day commercial threat or opportunity, management often considers them "real" enough to attempt to quantify them and take some kind of action, using quantification methods that are more art than science.

Overall, the study participants described a process for evaluating emerging risk, represented in Figure 3. At a high level, the steps in the process are similar to some well-known frameworks (COSO, 2017, 2018; ISO, 2018) widely used to evaluate more concrete enterprise risks. As one interviewee summarized:

> P9: And we have a separate more simplified process for emerging risks, which is, continuously scanning the environment, evaluating for potential or perceived impacts, and estimating probabilities if we can, primarily its velocity. And then doing scenario analysis when we think it becomes something that could come to fruition, and have a significant impact and, then, developing our response plan. Where with risks, you're actually gonna apply with real - no I shouldn't say real, they're all real risks - with known risks, you're actually gonna apply mitigation. And you're gonna, maybe, purchase insurance, and buy things, and develop products, and allocate resources to it that you're not gonna do with emerging risks.

The consistency of the high-level process described by interviewees is perhaps unsurprising because most of the companies in the sample have similar regulatory and business environments (after the formal interview had concluded, Participant 3 made this very point about expecting consistent interview results).

FIGURE 3
The Process of Evaluating Emerging Risks



The risk manager is the facilitator of this risk assessment process. Before describing the findings, it is helpful to put the risk manager role into historical context,

using the interviewees' own words. The role is relatively new and is still evolving in many of the sample companies:

> P4: So just to give you a brief history, because it'll probably come up, the risk function, obviously, as you know, hasn't been around forever at companies. Very large, complex organizations had their risk functions prior to the credit crisis. But they really gained in popularity post credit crisis. And insurance companies' state regulators implemented what's called an ORSA, it's an Own Risk Solvency Assessment. In essence, it required companies to stand up their own risk assessment function within. So many insurance companies started risk functions post credit crisis. We started ours here at the Company and hired the chief risk officer in 2012.

> P11: I think when you think about enterprise risk management, the chief risk officer role, it's a new innovation. There was no such thing as this role 15 years ago, really, or 20 years ago, really it's kind of a new invention. And if you talk to some of the old timers in the industry [they will] say, "you know, this industry's been around 300 years, and I've been in this career for 30 or 40 years, never had a chief risk officer, why do we need it now?" You know? So, I think it's an open question, that only time will tell is the investment in things like economic capital models, chief risk officer roles, ORSAs, emerging risks, is the benefit commensurate with the cost.

Finding 1: Emerging risks are strategic risks.

Emerging risks are strategic risks for the insurance companies in the sample. Most participants defined or described emerging risks as having the potential to affect their organization's business model or commercial prospects in a fundamental way:

> P1: So, really, the way I define emerging risk is any developing or trending risk that has the potential to impact the Company's business model.

> P12: Situations or trends that may not be fully understood or contemplated in existing management processes or contract terms, and may impact the company's financial strength, competitive position, or reputation.

These risks present both strategic opportunities (to offer new types of coverage) and strategic threats (not adapting quickly enough to a changing business environment). I was surprised that participants in the study consistently framed emerging risks as commercial opportunities and potential sources of competitive advantage, although in

hindsight, I should not have been surprised since risk is the raw material of an insurance business. Participant 9 expressed the recurring view that opportunity is inherent in emerging risks, while Participant 11 pointed out that these risks have both an upside and downside dimension.

> P9: Emerging risks present way more opportunities than your existing risk portfolio does. Because if you can respond first, you have a competitive advantage.

> P11: […] risk is not simply a negative, defensive function, but also an offensive, and therefore strategic function as well. So, I think there's sort of a natural connection there.

The main problem with emerging risks is their large range of uncertainty and the fact that quantification is difficult or impossible:

> P15: I think from an emerging risk standpoint you always kind of think, wow that's almost like the part that I wasn't really thinking about. And that could be the one that's giant. .

> P19: We say that emerging risks are slow to appear, difficult to describe, represent more idea than project, they are longer term horizons, they result from changing political, legal, physical, technological, and societal changes in our environment and where the emerging risk frequency and severity is usually unknown and quantifying opportunity is challenging at this phase.

Figure 4 provides additional representative quotations to support this finding.

FIGURE 4
Emerging Risks Are Strategic Risks

Finding 1a: Fundamental impact on business model

P4: […] an emerging would be any risk that may not be existing within the current environment or on your balance sheet that would prevent you from achieving your long-term strategic objectives of a company.

P16: We define it as future threats [to] the Company, which may be... and there's a certain degree from weak signals to a very massive influence.

Finding 1b: Risk as opportunity and innovation as self-defense

P20: If there is an emerging risk looming out there, and you're good at understanding it and managing it, then actually you might have a strategic advantage over others that aren't, because you may be able to help your clients better understand their risk, help them understand solutions for it, including insurance solutions or maybe other risk mitigation solutions, and then really help them be good at their emerging risk process, and proactive. And that's where the real value of risk management comes in, because it's not just an oh, crap, this could happen to us, but wow, this is an opportunity.

P17: Another one, this is more of a strategic risk, is insure-tech innovation. Will innovative insure-tech startups disrupt traditional insurance and reinsurance companies undermining our business plan. Out of self-defense, our parent company, ConglomerateCo, has set up an innovation lab.

Finding 1c: Scope of uncertainty and complexity

P6: Because at this stage in our degree of comfort with those types of risks, that's the kind of Armageddon scenario we need to contemplate, because I just don't know how likely or unlikely it is.

P 18: […] broadly speaking, it's about any risks that for whatever reason is not fully understood or fully measured. […] And that could be a new risk, something that is, if you like, emerging for the first time or it could be a new take on an old risk where the understanding of that that risk is changing for whatever reason.

Finding 2: Risk managers encourage an inclusive risk evaluation process. However, there is less evidence of constructive professional tension than expected between risk managers and front-line business managers regarding assumptions about emerging risks.

Because of the importance of emerging risks, risk managers value diverse views from inside and outside the organization, as well as debate and a two-way flow of information with the business when identifying and prioritizing emerging risks:

> P18: This isn't some topic where there are individuals who have some amazing different insight to everybody else. It's one where everyone comes with a different, their own perspective. And it's those different perspectives that give you the richness of content.

> P5: Generally speaking, for the emerging risks, we have two inputs. One is a bottom-up business process, and included in that is a regular half yearly formal consultation with the business on what they're seeing as emerging risks that are coming up that aren't currently on our system. And then there's a second process we have also half yearly where we gather external intelligence. So, from either from specialist consultancies or from people who generally look at emerging risks.

They especially value the views of underwriters, who are the businesspeople closest to clients and the markets. In fact, many of the risk managers in the sample are former underwriters, and some believe that good insurance underwriting has always included an assessment of the evolving threats and opportunities that nowadays are called emerging risks. Therefore, evaluating emerging risk is seen by some as a natural part of an underwriter's job, which they do without even realizing that they are doing it. Participant 10 illustrated this point concisely:

> P10: I think I'm saying that if you're a really good underwriter, you do emerging risks without it being a separate discipline. It's part and parcel of who you are and what you do. Because it means you truly understand your risk, you truly understand your customers, and therefore you, you truly understand how it will change, or you are open to how it might change. And you've got enough history to test whether that's true or not, because no matter what risk you took, as in what policy risk you took, insured risk you took, the nature of that risk will have changed over the last, what, 400 years.

Participant 6 went even further by questioning the value of segregating the risk management function from the front-line underwriting function:

> P6: I happen to think that actually having entirely segregated "three lines of defense" is counterproductive, because too often risk management is seen as something that happens kind of at the end of the process, it is control driven, it's job is to say no to things, and consequently, it's seen as kind of, not exactly the enemy by half the company, but it's just not integrated into the company, it doesn't have front line experience of what's going on, it can't really see how things are happening.

I was surprised by how few participants specifically pointed out their own obligation to challenge the assumptions of front-line business managers, although most

interviewees did attribute that responsibility to a risk committee (as noted in Finding 3 on communication). The following comments illustrate the risk manager's role as a counterweight:

> P20: I think, and this to me is a fundamental responsibility of an enterprise risk manager, is to continue to push and continue to constructively challenge the whole organization, even including the board, if the board is not expressing interest or willingness. And if you end up being a lone voice, then that's unfortunate, but at a minimum, you need to go on the record and clearly state what the concern is, why you think it should be investigated, and then at least capture it as a topic which was raised, discussed, and agreed not to be pursued relative to other things.

> P21: It's not my responsibility to determine exactly what the emerging risks are. It's my responsibility to make sure we've polled everybody. We've gotten the information out of the various constituents, and then to try to formulate some sort of a view, and some sort of a risk ranking if you will, to say, hey these are the ones that we think you ought to pay attention to. Here's some others that may not be as important but, again, it's not my responsibility to pick them. It's my responsibility to make sure that we're having those conversations and driving those conversations.

I was also surprised that four participants were responsible not only for risk management but also for strategy, reinsurance purchasing (i.e., hedging), or product development. These other functions are, arguably, aligned closely enough with the underwriting function to threaten the objectivity of a risk manager's risk assessment.

Some interviewees indicated that the inclusiveness of their emerging risk process was dependent on the resources dedicated to the process:

> P15: Like what are the unknown unknowns? I have the things that I'm monitoring, but there's so many things out there. I only have so much time and resource to prioritize, so how do I make sure what I'm monitoring is gonna bring value to my organization?

> P17: You probably never can do enough. We're on the more active practical end of the spectrum as opposed to having somebody thinking about what could be the next problem that we haven't thought about yet. We're a relatively small company, 1,000 people worldwide. […]. We just don't

believe we have the luxury of devoting resources to the more theoretical or academic aspects of it. So, we always try to keep it connected to the business.

Figure 5 provides additional representative quotations to support this finding.

FIGURE 5
An Inclusive Risk Evaluation Process

Finding 2a: Aligning with the front line

P11: And so, by fragmenting that, and by separating the profitability and the underwriting and the assumption of risk, from the management of risk, you could, in fact, inadvertently be undermining focus. Because I often say, the best risk management happens at the point of sale.

P15: Some companies might say, oh that's not part of enterprise risk management. Well it's part of underwriting. In the end, it's like it doesn't really matter what you call it as long as you're doing it. […]. You always have imperfect information, so you're always tasked with thinking about that. So how are you just making sure that you have a framework and a forum for such that those conversations are being had and right people at the table.

Finding 2b: Counterbalancing the front line

P12: We coordinate the risk management process, the year-end process, for the group. But we don't own any risks so we, we're pretty assertive that responsibility and accountability for risk management lies with responsibility and accountability for managing the business.

P10: Yeah, it, it's a lot of back and forth, and I guess it depends on what your end goal is. If your end goal is… if you're trying to beat people up, it's a negotiation, right? If the ultimate end will be you have to hold more capital, then that is a bad outcome for the underwriter. So, you've got to approach it as though we're trying to understand your risk better, and we're trying to work out if you need to or should be taking different action.

Finding 2c: Diversifying sources and diversifying imagination to evaluate emerging risks

P 12: You've gotta be able to provide some people room to be creative in how they think. And back it up with hard analysis to determine whether it's real or not. […] So, if you can bring the two of them together and... it's difficult for any one person to do that, you're gonna need a team generally. You need a team, and you need the culture that they can work within. […] But it, it's always struck me that to be successful at identifying emerging risks, you have to apply imagination. And you have to be in a corporate culture that encourages that and doesn't discourage it.

P16: As a background of our emerging risk approach, we have a working group here in European Country B, which serves as a kind of think tank and a knowledge pool for the [corporate group]. That consists of 20 people. Those 20 people are coming from different departments, but mostly from the underwriting and from the claims department. […] Of course, we have also a scientific approach and that's the third group within this working group. A bunch of people who are scientists and those are physicians and doctors and geologists and all kind of rather scientific background.

Finding 2d: Having the resources for a more inclusive process

P16: We are a rather very efficient reinsurer in comparison with our peers. We have not so much of a staffing. So, the people are doing very much on their own and our thinking is that if we would involve some external experts, that would be a burden on our budget and peers like GlobalRe X or GlobalRe Y are going for maybe some projects with externals but that's not the Company way.

P20: I think what was really successful about our approach was that we would actually communicate it at the highest level, the CEO level and even the board, get a sponsorship to actually do what we would call a black swan, deep dive project, and really kind of try to understand everything that's currently known about the risk in the world, and then begin to translate that into thinking about well, what are the what-if scenarios that you could think about that might then affect your clients and therefore the insurance portfolio.

Finding 3: Various channels of communication help to educate, motivate, and build consensus among the people evaluating emerging risk. However, some risk managers filter their own communication if it conflicts with the risk perceptions of front-line business managers.

Risk managers in the sample described the process by which inclusive groups, such as risk committees and task forces, reached consensus on issues related to emerging risks:

> P21: We collect the information I would say, and then we discuss it with the executive leadership in the executive risk committee to get their ideas, get their thoughts. Are we on track? Are we off? Are there other significant emerging risks that we ought to be thinking about? So, the leaders in the business are going to have a much more in-depth discussion with their teams about what they're seeing on the front lines than I could ever possible hope to have.

> P16: We [emerging risk committee] are discussing it in the first round, and then we put up a ranking. Then again, everyone has to look if she or he feels comfortable with the ranking or if there is anything missing or if there is a risk which is too much or overstated or understated. It all is founded on exchange and discussion and argumentation.

They also described the ways in which information about emerging risks was shared within their organization. The sharing of information about emerging risks up, down, and across the organization was perceived by participants as serving an important educational purpose—it helps employees to do a better job by arming them with risk insights:

> P2: So, it's really difficult to say here's our risk appetite for climate change because it's, it's not something you can or cannot have an appetite for. It's something that is coming, or has partially come and is going to keep coming. So, it's really more about just educating people internally on the types of impacts.

> P20: And that's actually probably the least important thing is to have a 100-page manual about emerging risks and how to do them. It's more about making it a living, interesting process with the organization […]

Furthermore, by highlighting the benefits of the emerging risk evaluation process, this communication was also seen as an important motivational device.

> P12: We are also planning on meeting on a monthly basis going forward. Due to the, the desire to stand this up and keep momentum going. In previous iterations, we tried to meet quarterly, not wanting to be too intrusive on people, but the sponsors wanna keep this thing going. And they said we can always meet less frequently once we have momentum. Which, I think makes sense.

> P9: […] getting a few, like, success stories for us, drones was one of them where we could say from beginning to end, it unfolded and we definitely had a positive impact because of it. Those are the kinds of examples that get people excited about it. When you get people excited, the momentum is crazy. I mean it's- it's fun. The task force, I think, is gonna be a blast.

However, some risk managers seemed to think about emerging risks in a different way than their colleagues who are actually making commercial business decisions. In particular, risk information that is considered relevant for each group can differ with respect to timeframe and level of certainty. These risk managers expressed the need to restrict (filter) their communication to risks that the business decision-makers consider relevant (shorter-term and more certain); otherwise, the business side may disengage from the emerging risk management process. These examples of risk managers holding back what they really think seem to correspond with the fewer-than-expected examples of counter-balancing behavior noted in Finding 2:

> P10: In reality, when I'm working with the business, that's not what they want to hear about. What they want to get at and talk about is much shorter term and much more certainty. So, although I'm worrying on a longer timeframe, and a less certain timeframe, I'm not going to commission a 10-page report on something very niche and very out there that everyone's going to go, "So what? I don't care."

> P14: So, you're basically kicking the can down the road. So [climate change] is an example, the most frustrating example which I have of the life of a risk manager. […] But otherwise, you know, it doesn't become, it's not a standing agenda item. Because it gets on people's nerves, right?

Figure 6 provides additional representative quotations to support this finding.

FIGURE 6
Communication Channels and Self-Filtering

Finding 3a: Consensus-Building

P22: Each risk is assigned to a point-person who is the business owner of the risk. The risk owner would be a subject matter expert and is normally one of the ERC (emerging risk committee) members' direct reports. The risk owner does the initial rating and then the ERC discusses it and challenges it if necessary.

P9: And, so, what they'll do is they'll collaborate with other teams who have input on those risks, and make sure that they're getting a full picture of that. And then these other teams, these other departments are going to be in that risk committee meeting, and when the risk owner comes back and says here's how I rated this risk, here's what I considered, here's the background on the risk, the team will challenge them. Are you sure? Did you consider X? But what about Y? And that challenge process is so important. Sometimes risks are adjusted because of that.

Finding 3b: Educating

P15: I think sometimes people think the goal of the risk assessment is to produce the report, but I don't think so. I think the goal of the risk assessment is to have a framework for having a conversation about risk such that if there's things that you need to do differently you set yourself up for dealing with that.

P3: So, it was more of a conversation piece. For understanding, I think it's a lot of where these emerging risks help is [with]better understanding. So just created a better mutual understanding I'd say.

Finding 3c: Motivating

P19: Yes, I mean people have great incentive to make, financial incentive, to make the company more valuable and if it's determined that the trend is a priority then accountability and passion for the subject generally follow, because it's a group driven prioritization process.

P15. You can come up with whatever templates or have whatever requirements you want, but if you don't take the time to figure out how it's gonna work within an organization you lose the value of the conversation about what you're really trying to accomplish, and it just turns into compliance. People just try to get it done.

Finding 3d: Filtering and holding back

P1: So, I found the trick is very much to talk to them about year two, three, four. Because that they have got some confidence in, they can see that potentially it's still going to be the same business that they've got now, but they can see it changing slightly.

P17: We're letting the front-end business people by and large and together with claims identify what there might be in early stages that we should be aware of. […] We're basically getting our ideas from what actually is real enough to be showing up in some way in the market.

Finding 4: Interviewees' organizations attempt to measure the unmeasurable by using collective risk ratings and, if there is enough commercial incentive, by applying an art of quantification.

Despite acknowledging the difficulty or impossibility of quantifying emerging risks, almost all of the interviewee organizations attempted some kind of measurement in

order to decide what to do about them. Many participants noted that speculative quantification of emerging risks is inefficient and potentially misleading. Instead, almost all participants described a process of ranking emerging risks using collective judgment (e.g., using a scale for timeframe and severity), thereby allowing management teams to focus on the most important risks. I found it interesting that the methods used to establish risk rankings ranged from a simple color scheme representing high, medium and low importance to a complicated database-driven algorithm with dozens of numerically weighted criteria. There was some disagreement among interviewees about the benefit of assigning quantitative thresholds to scales (e.g., assigning dollar impacts to high, medium, and low severity). Participant 20's organization used financial thresholds to establish a rating scale:

> P20: So, yes, there would be a scale just to guide everybody's thinking, so that we were at least defining high, medium and low in a similar way, even if our method of measuring might be primitive, if existing at all.

In contrast, Participant 19 was highly skeptical of assigning financial impact, saying:

> P19: We have learned long ago in our risk assessment heat mapping process that it's just not worth your time to try to go, "Is this a million dollars or five million?" I mean who the heck knows, it's a useless exercise we have concluded to try to pin down number breaks. […] You get to the right answer of what in your heart you know should be in the red zone with high, medium, and low.

Some risk managers favor quantification beyond simple risk rating scales. They think numbers, however crude, are better at getting peoples' attention:

> P11: But the attitude is, it's better to quantify it and recognize that there's potentially some meaningful numbers here, rather than walk around ignoring it, where it tends to be managerially that in the absence of any number, people tend to assume the number-, behave as if the expectation is zero. And obviously, whatever the answer is, it's bigger than zero.

Significant judgment is involved in such cases because, although the quantification tools (models) and methods (scenarios, simulations) are available, there is little or no history to use as an input. As Participant 8 noted:

> P8: I think the biggest limiting factor, I think the tools are out there, and I think the human intelligence is out there. The most limiting factor I think you touched upon it a little earlier is the available data set. If you have a very finite number of events, it's hard […].

Imagination must substitute for the missing historical data about emerging risks. Participant 12 highlighted the importance of imagining extreme scenarios as a way of understanding the limits of exposure to emerging risks, while Participant 18 described the risk manager's role in guarding against the shortcomings of human judgment when imagining extreme events:

> P12: I think scenario analysis is really the only way to get your head around some of this.

> P18: And it's kind of similar with some of the emerging risks because if people were thinking through the scenarios with limited reference points, they tend to make things worse than they really are. Particularly single impact events. […] So, it's one of those ones as a risk person, your job is to sort of help people think about it and steer and challenge and all the rest of it. But it's the area where people, absent that steering, tend to default to extreme outcomes.

Most interviewee organizations attempted to quantify partially emerged risks in response to a commercial opportunity or threat, even though they may be skeptical about the accuracy of the numbers. Many risk managers identified cyber risk as a partially emerged risk for which there was enough commercial incentive to quantify cautiously, as illustrated by the following quote:

> P17: The industry actually embraces the idea of insuring cyber risk. We're cautiously participating in that, but it is kind of daunting because nobody really knows the potential scope. […] So, it's something that the industry has marched forward with without a lot of knowledge. We're kind of

> groping in the dark. Eventually, we'll get enough claims that we'll know how we should write the policies and what we should avoid and how to limit the downside, but at the same time, to offer a product that the buyer actually finds valuable. So, that's the case that it's here. It's arrived, but it's still emerging because we don't know what the full consequences are yet.

Others saw Brexit as a partially emerged risk that posed a commercial threat, which justified the effort to quantify it in the absence of historical data:

> P7: I mean the Brexit really boiled down to what business are we likely to lose, and therefore what income or profit? How much would it cost to set up an overseas office in Europe in order to retain that business? At this point in time does it make sense to do that or not?

In general, risk managers in the sample expressed skepticism about numbers produced when trying to measure a risk that may not be measurable. They considered the quantitative measurement of emerging risks to be more of an art than a science. Participant 11 felt it was important not to forget the shaky ground on which the analyses were constructed:

> P11: So, we actually have models, and it looks very scientific, and we always have to remind ourselves let's remember, most of these numbers are pulled out of our behinds, right? There isn't enough historical data to calibrate models. Over time we'll build experience and be able to calibrate them.

Participant 2 concurred but also acknowledged the benefit of having figures as an initial reference point for business decision makers:

> P2: On this liability side, I don't have that much confidence in how accurate the projections are. But worst-case scenario, you're still socializing this stuff with the management team. So, they can understand what potential losses are in store for us if we keep pursuing those classes of business.

Figure 7 provides additional representative quotations to support this finding.

FIGURE 7
Measuring the Unmeasurable

Finding 4a: Qualitative risk rankings provide focus

P11: We do an annual survey, where we survey 150 people, probably 25% of our entire worldwide staff. Not necessarily secretaries, but people from all disciplines. And ideally, a little bit more senior. And survey them, what do they think are the emerging risks? We also ask them to help prioritize them in terms of both potential magnitude, the frequency that these kinds of scenarios might affect us.

P18: Interviewer: And in the case of these emerging risks, who actually sets or decides on the rating for the frequency and severity? Participant: Kind of the group collectively. That is, basically the group collectively will have a discussion. Typically, you'll rank them, but you will rank the ones that you're discussing in any depth. […] But on these things, it's so judgmental that whether something's number one or number five really doesn't make a difference. Whether it's number one or 100 probably does make a difference.

P10: Is it going to impact us operational in kind of a high, medium, low type thing? You know, based on what? Based on judgment. You know, this is not at all scientific at this stage. It's just a gut feel of if this did happen that would be pretty big. But it's 15 years out. Or, you know, this could happen tomorrow, but it's pretty negligible. […] I mean, it's not terribly scientific. It should be more scientific.

Finding 4b: Quantitative measurement is more art than science

4b(i) Applying quantitative judgment

P1: […] I think when you're talking about emerging risks, if you can get some reasonable numbers, and plug them into the analysis, that definitely helps keep people's attention. Now it's very good to reference a piece of research for instance, but it's got to be credible research.

P3: So, we had a very defined framework within the vendor models and with our own financial modeling, to come up with a framework as to how do we quantify these risks. Even a reputational risk we can say it could be $1,000,000 dollars or it could be $100,000,000 you know. Have a go at that and then, is it likely to happen every year or I don't know, 1 in 100 years. It's not an exact science, so what we do, we quantify, using that sort of measure in the risk register. So, if an emerging risk gets in, it gets quantified.

4b(ii) Imagining extreme events

P20: And so, you just do your best of balancing between what has been observed and what could potentially happen. And so again, there's a bit of art, a bit of science to it. [….] And we all recognize that whatever happens in reality, if it ever happens, we'll never exactly mimic the exact scenario that we described, but we still had to put a stake in the ground to at least have everybody thinking about and stimulating their loss imagination a little bit, by outlining a specific scenario.

P6: Yes, so there was some sort of realistic disaster scenario testing that you sort of ask people to do, you know, try and develop a sort of common view of the issue being that you're trying to establish a common language across all of your potential cedants.

4b(iii) Quantifying partially emerged risks

P19: We are in an oversight role, but really when you're talking about something like autonomous vehicles that's a business unit, it's impacting personal and commercial lines, so the best R&D and product experts in those front lines of business would be most involved and not me. […] Remember this is a huge company. My risk modelers are in the capital adequacy business, and so my group quantifies very basic things like investment risk and catastrophe risk, and cyber risk, and da da da. Those guys would be quantifying on topics that they know best.

P10: So, on the blockchain piece, it was mainly informative as a piece of work. And in fairness, I think it was largely focused on the opportunity here, with the risk being your business model might be threatened in due course by you will be more expensive than your competitors.

4b(iv) Quantifying skeptically

P6: […] the problem with a lot of these things is you see people, and they come up with all these fancy calculations to come up with a 1 in 250 PML for their cyber risk, and it's a junk number, I mean, I'm not an enthusiast for the 1 in 250 property [catastrophe] PMLs either so I think they're pretty junky numbers but at least they're more robust to some extent and they are shared across the industry.

P14: Well, to be quite frank, we don't have a good methodology for this. So generally speaking, we try to manage everything to 1 in 200, but how do you pick one of these emerging or future scenarios on distribution screen and say this is the 1 in 200. What you can build is a range of scenarios and keep on stressing, stressing and stressing. And one point you're saying, okay, now that looks completely ridiculous now, and then you just cut it off. But this is very judgment based and probably a far cry from anything scientific.

Finding 5: Taking action on emerging risks is constrained by a short business planning horizon and by commercial realities.

Taking action in response to emerging risks seems to be constrained by a relatively short business planning horizon and the market environment. Participants' examples and narratives imply that the risks the business prioritizes and acts upon may not be true emerging risks but risks that have already partially emerged (e.g., Brexit, cyber, autonomous cars) and can, therefore, be more reliably quantified because there is some data available.

Participants indicated that their organizations look ahead three to five years when making business plans. Such a planning horizon is too short to include the potential effects of many emerging risks. As a result, organizations might not act soon enough to prepare for the potential effects of emerging trends. My conversation with Participant 18 captures this seemingly inevitable result:

> P18: […] one of the big constraints is that the planning horizon tends to be short enough that most, not all, but most emerging risks fall away. When you look through them in a lens that only goes three years down the path. Interviewer: And that planning horizon, you, as a risk manager, are you constrained by that planning horizon as well in terms of what you're

> thinking about? Participant: No. But in terms of what you're going to deploy resource to deal with. […] And it's not to say that things are ignored beyond that planning horizon, because there are... Companies are like tankers, you don't change quickly.

Participant 21 confirmed that even risk managers can allow the urgency of short-term objectives to displace more strategic longer-term thinking about risk:

> P 21: So, if you engage on a conversation around emerging risks, very rarely will you walk out of that and say, "Okay, here's the three things we're going to go do now when we go back to our desk because of this conversation." It's really a longer-term play and it's a more strategic level of thinking than honestly a lot of risk managers are willing to give it when they're chasing shorter term deliverables.

Regarding long-term emerging risks such as climate change, business managers can be reluctant to make early moves in the market, as the following two comments illustrate:

> P17: Even if you identify some of these risks, it's really hard to know what to do about it. […] In that respect, underwriters and underwriting managers and executives are risk averse about overreacting to remote risks because the consequences could be very swift and severe. […] A company decides, "We're worried about climate change liability. So, let's put an absolute climate change exclusion in our general liability policies or maybe in our directors and officer liability policies." The first company that does that is out of the market. […] There have been some false alarms in the past that people were pretty worried about: lead paint and [electromagnetic fields], and other things. So, that's one of the things that makes this very tricky.

> P20: I think there is some mentality that well, we're not an outlier, so we actually are fairly relatively well-placed compared to our peers. So yeah, we might get stung, or might even take a capital hit from a large event, like say a shift in the climate risk or losses, but we'll do better than others. I guess it's a very pragmatic perspective, and a lot of companies do that. Because they definitely look at where they sit relative to their peers in many dimensions, including that type of exposure.

It is interesting that some interviewees perceived front-line businesspeople as risk averse, short-term thinkers driven by the market, and yet a thread throughout the sample (e.g., Finding 2) is that those same people are best placed to assess emerging risk because they

are closest to the market and their underwriting skills lend themselves naturally to the task.

Participants spoke about the lifecycle of an emerging risk as it evolves into a risk that can be managed using traditional risk management processes:

> P2: But if you can either quantify or, roughly quantify, or at least have a very good understanding of the impact, to the extent that you can establish countermeasures to mitigate the risks, then it's not really an emerging risk. It should be a candidate for a top risk. So, we have this new thing called top risks.

The very large companies in the sample seemed to devote more resources to a deeper analysis of emerging risks that were earlier in the lifecycle and further out on the planning horizon:

> P19: But, it's just less of a deep dive because it's too emerging and it's a time horizon is just not concrete enough to turn the potential benefits of quantum computing into an actual project that hits our bottom line in the next couple of years.

Ultimately, several interviewees expressed their frustration with the conundrum of not knowing what to do about truly emerging risks even though they know that the risks could eventually materialize:

> P17: As I've talked about this kind of stuff with other CROs and risk management people, I get the impression that everybody kind of shrugs their shoulders about how do you deal with emerging risks, but we never go into it very deeply.

They also perceived it to be a dilemma shared by many other organizations:

> P15: […]I think that's something every organization struggles with and it's really hard to get your arms around.

Figure 8 provides additional representative quotations to support this finding.

FIGURE 8
Taking Action is Constrained

Finding 5a: Relevance of the planning horizon

P11: The other thing on climate issues, while it's hard to deny that there are long term impacts, they're long term and our contracts tend to be annual, or at the most, two or three years in duration. […] We don't panic about it, in part, because we're in the risk business. So, in the long term, not to be greedy, but more risk is good for us.

P12: - I certainly don't feel very comfortable going out much more than five years. But I could see some merit in trying to think 10, 15, 20 years out. Just to, if for nothing else, to challenge yourself as to what things could be like, and what the company is going to need to look like from a balance sheet perspective to protect themselves.

Finding 5b: Responding to market pressure

P11: We are fundamentally, at the end of the day, price takers. And so, we can't just say, "Well, we're going to exclude cyber". And the client says, "Well too bad, anybody else will do it." Then okay, we're excluding cyber, but the byproduct of that is, we're not on that treaty.

P5: So, we no longer insure any new coal mines or new power, coal power stations, but we carry on with existing coal power stations and the coal mines until we hit 2030 when we will stop even underwriting existing ones. So, part of this is also reflecting the value of that business to us. And lastly, it's been a huge reputational issue for us. We've had a lot of activists acting on it. And putting pressure on the company. We've had a lot of shareholder resolutions at our AGM about it.

P14: So, then you can say, OK, fine, if the markets don't allow me to price for this additional volatility, then probably I need to absorb it in my capital. Don't I? If I believe the shock is going to come, then somewhere I need to take the hit. But if you now translate that into increased capital requirements, I suppose your CFO will give you a very stern look and say, sorry guys, you just made our business maximally unattractive for investors.

Finding 5c: Stage in risk life cycle.

P16: Because when that happens and the risk can be calculated, it's not an emerging risk anymore. Then it's a regular standard risk of our register and can be countered by specific risk capital. […] Of course, at some point, like in the case of cyber, we just take it out of that watch list of emerging risks and put it into our normal business and treat it as a line of business.

P10: Cyber risk. That's not an emerging risk. That risk is a well-known and defined risk. We don't know what the impact's going to be yet. We don't know how likely it's going to be. We don't know quite all the tendrils it's going to have. But we can start talking about shaping it now, and that's useful to the business. It's an unknown that we can start picking at. It's not an out-there unknown of who knows?

Finding 5d: It's just plain hard

P20: I guess as I was reflecting on it, emerging risks is such a broad topic. It's so wide it's really difficult for people to spend the time and energy on it when there's a lot of other things going on. So, I think that it's a soft spot for a lot of organizations.

P22: As you noted earlier, it has been a challenge to turn the ERC discussion into action because of the nature of these risks.

Summarizing my five main findings: Emerging risks are strategic risks to the insurance industry. Therefore, inclusiveness and communication are important in

evaluating these risks. However, there is little evidence of the healthy professional tension that I expected between risk managers and the front line with respect to emerging risks. In addition, some risk managers pre-filter communication to focus on risks that the business decision makers consider to be "relevant" and "real," even if the risk managers worry about longer-term risks. Further filtering and prioritizing of emerging risks is achieved by a collective risk ranking process using judgmental qualitative measurement scales because there is little data and no credible method of quantifying the risks. However, in the case of emerging risks that have partially emerged as a material present-day commercial threat or opportunity, business decision makers consider them "real" enough to attempt to quantify them and take some kind of action, using quantification methods that are more art than science.

Discussion

From the point of view of risk managers, this study highlights the strategic significance of emerging risks to companies in the insurance industry, the perceived importance of inclusiveness and communication channels in the risk evaluation process, the approaches used to measure emerging risks, and the perceived limitations of these methods, and factors that may constrain an organization's response to emerging risks. Although the individual risk manager is my unit of analysis, interviewees described a risk assessment process involving elements of group judgment and group decision making throughout. Corner et al. (1994) imply that the individual information processing experience of the participants must be considered in connection with group-level information processing because the two levels interact with each other. I formed my understanding of group-level sensemaking based on the stories that individual risk

managers told us. In doing so, I respond to Maitlis and Christianson's (2014) call for more research on the relationship between sensemaking and key team processes such as strategic decision-making. And by studying the fundamental ways in which one type of actor (the risk manager) makes sense of his or her place in the organization's risk assessment process for emerging risks, a context that, to my knowledge, has not been investigated previously, I "reveal more of the qualities, tensions, and challenges of sensemaking, as well as the other processes it enables at and across different levels" (Maitlis & Christianson, 2014: 108).

This study contributes to the evolving literature on ERM by applying a broad management perspective, sensemaking, to a topic that has, to date, been studied primarily by accounting and finance scholars through the lenses of agency theory and institutional theory. The study responds to calls for more research on the complexity of risk judgments in groups, efforts to quantify risk, the extent to which risk is a downside-only concept, and for detailed insights that can increase our understanding of the seemingly elusive link between ERM and strategy (Viscelli et al., 2017; Bromiley et al., 2015).

The study's main practical contribution is the observation that, when evaluating and making decisions about complex emerging risks, organizations must strike a balance between the contributions of front-line business experts and the contributions of other participants who have less market expertise but also have fewer direct commercial incentives. Paradoxically, in attempting to diversify risk committees by seeking representation from multiple business units, some organizations may end up with less diverse risk information and fewer decision options because too many group members

share a similar mental model (that of an underwriting executive) or because the balance of power is tipped too far toward front-line group members.

The Strategic Significance of Emerging Risks

Insurance companies are in business to absorb risk. That explains why participants consistently framed emerging risks as commercial opportunities or sources of competitive advantage. Several participants even described the downside of emerging risks as the risk of missing a potential business opportunity. That is in contrast to a view of risk held by managers in many industries that risk is the possibility of bad things happening devoid of opportunity (March & Shapira, 1987), as the chairman of COSO, an international risk management standards organization recently noted (Broughton, 2020).

The potential for an emerging risk to fundamentally affect a company's future and the wide range of uncertainty about its impact, likelihood, and timeframe make it necessary for organizations to develop information-processing mechanisms that transcend the cognitive limitations of individual managers when detecting trends and interpreting environmental cues (Corner et al., 1994; Daft & Weick, 1984). The strategic importance of these risks explains why participants told me about their emerging risk committees comprised of other senior executives as well as emerging risk task forces, which either included top managers or reported to top managers. These groups were the mechanisms by which strategic-level managers formulated their organization's interpretation of information about emerging risks. Many other people in the participants' organizations played a part in the scanning and processing of data, as described in my findings on inclusiveness and communication, but it was at the committee level that risk information was consolidated and interpreted.

Ganzin, Islam, and Suddaby's (2020) study about future-oriented sensemaking in an entrepreneurial setting where there is no past experience to call upon is germane to strategic long-term risks where a lack of historical data prevents reliable estimation of probabilities. In making sense of an uncertain future, organizations and individuals systematically reconstruct the past to create optimistic visions of the future that they can act upon (Ganzin et al., 2020; Gephart, Topal, & Zhang, 2010; Goretzki & Messner, 2016). Ganzin et al.'s (2020) entrepreneurs navigated uncertainty by constructing a positive image of the future to justify their entrepreneurial behavior; in lieu of past experience or past success, they relied on a spiritual orientation. My risk manager participants did not indicate any similar metaphysical orientation to justify the opportunities that their organizations perceived as inherent in emerging risks and I did not detect any obvious evidence of reconstructing the past in their stories. Instead, their faith lay in the collective judgment process to select an appropriate response to emerging risks, as discussed further below.

Inclusiveness in Assessing Emerging Risks

Most interviewees described the systematic collection of data and points of view about emerging risks from internal sources, such as employee surveys and working groups, and external sources, such as professional forums and publications. This scanning and gathering of risk cues from multiple sources and the inclusion of people with diverse interests and expertise in evaluating those cues allows for a more complex representation of the risks under consideration (Ocasio, 1997; Rerup, 2009).

The data indicate that including front-line executives in the risk evaluation process is critical because they possess unique information about the business

environment and contribute their own significant risk assessment skills to the collective evaluation of emerging risks. The findings show some evidence of tension between the opportunity-seeking, revenue-generating role of front-line executives and the harm-avoiding, control-focused role of a traditional risk management function, as previously noted by Power et al. (2017, 2013), Lim et al. (2017) and Mikes (2009) in their studies of financial institutions. However, unlike the previous research, my findings indicate that tension in the relationship is not prevalent. Many risk managers in the sample saw their role simply as a facilitator of the risk evaluation process rather than as a counterweight to challenge front-line executives. There are at least three possible explanations for this result.

First, the fact that some risk managers held concurrent quasi-front-line responsibilities such as strategic planning and product development highlights the difference between the banking and insurance sectors in the degree to which a strict three lines of defense model of risk management is applied. Regulatory evolution in the European and Asian insurance sector toward the stricter banking model to reduce potential conflicts of interest (EY, 2018) suggests that, if I was to replicate this study in the future, I might observe more tension between the risk management function and the underwriters.

Second, many of the risk managers in the sample were either former underwriters or had previously held an underwriting support role such as pricing actuary. Corner et al. (1994) imply that an executive team whose members have similar functional backgrounds will share similar beliefs and therefore attend to similar information and interpret it consistently. This sharing of meaning and mental models among risk

managers and front-line executives could help explain why so few participants told stories about explicitly challenging the views of other executives when evaluating emerging risks. Presumably, most risk managers already agreed with other executives or were easily persuaded about what risk information was relevant and deserving of attention, and what eventualities were "real." A third possibility, examined more fully below in relation to communication processes, is that risk managers are outnumbered in the collective risk evaluation process and therefore succumb to political pressure.

Communication in Assessing Emerging Risks

The participants described a process by which executives held regular meetings to build a consensus frame (Corner et al., 1994) and interpret information about emerging risks. Previous research has highlighted the important role of communication channels in funneling environmental cues and directing the limited attention of decision makers (Corner et al., 1994; Daft & Weick, 1984; Ocasio, 1997). The findings indicate the use of top-down, bottom-up, and lateral communication channels in evaluating emerging risks. Bottom-up communication adds breadth to the pool of risk data captured. In the top-down communication described by participants, I see evidence of sensegiving (Maitlis & Lawrence, 2007) as a way to educate the rank and file about the value of the risk assessment process and motivate them to be vigilant. Sensegiving is a component of sensemaking by which organizational actors influence the sensemaking of other organizational actors though the use of persuasive techniques including evocative language, symbols and images.

Sensegiving is also an essential element in lateral communication within groups of executives as they form their consensus views on emerging risks and opportunities.

Senior executives employ political tactics such as forming coalitions, cooption, and strategic use of information so that, ultimately, it is the most powerful decision makers that shape the consensus frame and determine decision outcomes (Corner et al., 1994; Eisenhardt & Zbaracki, 1992). Some risk managers in the sample spoke about holding back their true risk perceptions to conform with front-line executives' risk perceptions. This evidence, taken together with the limited number of stories about risk managers explicitly challenging the assumptions of other executives and together with the fact that risk managers typically occupy only one seat at the executive table, indicates a potential power imbalance between the risk management function and the front-line function when evaluating emerging risks. My conjecture is consistent with Lim et al. (2017), who found that revenue-generating functions in banking hold significantly more power than control functions by virtue of their greater status and product knowledge.

An important implication of this study is that, although risk managers may lack power in group decisions about emerging risks, their ability to pre-filter risk information wields enormous influence on the outcome of the consensus view. As facilitators of the risk assessment process, risk managers act as gatekeepers and perform some initial screening to distill data gathered during the scanning phase. To a large extent, they determine which risk information is attended to by risk committees and other executive teams, where it is then further filtered by the group consensus frame. If risk managers pre-filter risk information—either to conform with the risk perceptions of front-line executives or because they already share the same mental model of emerging risk (as noted in the discussion of inclusiveness above)—then the range of potential risks

attended to, interpretation of these risks, and alternative responses to these risks may be narrowed considerably.

Attempts to Measure Unmeasurable Emerging Risks

Although almost all of the participants' organizations used some method to rank emerging risks according to their importance, it was interesting to hear about the assortment of techniques from a simple scale of High, Medium, or Low to complicated weighting algorithms. Arena et al. (2010) observed a variety of approaches to risk measurement and reporting within ERM systems, including Likert scales, economic and financial measures, risk maps, scorecards, and key risk indicators. Some research indicates that popular scoring methods by which managers rate the likelihood and impact of various risks are useless (Bromiley et al., 2016; Hubbard, 2020) because individuals interpret qualitative descriptions differently and, therefore, use the scales differently. The data in this study indicate that most risk managers recognize the limitations of these methods but consider them reliable enough for prioritizing the scarce attention of executives (Gavetti et al., 2007).

The large range of uncertainty involved with emerging risks requires that executives engage in a process of plausibilization (Goretzki & Messner, 2016; Weick, 1995) to reach social agreement that risk rankings, scale ratings, and quantifications are sufficiently plausible to base decisions on them. My findings in this area support Goretzki and Messner's (2016) notion that "collectivization of judgment," which they observed in cross-functional production planning meetings, creates comfort for individuals in the meetings because responsibility for relying on numerical forecasts is shared among the group. Goretzki and Messner's (2016) insights were drawn from a qualitative case study

at a manufacturing company in which production and sales managers met each month to discuss sales forecasts for the following months. My findings extend this research by analyzing collective judgment in cross-functional planning much further into the future and with much more uncertainty.

Previous research has shown that individual managers are prone to several pervasive cognitive biases that can result in unrealizable plans and forecasts: e.g., unrealistic optimism, the illusion of control over events, and insensitivity to low probability estimates (Durand, 2003; Kahneman & Lovallo, 1993; March & Shapira, 1987). These individual cognitive limitations underscore the benefit of including multiple perspectives (Corner et al., 1994) when forming social agreement about risk rankings and risk measurements.

Constrained Action on Emerging Risks

Most interviewees framed emerging risks as business opportunities. For a risk to be insurable, it needs to be measurable. I found that the participants' organizations seemed to prioritize and act on partially emerged risks like cyber, which have evolved enough to be quantifiable in some fashion, and where there is a growing market, even though a great deal of uncertainty exists about potential claims. In contrast, I found some reluctance to act defensively on longer-term risks like climate change (for example, by excluding climate change liability risk from policies) or to seriously consider the effect of climate change because either nobody else in the market is doing so or because the polices can be repriced at a later date. The data indicate that there may be elements of rational behavior (responding to the market) and myopic behavior (the planning horizon is too short) involved in these responses. Souder and Bromiley (2012) summarize

evidence from previous research showing that most corporate managers, especially in the United States, have short temporal orientations, which lead their firms to trade off long-term performance for short-term results. Since strategic decisions about emerging risks are not made rationally but instead develop as the outcome of a collective sensemaking process applied to the information available for interpretation (Corner et al., 1994), it is possible that some of the stories I heard from risk managers reflect the outsized influence of short-sighted underwriting executives.

Limitations and Suggestions for Future Research

My findings and interpretation are subject to several limitations. First, by focusing on the insurance industry, the generalizability of some of the findings to other industries may be limited. On the one hand, because of the broad protection it provides to firms in all industries, the insurance industry as a whole is keenly aware of the entire spectrum of emerging risks. An insurance company is an extreme example of an organization focused on risk assessment and risk management. To the extent that all organizations have to manage risk and make sense of it, insurance companies are positioned especially well to make visible key processes that are hard to see in other organizations. However, on the other hand, because of the industry's specialized risk assessment skills and regulatory incentives, an insurance company's ability to evaluate and respond to emerging risks is unlikely to be replicated to the same degree in a non-financial firm. Even so, there is some likelihood that my interpretations of group dynamics during risk assessment (such as the interaction between risk managers and front-line business managers) will generalize to other industries. Future research should investigate how managers in non-financial organizations evaluate and respond to emerging risks.

A second limitation is the relatively small size of the sample. Although the seniority of participants and their depth of experience allowed me to elicit interesting and varied points of view, additional research using a larger sample size may provide different and important contributions to the research question.

Third, the study takes the perspective of risk managers who have only one voice in a collective risk assessment process. It is possible that including underwriting managers and other managerial decision makers in the study would have provided new or different insights into the process of evaluating emerging risks in the insurance industry. Future research should consider a group of participants representing several functional areas within the organization.

Finally, the participants' organizations ranged in size from revenues in the hundreds of millions of dollars with less than one hundred employees to revenues in the tens of billions of dollars with tens of thousands of employees. Although my findings acknowledge the influence of a firm's size and access to resources on its process of evaluating emerging risks, I did not thoroughly investigate this variation. Future research should consider the contingent effect of firm size on the assessment of emerging risks.

Conclusion

Managers in most firms struggle to integrate risk management processes with business planning and decision-making. One reason for the difficulty is the presence of emerging societal, technological, and environmental risks, which are complex and hard to predict. The study finds that these risks represent strategic risks to the insurance industry. Inclusiveness and communication are therefore important in evaluating these risks. However, there is little evidence of the professional tension that I expected between risk

managers and the front line. Also, some risk managers pre-filter communication to focus on risks that front-line executives consider to be “relevant” and “real,” even if the risk managers worry about longer-term risks.

Further filtering and prioritizing of emerging risks is achieved by a collective risk ranking process using judgmental qualitative measurement scales because there is little data and no credible method of quantifying the risks. However, in the case of emerging risks that have partially emerged as a material present-day commercial threat or opportunity, business decision makers consider them “real” enough to attempt to quantify them and take some kind of action, using quantification methods that are more art than science. The study contributes to the literature on ERM by applying a broad management perspective, sensemaking, to a topic that has so far been studied primarily by accounting and finance scholars through the lenses of agency theory and institutional theory. The study’s main practical contribution is the observation that, when evaluating and making decisions about complex emerging risks, organizations must strike a balance between the contributions of front-line business experts and the contributions of other participants who have less market expertise but also have fewer direct commercial incentives.

CHAPTER 3: STUDY 2: THE EFFECT OF RISK FRAMING AND SHARED SOCIAL IDENTITY ON RISK MANAGERS' JUDGMENT

Introduction

Today's risk managers must navigate conflicting imperatives. On the one hand, they must be willing to challenge decision-making that does not consider the full downside potential of "non-existent yet possible events" (Power, 2013: 530). On the other hand, they aspire to be trusted business partners—not just rule-enforcers and nay-sayers—who help achieve commercial objectives, including identifying and assessing risk where it represents strategic opportunity (Deloitte, 2021; EY, 2017; Mikes, 2010).

Influential risk management bodies argue that enterprise-wide risk management (ERM) ought to evolve from its traditional focus on threats to become as much about taking strategic risks as avoiding them (Broughton, 2020; Fox, 2018). Nevertheless, research and consulting surveys continue to show that firms have difficulty actually integrating their ERM programs with their strategic planning (Bromiley et al., 2015; Deloitte, 2013; Ittner & Michels, 2017; Marsh & McLennan, 2018; Viscelli et al., 2017). Part of the difficulty is because strategic risks are often emergent and ambiguous (Bromiley et al., 2016). These risks are not captured well by traditional ERM programs since they manifest over uncertain timeframes, and their lack of historical precedent makes it difficult to estimate their impact (Allan et al., 2013; Borsa et al., 2014).

There is an ongoing debate among practitioners about how best to configure the roles of business managers and risk managers in order to improve the integration of ERM and business strategy while preserving appropriate amounts of independence and objectivity among risk managers (Chambers, 2013; COSO, 2020; Institute of Internal Auditors, 2020; Lim et al., 2017; McCafferty, 2019; Mont, 2015; Parliamentary

Commission on Banking Standards, 2013). A completely independent risk management unit may become so detached from the business that its contributions to complex strategic discussions are minimal, and its ability to evaluate strategic risks is compromised. At the other extreme, too little separation of the risk management unit from the business can introduce conflicts of interest and the possibility of capture (Power et al., 2013; PwC, 2018b, 2018a).

While much of the debate concerns a proper degree of separation between business managers' responsibilities and those of risk managers, an important related consideration is the suitability of a risk manager's functional background in relation to the business unit being evaluated. The professionalization of risk management is at an early stage (Arena et al., 2010; Mikes, 2011), and there is no standard functional background. The field has been called "a canvas with a host of aspiring artists" (Hayne & Free, 2014: 312). Multiple actors have staked a claim, including accounting professionals (Hayne & Free, 2014) because of their expertise in internal control, actuaries[3] (Tripp et al., 2008) because of their statistical training, and professional risk management associations such as the Risk and Insurance Management Society (RIMS) and the Institute of Risk Management (IRM), both of which were born of the corporate insurance purchasing function. A recent survey of Chief Risk Officers in the European insurance industry revealed that 45% had actuarial backgrounds, 15% came from accounting, and the remainder comprised multiple other backgrounds including insurance underwriting (EY, 2019). To increase the amount of real business understanding among their risk

[3] In 2009, 14 actuarial organizations from around the world collaborated to introduce a new qualification in ERM, the Chartered Enterprise Risk Actuary (CERA). As of 2020, there were over 5,500 actuaries with the CERA designation. https://ceraglobal.org/about

management teams, the survey respondents planned to hire from within their firms through active internal recruitment. So, there is reason to expect an increase in the proportion of risk managers who have a functional background like the business unit managers they evaluate.

Whichever configuration of roles and functional backgrounds an organization chooses for risk management, it must balance tensions between the opportunity-seeking, revenue-generating incentives of front-line executives and the harm-avoiding, control focus of a traditional risk management unit (Financial Conduct Authority (UK), 2013) which forms a second line in the ubiquitous Three Lines of Defense model (COSO, 2015) of risk management. Furthermore, as acknowledged in ERM guidance (COSO, 2017, 2018), an organization should also be aware of potential judgment biases introduced when a risk is framed to focus on either the potential upside or downside.

This study aims to understand whether it matters how managers organize themselves to respond to the inherent threats and opportunities of ambiguous emergent risks and whether the positive nature of an opportunity affects the way its risk is evaluated. The problem is important because it has implications for organizational resilience and for the effectiveness of the risk management function. I examine the problem by conducting an experimental study to determine whether the following factors affect a risk manager's objectivity when evaluating an ambiguous risk: similarity of the risk manager's functional background to the business unit and positive versus negative framing of the risk.

Previous social psychology research has shown that individuals behave favorably towards groups with which they feel a strong affiliation (Hogg & Terry, 2000; Mael &

Ashforth, 1992; O'Reilly, Chatman, & Caldwell, 1991). Previous research on decision making has also shown that contextual features like how information is delivered (e.g., face-to-face or in writing, or framed positively or negatively) can affect how individual judgments are formed (Chaiken, 1980; Kahneman & Tversky, 1979; Levin et al., 1998; Petty & Cacioppo, 1986). For my hypotheses in this study, I rely on social identity theory (SIT) and previous research on information framing biases. Specifically, SIT (Ashforth & Mael, 1989; Tajfel & Turner, 1985) suggests that, because of a shared functional background, risk managers who feel a strong group affiliation with the business unit managers they evaluate will be less objective in their risk judgments. Research on attribute framing biases (Levin et al., 1998) suggests that risk managers will be less objective when an ambiguous risk is framed as an opportunity than when it is framed as a threat. As a research question, I also consider whether the framing bias moderates the social identity bias (i.e., they interact).

In the experiment, I manipulated risk manager functional background (same as/different from business unit) and risk frame (upside/downside) between-subjects to test my predictions about risk managers' objectivity. I also tested whether shared social identity acts as a mediating variable between functional background and objectivity. Participants were 115 financial professionals recruited through the Qualtrics panel service, and more than 80% of them assessed risk as part of their daily work. Consistent with my prediction, I found that participants evaluate the positively framed risk less objectively. I also found that higher shared social identity is associated with lower objectivity, although, contrary to my prediction, the relationship is not dependent on a shared functional background. In response to my research question, I found that risk

framing does not moderate the effect of shared social identity on a risk manager's objectivity.

This paper contributes to the ERM literature and practice in several ways. First, it responds to calls for more research on the extent to which risk is a downside-only concept and on the seemingly elusive link between ERM and strategy (Viscelli et al., 2017; Bromiley et al., 2015). Second, it confirms that the biasing effects of frame and social identity, which have been observed in auditors (Bamber & Iyer, 2007; Bauer, 2015; Stefaniak et al., 2012; Mock & Fukukawa, 2016; Fukukawa & Mock, 2011) attempting to objectively evaluate the work of other actors, carry over to a risk management context in which risk managers evaluate the risk judgment of business unit managers. The findings should remind organizations that any enthusiasm they have for an ERM configuration in which risk managers are visionary champions of opportunity (Deloitte, 2021; PwC, 2018a) should be tempered by a healthy appreciation of worst-case scenarios. Organizations should also be wary of the potential negative influence of group affiliation. Internal risk management policies and training that make values like objectivity salient may help as a safeguard (Bauer, 2015; Burt & Libby, 2021). Finally, if functional background does not produce bias, as the findings suggest, then organizations may benefit from staffing their risk management units with former business unit managers who have the knowledge and experience to form competent judgments about complex strategic risks.

The remainder of the paper is organized as follows. In the next section, I review related literature and develop hypotheses. I then describe my experimental design and

method in the third section and summarize my results in the fourth section. Implications of my study for research and practice are outlined in the fifth section.

Background and Hypothesis Development

ERM in Context

ERM is a holistic, coordinated approach to managing an organization's significant risk exposures. By managing the enterprise's risks as a portfolio rather than individually, managers attempt to optimize risk-return trade-offs (Nocco & Stulz, 2006) and thereby make the achievement of business objectives more likely (COSO, 2017). Interest in implementing ERM as a form of risk governance has grown rapidly since the U.S. Sarbanes-Oxley Act of 2002 and the subsequent global financial crisis, with regulators, rating agencies, stock exchanges, professional associations, international standards organizations, and consulting firms promoting ERM adoption (Arena et al., 2010; Lundqvist, 2015; Bromiley et al., 2015).

In many industries, such as banking, insurance, energy, utilities, healthcare, and mining, the centralization of an organization's risk management processes often results in the appointment of a Chief Risk Officer (CRO) to oversee ERM (Mikes, 2010; Pagach & Warr, 2011). The typical CRO role in a financial services company leads a risk management unit that is mainly responsible for independent oversight of risk-taking activities across the organization. The unit acts as the second line of defense in a Three Lines of Defense model of risk governance which has become orthodoxy in the thinking of financial services regulators and advisors. The first line of defense is the business line manager, who owns the risk and related controls. The second line of defense is a central risk management unit that monitors and advises on risk policy, and the third line is

internal audit (COSO, 2015; Deloitte, 2018; Lim et al., 2017). Contemporary ERM guidance expects risk managers to be sufficiently independent of business managers and other functions so as to provide an objective (i.e., unbiased) perspective on strategies and potential risk issues (COSO, 2017, Appendix C; IAIS, 2019, 2021a).

The Effect of Group Membership: Social Identity Theory

Understanding a risk manager's group affiliation may help to explain his or her risk management behavior. SIT suggests that an individual's self-concept is partly derived from membership in certain social groups (Ashforth & Mael, 1989; Tajfel & Turner, 1985). Once individuals are psychologically attached to a group, they have difficulty being objective when evaluating information related to the group (Brewer, 1999). They are less likely to disagree with questionable group behavior and more likely to give the group the benefit of the doubt. In a recent qualitative study (Gletsu, 2020), I found that risk managers did not challenge the opinions of front-line business managers as vigorously as their job description suggested they should, possibly because of shared mental models and shared meanings among risk managers and front-line executives. These shared perspectives and social identities can arise from a common history in the form of professional education or functional background (Ashforth & Mael, 1989; Corner et al., 1994; Randel & Jaussi, 2003).

There is widespread support for the effect of social identification on individual behavior (Hogg & Terry, 2000; Mael & Ashforth, 1992; O'Reilly et al., 1991), including professional auditors, who resemble risk managers in their efforts to objectively evaluate the work of other professionals. Holding economic incentives constant, *external* auditors who identify more highly with their clients exhibit greater leniency (i.e., less objectivity)

when evaluating accounting and internal control issues (Bamber & Iyer, 2007; Bauer, 2015; Bhattacharjee & Owen Brown, 2018; Kachelmeier & Van Landuyt, 2017; Stefaniak et al., 2012). Interestingly, in *internal* auditors, the opposite effect has been demonstrated. Internal auditors who identify more highly with their employer are less lenient (i.e., more objective) in their control evaluation, arguably because those with greater company identification are more willing to preserve the firm's long-term interests by assessing controls more strictly (Stefaniak et al., 2012). For both internal and external auditors, increasing the salience of professional identity by highlighting professional values such as independence and objectivity has been shown to increase the objectivity of their control evaluations (Bauer, 2015; Burt & Libby, 2021).

Risk managers with a functional background very similar to those in a business unit that they evaluate and advise may see themselves as part of the same team as the business unit and develop strong social bonds. SIT suggests this group affiliation will result in less objective risk manager judgments (e.g., weaker challenges to a business unit manager's self-assessment of risk) even though leniency is harmful to the firm. This reasoning leads me to the following hypothesis:

> *Hypothesis 1. Risk managers with functional backgrounds more (less) like the front line will feel more (less) of a shared social identity with the front line and, therefore, will be less (more) likely to challenge a front-line manager's assessment of an emerging risk.*

The Effect of Positive or Negative Framing: Attribute-framing Bias

Risk includes the possibility of uncertain events with a potentially positive effect on the organization (i.e., opportunities) not being captured or not materializing (Chambers, 2013; COSO, 2017, 2018). In Gletsu (2020), I found that many insurance industry risk managers were enthusiastic about the strategic opportunities inherent in

ambiguous emerging trends like cybercrime, which are typically viewed as threats and approached defensively in other industries. They shared the perspective that risk management should contribute to the avoidance of threats but also to maximizing an organization's potential to harness upside risk.

Emphasizing either the upside or the downside of a risk is a form of information framing (i.e., using different words to describe identical situations) that relies on the valence of critical information. Valence framing effects were most closely associated with prospect theory (Kahneman & Tversky, 1979) until Levin, Schneider, and Gaeth (1998) helped to organize the framing literature by delineating three types of framing effects that can influence decision making: attribute framing, risky-choice framing, and goal framing. In attribute framing, some characteristic of an object or event is framed, and the framing affects evaluations of the characteristic. Risky-choice framing was introduced by Kahneman and Tversky (1979) and is the form most often associated with the term "framing." It involves a choice among a set of options with different risk levels, and the framing affects the choice. In goal framing, the goal or consequence of an action or behavior is framed, and the framing affects the persuasiveness of a communication.

Attribute framing is the simplest form of framing because the dependent measure of interest is an evaluation of complementary options (e.g., 50% success rate versus 50% failure rate) rather than a choice between independent options (Levin et al., 1998). Attribute framing bias (AFB) refers to the evaluation of a positively framed circumstance more favorably than the identical circumstance framed negatively. AFB is thought to be a type of confirmation bias that occurs when the positive (negative) labeling of an attribute evokes selective attention and cognitive search mechanisms that call up favorable

(unfavorable) associations in memory (Levin et al., 1998). These favorable (unfavorable) associations make an evaluation more favorable (unfavorable) than it otherwise would be.

Framing biases have been examined in research on auditors' risk assessments (Chang, Yen, & Duh, 2002; Fukukawa & Mock, 2011; Kotchetova & Salterio, 2008; Mock & Fukukawa, 2016). Fukukawa and Mock tested AFB in experimental studies and found that auditors were more risk-sensitive and exhibited a higher level of professional skepticism when an assertion being audited was stated in a negative way than when it was stated in a positive way (Fukukawa & Mock, 2011; Mock & Fukukawa, 2016). Therefore, it is plausible that risk managers will judge a risk exposure to be different when it is perceived as a potential lost opportunity (positive framing) than when it is perceived as a potential adverse event (negative framing).

AFB suggests that when evaluating ambiguous emerging risks, risk managers will perform less critical evaluations of front-line manager self-assessments when a risk is framed as an opportunity than when it is framed as a threat. This reasoning leads me to the following hypothesis:

> *Hypothesis 2. Positive (negative) framing of an emerging risk will reduce (increase) a risk manager's inclination to challenge front-line management's risk assessment.*

Interaction of Shared Social Identity and Attribute-framing Bias

Although previous research (Lim et al., 2017; Palermo et al., 2017) indicates that a risk manager's objectivity may be affected by organizational structure and reporting lines, I am not aware of any research demonstrating whether (and if so, how and why) a judgment bias arising from shared social identity interacts with a framing bias introduced when a risk represents an opportunity instead of a threat. If positive affective associations

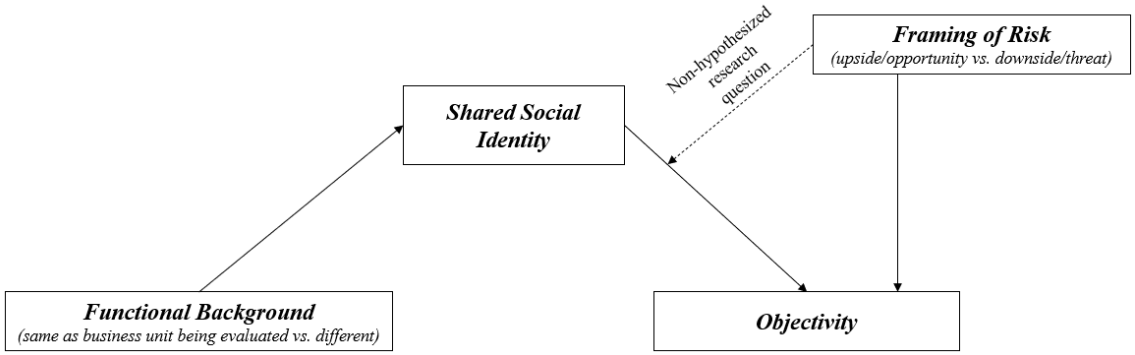
are selectively retrieved from memory when confronted with a positively framed risk (Levin et al., 1998), it seems logical that the ensuing positive evaluation could be more pronounced when perceptions of shared social identity are greater. This reasoning leads me to the following research question:

> *RQ: Does the effect of feelings of shared social identity on a risk manager's inclination to challenge front-line management's risk assessment depend on the positive or negative framing of the risk?*

Experimental Method and Design

Figure 9 illustrates the conceptual relationships between risk manager objectivity, functional background, shared social identity, and risk framing, which are tested in this experiment.

FIGURE 9
Effect of Risk Framing and Risk Manager Functional Background on Risk Manager Objectivity



Design

I performed a 2x2 between-subjects experiment with risk manager objectivity as the dependent variable. I manipulated the risk manager's functional background (same functional background as the people in the business unit being evaluated versus different) and the framing of the risk (upside/opportunity versus downside/threat). I predicted that

the similarity of a risk manager's functional background to the business unit being evaluated would result in less objectivity because of higher shared social identity and that the degree to which objectivity is compromised would be higher for a positively framed risk.

Participants

The participants were 115 numerate financial professionals recruited though the Qualtrics panel service. Most participants worked in either Banking (27.8%), Investment Services (24.3%), or Accounting Firms (13.9%), and all had at least a bachelor's degree and at least five years of business experience. A total of 81.7% of the participants assessed risk as part of their daily work, and all participants either prepared or interpreted quantitative analysis regularly. Additional information about the sample can be found in Table 4.

I conducted the experiment electronically using a Qualtrics survey instrument distributed by the panel service. The instrument is reproduced in Appendix B. The survey tool randomly assigned participants to one of four treatment conditions. One hundred forty-three (143) people passed demographic screening questions and a multiple-choice question, which checked whether they were paying attention to the survey instructions. Of the 143 completed responses, I eliminated 28 people who provided nonsensical answers to a free-form question in the survey because their answers indicated a lack of attention to the experimental task. Hence, my final sample is 115 professionals. The task took final participants an average (standard deviation) of 9.86 (21.69) minutes to complete, and completion times ranged from two to 193 minutes. Although 27 (23.5%) of the 115 final participants completed the task in less than three minutes, their answers to

the free-form question indicated that they gave adequate attention to the task. The practical and statistical significance of the experimental results are unaffected by excluding these 27 participants.

TABLE 4
Participant Profile (*N* = 115)

	Count	Frequency		Count	Frequency
Gender			**Industry**		
Male	83	72.2%	Accounting Firms	16	13.9%
Female	32	27.8%	Banking	32	27.8%
			Credit Card Company	2	1.7%
Age			Credit Unions	3	2.6%
18–27	10	8.7%	Insurance	8	7.0%
28–37	47	40.9%	Investment Services	28	24.3%
38–47	39	33.9%	Other Financial Services	13	11.3%
48–57	15	13.0%	Private Equity	7	6.1%
> 57	4	3.5%	Stock Brokerage	3	2.6%
			Venture Capital	3	2.6%
Years of Experience			**Education**		
6–10	35	30.4%	Bachelor's degree	51	44.4%
11–15	41	35.7%	Master's degree	55	47.8%
16–20	16	13.9%	Doctoral degree	9	7.8%
> 20	23	20.0%			

Experimental Task

Participants were asked to assume the role of Pat, the Chief Risk Officer at XYZ Indemnity Corp. (XYZ), a hypothetical insurance company. The experimental instrument described the role of the risk management team overseen by Pat and highlighted the team's responsibility to challenge whether business unit managers have adequately considered all relevant risks to their business. This was followed by a description of Pat's

functional background (Hypotheses 1, the RQ, and "functional background" discussed below under Independent Variables). The participants then read a scenario in which an underwriting executive in charge of XYZ's Specialty business unit proposes a new cyber insurance product to protect clients against damages that are the direct result of a data breach or cyber-attack. The scenario described the uncertainty surrounding the Specialty executive's new cyber insurance business plan in either positive or negative terms, in the same way that a glass of water could be described as either half full or half empty (Hypotheses 2, the RQ, and the "frame" discussed below under Independent Variables).

After reading the scenario, participants answered a set of questions designed to measure their likelihood of recommending approval for the Specialty business unit's risky cyber insurance business plan (discussed below under Dependent Variable). Participants also responded to questions checking the effectiveness of experimental manipulations as well as a set of questions measuring the extent to which they thought Pat identified with XYZ business unit executives (discussed below under Mediating Variable). The instrument concluded with demographic questions.

I developed the experimental scenarios based on insurance industry trade publications, my experience in the industry, and discussions held with risk management professionals as part of another research project (Gletsu, 2020). Two professional accountants with extensive insurance industry experience tested an early version of the instrument and provided comments. I then conducted a pilot test on a different sample of 84 Qualtrics panelists and made additional modifications to finalize the instrument.

Independent Variables

Functional background. I manipulated the functional background of Pat, the Chief Risk Officer, between participants. Pat had either a functional background that was different (internal audit) from the business unit (underwriters) being evaluated or the same functional background as the business unit (i.e., shared underwriting backgrounds)

Frame. I manipulated the way in which risk was framed between participants by emphasizing the positive or negative aspects of uncertainty in XYZ's cyber business plan. The positive (*negative*) frame read:

> "Discussions among the executive team have focused on the following three things:
>
> (1) [If / *Even if*] XYZ enters cyber now, it [could / *might not*] capture enough market share before competitors pile in. It [could also / *also might not*] learn and adapt [quickly / *quickly enough*] as it gains experience with cyber risks.
>
> (2) Premiums can't be set using traditional actuarial methods because there isn't enough historical cyber claims data. Instead, Morgan's underwriters must price the business by developing a catalogue of [analogous / *hypothetical*] claims scenarios in place of [historic / *real*] data. And since premiums are set annually, they [can always be adjusted / *can't be adjusted until*] next year if XYZ gets them wrong.
>
> (3) In a worst-case loss scenario XYZ would [still have 95% / *lose 5%*] of its equity capital, which is a significant amount."

Mediating Variable: Shared Social Identity

Social identity can be defined as an individual's psychological attachment to a group (Tajfel & Turner, 1985). Participants assessed the group affiliation that Pat, the Chief Risk Officer, felt for the business units by responding to a three-item scale adapted from Tropp and Wright (2001). Participants were asked about the degree to which Pat (a) feels strong ties to the business units, (b) sees self as a member of the business units, and

(c) identifies with the business units. Responses to these items ranged from 1 = "strongly disagree" to 7 = "strongly agree."

Dependent Variable: Objectivity

I define a risk manager's objectivity as his or her propensity to challenge a business unit manager's risk self-assessment. I operationalized objectivity as the likelihood that Pat recommends approval of a risky cyber-insurance business plan proposed by Morgan, the underwriting executive in charge of XYZ's Specialty insurance business unit. A lower likelihood of recommending the plan's approval is evidence of higher objectivity.[4] I first asked participants to answer "yes" or "no" to whether they though Pat would recommend implementing Morgan's cyber insurance business plan. Then, I measured objectivity by asking, "How confident are you that Pat will recommend implementing Morgan's cyber insurance business plan?" Participants indicated their response on a 101-point sliding scale anchored with 0 = "certainly won't" and 100 = "certainly will." I scored the response reversely by subtracting it from 100 so that, for example, a response of 95 became an objectivity score of 5, and a response of 5 became an objectivity score of 95. Lastly, participants were asked to write down which factors Pat would consider when deciding what to do. A free-form response to this question was required to continue with the instrument.

[4] This measure of objectivity assumes that disagreement with a business unit manager is evidence of objectivity. It is a crude measure since in practice a business unit manager's risk assessment will often be credible, and an objective (i.e., unbiased) risk manager will agree. Nonetheless, the measure is adequate for this study because it indicates the inclination of a risk manager to agree with a business manager when there is limited and ambiguous information about the risk. It is also consistent with how Hoos et al. (2018) measure objectivity in an experiment with internal auditors.

Covariates

To help isolate the effects of my hypothesized relationships, I measured three demographic variables that are not of specific interest to this study but are thought to be associated with individual risk perceptions. These control variables are age, gender, and years of experience (Bodnar, Giambona, Graham, & Harvey, 2019; Graham, Harvey, & Puri, 2013). Age and years of experience were coded as ordinal variables (see Table 4 for ordinal categories).

Results

Univariate Data Screening

There were no missing data in the 115 survey responses available for analysis. I tested the assumption of normality by evaluating the skewness and kurtosis of the ordinal, interval, and continuous variables included in the study. All variables exhibited acceptable skewness and kurtosis between +/- 2.2 based on recommended thresholds (Sposito, Hand, & Skarpness, 1983). However, three observations of the dependent variable are potentially influential outliers because their standardized values exceed +/- 3.0 (Hair, Black, Babin, & Anderson, 2019). I address these outliers in the tests of hypotheses below. Apart from the outliers, there do not appear to be any issues with the data that violate the statistical assumptions required to test my hypotheses.

Manipulation Checks

Manipulation checks indicated that both the Frame and Functional Background manipulations were ineffective. However, the results of hypothesis tests suggest that they may have been somewhat effective.[5]

[5] See Discussion section for discussion of potential threat to internal validity.

To check the Frame manipulation (positive/opportunity versus negative/threat), participants were asked the extent to which they agreed with three statements measured on a 7-point scale ranging from 1 = "strongly disagree" to 7 = "strongly agree": (a) cyber risk is an overall positive thing for XYZ; (b) cyber insurance is a good business opportunity for XYZ; and (c) XYZ should be worried about entering the cyber insurance market (reverse coded).[6] I then calculated the mean score of the three items for each participant. The overall mean score for participants in the positive frame condition was 5.01 (*SD* = 0.95). The overall mean score for participants in the negative frame condition was 4.91 (*SD* = 28.67). Although the mean score in the positive frame condition is higher, suggesting successful manipulation, an independent sample t-test showed that the scores do not differ significantly between the two groups ($t = 0.51$, $p = 0.614$). The evident failure of this manipulation is surprising because a similar manipulation in the pilot sample was successful, and, in this study, the effect of Frame on Objectivity is significant (see Table 7 below).

To check the Functional Background manipulation (same background as business unit versus different background), I used the same three items which measure the Shared Social Identity mediator variable (Hauser, Ellsworth, & Gonzalez, 2018) and calculated the mean score of the three items for each participant. The overall mean score for participants in the same-background condition was 5.77 (SD=1.13). The overall mean score for participants in the different-background condition was 6.02 (SD=0.87).

[6] In the pilot study, these three items were also intended to measure "affective association" as a potential mediating variable between Frame and Objectivity. However, exploratory factor analysis on pilot data showed that the items did not load well on a common factor, so the mediator was not hypothesized in this study.

Although a lower mean score for the same-background condition is the opposite of the manipulation's intended outcome, an independent sample t-test showed that the scores do not differ significantly between the two groups (t = -1.31, p = 0.19). On the one hand, the apparent failure of this manipulation is not surprising because the pilot study unsuccessfully employed a similar manipulation to trigger social identity, and modifications in this study that were intended to make the manipulation more effective were not piloted due to time and cost constraints. On the other hand, it is surprising that the instrument still generated enough variation in shared social identity between participants that the effect of Shared Social Identity on Objectivity is significant (see Table 8 in the supplemental analysis section below).

Descriptive Statistics

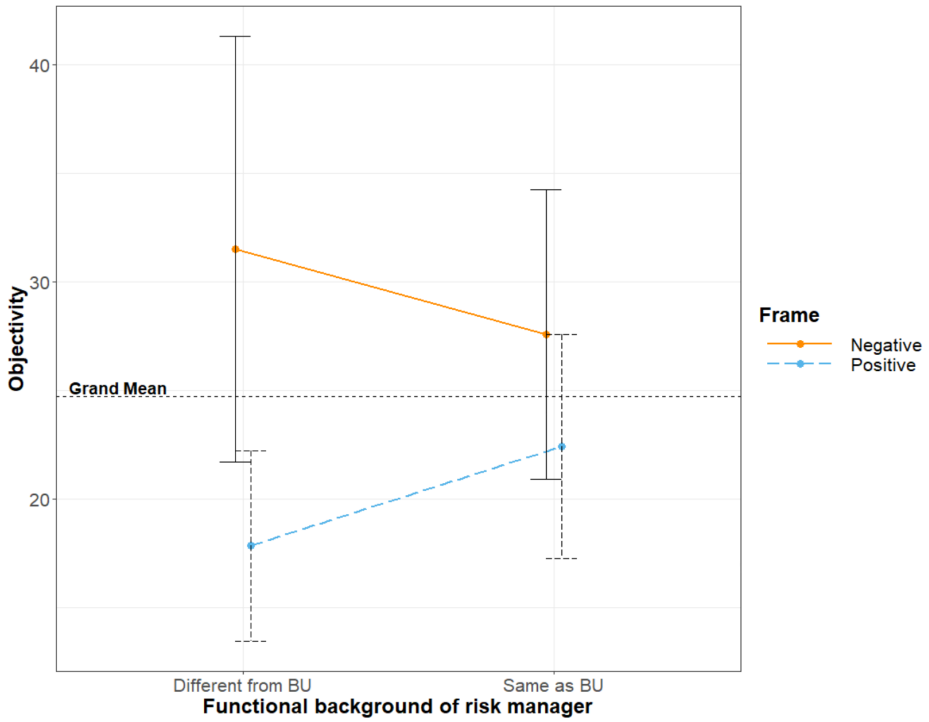
Descriptive statistics for the risk manager's objectivity (higher score = higher objectivity) are tabulated in Table 5 and shown graphically in Figure 10. The table and the figure show the following distribution of means: 31.67 in the negative-frame/different-background cell, 17.43 in the positive-frame/different-background cell, 27.68 in the negative-frame/same-background cell, and 22.52 in the positive-frame/same-background cell. Subject to the inferential tests which follow in the next section, these descriptive statistics suggest that participants in the downside scenario were more objective than participants in the upside scenario, and that participants in the different-background scenario were no more or less objective than participants in the same-background scenarios.

TABLE 5
Cell Means (Standard Deviation) for Risk Managers' Objectivity Across Treatment Conditions

	Different Background	Same Background	Main Effect: Frame
Negative Frame	31.67	27.68	29.68
	(3.36)	(3.38)	(2.36)
	$n = 28$	$n = 28$	$n = 56$
Positive Frame	17.43	22.52	19.98
	(3.30)	(3.24)	(2.30)
	$n = 29$	$n = 30$	$n = 59$
Main Effect: Background	24.55	25.10	24.82
	(2.33)	(2.31)	(1.64)
	$n = 57$	$n = 58$	$n = 115$

Cell means represent a reverse-scoring of participant responses to the question, "How confident are you that Pat will recommend implementing Morgan's cyber insurance business plan?" Participants indicated their response on a sliding scale from 0 to 100, anchored with "Certainly Won't" and "Certainly Will." The response was scored reversely by subtracting it from 100 so that, for example, a response of 95 became a score of 5.

FIGURE 10
Graphical Illustration of Mean Objectivity in the Sample (with 95% Confidence Intervals)



Tests of Hypotheses and Research Question

Using IBM SPSS version 28, I conducted a 2x2 factorial ANOVA to test differences in average objectivity between the experimental groups as hypothesized in H1 and H2 and set out in the RQ. Table 6 summarizes the test results. ANOVA results are presented in Table 7. Control variables (gender, age, and experience) are not included in the model, but including them does not change the practical or statistical significance of the results (untabulated).[7]

Levene's test for homogeneity of variance indicated that the assumption of equal variances in the four conditions was not met ($F_{3,111} = 2.72$, $p = .048$). This violation appears to be the result of three outliers noted in the univariate data screening subsection above, which all happen to be in the same treatment group (Different Background/Downside Frame). Based on the analysis in the following paragraph, I conclude that the ANOVA results in Table 7 are robust to this violation of the assumption of equal variance.

To determine the severity of the violation, I conducted the 2x2 ANOVA with and without the outliers. After removing the outliers, Levene's test indicated that the assumption of equal variances in the four conditions was met ($F_{3,108} = 0.86$, $p = .466$). Untabulated results of the ANOVA without outliers are inferentially similar to the results in Table 7, which include the outliers. I also conducted Welch's ANOVA with the four treatment groups, including outliers, and compared its results with those of the classic

[7] Additionally, in untabulated analyses, I conducted three separate one-way ANCOVAs (one for each control variable) which included an interaction between the control variable and the treatment (comprising four treatment groups). None of the interaction terms was significant, which suggests that any significant differences in mean Objectivity between the treatment groups are not attributable to the covariates.

one-way ANOVA, including outliers. The Welch ANOVA is more robust to violations of the assumption of equal variances than a classic one-way ANOVA. Welch's ANOVA indicated significant between-groups variation ($F_{3,59.48} = 3.48$, $p = .021$), consistent with the classic one-way ANOVA ($F_{3,114} = 3.27$, $p = .024$).

TABLE 6
Results of Hypotheses Testing and Research Question

Hypotheses and Research Question	Supported
H1: *Risk managers with functional backgrounds more (less) like the front line will feel more (less) of a shared social identity with the front line and, therefore, will be less (more) likely to challenge a front-line manager's assessment of an emerging risk.*	No*
H2: *Positive (negative) framing of an emerging risk will reduce (increase) a risk manager's inclination to challenge front-line management's risk assessment.*	Yes
RQ: *Does the effect of feelings of shared social identity on a risk manager's inclination to challenge front-line management's risk assessment depend on the positive or negative framing of the risk?*	No

*H1 had partial support in the form of a significant negative relationship between shared social identity and a risk manager's propensity to challenge a front-line manager's risk assessment.

Test of Hypothesis 1. H1 predicts that a risk manager is less objective when they feel more of a shared identity with the business unit and that this shared identity will result from the risk manager and business unit employees having similar functional backgrounds. The main effect of Functional Background is not significant ($F_{1,111} = 0.01$, p = 0.922); therefore, the data do not appear to support H1. Since H1 predicts mediation through Shared Social Identity, and since my ANOVA results indicate that the total effect of Functional Background on Objectivity is not significant, I can conclude that Shared Social Identity does not fully mediate the relationship (Zhao, Lynch, & Chen, 2010).

Supplemental analysis in the next section tests for the possibility that the non-significant result for H1 decomposes into significant but offsetting direct and indirect effects, which Zhao et al. (2010) refer to as competitive mediation. Results of the supplemental analysis show that Shared Social Identity is not a mediator, but it does have a significant negative effect on Objectivity, as predicted by H1.

Test of Hypothesis 2. H2 predicts that the positive framing of a risk will negatively affect a risk manager's Objectivity. The main effect of Frame is significant ($F_{1,111} = 8.19$, $p = 0.005$); therefore, the data are consistent with my hypothesis.

Research question. The RQ asks whether there is an interaction between the effects of social identity and frame on a risk manager's objectivity. My ANOVA tests the interaction of Functional Background and Frame because Shared Social Identity was not measured directly and because H1 predicted that shared functional background increases shared social identity. The interaction is not significant ($F_{1,111} = 1.67$, $p = 0.199$); therefore, the ANOVA results do not provide evidence that the effect of Shared Social Identity on Objectivity is moderated by Frame.

I performed an alternate and more direct test of the interaction (test of moderated mediation) as a supplemental analysis below. The supplemental analysis results also suggest no significant interaction between Shared Social Identity and Frame.

TABLE 7
ANOVA Summary Table for Risk Managers' Objectivity

	SS	*df*	MS	*F*	*p*-value
Functional Background	2.98	1	2.98	0.010	0.922
Frame	2,550.12	1	2,550.12	8.190	0.005
Functional Background * Frame	518.99	1	518.99	1.667	0.199
Error	34,563.20	111	311.38		
Total	107,901.00	115			

R-squared = 0.081, Adjusted *R*-squared = 0.056. All *p*-values are one-tailed.

Supplemental Analyses

Shared social identity as a mediator. I performed supplemental analysis to evaluate the mediating effect of Shared Social Identity hypothesized in H1. First, I averaged the three items measuring Shared Social Identity because they had a Cronbach's alpha reliability measure of 0.86, which implies that they adequately measure the same construct (Nunnally, 1978). Then, I used the Hayes (2022) PROCESS macro for SPSS, configured for Model 4, and employed the Preacher and Hayes (2008) bootstrapping approach to test the indirect effect of Functional Background on Objectivity through Shared Social Identity.[8]

Table 8 presents coefficients and standard errors from the results of two Ordinary Least Squares (OLS) regressions, which comprise the mediation model, both conducted using the PROCESS tool. Figure 11 is a graphical representation of the mediation model depicting the paths between the variables and the estimated path coefficients.

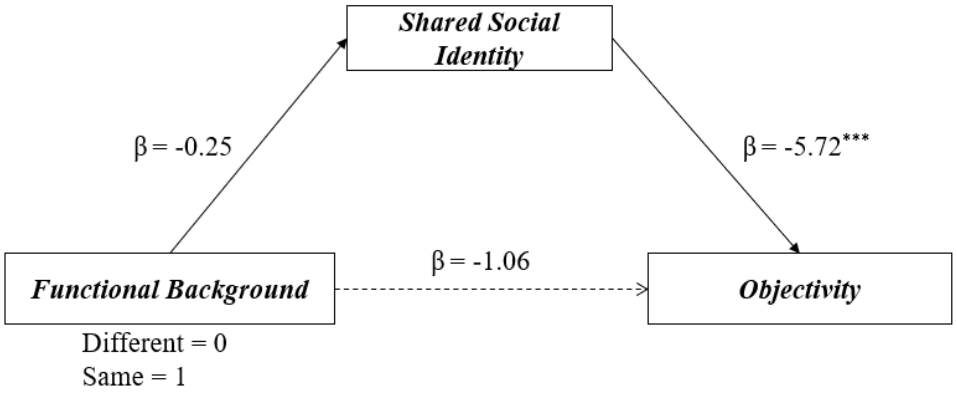
[8] Control variables (gender, age, and experience) are not included in the model but including them does not change the practical or statistical significance of the results (untabulated).

TABLE 8
OLS Regression Coefficients (Standard Errors) for a Model of the Effect of a Risk Manager's Functional Background on Objectivity

	Mediator	
	Shared Social Identity	**Objectivity**
Constant	6.02***	58.97***
	(0.13)	(10.00)
Functional Background	-0.25	-1.06
	(0.19)	(3.27)
Shared Social Identity		-5.72***
		(1.62)
n	115	115
R-squared	0.02	0.10

***, **, * Indicates significance of coefficients at $p < 0.01$, $p < 0.05$, and $p < 0.10$, respectively.

FIGURE 11
Mediation Model



***, **, * Indicates significance of coefficients at $p < 0.01$, $p < 0.05$, and $p < 0.10$, respectively.

Shared Social Identity (β = -5.72, $p < .001$) has a significant negative relationship with Objectivity, and its coefficient indicates a practically meaningful effect size relative to the 101-point Objectivity scale. However, there is no significant direct effect of Functional Background on Shared Social Identity. According to Zhao et al. (2010), the strength of mediation should be measured by the size and significance of the indirect effect, which is the product of (a) the path coefficient from Functional Background to

Shared Social Identity (β = -0.25) and (b) the path coefficient from Shared Social Identity to Objectivity (β = -5.72). To estimate this product, I applied the Preacher & Hayes method (2008) using 5,000 bootstrapped resamples of the data with replacement to estimate 95% confidence intervals. Results indicate a non-significant indirect effect of Functional background on Objectivity through Shared Social Identity (1.41, 95% CI [-0.66, 3.67]). Thus, I can conclude that Shared Social Identity does not play a mediating role.

Moderating effect of frame. To test for interaction between Shared Social Identity and Frame, I used the Hayes (2022) PROCESS macro for SPSS, this time configured for Model 14, which specifies that Frame moderates the path from Shared Social Identity to Objectivity.[9] Descriptive statistics indicated a very high correlation in the sample data between Frame and the multiplicative term which represents the interaction of Frame and Shared Social Identity (Variance Inflation Factors of 35.40 and 37.60, respectively). Although such multicollinearity does not affect inferences regarding the interaction itself (Hayes, 2022: 325), it does make the coefficients unstable and difficult to interpret. Therefore, I mean-centered the Shared Social Identity variable to reduce multicollinearity between the variables and their interaction term (new Variance Inflation Factors of 1.01 and 2.05, respectively), thereby rendering the coefficients more stable and easier to interpret (Hayes, 2022).

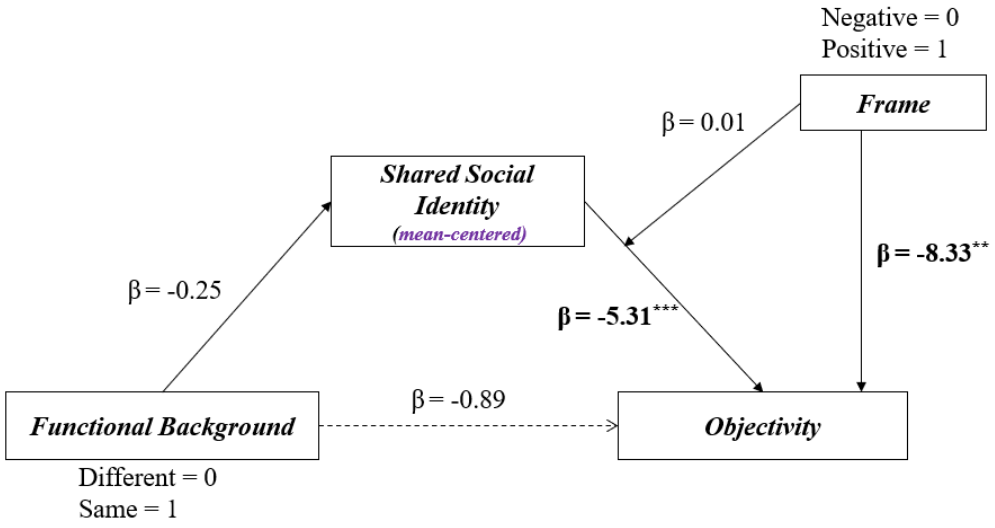
Figure 12 depicts the moderated mediation model and its estimated path coefficients. The coefficient for the interaction term is not significant (β = 0.01, *p* =

[9] Control variables (gender, age, and experience) are not included in the model but including them does not change the practical or statistical significance of the results (untabulated).

.999)., indicating that Frame does not moderate the effect of Shared Social Identity on Objectivity.[10] Furthermore, the bootstrapped confidence interval for the index of moderated mediation[11] includes zero, (> -0.01, 95% CI [-1.95, 2.25]), indicating that Frame also does not moderate the indirect effect of Functional Background on Objectivity through Shared Social Identity.

The direct effect of Frame on Objectivity is significant (β = -8.33, p = .010). This means that changing from a negative to a positive frame reduces objectivity in participants, on average, by 8.33 on a 101-point scale, which is a practically meaningful effect.

FIGURE 12
Moderated Mediation Model



***, **, * Indicates significance of coefficients at p < 0.01, p < 0.05, and p < 0.10, respectively.

[10] I obtained similar results by performing a test of multi-group invariance using a covariance-based structural equation model specified in Mplus version 8.4, in which Shared Social Identity was a latent variable comprised of three indicator items, and each Frame condition (positive and negative) represented a separate group (Kline, 2015).

[11] This index directly quantifies the change in the indirect effect of the independent variable on the dependent variable as the moderator changes by one unit (Hayes, 2022). It is calculated as the product of the coefficient of the interaction term (β = 0.01) and the coefficient of the path from Functional Background to Shared Social Identity (β = -0.25).

Additional visual evidence of the effect on Objectivity of Frame and Shared Social Identity. Figures 13 and 14 provide additional visual evidence of the relationship between Objectivity, Frame, and Shared Social Identity. Box plots in Figure 13 show the effect of Frame on Objectivity in the sample, while Figure 14 shows that there is a negative linear relationship between Shared Social Identity and Objectivity in the sample regardless of the Frame.

FIGURE 13
Effect of Frame on Objectivity

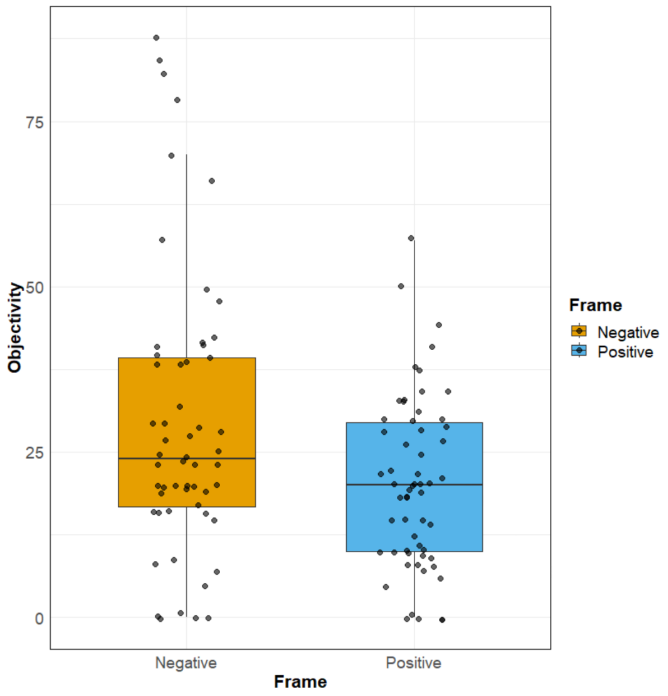
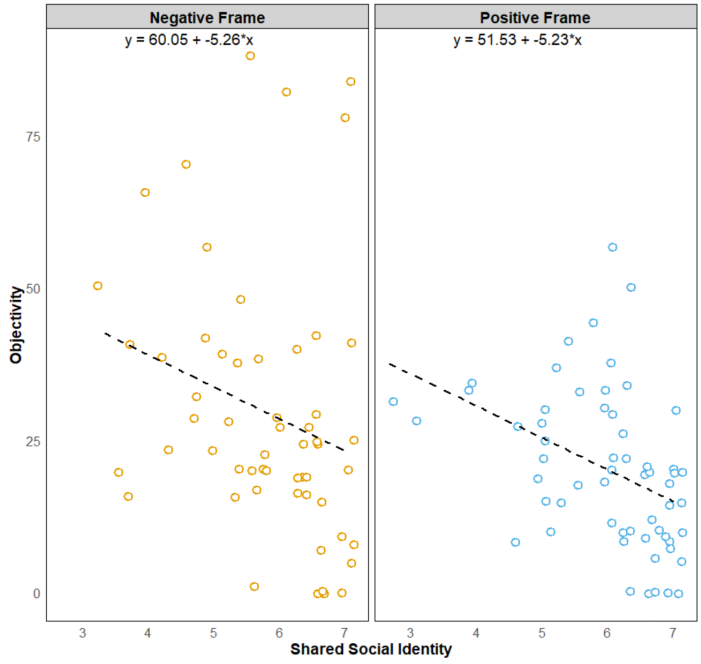


FIGURE 14
Linear Relationship Between Shared Social Identity and Objectivity



Discussion

Summary of Findings

In this study, I extended lines of research undertaken on professional judgment in auditing (Bauer, 2015; Stefaniak et al., 2012; Burt & Libby, 2021; Fukukawa & Mock, 2011; Mock & Fukukawa, 2016) by examining whether previously observed cognitive biases arising from shared social identity and positive framing also apply in a risk management context. Consistent with my prediction and previous research, I found that risk managers evaluated a positively framed risk less objectively than a negatively framed risk. Although results did not support my hypothesis of a negative relationship between shared functional background and objectivity mediated by shared social identity, I did find evidence consistent with previous research that higher shared social identity is associated with lower objectivity. In response to my research question, I did not detect

any interaction between the effects of risk framing and shared social identity on a risk manager's objectivity.

Implications for Research and Practice

This paper contributes to the ERM literature and practice in several ways. First, it responds to calls for research on the extent to which risk is thought of as only a negative concept (Bromiley et al., 2015) as well as calls for more research on why organizations have difficulty integrating ERM and strategy (Bromiley et al., 2015; Viscelli et al., 2017). Second, it confirms that cognitive biases arising from the way information is framed and from shared social identity, both of which have been observed in auditors (Bauer, 2015; Fukukawa & Mock, 2011; Mock & Fukukawa, 2016; Stefaniak et al., 2012) evaluating the work of other professionals, carry over to a risk management context in which risk managers evaluate the risk judgment of business unit managers. The finding that positive framing compromises the objectivity of professional participants who assess risk in their day-to-day work has implications for whoever is assigned responsibility for assessing the strategic opportunities inherent in emergent risks to the organization. Risk managers may be given this responsibility in an effort to modernize the Three Lines of Defense model (PwC, 2018a) or in an attempt to turn risk managers into "strategists, visionaries, influencers, and future CEOs" (Deloitte, 2021). If so, organizations should be aware of the potential cognitive bias introduced when evaluating an opportunity and should take measures to neutralize the bias (e.g., by having risk managers review the full spectrum of downside possibilities associated with the opportunity). Organizations should also be sensitive to the potential negative influence of group affiliation on a risk manager's objectivity. The audit literature has shown that making professional values salient can act

as a safeguard (Bauer, 2015; Burt & Libby, 2021). Highlighting the value of objectivity in internal risk management policies and training may serve this purpose. Finally, although a common functional background is thought to reduce the quality of decision making in executive teams (Corner et al., 1994), my results suggest that a shared functional background does not compromise the objectivity of an individual who is evaluating another individual's risk assessment. This implies that organizations may benefit from recruiting risk managers with significant first-line or other inside business experience and knowledge because they may be just as unbiased as the risk managers who are more removed from the business units while being more capable of informed discussions, debates, and judgments about complex strategic risks.

Limitations and Opportunities for Future Research

This study has several limitations. First, although over 80% of participants assess risk in their daily work, they are not risk managers. Since the findings are based on their perceptions of what a hypothetical chief risk officer would do in the experimental scenarios, the results may reflect weaknesses in the scenario descriptions. A future study with actual risk managers may yield different results. Second, manipulation checks indicate that my attempt to trigger shared social identity through a shared functional background did not work, yet shared social identity was triggered and did have a significant effect on objectivity in the direction predicted. If functional background did not cause the observed variation in shared social identity among participants, what did?

Similarly, the frame manipulation check was unsuccessful, yet Frame had a significant effect on Objectivity. These outcomes are puzzling and raise concerns about the study's internal validity. To avoid this concern in any replication of this study, the

manipulations should be tested more rigorously before implementation. Third and relatedly, future research should establish the antecedents of shared social identity in a risk management context. Fourth, my measurement of objectivity assumes that disagreement with a business unit manager is evidence of objectivity. Although consistent with a previous study of objectivity in internal auditors (Hoos, Messier, Smith, & Tandy, 2018), this is a crude measure since, in practice, a business unit manager's risk assessment will often be credible, and an objective risk manager will agree.

Nonetheless, the measure seems adequate for this study because it indicates the inclination of a risk manager to agree with a business manager when there is limited and ambiguous information about the risk. Finally, a few outlying participant responses affected the statistical assumptions upon which some of my inferential tests were based. Although additional analysis suggested that my conclusions were robust to the violation of these assumptions, it is possible that more sophisticated remedial techniques could have produced different results.

Despite these limitations, the study contributes additional empirical evidence to inform the debates about threats to the objectivity of individuals who evaluate the work of others and about the configuration of roles and responsibilities most appropriate for ERM practice.

CHAPTER 4: STUDY 3: THE EFFECT OF RISK QUANTIFICATION, RISK TIME HORIZON, AND NUMERACY ON RISK MANAGERS' JUDGMENT

Introduction

Risk managers, guided by popular enterprise-wide risk management (ERM) standards, are increasingly expected to provide strategic value to organizations (COSO, 2017, 2018; ISO, 2018; RIMS, 2020) while remaining sufficiently objective and unbiased (COSO, 2015; Institute of Internal Auditors, 2020; The Risk Coalition, 2020). Risks to an organization's strategic objectives are often emergent, highly uncertain, and difficult to measure, and their time frame can be distant (Allan et al., 2013; Borsa et al., 2014; Sax & Andersen, 2020). Whether these risks should, or even can, be managed using the same formal control-based risk management methods as more routine, conventional risks is an open question (Andersen & Young, 2020; Bromiley et al., 2016; PwC, 2018a), as is whether attempts to quantify them are worthwhile (Hubbard, 2020; Mikes, 2009, 2011; Stoel et al., 2017). Often lacking historical data for strategic risks, many organizations rely on some type of risk mapping exercise, plotting potential impacts against the probabilities of occurrence in order to give priority to risks with the greatest potential effects (Fraser, Quail, & Simkins, 2021; Jordan, Jørgensen, & Mitterhofer, 2013; Jordan, Mitterhofer, & Jørgensen, 2018; Stoel et al., 2017).

Since ERM is a relatively young professional field, it is not yet clear which specific traits and abilities are best suited for risk management roles (Hayne & Free, 2014; Mikes, 2010). For example, an individual's education, professional training, industry, and functional background may influence their inclination for and proficiency with quantitative risk information. Mikes (2009) categorized top managers in certain financial services companies as "quantitative enthusiasts" because of their preference for

quantitative risk data. In contrast, top managers at other financial firms were labeled "quantitative skeptics" for their relative distrust in numbers. With their advanced statistical training, actuaries stand out as quintessential quantitative enthusiasts (Allan et al., 2013). They frequently occupy Chief Risk Officer roles in the insurance industry (EY, 2019; North American CRO Council, 2016) and are increasingly serving in risk management roles at non-financial organizations like Uber, Google, Hertz, Expedia, Tesla, and Lowe's (Casualty Actuarial Society, n.d.). Professional accountants, who only need basic algebra skills for certification and practice (Thorne, 2012), have also established a prominent place in the risk management field (COSO, 2017; Hayne & Free, 2014). Furthermore, with risk management teams recruiting internally from front-line business units in order to increase their practical business understanding (EY, 2019), the range of numerical skill and aptitude among risk management professionals may vary considerably.

Despite their varied background and aptitudes, risk managers are tasked with providing unbiased oversight and objective challenge to an organization's risk-taking activities, including those involving ambiguous strategic risks (COSO, 2017). In risk assessment tasks, they must interpret and evaluate risk information, which often includes the inherent uncertainty of a risk, its time horizon, and the presentation format of the organization's risk report. Research has demonstrated that uncertainty, time frame, presentation format, and numerical ability can each introduce biases in decision-making (Kelton et al., 2010; Nussbaum et al., 2006; Peters, 2012; Vessey, 1991).

This study explores how ambiguity in key elements of the decision process affects managerial decisions about highly uncertain risks. Specifically, it aims to improve our

understanding of how the inherent ambiguity in such risks interacts with varying degrees of ambiguity introduced by risk presentation formats (more or less quantification) and time frames (distant versus near future) to affect risk management decisions. It also investigates the role of a decision maker's numerical ability within these interactions. The problem is important because it has implications for organizational risk communication, risk ranking (often done collectively by groups of employees and aggregated), and the recruitment and training of risk management professionals with respect to numerical ability.

Research in cognitive psychology on the effect of information format on user judgments indicates that format influences the mental representation of a problem (Kelton et al., 2010; Vessey, 1991). A subset of the information processing literature shows that quantification of information can affect decisions (Eilifsen et al., 2021; Kadous, Koonce, & Towry, 2005) and that a person's numerical ability can affect their processing of quantitative and qualitative information (Elliott, Grant, & Rennekamp, 2017; Reyna, Nelson, Han, & Dieckmann, 2009). In addition, related research finds that processing fluency (the perceived ease with which information is processed) arising from a fit between information and its presentation style can affect the perceived reliability of the information (Elliott et al., 2017; Rennekamp, 2012).

Psychology scholars have also investigated the effect of time frame on decision making and have accumulated a body of research showing that people, including professional managers, tend to be more optimistic about outcomes in the distant future than in the near future. The reasons for this behavior include insensitivity to low-probability events and illusions of control over the future (Gilovich, Kerr, & Medvec,

1993; Kahneman & Lovallo, 1993; March & Shapira, 1987; Mitchell, Thompson, Peterson, & Cronk, 1997; Nisan, 1972; Nussbaum et al., 2006; Savitsky, Medvec, Charlton, & Gilovich, 1998). Underlying most of these theories about future decisions, evaluations, and judgments is the principle of time discounting (Weisner, 2015a). Liberman, Sagristano, and Trope (2002) proposed the construal level theory (CLT) of psychological distance as a potential common cognitive mechanism that explains elements of time discounting identified by earlier theories. CLT suggests that the more psychologically distant a person perceives themself to be from a target (e.g., object, event, person, place, etc.) the more abstract the person's mental representations of the target become, thereby affecting the person's predictions, evaluations, and actions involving the target. Based on the concept of psychological distance, CLT implies that the more uncertain a potential event is, the more abstractly it will be construed in the mind of the evaluator. Conversely, the more certain a potential event is, the more concrete its mental construal will be (Fujita, Trope, & Liberman, 2015).

CLT has the potential to explain the joint effects of time frame, quantification, and numeracy on risk management decisions and has already been shown to be relevant to other judgments about risk in a professional setting (Fehrenbacher et al., 2022; Lee, Keil, & Shalev, 2019; Liu & Wong-On-Wing, 2021; Shalev, Keil, Lee, & Ganzach, 2014). I extend this line of CLT-related ERM research by conducting a between-subjects experimental study in which I ask professional risk managers to evaluate a set of highly uncertain potential events that are intended to trigger abstract construal. I rely on CLT and the concept of processing fluency to predict that, when other central aspects of the risk assessment task are also construed abstractly, the alignment of abstract construal

cues will cause risk managers to be less critical in their assessment than when construal levels are misaligned (i.e., some aspects of the risk assessment task construed concretely and some abstractly). Specifically, an alignment of abstract construal cues triggered by (1) high uncertainty in the risk itself, (2) a qualitative-hybrid report presentation format in which qualitative risk information is more salient than quantitative risk information, and (3) a distant time horizon, should lead risk managers to experience feelings of processing fluency, thereby eliciting positive affect (which signals that the reported risk information can be relied upon), and in turn reducing their inclination to challenge the risk information. Furthermore, when a quantitative (i.e., concrete) presentation format is the only thing preventing abstract construal alignment during a risk assessment task, less numerate risk managers should experience relatively stronger feelings of processing *disfluency* and, therefore, should be more critical in their evaluations, relative to more numerate risk managers.

Consistent with my predictions, I found significant indirect effects of the report presentation format on participants' propensity to challenge the risk information through subjective feelings of processing fluency and perceptions of report reliability. These indirect effects were moderated by time frame and numeracy. Specifically, controlling for numeracy, participants who were considering the distant future along with a quantitative presentation experienced greater difficulty processing the risk information, which they then perceived as less reliable. Additionally, controlling for time horizon, less numerate participants perceived quantitative risk information to be less reliable than more numerate participants.

Contrary to my predictions, I did not find a significant difference in the propensity to challenge the risk information between participants exposed to the combination of treatments intended to activate a more abstract mindset (aligned abstract construals) and those exposed to combinations intended to activate a more concrete mindset (misaligned construals). However, a second experiment designed specifically to measure construal levels in the treatment groups provided modest evidence that my experimental manipulations influenced construal levels and that construal levels were related to processing fluency, which indirectly affected the propensity to challenge the risk information.

In supplemental analysis, I found that overall, participants were more inclined to challenge risk information involving the distant future than the near future. Less numerate participants were more likely to challenge a quantitative risk presentation than a qualitative-hybrid presentation, with this tendency stronger for risks in the distant future, and their reaction to both presentation formats was more extreme than that of more numerate participants. I also found some notable differences in the behavior of participants from financial and non-financial industries. Controlling for numeracy, participants from non-financial industries perceived a quantitative risk presentation to be less reliable than a qualitative-hybrid presentation and were, therefore, more prone to challenge it regardless of the time horizon. In comparison, participants from financial industries exhibited this behavior only when risk was in the distant future. Controlling for numeracy and time horizon, participants from non-financial industries experienced greater difficulty processing a quantitative presentation, which they then perceived as less reliable and were more likely to challenge.

This study directly extends Fehrenbacher et al. (2022) and Stoel et al. (2017) by considering numeracy and time frame as additional factors that influence the judgment of professional risk managers and by combining less salient quantitative risk information with salient qualitative risk information to reflect common practice in the field.

The results highlight the need to integrate both qualitative descriptions and quantitative measures in internal risk communication where feasible to accommodate varying levels of numeracy among employees across different departments and reduce the potential for bias in risk-related decisions. Furthermore, the results emphasize the potential importance of numerical ability as an aspect of cognitive diversity in organizational decisions about ambiguous risks. Since numerical ability is distinct from general intelligence, which is a broad and multifaceted concept, including people with different numerical abilities may improve decisions through the constructive disagreement of diverse viewpoints. The findings also suggest that organizations may benefit from training programs and decision aids to help corporate managers become more comfortable assessing ambiguous risks with distant time frames. Additionally, the findings may reflect a lack of familiarity in non-financial industries with advanced risk management practices which are well understood in regulated financial industries.

The remainder of the paper is organized as follows. In the next section, I review related literature and develop hypotheses. I then describe my experimental design and method in the third section and summarize my results in the fourth section. Finally, implications of my study for research and practice are outlined in the fifth section.

Background and Hypothesis Development

Construal Level, Abstractness, and Psychological Distance

CLT suggests that one's mental representations of a target (e.g., object, action, situation, event, person, place, etc.) should affect one's predictions, evaluations, and actions (Fujita et al., 2015). Construal level is a type of mental representation that is associated with psychological distance: as a target of attention becomes further removed from a person's direct experience, the person involuntarily adopts an abstract, schematic mental representation of the target and discounts incidental or contextual aspects of the target because they subconsciously expect that less information about the target should be available. This cognitive process leads to mental representations with varying levels of abstraction that depend on the degree of psychological distance. The association between construal level and psychological distance appears to be bidirectional: psychologically distant objects or events invoke abstract construal, and abstract construal prompts thoughts about more remote objects or events (Liberman, Trope, & Stephan, 2007). Related cognitive research also suggests that abstraction is associated with an increased focus on qualitative information because words represent broad meaning (gist), in contrast to quantitative information, which is more concrete and precise (Fukukura, Ferguson, & Fujita, 2013; Rahimi-Golkhandan, Garavito, Reyna-Brainerd, & Reyna, 2017).

Liberman et al. (2007) identified four dimensions of psychological distance: Hypotheticality (away from certainty), temporal distance (away from "now"), social distance (away from oneself), and spatial distance (away from "here"). Things that are perceived to be psychologically near tend to be automatically represented concretely, and

things that are psychologically distant tend to be automatically represented abstractly. The level of abstraction influences the focus of a person's attention, and the focus then affects decisions. Research indicates that an abstract mindset can make decisions either better or worse depending on the circumstances. For example, Weisner's (2015) survey of CLT research shows that an abstract mental representation can bias decisions in several ways, such as impeding performance on analytical tasks, making people more optimistic about outcomes in the distant future than the near future, and directing more attention to pros and idealistic concerns than to cons and pragmatic concerns. Similarly, Backof, Carpenter, and Thayer (2018) found that auditors of complex accounting estimates exhibited less skepticism when their mindset was abstract than when it was concrete. Conversely, abstract mental representations can improve managerial decisions by focusing attention on the big-picture impact (Guggenmos & Van der Stede, 2020) and may enhance the professional skepticism of auditors who evaluate broad, incomplete audit evidence (Fehrenbacher, Triki, & Weisner, 2021; Rasso, 2015) or ambiguous accounting standards (Backof, Bamber, & Carpenter, 2016).

Risk-taking behavior appears to be influenced by construal level. Basic psychology research finds that when people are led to adopt an abstract construal mindset, they make lower probability assessments than those led to adopt a more concrete construal mindset (Lermer, Streicher, Sachs, Raue, & Frey, 2015; Wakslak & Trope, 2009). Using practicing risk managers in a professional context, Fehrenbacher, Sutton, and Weisner (2022) provided support for the negative effect of spatial distance on probability assessments, including an interactive effect whereby differences in subjective probability judgments between operational (concrete) and non-operational (abstract) risks

were shown to be larger for geographically proximate targets. Lee et al. (2019), also using professional participants, built on Shalev et al. (2014) to show in a series of experiments that inducing an abstract mental construal in IT project managers increased optimism in risk identification, risk impact assessment, and risk response planning.

Construal Alignment,[12] Processing Fluency, and Numeracy

Research has shown that the effect of construal level on decisions can operate through processing fluency, which is the perceived ease of processing information (Elliott et al., 2017; Lee, Keller, & Sternthal, 2010; Liu & Wong-On-Wing, 2021). When construal cues triggered by the decision environment were congruent (all abstract or all concrete), decision makers experienced fluency. Mismatched construal cues (some abstract and others concrete) created disfluency.

Most previous research indicates that people rate fluent stimuli more positively than disfluent stimuli even though such assessments are often inaccurate (Alter & Oppenheimer, 2009) and that the positive evaluations associated with fluency can occur whether aligned construals are abstract[13] or concrete (Lee et al., 2010). Processing fluency has been shown to foster a less effortful, top-down, heuristic processing style and novel, risky exploration, while disfluency fosters an analytic, systematic, bottom-up processing style with considerable attention to detail (Alter, 2007; Schwarz, 2012). Processing fluency has also been shown to elicit positive affect, which people may subconsciously interpret as a reliability cue (Elliott et al., 2017; Rennekamp, 2012). There is, however, some conflicting evidence about the relationship between processing

[12] The CLT literature uses the terms "alignment," "match," "fit," and "congruence" interchangeably.

[13] This study focuses on the effect of fluency on decisions when the aligned construals are abstract.

fluency and decision making. A few studies that manipulated fluency by varying the legibility of text exhibits suggest that disfluently processed information may be perceived more abstractly as a result of feeling more psychologically distant (Alter, 2013; Alter & Oppenheimer, 2008) or may be perceived more positively by evoking curiosity (Sung, Vanman, & Hartley, 2022). In other contexts, fluency can amplify pre-existing negative feelings about an object of attention (Motyka, Suri, Grewal, & Kohli, 2016; Rennekamp, 2012).

Research suggests that a person's numerical ability can affect their perception of processing fluency when evaluating quantitative information. Peters et al. define numeracy as "the ability to process basic probability and numerical concepts" and distinguish it from general intelligence (2006: 407). People's numeracy levels vary widely, and studies indicate that even highly educated laypersons and healthcare professionals have an inadequate understanding of probabilities, risks, and related concepts (Reyna et al., 2009). Less numerate people tend to be more sensitive to the formatting of probability and risk information and more trusting of narrative than numerical information (Elliott et al., 2017; Reyna et al., 2009; Zhang, Seufert, & Dellaportas, 2024). In contrast, more numerate people appear to obtain more gist from numbers, and since highly numerate people derive more affective meaning from probabilities and numerical comparisons, they may be more susceptible to bias involving the processing of numbers (Henry & Peytcheva, 2018; Kahan, Peters, Dawson, & Slovic, 2017; Peters, 2012; Peters et al., 2006).

This study builds on recent investigations into the effects of construal alignment and processing fluency on decisions, including one study (Elliott et al., 2017) that also

addressed the moderating effect of numeracy. Using student participants, Elliott, Grant, and Rennekamp (2017) demonstrated that a construal fit between the presentation style (words vs. pictures) of Corporate Social Responsibility (CSR) performance reports and CSR strategy (global vs. local) increased investors' willingness to invest, that the effects were stronger for less numerate investors, and that the effects were mediated by processing fluency, affect, and perceived reliability of the reported information. Using student participants, Wong-on-Wing and Liu (2021) found evidence that employees are more proactive in their risk management efforts when there is alignment between the construal level of a firm's risk management philosophy (focus on feasibility vs. focus on desirability) and the presentation format of key risk indicators (quantitative vs. qualitative), and that the effects are mediated by processing fluency. Using professional risk managers, Stoel et al. (2017) discovered that risk managers have more confidence in reported risk information for strategic risks when the information is qualitative than when it is quantitative. The authors attribute their finding to a cognitive misfit between the subjective nature of strategic risks and the precise nature of a quantitative presentation format. Although Stoel et al. (2017) do not explicitly propose construal alignment or processing fluency to explain their result, it is consistent with the literature above. Table 9 organizes the various studies discussed above by key concept and indicates how they are related.

TABLE 9
Summary of Key Literature on Construal Level, Processing Fluency, and Numeracy

Key Concept	Authors and Year	Study Details	Main Findings	Relation to Other Key Concepts
Construal Level and Psychological Distance	(Fujita et al., 2015; Liberman et al., 2002, 2007)	Explores mental representations (abstract vs. concrete) and their relationship with psychological distance.	An individual's level of mental abstraction influences the focus of their attention, and the focus then affects decisions.	Foundational studies in CLT.
Influence of Abstractness on Decisions	Backof et al. (2016, 2018); Fehrenbacher et al. (2021); Guggenmos & Van der Stede (2020); Rasso (2015)	Studies on how abstract thinking influences decision-making in different contexts.	Abstract thinking can both improve and impair decision-making, depending on the context.	Extends the application of CLT findings.
Influence of Abstractness on Risk Perception	Fehrenbacher et al. (2022); Lee et al. (2019); Lermer et al. (2015); Shalev et al. (2014); Wakslak & Trope (2009)	Studies on how construal level affects risk perception and risk management.	Abstract construal leads to lower risk assessment.	Builds on CLT to explore specific implications of abstractness for risk evaluation.
Construal Alignment and Processing Fluency	Elliott et al. (2017); Lee et al. (2010); Liu & Wong-On-Wing (2021)	Studies on how congruence in the mental representations of different aspects of a problem can influence decision making through perceived processing fluency.	Aligned construal levels (whether abstract or concrete) affect decisions through increased processing fluency.	Links CLT with processing fluency.
Varied Influences of Processing Fluency on Decisions	Alter (2013); Alter & Oppenheimer (2009); Motyka et al. (2016); Schwarz (2012); Sung et al. (2022)	Studies investigating how processing fluency influences judgments and decision-making.	Both positive and negative impacts of fluency on decision-making, depending on context.	Provides a nuanced view of the role of processing fluency in decisions.
Numeracy and Decision Making	Elliott et al. (2017); Henry & Peytcheva (2018); Kahan et al. (2017); Peters (2012); Peters et al. (2006); Reyna et al. (2009); Zhang et al. (2023)	Studies exploring the relationship between numeracy and decision-making.	Numeracy affects how individuals process information. Less numerate people are more sensitive to presentation format and more trusting of qualitative information.	Links numeracy to processing fluency.
Quantification and Abstractness	Fukukura et al. (2013); Rahimi-Golkhandan et al. (2017)	Studies exploring mental representations, including the relationship between quantification and abstractness.	Qualitative information is generally associated with abstractness and quantitative information with concreteness.	Links CLT with quantification of information.

The present study is unique because it uses professional risk managers to test the effect on decision-making of construal cues which are commonly encountered in risk

management tasks (hypotheticality, time frame, quantitative/qualitative report format) but which, to my knowledge, have not been tested together previously. The study is also unique in that it tests a potential counterintuitive implication of theory: less numerate risk managers may, in certain circumstances, make more thoughtful evaluations than more numerate risk managers. Although prior research has documented that, in general, numeracy improves risk judgment in students and the general public, it is not clear how numerical ability in seasoned risk managers will interact with construal cues in a typical risk management task.

The study responds directly to Fehrenbacher et al.'s (2022) call for research on risk estimation when risks are considered relatively unlikely and when strategic risk factors are considered in long-term planning. It also responds to Stoel et al.'s (2017) call for research on whether some risk managers are predisposed to expect quantitative information, as well as the effects on risk judgment, if any, of combining qualitative with quantitative risk information.

Hypotheses

Risk managers engaged in a risk assessment task must interpret and evaluate risk information, which often includes the amount of uncertainty inherent in the risk, the risk's time horizon, and the presentation format of a firm's risk report. When these three elements are each construed abstractly, the alignment of abstract construals should generate feelings of processing fluency, which should then produce positive affect that is subconsciously interpreted as a cue that the reported risk information is reliable. All else being equal, risk managers in this situation should be less inclined to critically scrutinize the risk information, relying more on heuristics and intuition than they would in the

absence of aligned abstract construal. In the absence of such construal alignment (i.e., a construal misalignment), I expect risk managers to experience feelings of processing disfluency, which should then prompt a more deliberative, critical stance towards reported risk information. Furthermore, when a quantitative (i.e., concrete) presentation format is the only thing preventing aligned abstract construal in this situation, I expect less numerate risk managers to experience relatively stronger feelings of processing *disfluency*, leading them to evaluate reported risk information more critically[14] than their more numerate counterparts.

Construal level is thought to be a continuum between abstract and concrete (Fujita et al., 2015), and there is evidence that psychological distance in one dimension reduces sensitivity to further psychological distance in other dimensions (Fehrenbacher et al., 2022; Maglio, Trope, & Liberman, 2013). It is, therefore, possible that some misaligned construal combinations will result in greater processing disfluency than other misaligned combinations. Nonetheless, although I can make a prediction for one specific case of construal misalignment described above (the quantitative/numeracy interaction), I cannot make any formal predictions about differences in risk managers' judgments in the other mismatched construal conditions because there is insufficient theory and research evidence about the interaction of opposing psychological distances (Soderberg et al., 2015). Instead, I assume that risk managers' judgments will be equally critical in each of the remaining mismatched construal conditions, and I will explore potential differences as supplemental analysis.

[14] I acknowledge that more scrutiny by a non-numerate risk manager may not lead to a better judgment of risk than less scrutiny by a numerate risk manager.

The discussion above leads me to the following formal hypotheses:

*Hypothesis 1. When a highly uncertain risk is in the **distant future** and the risk report presentation is **qual**itative, risk managers will be **less inclined to challenge** front-line management's risk assessment **than** in **all other** combinations of time horizon and report presentation style.*

*Hypothesis 2. When a highly uncertain risk is in the **distant future** and the risk report presentation is **quant**itative, **less numerate** risk managers will be **more inclined to challenge** front-line management's risk assessment **than more numerate** risk managers.*

*Hypothesis 3. The joint **effects** of presentation format, time horizon, and numeracy **on** a risk manager's **inclination to challenge** front-line management's risk assessment **act indirectly and serially through** subjective feelings of **processing fluency** and the **perceived reliability** of the risk report.*

Experimental Method and Design

Study Design

To test these hypotheses, I conducted a between-subjects experiment with construal alignment as a manipulated variable (one aligned abstract construal condition and three misaligned construal conditions) and risk managers' numeracy as a measured variable. To manipulate construal alignment, I had all participants undertake a risk assessment task with an identical set of highly uncertain risks intended to trigger abstract construal. I created a single aligned construal condition by assigning participants randomly to a scenario in which words describing the likelihood and financial impact of risks are emphasized more than numbers (a qualitative-hybrid presentation format intended to trigger abstract construal) and in which the risk exposure is in the far future (a distant time horizon intended to trigger abstract construal). I also created three additional construal conditions, each of which is misaligned relative to the set of abstractly construed risks being evaluated, by assigning participants randomly to scenarios with the following combinations of risk presentation format and time horizon: *Quantitative*

presentation (concrete) + Distant future (abstract); Qualitative-hybrid presentation (abstract) + Near future (concrete); Quantitative presentation (concrete) + Near future (concrete).

Participants

The participants were 193 risk management professionals recruited though a research panel service.[15] All participants indicated that they were employed for at least two years in a position that required them to make decisions associated with organizational risk management. Sixty-four percent (64%) of participants held at least one professional certification relevant to risk management, and 73% had experience using a risk register or similar tool that lists various risk factors and requires the user to judge the likelihood that those risks will materialize.

Participants were predominantly managers (47%) and executives (32%), with approximately 50% working in non-financial industries, while the remainder worked in either Banking (12%), Accounting Firms (12%), Insurance (7%), or other financial services (18%). Additional information about the sample can be found in Table 10.

I conducted the experiment electronically using a Qualtrics survey instrument distributed by the panel service. The instrument is reproduced in Appendix C. The survey tool randomly assigned participants to one of four treatment conditions. Two hundred twenty-nine (229) people passed the demographic screening questions. Of the 229 completed responses, I eliminated two people who answered a free-form question by

[15] Empanel Online (https://empanelonline.com). To help recruit suitable participants, I followed Fehrenbacher et al. (Fehrenbacher, Sutton, & Weisner, 2022) and provide the panel service company with a list of typical risk management job titles such as Chief Risk Officer, Vice President – Risk Management, Supply Chain Risk Manager / Director, Business Continuity Manager, Director – (Enterprise) Risk Management, Enterprise Risk Management Analyst / Specialist, Risk Management Specialist, Associate / Manager / Senior Manager – Risk Management, Corporate Risk Analyst.

indicating that they did not understand the experimental task, five people who provided nonsensical answers to the free-form question (thereby suggesting a lack of attention), and three people whose job titles[16] were unrelated to business risk management even though they claimed to have at least two years of risk management experience. I also excluded three people who chose the maximum possible score for all scaled questions in the instrument because their answers indicated a lack of attention. Of the remaining 216 participants, I eliminated a further 20 participants (speeders) who completed the instrument in less than 5 minutes and three participants (laggards) who spent more than 60 minutes on the instrument (median completion time was 10 minutes, which suggests that the speeders and laggards did not pay sufficient attention to the experimental task). Hence, my final sample is 193 professionals. The task took final participants an average (standard deviation) of 12.60 (7.39) minutes to complete, and completion times ranged from 5.00 to 47.67 minutes. Most experimental results are robust to including the 23 participants who completed the study too quickly (20) or too slowly (3). Using all 229 completed responses, the results are qualitatively similar. See Appendix C, Table C4, for a reconciliation of the number of completed responses to the number of final participants and the related effect on results.[17]

The instrument included one multiple-choice question that tested fundamental risk management knowledge based on popular risk management standards (COSO, 2017;

[16] Spanish teacher; Piano teacher; Cook. The last may have been a typographical error since the person also claimed to hold Financial Risk Manager (FRM) certification, have 'some college' education, and work in an accounting firm.

[17] The reconciliation also compares results for 138 participants who scored 75% or higher on a risk management knowledge testing question. Their results are consistent with those of the final sample of 193.

ISO, 2018; Project Management Institute, 2017). The question checked whether participants could correctly identify four valid options for managing a risk (Accept/Retain the risk; Transfer the risk; Avoid the risk; Reduce/Mitigate the risk). I added this question to the study after an initial "soft" launch therefore only 173 of the 193 final participants received the question. One hundred fourteen (114, 66%) of them correctly identified all four valid responses; 138 (80%) identified at least three of the four valid responses; 165 (95%) identified at least two of the four valid responses. The result of the knowledge testing question is persuasive evidence that this sample of participants is appropriate for the experimental task[18].

To keep the experiment relatively brief and to avoid potential confounding (see Lee et al., 2019), I measured the effect of experimental manipulations on construal levels in a separate, secondary sample of participants who received a modified version of the instrument.[19] Their demographic details are discussed separately in the "Results" section.

[18] Different risk management frameworks use slightly different words to describe the same technique (e.g., risk "sharing" instead of risk "transfer"). This may help explain why performance on this knowledge test was not better.

[19] For the secondary sample, I recruited businesspeople from the Prolific (Palan & Schitter, 2018) crowdsourcing platform. I did this because the recruitment costs for Prolific participants are significantly lower than for professional risk managers recruited by the research panel service.

TABLE 10
Participants

Panel A: Professional Profile[20]

	***N* = 193**[1]
Position	
Partner or Owner	24 (12.4%)
Executive	61 (31.6%)
Manager	90 (46.6%)
Staff	18 (9.3%)
Work Experience	
< 5	17 (8.8%)
5–10	39 (20.2%)
11–15	42 (21.8%)
16–20	30 (15.5%)
> 20	65 (33.7%)
Have used a Risk Register	
Yes	141 (73.1%)
No	43 (22.3%)
Not sure	9 (4.7%)

[1] *n* (%)

[20] I coded participants into four job "Position" categories based on their answers to demographic and screening questions: *Staff* – Assesses risk and may also manage projects but neither supervises staff nor communicates regularly with senior managers; *Manager* - Assesses risk and either supervises staff or manages projects which involve regular interaction with senior management; *Executive* - In addition to Manager responsibilities, holds at least a director title (usually the lowest executive level in U.S. organizations); *Partner or Owner* - Assesses risk and owns at least part of the business.

Panel B: Certificates and Licenses

Professional Certification	Count	Percentage
None	70	(36.3%)
CRMP (Certified Risk Management Professional)	44	(22.8%)
FRM (Financial Risk Manager)	41	(21.2%)
CPA (Certified Public Accountant)	39	(20.2%)
PRM (Professional Risk Manager)	34	(17.6%)
CFA (Chartered Financial Analyst)	17	(8.8%)
CMA (Certified Management Accountant)	16	(8.3%)
CIA (Certified Internal Auditor)	14	(7.3%)
Other	9	(4.7%)

Several participants indicated that they hold more than one professional certification. Therefore, the totals for count and percentage exceed 100% of the sample.

Panel C: General Demographic Information

	***N* = 193**[1]
Industry	
Non-Financial Industry	97 (50.3%)
Other Financial Services	35 (18.1%)
Accounting Firms	24 (12.4%)
Banking	23 (11.9%)
Insurance	14 (7.3%)
Education	
Bachelor's degree	91 (47.2%)
Master's degree	59 (30.6%)
Some College	26 (13.5%)
Doctoral degree	11 (5.7%)
No College	6 (3.1%)
Age	
18–27	15 (7.8%)
28–37	50 (25.9%)
38–47	62 (32.1%)
48–57	31 (16.1%)
58+	35 (18.1%)
Gender	
Male	130 (67.4%)
Female	63 (32.6%)

[1] *n* (%)

Experimental Task

Participants were asked to assume the role of a risk manager in a hypothetical insurance company's Enterprise Risk Management department, with the responsibility to challenge whether business unit managers have adequately considered all relevant risks for their business. Participants then read a scenario in which business management had prepared a strategic risk self-assessment report in connection with business planning. After reading the scenario, participants were presented with an excerpt from the risk self-assessment report, which focused on three ambiguous strategic risks, and were asked to review the self-assessment carefully before it was finalized and sent to the board of directors. To strengthen the manipulations, participants were asked to evaluate the three risks individually and then all three risks collectively. Participants then answered a set of questions measuring the extent to which they were confident in the estimated risk exposure, how much they felt they could rely on the risk information, and how easy or difficult the information in the report was to understand and process. Participants also answered a short quiz to measure their statistical numeracy. The instrument concluded with questions to measure potential covariates and demographic questions.

I developed the experimental case materials based on industry trade publications, my industry experience, discussions with risk management professionals, COSO guidance, and previous research by Stoel et al. (2017) and Fehrnenbacher et al. (2022). Similar to Fehrnenbacher et al. (2022), the risks in the report (shifts in stakeholder expectations, executive succession challenges, and disruptive competition) are adapted from a recent study by Protiviti and North Carolina State University’s ERM Initiative

(2022) in which CEOs from several industries rated these risks as among the most worrisome.

Two professional accountants with extensive industry experience tested an early version of the instrument and provided comments. I then conducted a pilot test on a sample of 97 people recruited from Prolific and made additional modifications to finalize the instrument. The instrument is reproduced in Appendix D. Table 11 summarizes the main variables measured in this study.

Independent Variables

Construal alignment. To manipulate construal alignment between aligned abstract construal (one treatment group) and misaligned construal (three treatment groups), I instructed all participants to review the same set of three ambiguous strategic risks (high hypotheticality should elicit abstract mental representation for all participants). However, consistent with the text of the scenario they were assigned to, participants varied in whether the time horizon of the risk report was the one-year period in 2027 (abstract representation) or the upcoming one-year period in 2023[21] (concrete representation). Participants also varied in whether the visual presentation format of the risk report had more salient qualitative information (abstract representation) or quantitative information (concrete representation).

Presentation format. For participants assigned to the quantitative presentation format, the estimated likelihood and financial impact of the risks were expressed quantitatively using percentage and dollar thresholds. For participants assigned the

[21] The data were collected during December 2022.

qualitative-hybrid presentation format, estimations of likelihood and financial impact were described in the risk report qualitatively by using words[22] such as "rare" for likelihood and "moderate" for impact. See Figure 15 for an example of the risk self-assessment report.

Participants who received the qualitative-hybrid presentation format also had access to a less salient exhibit (see Figure 16) which mapped qualitative risk expressions to the equivalent quantitative thresholds from the quantitative presentation format. These participants were informed that business managers had used the contents of the mapping exhibit as guidelines for assessing the risks. The participants viewed this less salient mapping exhibit on a separate screen before being shown the more salient risk report, which contained purely qualitative estimations of likelihood and financial impact, and were instructed that they could return to the mapping exhibit at any time by clicking the back arrow at the bottom of a screen. Access to the mapping exhibit helps ensure that information contained in the qualitative-hybrid presentation format is consistent with information contained in the quantitative presentation format so that experimental results can more confidently be attributed to format instead of content (Budescu, Por, & Broomell, 2012; Elliott et al., 2017; Wallsten, Budescu, Rapoport, Zwick, & Forsyth, 1986), and it also reflects actual practice (CPA Canada, 2020; Fraser et al., 2021; Segal,

[22] Qualitative expressions for likelihood and impact in the risk report are based on COSO guidance (COSO, 2012; COSO, 2020).

2011).[23] Participants who received the qualitative-hybrid presentation format viewed the mapping exhibit for an average of 27 seconds (standard deviation 36 seconds; median 17 seconds).

Time horizon. I manipulated the time horizon in the headings of the report (see Figures 15 and 16) and in the scenario's text:

> "In connection with XYZ's [short-term / *long-term*] business planning process, each business unit performs a self-assessment of the business risks inherent in its strategic plan and prioritizes the risks in the [immediate future / *distant future*] that are most deserving of management attention and resources. The relative importance of each [short-term / *long-term*] risk is determined by estimating its likelihood of occurring and the financial impact if it did materialize.
> […]
> Since your role as risk manager includes constructively challenging the business managers' views of risk, you have been assigned a portion of XYZ's [short-term / *long-term*] risk self-assessment report for your careful review before the report is finalized and sent to the board of directors. The report covers the risks anticipated in [Year 1 / *Year 5*] of the business plan, which means that the reported likelihood and impact of each risk is for the [one-year period in 2023 / *one-year period in 2027*]".

FIGURE 15
Salient Risk Information in the Self-Assessment Report

Panel A: Quantitative Report Presentation Format With Risk in the Distant Future

	Realistic Worst Case* during **2027**	
Risk Description	Annual Financial Impact	Annual Occurrence Likelihood
Shifts in stakeholder expectations XYZ may be unable to satisfy shifting stakeholder demands and expectations regarding environmental, social and governance ("ESG") practices, which could affect XYZ's ability to attract and retain customers, employees, and investors.	**55% ($121m)** reduction in planned pre-tax income	**2%** (i.e., once in 50 years)
Succession challenges Departure of key underwriting personnel in a tightening talent market may limit XYZ's ability to achieve strategic objectives.	**5% ($11m)** reduction in planned pre-tax income	**66%** (i.e., once in 1.5 years)

[23] I also collected data from participants assigned to a pure qualitative presentation format which did not include access to a mapping of qualitative and quantitative expressions of likelihood and impact. However, because vague qualitative information is subject to individual differences in interpretation (Wallsten, Budescu, Rapoport, Zwick, & Forsyth, 1986) and does not represent typical practice settings in which qualitative risk ratings are usually presented with reference to quantitative thresholds, I did not analyze the data as part of this study.

Disruptive competition Rapid speed of disruptive "InsurTech" innovations enabled by advanced technology may outpace XYZ's ability to compete in certain insurance segments.	**25% ($55m)** reduction in planned pre-tax income	**20%** (i.e., once in 5 years)

* Pessimistic enough to have a low chance of occurring in any particular year but reasonable enough to be believable. When historic data is sparse or not representative of the future, the risk assessment is informed by scenario analysis, stress testing, and expert judgment.

Panel B: Salient Qualitative Element of the Qualitative Hybrid Report Presentation Format with Risk in the Distant Future

	Realistic Worst Case* during **2027**	
Risk Description	Annual Financial Impact [a]	Annual Occurrence Likelihood [b]
Shifts in stakeholder expectations XYZ may be unable to satisfy shifting stakeholder demands and expectations regarding environmental, social and governance ("ESG") practices, which could affect XYZ's ability to attract and retain customers, employees, and investors.	**Major**	**Rare**
Succession challenges Departure of key underwriting executives in a tightening talent market may limit XYZ's ability to achieve strategic objectives.	**Minor**	**Likely**
Disruptive competition Rapid speed of disruptive "InsurTech" innovations enabled by advanced technology may outpace XYZ's ability to compete in certain insurance segments.	**Moderate**	**Possible**

* Pessimistic enough to have a low chance of occurring in any particular year but reasonable enough to be believable. When historic data is sparse or not representative of the future, the risk assessment is informed by scenario analysis, stress testing, and expert judgment.

FIGURE 16
Less Salient Quantitative Mapping Element of the Qualitative Hybrid Report Presentation Format

Business managers determined the financial impact and likelihood of each risk for 2023 [*2027*] using the guidelines below. Please review them before continuing. If necessary, you can return to this screen at any time by clicking the back arrow at the bottom of a page.

Annual Financial Impact	***Annual Occurrence Likelihood***
Minor: 5% ($11m) reduction in planned pre-tax income	*Rare: 2% chance per year (i.e., once in 50 years)*
Moderate: 25% ($55m) reduction in planned pre-tax income	*Unlikely: 10% chance per year (i.e., once in 10 years)*
Major: 55% ($121m) reduction in planned pre-tax income	*Possible: 20% chance per year (i.e., once in 5 years)*
Severe: 95% ($209m) reduction in planned pre-tax income	*Likely: 66% chance per year (i.e., once in 1.5 years)*
Extreme: 200% ($440m) reduction in planned pre-tax income	*Frequent: 100% chance per year (once every year)*

Numeracy. I measured each participant's statistical numeracy using a five-item multiple-choice numeracy scale adapted from Elliott et al. (2017). The first two questions

test an understanding of basic probabilities and frequencies (Schwartz, Woloshin, Welch, & Black, 1997), while the last three questions test higher-order numeracy skills like conditional probability (Cokely, Galesic, Schulz, Ghazal, & Garcia-Retamero, 2012). Since answers to the questions used by Elliott et al. (2017) are available on the internet, I made slight modifications to the content of the questions and the order of multiple-choice answers. For example, one of the original questions asked (italics and underlining added here to emphasize what was modified), "Out of 1,000 individuals in a village, 500 are members of a club. Out of these 500 members in the club, *100* are men. Out of the 500 individuals that are not in the club, *300* are men. What is the probability that a randomly drawn man is a member of the club?" I modified the question to be "Out of 1,000 individuals in a village, 500 are members of a club. Out of these 500 members in the club, *300* are men. Out of the 500 individuals that are not in the club, *100* are men. What is the probability that a randomly drawn man is a member of the club?"

I measured numeracy as the total number of correct responses out of the five items in this scale. Overall, the performance of my sample of practitioners is consistent with, but slightly worse than, the business student participants in Elliott et al. (2017). See Appendix C, Table C1 for a question-by-question comparison of performance between the two studies and Appendix C, Figure C1 for the distribution of my participants' numeracy scores. To simplify analysis and interpretation, I classified the 193 participants as Low Numeracy (0 to 1 correct answers; $n = 71$), Moderate Numeracy (2 correct answers; $n = 56$), or High Numeracy (3 to 5 correct answers; $n = 66$). As noted in the Results section below, a Chi-square test of independence did not indicate any significant

systematic relationship between experimental treatment groups and these numeracy categories.

Remarkably, the 71 participants with low numeracy scores had a demographic and professional profile very similar to the overall sample: predominantly managers (52%) and executives (25%); 51% worked in non-financial industries; 73% held at least one professional certification relevant for risk management; and 72% had experience using a risk register. Additional information about the low numeracy subsample can be found in Table C2 of Appendix C.

Mediating Variables

Processing fluency. Based on Liu and Wong-on-Wing (2021) and Elliott et al. (2017), I measured subjective feelings of processing fluency with a three-item scale. I asked participants the degree to which the information in the risk report (a) was easy to process, (b) was difficult to understand, and (c) felt easy to read. Responses to these items ranged from 1 = " strongly disagree" to 7 = "strongly agree."

Perceived reliability. Based on Rennekamp (2012) and Elliott et al. (2017), I measured the perceived reliability of the report as the response to the statement, "Overall, I felt like I could rely on the information in the risk self-assessment report." Participants responded on a 7-point scale anchored with 1 = "strongly disagree and 7 = "strongly agree."

Construal level. I used the 25-item Behavioral Identification Form (Vallacher & Wegner, 1989) to measure construal level in a second sample of participants who received a modified version of the experiment. See the Results section for a discussion of the modified instrument.

Dependent Variable

Propensity to challenge. The dependent variable is a risk manager's propensity to challenge the business's own risk assessment. As an overall measure of propensity to challenge the report, I asked, "Overall, how confident are you that the risk self-assessment report presents a reasonable estimate of these risks."[24] Participants indicated their responses on an 11-point scale anchored with 0 = "lowest confidence" and 10 = "highest confidence." A lower level of confidence represents a higher propensity to challenge the business's self-assessment. I also collect a free-form explanation of the overall confidence level expressed.

To strengthen the presentation format and time horizon manipulations, when participants saw each risk displayed individually and sequentially on a separate screen before being shown the exhibit with the set of three risks displayed collectively (see Figure 15), they also answered the following question each time: "How confident are you that the business's self-assessment is a reasonable estimate of this risk?".

Covariates

To help isolate the effects of my hypothesized relationships, I measure other variables that are not of specific interest to this study but which are thought to be associated with individual risk perceptions:

Quantitative enthusiasm. Quantitative enthusiasm (Mikes, 2009) measured as the response to the statement, "Quantitative risk information is better for making decisions

[24] Experiments with auditors have used a similar measure to operationalize professional skepticism (e.g., Backof, Carpenter, & Thayer, 2018; Griffith, Hammersley, Kadous, & Young, 2015). I acknowledge that a more skeptical risk manager is not necessarily a more effective risk manager. Nonetheless, the measure is adequate for this study because it indicates the inclination of a risk manager to agree with a business manager when there is limited and ambiguous information about the risk.

than qualitative risk information." Participants responded on a 7-point scale anchored with 1 = "strongly disagree" and 7 = "strongly agree".

Expertise. Expertise measured as the response to the statement, "Please indicate your amount of actual, real-life experience evaluating at least one of the specific risks addressed in the XYZ report." Participants indicated their responses on an 11-point scale anchored with 0 = "no experience evaluating any of these specific risks" and 10 = "extensive experience evaluating one or more of these specific risks."

Risk aversion. Risk aversion (Bodnar et al., 2019; Graham et al., 2013), measured by choice among hypothetical risky job and salary options and scored from 0 (highly risk averse) to 3 (risk seeking). See the experimental instrument in Appendix D for the alternative job and salary options.

Demographic variables. The demographic variables were Age, Gender, and Work Experience (Bodnar et al., 2019; Graham et al., 2013).

TABLE 11
Variable Descriptions

Variable Name	Description	Informing Sources
Manipulated Independent Variables	Note: these manipulations were combined to create the primary independent variable: aligned vs. misaligned construal conditions at three levels.	
Presentation Format	The estimated likelihood and financial impact of each risk is expressed either qualitatively in words (an abstract representation of risk) or quantitatively in percentages and dollars (a concrete representation of risk).	Stoel et al. (2017), trade publications and discussions with practitioners
Time Horizon	The risk report covers a one-year period, which is either 5 years in the future (abstract representation) or the coming year (concrete representation).	
Measured Independent Variable		
Numeracy	A participant's statistical numeracy as measured by five multiple-choice questions, with each correct answer receiving one point. Each participant was assigned to a Low, Moderate, or High numeracy category based on their total points.	Elliott et al. (2017)

Mediating Variables		
Reliability	A participant's perception of the reliability of the risk report, indicated by response to the following statement: *Overall, I felt like I could rely on the information in the risk self-assessment report.* (1 = disagree strongly; to 7 = agree strongly)	Rennekamp (2012) and Elliott et al. (2017)
Processing Fluency	A participant's subjective feelings of processing fluency, indicated by responses to the following statements: 1. *...was easy to process.* 2. *...was difficulty to understand.* (reverse-scored) 3. *...felt easy to read.* (1 = disagree strongly; to 7 = agree strongly)	Liu and Wong-on-Wing (2021) and Elliott et al. (2017)
Construal Level	Level of mental abstraction was measured by a 25-item scale administered to a secondary sample of participants who received a modified version of the experiment.	Vallacher & Wegner (1989)
Dependent Variable		
Propensity to Challenge	Reverse scoring of a participant's response to the following question: *Overall, how confident are you that the risk self-assessment report presents a reasonable estimate of these risks?* (0: lowest confidence and 100: highest confidence)	Backof et al. (2018); Griffith et al. (2015)
Measured Covariates		
Quantitative Enthusiasm	A participant's preference for quantitative risk information over qualitative risk information, indicated by response to the following statement: *Quantitative risk information is better for making decisions than qualitative risk information.* (1 = disagree strongly; to 7 = agree strongly)	Mikes (2011) and discussion with practitioners
Expertise	A participant's experience evaluating the specific risks presented in the experimental scenario as indicated on the following scale: (0 = no experience evaluating any of these specific risks; to 10 = extensive experience evaluating one or more of these specific risks)	N/A
Risk Aversion	A participant's aversion to risk, measured by choice among hypothetical risky job and salary options. Scored from 0 (highly risk averse) to 3 (risk seeking).	Bodnar et al. (2019); Graham et al. (2013)
Demographic Covariates	Gender; Age; Years of Work Experience	Bodnar et al. (2019); Graham et al. (2013)

Results

Univariate Data Screening

Apart from some violations of homogeneity of variance between groups of unequal sample size addressed in the hypothesis testing section, the data meet all required statistical assumptions for subsequent analyses.

Manipulation Checks

Manipulation checks indicated that both Presentation Format and Time Horizon were manipulated effectively.[25] To keep the primary experiment brief, I performed manipulation checks in a separate, secondary sample of participants (see Lee et al., 2019 for an example of this approach). This group received a modified version of the instrument, which replaced questions measuring the dependent variable and mediator variables with questions that checked their comprehension of the time horizon and risk presentation format manipulations, as well as measured their construal levels. For details, see the Results subsection below-titled *Tests of the Relationship Between Construal Level and Processing Fluency*.

Descriptive Statistics and Data Visualization

Table 12 displays cell means for the participants' propensity to challenge a business's risk self-assessment (higher score = higher propensity). The predicted and actual pattern of means is illustrated graphically in Figures 17 through 23. This descriptive evidence is subject to inferential tests in the next section.

TABLE 12
Cell Means for Propensity to Challenge the Risk Assessment (by Construal Condition, Treatment Group, and Numeracy Category)

Panel A: Cell Means for Each Construal Condition

Construal Condition	Mean	Std. Dev	Sample Size
Aligned Abstract Construal	3.16	1.79	44
Misaligned Construal	3.03	1.38	149
Overall	3.06	1.48	193

[25] Some behavioral researchers (e.g., Hauser, Ellsworth, & Gonzalez, 2018) argue that the checks I conducted are better described as comprehension checks or attention checks since a manipulation can only be considered effective if it triggers the desired psychological state (which in my study would be either an abstract mindset or a concrete mindset).

Panel B: Cell Means by Treatment Group Within Each Construal Condition

Treatment Group	Mean	Std. Dev	Sample Size
Aligned Abstract Construal (Qualitative Hybrid / Distant Future)	3.16	1.79	44
Misaligned Construal (Quantitative / Distant Future)	3.48	1.27	50
Misaligned Construal (Qualitative Hybrid / Near Future)	2.56	1.40	48
Misaligned Construal (Quantitative / Near Future)	3.04	1.34	51
Overall	3.06	1.48	193

Panel C: Cell Means by Numeracy Category Within Each Treatment Group

Treatment Group		Numeracy			Row
		Low	Mod	High	Total
Aligned Abstract Construal (Qualitative Hybrid / Distant Future)	Mean	2.40	3.27	3.86	3.16
	Std. Dev	(1.50)	(1.67)	(1.99)	(1.79)
	Sample Size	$n = 15$	$n = 15$	$n = 14$	$n = 44$
Misaligned Construal (Quantitative / Distant Future)	Mean	3.89	3.08	3.37	3.48
	Std. Dev	(1.37)	(1.04)	(1.26)	(1.27)
	Sample Size	$n = 18$	$n = 13$	$n = 19$	$n = 50$
Misaligned Construal (Qualitative Hybrid / Near Future)	Mean	2.27	3.08	2.57	2.56
	Std. Dev	(1.32)	(1.78)	(1.09)	(1.40)
	Sample Size	$n = 22$	$n = 12$	$n = 14$	$n = 48$
Misaligned Construal (Quantitative / Near Future)	Mean	3.31	2.94	2.89	3.04
	Std. Dev	(1.40)	(1.00)	(1.56)	(1.34)
	Sample Size	$n = 16$	$n = 16$	$n = 19$	$n = 51$
Column Total	Mean	2.94	3.09	3.17	3.06
	Std. Dev	(1.52)	(1.37)	(1.54)	(1.48)
	Sample Size	$n = 71$	$n = 56$	$n = 66$	$n = 193$

Panel A of Table 12 and Figure 17 suggest that, contrary to my prediction, participants in the *Aligned Abstract Construal* condition were no more or less inclined to challenge the business's self-assessment than those in the *Misaligned Construal* condition. Furthermore, whereas I assumed that within the *Misaligned Construal* condition, there would be no differences between the three treatment groups (see the

rationale in the Hypotheses section), Panel B of Table 12 and Figure 18 indicate meaningful differences between the misaligned treatment groups (Quantitative/Distant Future; Qualitative-Hybrid / Near Future; Quantitative/Near Future*)*. In particular, participants assigned to a quantitative presentation of risk in the distant future appear much more inclined to challenge the self-assessment relative to those assigned to a qualitative-hybrid presentation of risk in the near future.

FIGURE 17
Graphical Illustration of Predicted and Actual Propensity to Challenge the Risk Assessment in Each Construal Condition

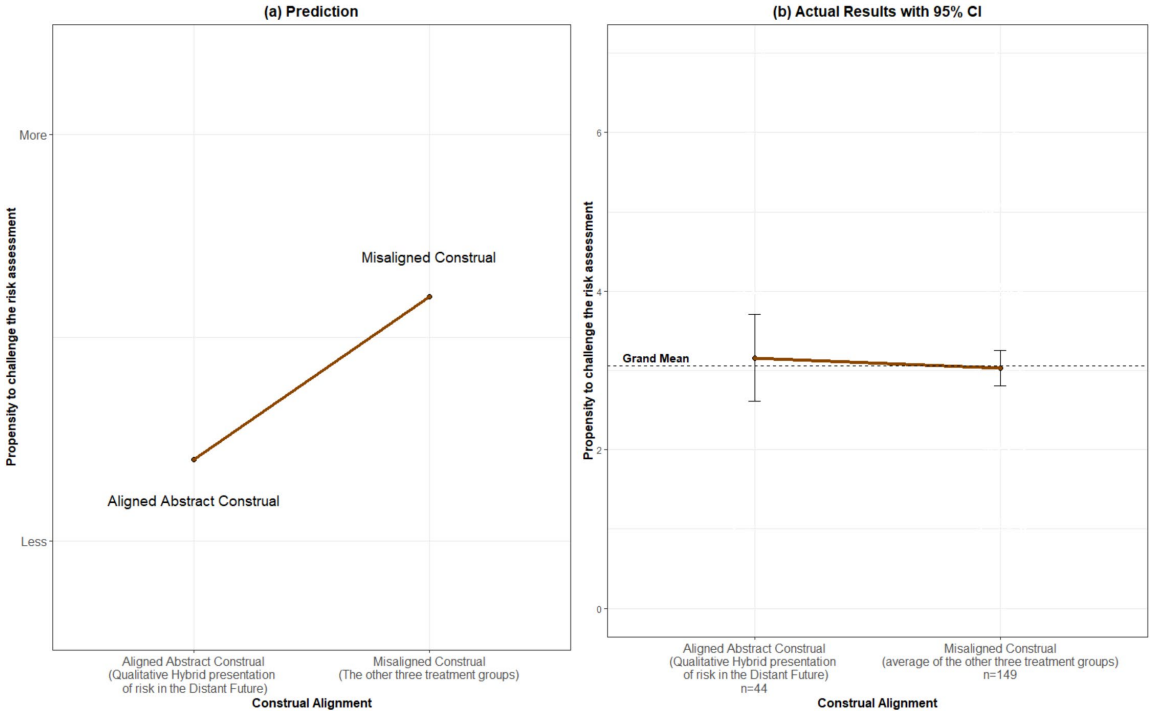
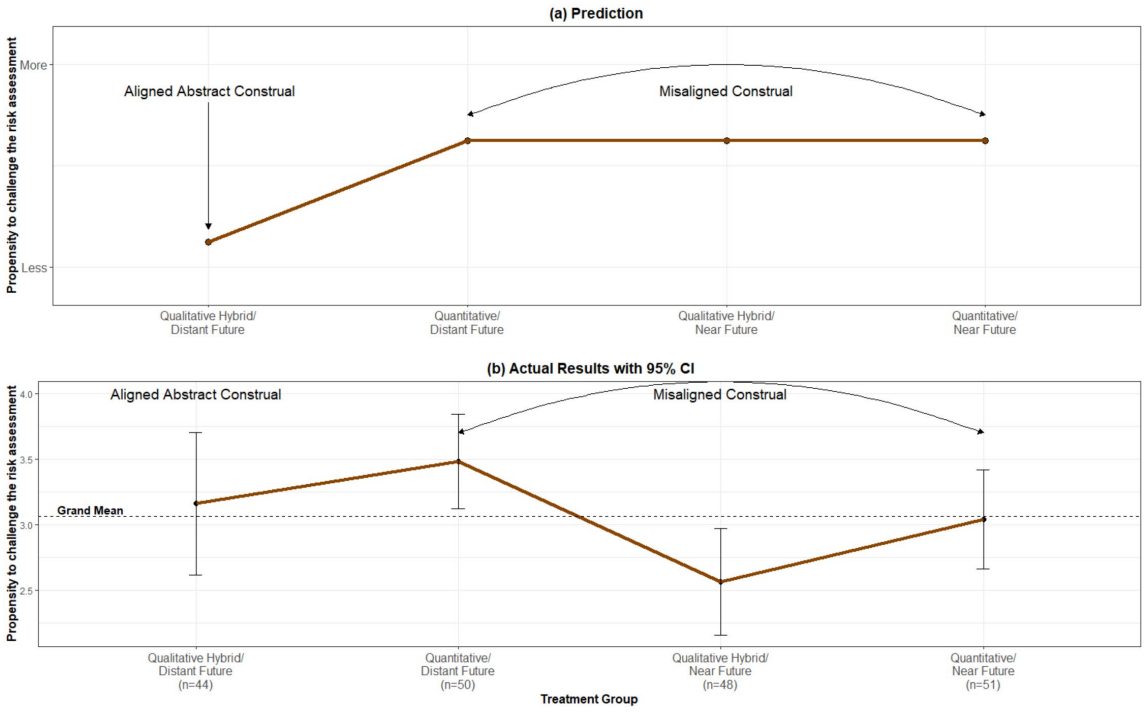


FIGURE 18
Further Breakdown of Predicted and Actual Propensity to Challenge the Risk Assessment (for Each Treatment Group Within Each Construal Condition)



Panel C of Table 12 and Figure 19 introduce numeracy categories to provide additional insight into the differences in experimental treatment groups illustrated by Figure 18. A Chi-square test of independence did not indicate any significant systematic relationship between treatment groups and numeracy categories, χ^2 (6, N = 193) = 3.26, p = .776. I predicted that a difference in behavior between more numerate and less numerate participants would be observed only when the presentation format is quantitative and the risk is in the distant future. The data do not provide descriptive support for my prediction. Instead, there is clear directional evidence that participants who are lower in numeracy are more prone to challenge a quantitative risk presentation than a qualitative risk presentation and that this tendency is stronger when the risk is in

the distant future. The behavior of higher numeracy participants is less distinguishable among treatment groups.

Although it was not part of the study design, I (unintentionally) recruited approximately half of the participants from financial services industries and the other half from non-financial industries. A Chi-square test of independence did not indicate any significant systematic relationship between industry type (financial and non-financial) and treatment group, χ^2 (3, N = 193) = 2.298, p = .435, or between industry type and numeracy categories, χ^2 (2, N = 193) = 0.537, p = .765. Figure C1 in Appendix C presents the distribution of numeracy scores within each industry type. Figure 20 shows that the pattern of means observed for the overall sample also holds within each industry type, although it seems to be more pronounced in the non-financial industry than in the financial industry.

FIGURE 19

Predicted and Actual Propensity to Challenge the Risk Assessment for Each Treatment Group Split by Numeracy

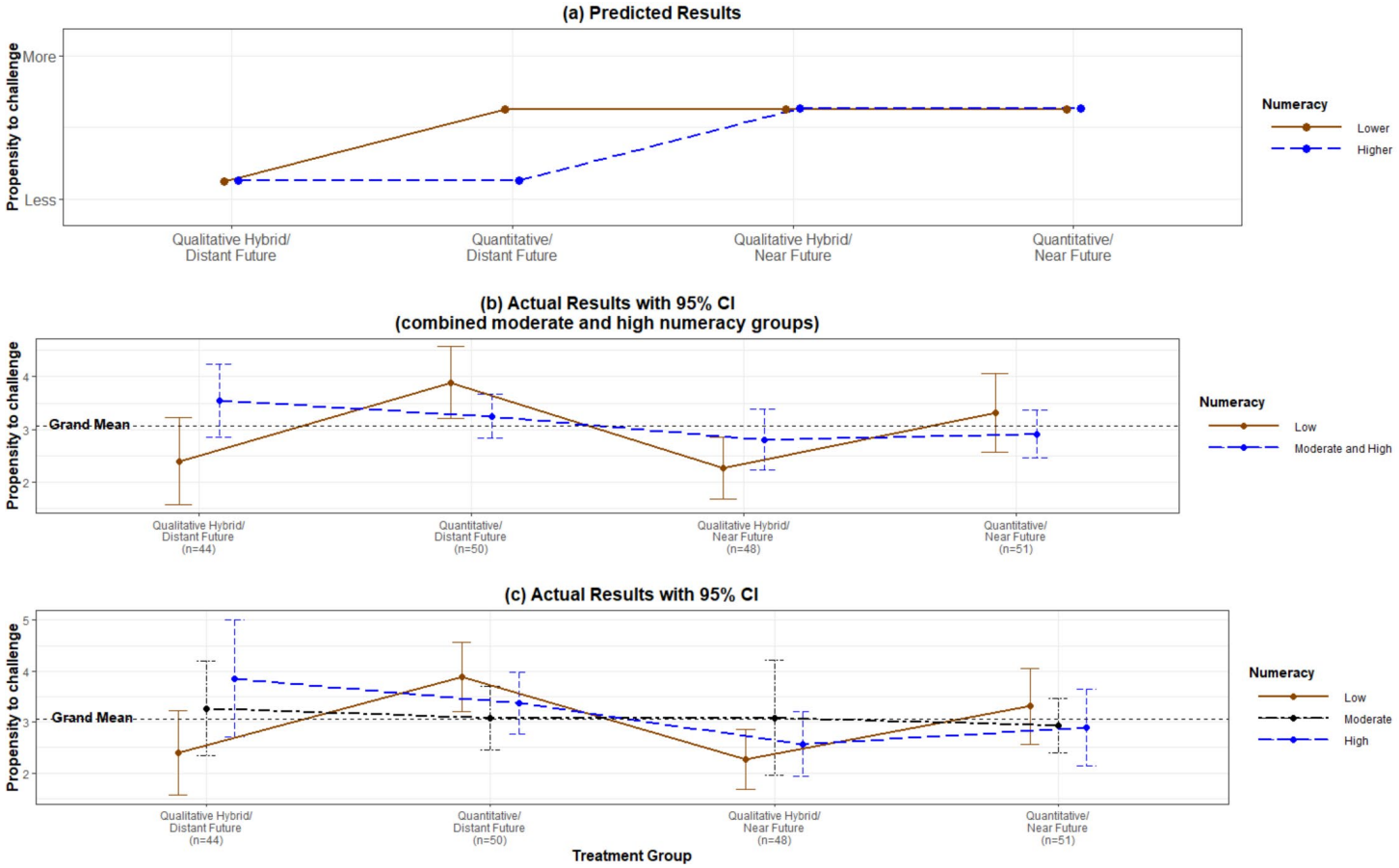


FIGURE 20

Actual Propensity to Challenge the Risk Assessment for Each Treatment Group Split by Numeracy and Industry Type

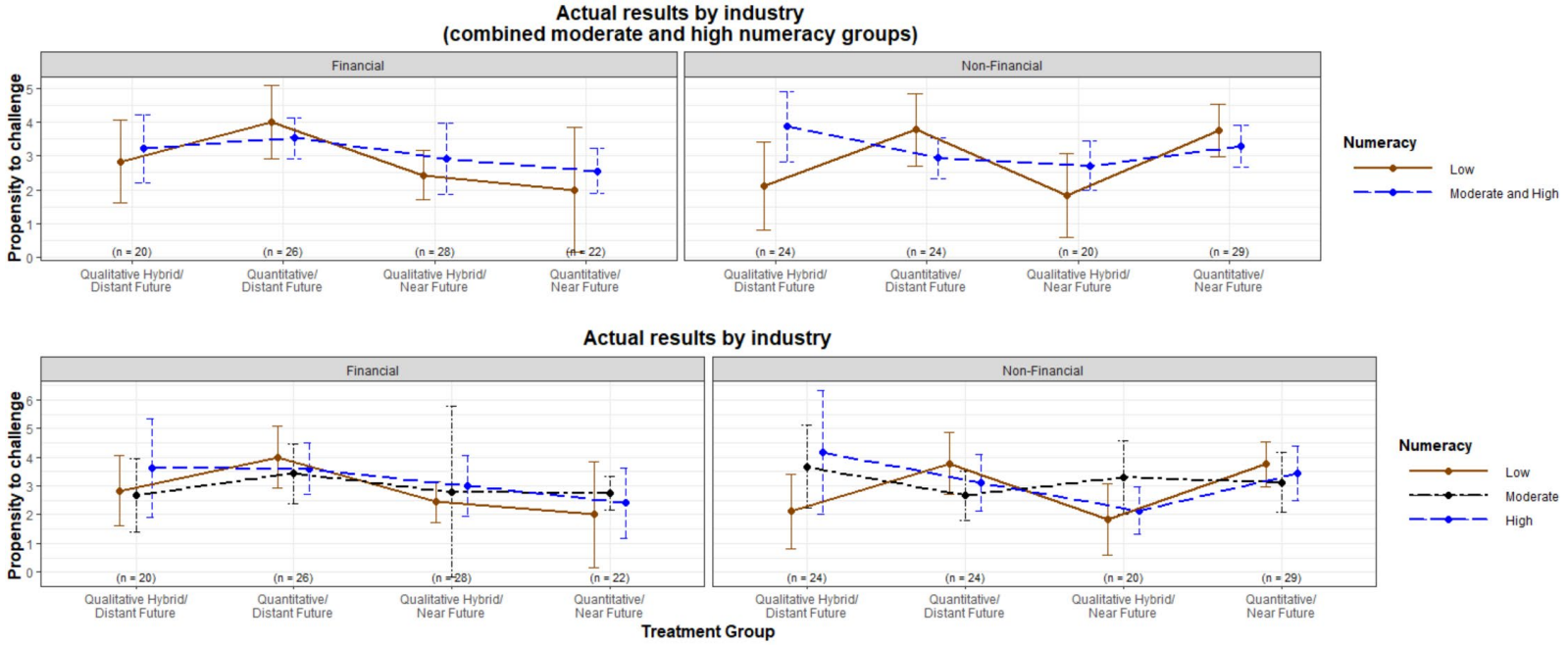


Table 13 and Figures 21 through 23 provide additional perspectives on the descriptive evidence noted above. Table 13 displays separate group means for the time horizon and risk presentation format manipulations (which cannot easily be deduced from the treatment group data in Table 12) for the overall sample as well as within each numeracy category. Figures 21 through 23 bring the potential relationships into starker relief.

TABLE 13
Cell Means for Propensity to Challenge the Risk Assessment (by Presentation Format, Time Horizon, and Numeracy Category)

Panel A: All Participants

		Time Horizon		
Risk Presentation		**Distant Future**	**Near Future**	**Row Total**
Qualitative Hybrid	Mean	3.16	2.56	2.85
	Std. Dev	(1.79)	(1.40)	(1.62)
	Sample Size	$n = 44$	$n = 48$	$n = 92$
Quantitative	Mean	3.48	3.04	3.26
	Std. Dev	(1.27)	(1.34)	(1.32)
	Sample Size	$n = 50$	$n = 51$	$n = 101$
Column Total	Mean	3.33	2.81	3.06
	Std. Dev	(1.53)	(1.38)	(1.48)
	Sample Size	$n = 94$	$n = 99$	$n = 193$

Panel B: Low Numeracy Participants

		Time Horizon		
Risk Presentation		**Distant Future**	**Near Future**	**Row Total**
Qualitative Hybrid	Mean	2.40	2.27	2.32
	Std. Dev	(1.50)	(1.32)	(1.38)
	Sample Size	$n = 15$	$n = 22$	$n = 37$
Quantitative	Mean	3.89	3.31	3.62
	Std. Dev	(1.37)	(1.40)	(1.39)
	Sample Size	$n = 18$	$n = 16$	$n = 34$
Column Total	Mean	3.21	2.71	2.94
	Std. Dev	(1.60)	(1.43)	(1.52)
	Sample Size	$n = 33$	$n = 38$	$n = 71$

Panel C: Moderate Numeracy Participants

		Time Horizon		
Risk Presentation		**Distant Future**	**Near Future**	**Row Total**
Qualitative Hybrid	Mean	3.27	3.08	3.19
	Std. Dev	(1.67)	(1.78)	(1.69)
	Sample Size	$n = 15$	$n = 12$	$n = 27$
Quantitative	Mean	3.08	2.94	3.00
	Std. Dev	(1.04)	(1.00)	(1.00)
	Sample Size	$n = 13$	$n = 16$	$n = 29$
Column Total	Mean	3.18	3.00	3.09
	Std. Dev	(1.39)	(1.36)	(1.37)
	Sample Size	$n = 28$	$n = 28$	$n = 56$

Panel D: High Numeracy Participants

		Time Horizon		
Risk Presentation		**Distant Future**	**Near Future**	**Row Total**
Qualitative Hybrid	Mean	3.86	2.57	3.21
	Std. Dev	(1.99)	(1.09)	(1.71)
	Sample Size	$n = 14$	$n = 14$	$n = 28$
Quantitative	Mean	3.37	2.89	3.13
	Std. Dev	(1.26)	(1.56)	(1.42)
	Sample Size	$n = 19$	$n = 19$	$n = 38$
Column Total	Mean	3.58	2.76	3.17
	Std. Dev	(1.60)	(1.37)	(1.54)
	Sample Size	$n = 33$	$n = 33$	$n = 66$

Figures 21 and 22 indicate that, overall, numeracy did not matter very much by itself. However, the effect of presentation format on risk judgment appears to be highly reliant on numeracy since less numerate participants show a much greater tendency than their more numerate counterparts to challenge the self-assessment when evaluating a quantitative presentation format. Conversely, they show a much lower tendency to challenge a qualitative-hybrid presentation format than their more numerate counterparts. The exhibits also indicate that this behavior is more prominent when risk is in the distant future than in the near future and is also more prominent when

participants come from a non-financial industry. Figure 23 suggests that, overall, a risk in the distant future is more likely to prompt a challenge than one in the near future. It also further illuminates potential industry differences by showing that less numerate participants from non-financial industries appear more inclined to challenge a quantitative presentation than a qualitative-hybrid presentation regardless of a risk's time horizon, whereas less numerate participants from financial industries exhibit this behavior only when risk is in the distant future.

FIGURE 21
Actual Propensity to Challenge the Risk Assessment Split by Numeracy Category

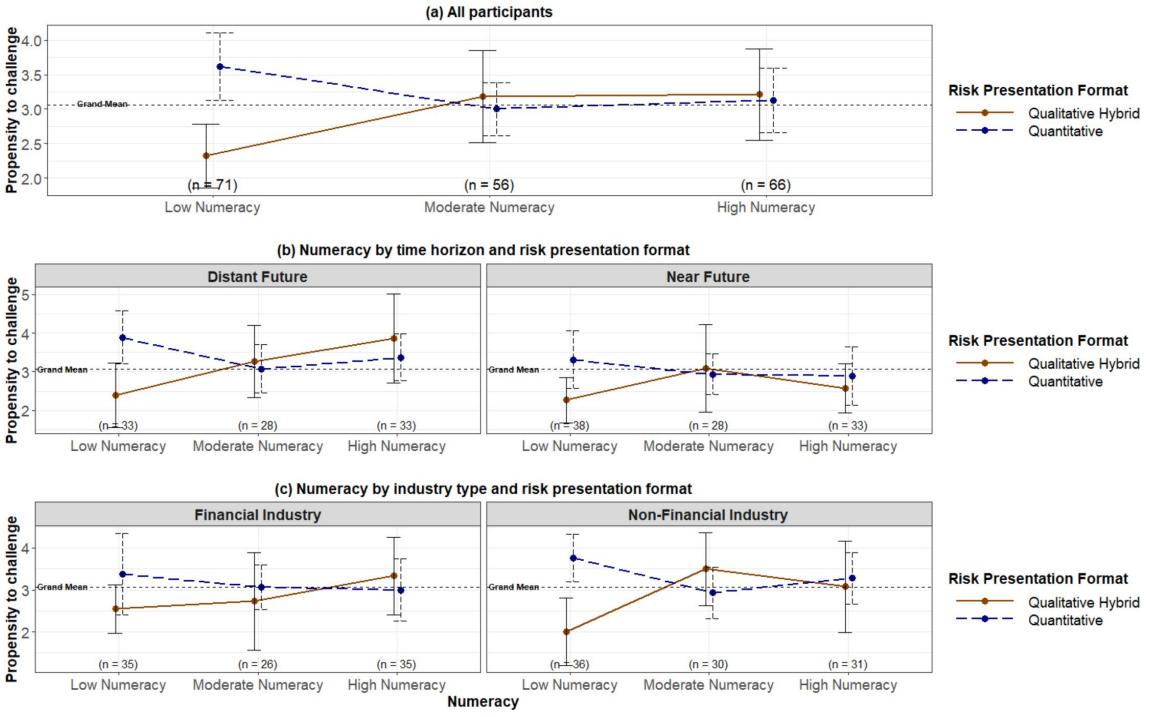


FIGURE 22
Actual Propensity to Challenge the Risk Assessment Split by Presentation Format

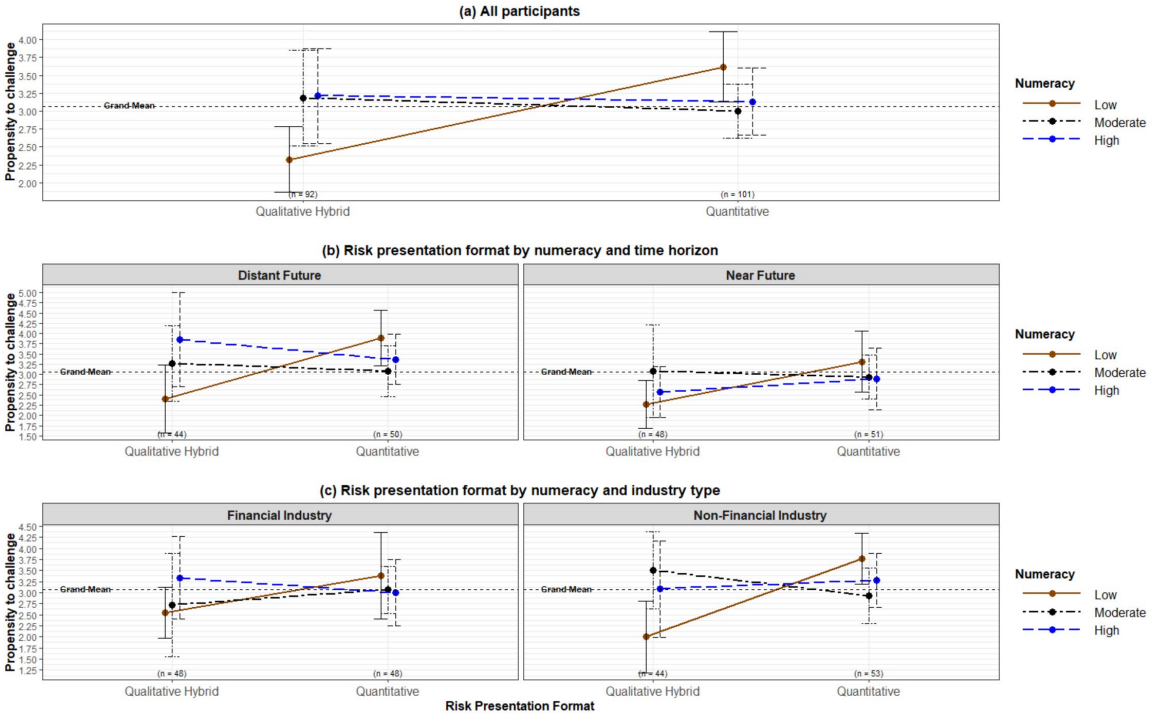
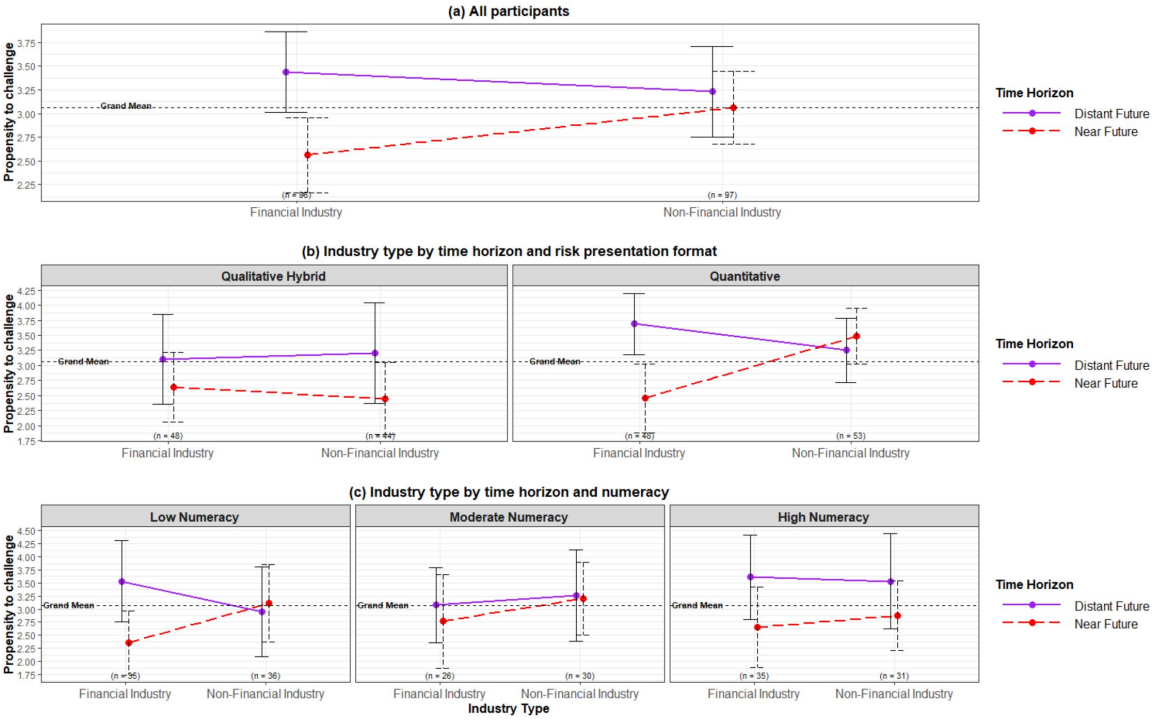


FIGURE 23
Actual Propensity to Challenge the Risk Assessment Split by Industry Type



Tests of Hypotheses[26]

Table 14 summarizes the hypotheses and test results.

TABLE 14
Results of Hypotheses Testing

Hypotheses	Supported
H1: When a highly uncertain risk is in the distant future, and the risk report presentation is qualitative, risk managers will be less inclined to challenge front-line management's risk assessment than in all other combinations of time horizon and report presentation style.	No
H2: When a highly uncertain risk is in the distant future and the risk report presentation is quantitative, less numerate risk managers will be more inclined to challenge front-line management's risk assessment than more numerate risk managers.	No*
H3: The joint effects of presentation format, time horizon, and numeracy on a risk manager's inclination to challenge front-line management's risk assessment act indirectly and serially through subjective feelings of processing fluency and the perceived reliability of the risk report.	YES

*H2 had partial support in the form of a marginally significant difference between propensity to challenge the risk self-assessment in low-numeracy participants compared to the average of moderate-numeracy and high-numeracy participants.

Test of Hypothesis 1. H1 predicts that *Propensity to Challenge* will be lower in the *Aligned Abstract Construal* condition than in the *Misaligned Construal* condition. However, the observed difference in sample means of 0.13 (see Table 12) is in the opposite direction. Therefore, H1 is not supported.

Levene's test for homogeneity of variance indicated that the assumption of equal variances in the two conditions was not met, $F(1, 191) = 4.70$, $p = .031$, so I conducted a Welch two-sample t-test to determine whether average *Propensity to Challenge* differed

[26]All statistical analyses were performed using either the R language and environment for statistical computing (R Core Team, 2023) or Mplus version 8.8. Hypotheses tests were also reproduced using IBM SPSS version 29.

between the two conditions. This test is more robust to violations of the assumption of equal variances than an independent samples t-test. The test indicated no significant difference between the two conditions, $t(58.82) = 0.43$, 95% CI [-0.46, 0.71], $p = .670$ (two-sided).

Test of Hypothesis 2. H2 predicts that *Propensity to Challenge* will be higher for less numerate risk managers in the *Quantitative/Distant Future* treatment group than for more numerate risk managers in the same treatment group. To test this hypothesis, I conducted two planned comparisons[27] (one-sided). One compared *Low Numeracy* participants in the *Quantitative/Distant Future* treatment group to the combination of *High Numeracy* and *Moderate Numeracy* participants in the same treatment group. The other compared *Moderate Numeracy* participants in the *Quantitative/Distant Future* treatment group to *High Numeracy* participants in the same treatment group. I then performed follow-up ANOVAs and post-hoc comparisons.

Levene's test for homogeneity of variance indicated that the assumption of equal variances was met for the groups being compared. A planned contrast between means of the combined *High*/*Moderate* numeracy participants and the *Low Numeracy* participants revealed a marginally significant difference (0.64, SE = 0.42) in the predicted direction, $t(185) = 1.52$, $p = .065$ (one-sided). A planned contrast between means of the *High Numeracy* and *Moderate Numeracy* participants within the *Quantitative/Distant Future* treatment group indicated that the observed difference (-0.29, SE = 0.51) was not

[27] I originally planned to do one comparison based on a median split. However, the numeracy data fit better into three categories than two, as I described earlier in the Results section.

significant, $t(181) = 0.57$, $p = 0.286$ (one-sided), and was in the opposite direction of my prediction.

The results of the planned comparisons provide some support for H2. However, the theory behind H2 also implies that when a risk is in the distant future, a quantitative risk presentation is the only format that will elicit a difference in mean *Propensity to Challenge* between less numerate and more numerate participants (i.e., a difference should be observable only in the *Quantitative/Distant Future* treatment group). To test this assumption, I conducted a 4x3 ANOVA with four treatment groups (*Qualitative Hybrid/Distant Future; Quantitative/Distant Future; Qualitative Hybrid/Near Future; Quantitative/Near Future*) and three numeracy categories (*Low Numeracy, Moderate Numeracy, High Numeracy*). The results of the analysis are summarized in Panel A of Table 15. I investigated the significant interaction between treatment group and numeracy, $F(6, 181) = 2.19$, $p = .045$, using pairwise comparisons to check whether there were differences between less numerate and more numerate participants in any other treatment groups. Post-hoc pairwise comparisons with no adjustment for Type I error (a more liberal test is appropriate in this case since it is more likely to disconfirm the assumptions connected with H2) showed that the only other significant (or marginally significant) difference was within the *Qualitative Hybrid/Distant Future* treatment group. The mean *Propensity to Challenge* for *High Numeracy* participants was significantly higher (1.46, SE = 0.53) than the mean for *Low Numeracy* participants, $t(181) = 2.74$, $p = .007$ (two-sided, unadjusted). This result is contrary to my theoretical assumptions. The difference was not statistically significant when pairwise comparisons were adjusted using the Tukey HSD test, $t(181) = 2.74$, $p = .215$ (two-sided, adjusted).

I re-performed these comparisons using the ANCOVA model in Panel B of Table 15 (see Covariate section below for a discussion of influential covariates) and obtained similar inferential results.[28] In untabulated analyses, I also repeated the ANOVA and post-hoc tests with two numeracy levels (High/Moderate and Low) instead of three levels and obtained similar inferential results.

TABLE 15
4x3 ANOVA/ANCOVA Summary Tables for Propensity to Challenge the Risk Self-Assessment

Panel A: ANOVA Model

Source	S.S.	*df*	*F*-Ratio	*p*-value
Treatment Group	15.51	3	2.53	0.059
Numeracy	1.42	2	0.35	0.707
Treatment Group * Numeracy	26.93	6	2.19	0.045
Error	370.24	181		

R-squared = 0.117, Adjusted *R*-squared = 0.063.

Panel B: ANCOVA Model

Source	S.S.	*df*	*F*-Ratio	*p*-value
Quantitative Enthusiasm	16.54	1	8.66	0.004
Expertise	13.05	1	6.83	0.010
Treatment Group	12.30	3	2.15	0.096
Numeracy	1.89	2	0.50	0.610
Treatment Group * Numeracy	25.77	6	2.25	0.041
Error	341.84	179		

R-squared = 0.185, Adjusted *R*-squared = 0.125.

Based on these analyses, I conclude that H2 is not supported despite the presence of a marginally significant mean difference in the predicted direction. Interestingly, the

[28] There is one notable change to the results when I control for covariates (*Quantitative Enthusiasm* and *Expertise*): The marginally significant planned contrast between means of the combined High/Moderate numeracy participants and the Low Numeracy participants (0.64, $p = .065$, one-sided) becomes significant (0.72, $p = .039$, one-sided).

tests provide statistical evidence that behavior in the *Qualitative Hybrid/Distant Future* treatment group, where more numerate participants had a higher mean *Propensity to Challenge* than less numerate participants, is the opposite of that in the *Quantitative/Distant Future* treatment group, where less numerate participants had a higher mean *Propensity to Challenge*. I conduct exploratory data analysis in a separate subsection below.

Covariates. Although participants were assigned randomly to experimental treatment groups, it is possible that a covariate was either unexpectedly affected by a manipulation or unevenly distributed across the treatment groups, in which cases the covariate's influence on the dependent variable (if any) could vary across experimental conditions. To help rule out the possibility that such instances confound the results of my statistical analyses, I followed the advice of Piercey (2023) and tested for unexpected covariate interactions by using the model comparison approach (Judd, McClelland, & Ryan, 2017) to conduct semiomnibus *F*-tests of all possible interaction terms involving the covariates. I conducted these tests for the measured covariates *Quantitative Enthusiasm*, *Expertise*, and *Risk Aversion* described in Table 11, as well as for the demographic[29] covariates *Gender*, *Age,* and *Work Experience,* which have been shown to affect risk judgments (Bodnar et al., 2019; Graham et al., 2013). I also conducted the same tests for industry type (financial/non-financial), whether or not the participant held a professional certification (yes/no) or had used a risk register (yes/no). Additionally, I noted that the least-numerate participants took, on average, 2.51 minutes less time to complete the instrument than participants in the two higher numeracy categories

[29] I coded the five ordinal categories of *Work Experience* and *Age* as integers for purposes of this test.

combined, Welch $t(163.13) = 2.39$, 95% CI [0.44, 4.59]; $p = .018$ (two-sided). So, to help satisfy myself that the effects being attributed to numeracy are not simply due to rushed inattention, I also conducted a semiomnibus *F*-test for study completion time.[30]

The tests identified *Quantitative Enthusiasm* and *Expertise* as potentially influential covariates. Table 16 displays the test results for all covariates which had interaction terms with $p < .10$ significance. To conduct the tests, I first created a 2 (*Presentation Format*) x 2 (*Time Horizon*) x 3 (*Numeracy*) linear model (the reduced model) with *Propensity to Challenge* as the dependent variable. See Panel A of Table 17 for the reduced model. Then, for each covariate, I created a version of the model that included all possible interaction terms involving the covariate being tested (the full model). There were four covariates for which the full model produced a covariate interaction term with $p < .10$. For these covariates, I then performed a semiomnibus *F*-test comparing the full model to the reduced model to establish whether there was a statistically significant shift within the total variation of *Propensity to Challenge* from unexplained to explained due to the additional terms in the full model. There were two covariates, *Quantitative Enthusiasm* and *Expertise*, for which the explanatory power of the full model was significantly better, so I conducted a second semiomnibus *F*-test comparing the full model to a version of the model that included only a covariate term with no interactions. The second test indicated no significant difference between the two models for each covariate. I therefore performed a third semiomnibus test comparing the reduced model to the model, including only a covariate term with no interactions. This

[30] As described earlier in the Descriptive Statistics and Data Visualization section, a chi-square test of independence did not indicate any significant systematic relationship between treatment groups and numeracy categories.

test indicated a significantly higher proportion of explained variability when either *Quantitative Enthusiasm* or *Expertise* was included as a covariate with no interactions. A fourth set of semiomnibus *F*-tests established that a model with both covariates and no interactions had significantly more explanatory power than a model that included either covariate term alone. See Panel B of Table 17 for the ANCOVA model, which includes both *Quantitative Enthusiasm* and *Expertise*.

TABLE 16
Results of Model Comparisons to Test the Influence of Covariates in a 2 (Presentation Format) x 2 (Time Horizon) x 3 (Numeracy) Linear Model

Covariate interactions with $p < .10$	Significantly more explained variance in full model with all covariate interaction terms compared to reduced model (no covariate).	Significantly more explained variance in full model with all covariate interaction terms compared to reduced model plus covariate with no interactions.	Significantly more explained variance in reduced model plus covariate with no interactions compared to reduced model.
Quantitative Enthusiasm (1) Quantitative Enthusiasm * Risk Presentation; (2) Quantitative Enthusiasm * Numeracy	Yes, F (12, 181), p = .030	No, F (11, 180), p = .166	Yes, F (1, 181), p = .006
Expertise Expertise * Numeracy	Yes, F (12, 181), p = .093	No, F (11, 180), p = .285	Yes, F (1, 181), p = .016
Industry Type (1) Industry Type * Presentation Format * Time Horizon; (2) Industry Type * Presentation Format * Numeracy	No, F (12, 181), p = .274	Test is not necessary	Test is not necessary
Certification Certification * Presentation Format * Time Horizon	No, F (12, 181), p = .204	Test is not necessary	Test is not necessary

Notably, including industry type (financial/non-financial) in the model does not explain significantly more variance in the dependent variable despite seeming important in the graphics of the Descriptive Statistics and Data Visualization section above. Industry type is discussed below in the exploratory data analysis subsection and the

supplemental moderated mediation analysis subsection. Table C3 of Appendix C shows the results of the full ANOVA model with all industry type interaction terms.

TABLE 17
2x2x3 ANOVA/ANCOVA Summary Tables for Propensity to Challenge the Risk Self-Assessment

Panel A: Reduced Model

Source	S.S.	*df*	*F*-Ratio	*p*-value
Presentation Format	5.36	1	2.62	0.107
Time Horizon	10.11	1	4.94	0.027
Numeracy	1.42	2	0.35	0.707
Presentation Format * Time Horizon	0.22	1	0.11	0.746
Presentation Format * Numeracy	21.19	2	5.18	0.006
Time Horizon * Numeracy	4.26	2	1.04	0.355
Presentation Format * Time Horizon * Numeracy	3.36	2	0.82	0.442
Residuals	370.24	181		

R-squared = 0.117, Adjusted *R*-squared = 0.063

Panel B: ANCOVA Model with Influential Covariates

Source	S.S.	*df*	*F*-Ratio	*p*-value
Quantitative Enthusiasm	16.54	1	8.66	0.004
Expertise	13.05	1	6.83	0.010
Presentation Format	3.69	1	1.93	0.166
Time Horizon	8.76	1	4.59	0.034
Numeracy	1.89	2	0.50	0.610
Presentation Format * Time Horizon	0.00	1	0.00	0.991
Presentation Format * Numeracy	21.49	2	5.63	0.004
Time Horizon * Numeracy	2.80	2	0.73	0.482
Presentation Format * Time Horizon * Numeracy	2.83	2	0.74	0.478
Residuals	341.84	179		

R-squared = 0.185, Adjusted *R*-squared = 0.125.

Exploratory data analysis. This subsection probes the data for statistical evidence to support the relationships depicted visually in the Descriptive Statistics and Data Visualization section. Since it is exploratory rather than confirmatory, I have not adjusted

inferences for type I error. The results indicate that (1) for the sample overall, a distant time frame was associated with greater propensity to challenge the risk assessment; (2) for the sample overall, participants with low numeracy were more prone to challenge a quantitative report format than a qualitative-hybrid format; (3) when faced with a quantitative presentation format, participants from financial industries were more prone to challenge it if risk was in the distant future whereas participants from non-financial industries were inclined to challenge it equally across time horizons.

The 2x2x3 reduced model in Panel A of Table 17 shows a significant main effect of *Time Horizon*, $F(1, 181) = 4.94$, $p = .027$, meaning that participants on average were significantly more inclined (0.47, 95% CI [0.05, 0.88]) to challenge a risk self-assessment involving the *Distant Future*.

There is also a significant interaction between *Presentation Format* and *Numeracy*, $F(2, 181) = 5.18$, $p = .006$. An analysis of the simple (i.e., conditional) effects of *Presentation Format* within each level of *Numeracy* revealed a significantly higher average inclination (1.26, 95% CI [0.59, 1.94]) to challenge the *Quantitative* format than the *Qualitative Hybrid* format in *Low Numeracy* participants, $t(181) = 3.69$, $p < .001$ (two-sided). This difference was not significant within *Moderate Numeracy* or *High Numeracy* participants. Furthermore, pairwise comparisons revealed that when the risk self-assessment was presented in a *Qualitative-Hybrid* format, *Low Numeracy* participants had a significantly lower mean propensity to challenge it than *Moderate Numeracy* participants (-0.84, 95% CI [-0.12, -1.56], $p = .023$, two-sided) or *High Numeracy* participants (-0.88, 95% CI [-0.17, -1.57], $p = .016$, two-sided). Conversely, when the risk self-assessment was presented in a *Quantitative* format, *Low Numeracy* participants

had a higher (but not significantly so) mean propensity to challenge it than *Moderate Numeracy* participants (0.59, 95% CI [-0.12, 1.31], $p = .104$, two-sided) and *High Numeracy* participants (0.47, 95% CI [-0.20, 1.14], $p = .167$, two-sided). I reperformed this analysis using the model, which includes covariates (*Quantitative Enthusiasm* and *Expertise*) in Panel B of Table 17, and obtained similar statistical results.[31]

Although not the focus of this study, adding *Industry Type* to the model reveals interesting additional statistical relationships. The results of a 2x2x3x2 ANOVA are shown in Table C3 of Appendix C. There is a significant three-way interaction between *Industry Type*, *Presentation Format,* and *Time Horizon*, $F(1, 181) = 6.34$, $p = .013$, and a marginally significant three-way interaction between *Industry Type*, *Presentation Format* and *Numeracy*, $F(2, 181) = 2.48$, $p = .087$.

Considering the *Industry Type*, *Presentation Format,* and *Time Horizon* interaction first, I examined the two-way interactions at each level of *Industry Type* and found that when the risk self-assessment was presented in a *Quantitative* format, only participants from financial industries had a significantly higher propensity (1.29, 95% CI [0.43, 2.14]) to challenge a *Distant Future* context than a *Near Future* context, $t(169) = 3.00$, $p = .003$ (two-sided). Participants from non-financial industries behaved consistently across time horizons when faced with a Quantitative format. Conversely, when the risk self-assessment was presented in a *Qualitative Hybrid* format, only participants from

[31] There are two notable changes to the results when I control for covariates:
(1) the non-significant difference in propensity to challenge (0.59, $p = .104$) observed in *Low Numeracy* participants viewing a *Quantitative* format compared to *Moderate Numeracy* participants viewing the same format becomes marginally significant (0.63, $p = .076$).
(2) the significant difference in propensity to challenge (-0.84, $p = .023$) observed in *Low Numeracy* participants viewing a *Qualitative Hybrid* format compared to *Moderate Numeracy* participants viewing the same format becomes marginally significant (-0.67, $p = .063$).

non-financial industries had a significantly higher mean propensity (0.89, 95% CI [0.04, 1.75]) to challenge a *Distant Future* context than a *Near Future* context, $t(169) = 2.06$, $p = .041$ (two-sided). Additionally, for risks expected to materialize in the *Near Future*, only participants from non-financial industries showed a significantly higher mean propensity (1.02, 95% CI [0.20, 1.84]) to challenge the *Quantitative* format over the *Qualitative Hybrid* format $t(169) = 2.45$, $p = .015$ (two-sided).

Considering the *Industry Type*, *Presentation Format,* and *Numeracy* interaction next, I examined the two-way interactions at each level of *Industry Type* and found that when the risk self-assessment was presented in a *Quantitative* format, *Low Numeracy* participants from both industry groups had a higher mean propensity to challenge it compared to a *Qualitative Hybrid* format. However, the difference was only significant in participants from non-financial industries (1.79, 95% CI [2.76, 0.86]), $t(169) = 3.67$, $p < .001$, two-sided). The reaction of participants from financial industries was much weaker (0.37, 95% CI[1.44, -0.71], $t(169) = 0.67$, $p = .505$, two-sided).

I re-performed the industry analysis with the covariates *Quantitative Enthusiasm* and *Expertise* in the model and obtained similar statistical results.[32] See Table C3 of Appendix C for the ANCOVA model, which includes all interaction terms involving *Industry Type*. The findings of this exploratory data analysis give statistical credence to the visual relationships that I portrayed earlier.

[32] There is one notable change to the results when I control for covariates: The significant difference in propensity to challenge (0.89, $p = .041$) observed in participants from non-financial industries when viewing a *Qualitative Hybrid* format with risk in *Distant Future* compared to the same format with risk in the *Near Future* becomes non-significant (0.68, $p = .110$).

Test of Hypothesis 3. H3 predicts that the effects of *Presentation Format*, *Time Horizon*, and *Numeracy* on participants' *Propensity to Challenge* operate indirectly through subjective feelings of *Processing Fluency,* which then affect the *Perceived Reliability* of the risk report. I used the Hayes (2022) PROCESS[33] tool, configured for Model 85, and employed the Preacher and Hayes (2008) bootstrapping approach to test the indirect effects predicted by H3. My depiction and interpretation of PROCESS model results in this section follows the example set by Brazel et al. (2022) and guidance from Jollineau and Bowen (2023), Hayes (2018, 2022), and Hayes and Rockwood (2020).

A moderated mediation path is significant if the bootstrapped confidence interval for the product of relevant path coefficients, which Hayes (2022) labels the *index of moderated mediation*, does not include zero. This index directly quantifies the change in the indirect effect of the independent variable on the dependent variable as the moderator changes by one unit. If a model has two moderators which each operate separately on the independent variable (i.e., no three-way interaction), each moderator has its own index of moderated mediation, which Hayes (2018) collectively labels the *indices of partial moderated mediation*. These "partial" indices quantify the index of moderated mediation for one moderator when the other moderator is held constant. If an index of moderated mediation provides affirmative evidence that an indirect effect is moderated, the next step is to derive conditional indirect effects for different values of the moderator (i.e., probe the interaction) and conduct inferences about these conditional indirect effects.

[33] I used the PROCESS function for R created by Hayes (2022) and reproduced the results with the PROCESS macro for SPSS. Model 85 is a standard pre-configured moderated serial mediation model with a single moderator. The model syntax is easily customized to include a second moderator, with or without three-way interaction, by adding either the "zmatrix" or "wzmatrix", respectively. See the Appendix in Hayes (2022) for details.

I tested for the indirect effect of *Presentation Format* on *Propensity to Challenge* via *Processing Fluency* and *Perceived Reliability*, conditional on *Time Horizon* and *Numeracy*, by estimating the following three Ordinary Least Squares (OLS) equations using PROCESS.[34] Table 18 presents coefficients and standard errors from the results of the regressions. Including *Quantitative Enthusiasm*, *Expertise*, and *Industry Type* in the regressions as covariates (untabulated) does not change any inferences.

(1) $Processing\ Fluency = \alpha_1 + \beta_{1.0}\, Presentation\ Format + \beta_{1.1}\, Time\ Horizon + \beta_{1.2}\, Numeracy + \beta_{1.3}\, Presentation\ Format{*}Time\ Horizon + \beta_{1.4}\, Presentation\ Format{*}Numeracy + \varepsilon$

(2) $Perceived\ Reliability = \alpha_2 + \beta_{2.0}\, Presentation\ Format + \beta_{2.1}\, Time\ Horizon + \beta_{2.2}\, Numeracy + \beta_{2.3}\, Presentation\ Format{*}Time\ Horizon + \beta_{2.4}\, Presentation\ Format{*}Numeracy + \beta_{2.5}\, Processing\ Fluency + \varepsilon$

(3) $Propensity\ to\ Challenge = \alpha_3 + \beta_{3.0}\, Presentation\ Format + \beta_{3.1}\, Time\ Horizon + \beta_{3.2}\, Numeracy + \beta_{3.3}\, Presentation\ Format{*}Time\ Horizon + \beta_{3.4}\, Presentation\ Format{*}Numeracy + \beta_{3.5}\, Processing\ Fluency + \beta_{3.6}\, Perceived\ Reliability + \varepsilon$

To further simplify analysis and interpretation, I combined the *Moderate* and *High Numeracy* participants into a single *Mod/High Numeracy* group. This is a reasonable approach since the *Low Numeracy* participants exhibited distinct behavior relative to *Moderate* and *High Numeracy* participants in the visual displays, hypothesis tests, and exploratory data analysis. I averaged the three items measuring *Processing*

[34] I first tested an untabulated set of OLS equations which included the three-way interaction of *Presentation Format * Time Horizon * Numeracy*. The *index of moderated-moderated mediation* (Hayes, 2018) indicated no evidence of indirect effects of a three-way interaction. Therefore, to simplify analysis and interpretation, I constrained the model to two interactions: *Presentation Format * Time Horizon* and *Presentation Format * Numeracy.*

Fluency (see description of variables in Table 11) as they had a Cronbach's alpha reliability measure of 0.79, which implies that they adequately measure the same construct.

TABLE 18
OLS Regression Coefficients (Standard Errors) for a Model of the Effect of Risk Presentation Format on Propensity to Challenge the Risk Self-Assessment

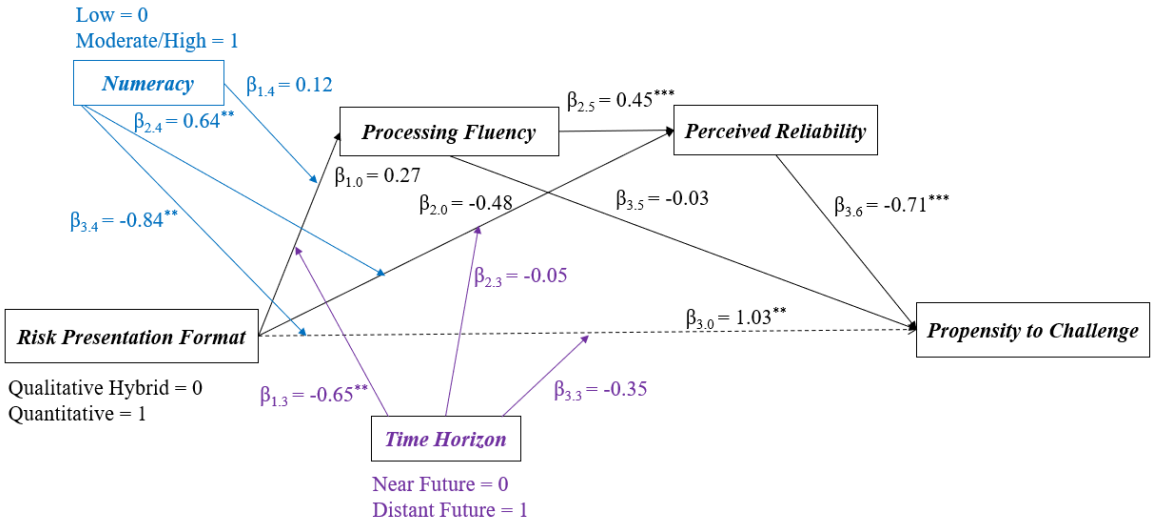
	MEDIATOR	MEDIATOR	OUTCOME
	Processing Fluency	**Perceived Reliability**	**Propensity to Challenge**
Constant	5.23***	3.24***	6.21***
	(0.20)	(0.43)	(0.54)
Presentation Format	0.27	-0.48	1.03**
	(0.29)	(0.29)	(0.32)
Time Horizon	0.18	-0.08	0.51**
	(0.22)	(0.22)	(0.24)
Numeracy	0.02	-0.56**	0.43*
	(0.23)	(0.23)	(0.25)
Presentation Format * Time Horizon	-0.65**	-0.05	-0.35
	(0.31)	(0.31)	(0.34)
Presentation Format * Numeracy	0.12	0.64**	-0.84**
	(0.32)	(0.32)	(0.35)
Processing Fluency		0.45***	-0.03
		(0.07)	(0.09)
Perceived Reliability			-0.71***
			(0.08)
n	193	193	193
R-squared	0.03	0.20	0.41

***, **, * Indicates significance of coefficients at $p < 0.01$, $p < 0.05$, and $p < 0.10$, respectively.

Figure 24, Panel A, is a graphical representation of the moderated serial mediation model depicting the paths between the variables and the estimated path coefficients. Figure 24, Panel B, and Table 19 present the results of tests for conditional indirect effects. The tests used 5,000 bootstrapped resamples of the data with replacement to estimate 95% confidence intervals.

FIGURE 24
Moderated Serial Mediation Model

Panel A: Path Diagram



***, **, * Indicates significance of coefficients at $p < 0.01$, $p < 0.05$, and $p < 0.10$, respectively.

Panel B: Indices of Partial Moderated Mediation

PATH		INDEX OF PARTIAL MODERATED MEDIATION (two-way interaction with Presentation Format, holding other moderators constant)	95% CI EXCLUDES ZERO
Presentation Format → Processing Fluency → Propensity to Challenge			
	Numeracy	$\beta_{1.4} * \beta_{3.5} = (0.12)\ (-0.03) = -0.01$	NO
	Time Horizon	$\beta_{1.3} * \beta_{3.5} = (-0.65)\ (-0.03) = 0.02$	NO
Presentation Format → Perceived Reliability → Propensity to Challenge			
	Numeracy	**$\beta_{2.4} * \beta_{3.6} = (0.64)\ (-0.71) = -0.45$**	**YES**
	Time Horizon	$\beta_{2.3} * \beta_{3.6} = (-0.05)\ (-0.71) = 0.04$	NO
Presentation Format → Processing Fluency → Perceived Reliability → Propensity to Challenge			
	Numeracy	$\beta_{1.4} * \beta_{2.5} * \beta_{3.6} = (0.12)\ (0.45)\ (-0.71) = -0.04$	NO
	Time Horizon	**$\beta_{1.3} * \beta_{2.5} * \beta_{3.6} = (-0.65)\ (0.45)\ (-0.71) = 0.21$**	**YES**

As shown in Figure 24, Panel B and Table 19, there is affirmative evidence that both *Numeracy* and *Time Horizon* moderate the indirect effects of *Presentation Format*

on *Propensity to Challenge* via two paths. The direction (i.e., sign) of the moderation indices is determined by the coding scheme for dichotomous variables, as detailed in Figure 24, Panel A.

The index of partial moderated mediation for *Numeracy* is significant for one path: *Presentation Format* → *Perceived Reliability* → *Propensity to Challenge*, -0.45, 95% CI [-0.96, -0.05]. The index of partial moderated mediation for *Time Horizon* is significant for a different path: *Presentation Format* → *Processing Fluency* → *Perceived Reliability* → *Propensity to Challenge*, 0.21, 95% CI [0.01, 0.44].

In the first path (mediation through *Perceived Reliability*), when participants are all evaluating risk in the same time horizon (i.e., controlling for time horizon and thereby holding it constant), the significant negative index of partial moderated mediation for numeracy indicates that a change from a qualitative-hybrid to a quantitative presentation format is indirectly associated with a lower propensity to challenge in participants who are more numerate compared to those who are less numerate. This happens (at least partly) because, when there is no difference in the time horizon, more numerate participants perceive a quantitative report format to be more reliable than less numerate participants do. Probing the indirect effect of the interaction in Table 19 shows that participants who are low in numeracy have a significantly higher propensity to challenge, 0.34, 95% CI [<0.01, 0.72], when the presentation format is quantitative than when it is qualitative-hybrid.

In the second path (serial mediation), when participants are of equal numeracy (i.e., controlling for numeracy and thereby holding it constant), the significant positive index of partial moderated mediation for time horizon indicates that a change from a

qualitative-hybrid to a quantitative presentation format is indirectly associated with a higher propensity to challenge in participants who are evaluating risk in the distant future compared to those evaluating risk in the near future. This happens (at least partly) because participants of equal numeracy who are considering the distant future along with a quantitative presentation experience greater difficulty processing the risk information, which they then perceive as less reliable. Probing the indirect effect of the interaction in Table 19 shows that participants considering the distant future have a higher propensity to challenge. However, the effects are weak, and all of the bootstrapped confidence intervals contain zero. Nonetheless, as Hayes (2022: 278) argues,[35] if two estimates of conditional effects differ significantly from each other based on a single test of the entire hypothesized indirect path (i.e., the index of moderated mediation), then we can be confident that they are not *both* zero even if that is implied by a pattern of multiple tests (e.g., probing of the conditional indirect effects). This means that at least one of the conditional indirect effects that define each Near/Distant pair (-.09/0.12 and -.12/.08) in Table 19 is significantly different from zero, even if we cannot say which one with a formal inferential test.[36]

[35] The author reviewed my specific results and agreed with the application of his argument to my results in email correspondence during July 2023.

[36] The moderating effect of time horizon is stronger in the subset of 138 participants who scored 75% or higher on a multiple-choice question which tested fundamental risk management knowledge (confidence intervals for the conditional indirect effect do not include zero. See Appendix C, Table C4). Additionally, the moderating effect of time horizon is stronger in the full sample of 193 participants when industry type is also included in the model as a moderator. See the subsection titled *Supplementary analysis of moderated serial mediation: the effect of industry type* for details.

TABLE 19
Tests of Conditional Indirect Effects of Risk Presentation Format on Propensity to Challenge the Risk Self-Assessment

Presentation Format → Processing Fluency → Propensity to Challenge

Indices of partial moderated mediation:

		Bootstrapped	
	Estimate	**C.I.**	**Significance**
Numeracy	-0.01	(-0.08, 0.06)	NO
Time Horizon	0.02	(-0.09, 0.19)	NO

Conditional indirect effects:

Numeracy	*Time Horizon*			
Low	*Near*	*-0.01*	*(-0.10, 0.05)*	*NO*
Low	*Distant*	*0.01*	*(-0.06, 0.13)*	*NO*
Mod/High	*Near*	*-0.01*	*(-0.12, 0.06)*	*NO*
Mod/High	*Distant*	*0.01*	*(-0.05, 0.10)*	*NO*

Presentation Format → Perceived Reliability → Propensity to Challenge

Indices of partial moderated mediation:

		Bootstrapped	
	Estimate	**C.I.**	**Significance**
Numeracy	**-0.45**	**(-0.96, -0.05)**	**YES**
Time Horizon	0.04	(-0.37, 0.46)	NO

Conditional indirect effects:

Numeracy	*Time Horizon*			
Low	***Near***	***0.34***	***(<0.01, 0.72)***	***YES***
Low	*Distant*	*0.37*	*(-0.01, 0.84)*	*NO*
Mod/High	*Near*	*-0.12*	*(-0.47, 0.21)*	*NO*
Mod/High	*Distant*	*-0.08*	*(-0.47, 0.29)*	*NO*

Presentation Format → Processing Fluency → Perceived Reliability → Propensity to Challenge

Indices of partial moderated mediation:

		Bootstrapped	
	Estimate	**C.I.**	**Significance**
Numeracy	-0.04	(-0.25, 0.17)	NO
Time Horizon	**0.21**	**(0.01, 0.44)**	**YES**

Conditional indirect effects:

Numeracy	*Time Horizon*			
Low	*Near*	*-0.09*	*(-0.29, 0.08)*	*NO*
Low	*Distant*	*0.12*	*(-0.07, 0.32)*	*NO*
Mod/High	*Near*	*-0.12*	*(-0.31, 0.02)*	*NO*
Mod/High	*Distant*	*0.08*	*(-0.09, 0.25)*	*NO*

Supplemental results in Table 20 also show a significant conditional direct effect of *Presentation Format* on *Propensity to Challenge*, conditional on *Numeracy*.

Regardless of the time horizon being considered, participants who are low in numeracy have a significantly higher propensity to challenge a risk self-assessment when the presentation format is quantitative than when it is qualitative-hybrid.

TABLE 20
Conditional Direct Effect of Risk Presentation Format on Propensity to Challenge the Risk Self-Assessment

		Estimate	*p*-value	C.I.	Significance
Conditional	**Direct Effects**				
Numeracy	Time Horizon				
Low	**Near**	**1.03**	**0.001**	**(0.40, 1.66)**	***YES***
Low	**Distant**	**0.69**	**0.041**	**(0.03, 1.34)**	***YES***
Mod/High	Near	0.19	0.481	(-0.35, 0.73)	*NO*
Mod/High	Distant	-0.16	0.564	(-0.69, 0.38)	*NO*

I conclude that H3 is supported by the presence of significant conditional indirect effects even though the data did not support H1 and H2.

Tests of the Relationship Between Construal Level and Processing Fluency

The results in this subsection establish a link between construal levels and the moderated serial mediation I identified in the previous subsection. Mental construal levels were the basis of my prediction in H1 that participants in the *Qualitative Hybrid / Distant Future* treatment group would find the risk information easier to process than other treatment groups and would, therefore, show a lower propensity to challenge the risk self-assessment than all other treatment groups. Although participants did not behave as predicted, I analyzed data from a separate, secondary experiment using different

participants to determine whether construal levels helped explain the observed behavior in the primary sample of participants.[37]

I recruited 100 participants with general business experience from the Prolific crowdsourcing platform, 40% of them female, for the secondary experiment. All participants held undergraduate degrees or higher, and 72% worked in non-financial industries. Seventy-seven percent (77%) had more than 5 years of work experience, with 62% working in management and the remainder working in consulting or as trained professionals. 50% of the sample had experience using a risk register.

Participants completed a modified version of the instrument, which replaced questions measuring the dependent variable and mediator variables with questions that checked their comprehension[38] of the time horizon and risk presentation format manipulations and then measured their construal level (i.e., level of abstractness in thinking) using the 25-item Behavioral Identification Form (Vallacher & Wegner, 1989).

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[37] Unlike participants in the primary sample who were exposed to the Qualitative Hybrid presentation format, participants in the secondary sample who were exposed to the Qualitative presentation format did not have access to a less salient mapping of qualitative risk expressions to equivalent quantitative thresholds (see Figure 16). It is possible that measured construal levels for those participants would have been different if they had access to the additional information.

[38] These checks indicated that both Presentation Format and Time Horizon were manipulated effectively. To check the Presentation Format manipulation (Qualitative versus Quantitative), I asked participants the following question measured on a 7-point scale ranging from 1 = “Very Quantitative” to 1 = “Very Qualitative”: "Which point on this scale best describes the reported information about Financial Impact and Occurrence Likelihood of the risks?". The mean score for participants in the Qualitative condition was 5.76 (SD = 1.52). The mean score for participants in the Quantitative condition was 3.23 (SD = 1.56). The mean score in the Qualitative condition is higher, indicating a successful manipulation, and an independent sample t-test showed that the scores differ significantly between the two groups ($t = 7.74$, $p < .001$).

To check the Time Horizon manipulation (Distant Future versus Near Future), I asked participants the following question measured on a 7-point scale ranging from 1 = “Near Future” to 7 = “Distant Future”: "Which point on this scale best describes the risks in XYZ's self-assessment report?". The mean score for participants in the Distant Future condition was 3.71 (SD = 1.39). The mean score for participants in the Near Future condition was 2.25 (SD = 1.08). The mean score in the Distant Future condition is higher, indicating a successful manipulation, and an independent sample t-test showed that the scores differ significantly between the two groups ($t = 5.54$, $p < .001$).

Table 21 displays group means for construal level in the secondary sample. Panel B restricts the secondary sample to 50 participants who have experience using a risk register (and whose behavior would arguably be closer to that of a professional risk manager). Higher scores indicate more abstract construal.

TABLE 21
Cell Means for Construal Level in the Secondary Sample

Panel A: Full Secondary Sample (*n* = 100)

		Time Horizon		
Risk Presentation		**Distant Future**	**Near Future**	**Row Total**
Quantitative	Mean	12.61	16.52	14.65
	Std. Dev	(7.10)	(5.53)	(6.57)
	Sample Size	*n* = 23	*n* = 25	*n* = 48
Pure Qualitative	Mean	13.54	14.38	13.96
	Std. Dev	(6.72)	(5.63)	(6.15)
	Sample Size	*n* = 26	*n* = 26	*n* = 52
Column Total	Mean	13.10	15.43	14.29
	Std. Dev	(6.84)	(5.63)	(6.33)
	Sample Size	*n* = 49	*n* = 51	*n* = 100

Panel B: Only Participants with Experience Using a Risk Register (*n* = 50)

		Time Horizon		
Risk Presentation		**Distant Future**	**Near Future**	**Row Total**
Quantitative	Mean	10.25	17.00	14.00
	Std. Dev	(4.68)	(6.11)	(6.38)
	Sample Size	*n* = 8	*n* = 10	*n* = 18
Pure Qualitative	Mean	14.00	14.24	14.12
	Std. Dev	(6.41)	(5.62)	(5.91)
	Sample Size	*n* = 15	*n* = 17	*n* = 32
Column Total	Mean	12.70	15.26	14.08
	Std. Dev	(6.04)	(5.85)	(6.02)
	Sample Size	*n* = 23	*n* = 27	*n* = 50

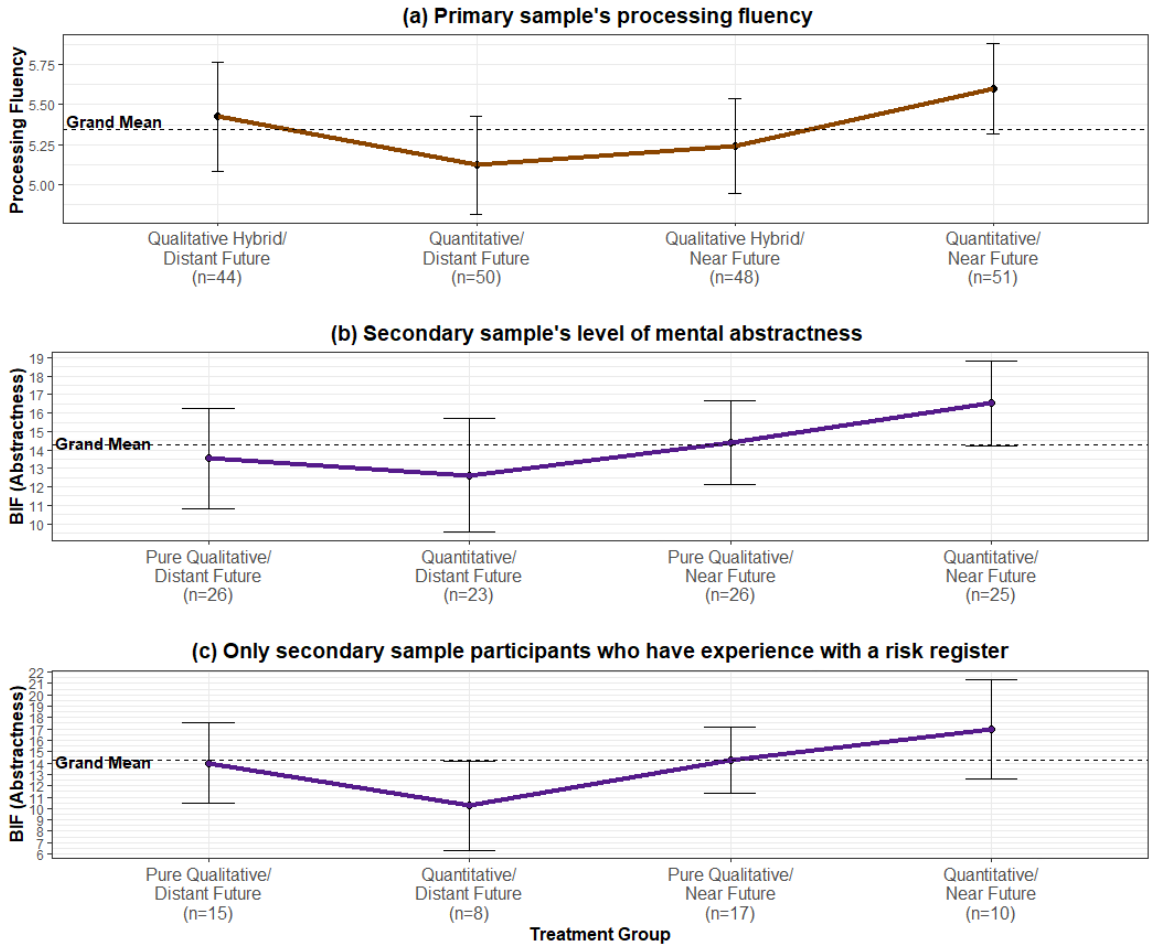
Table 22 displays group means for subjective feelings of processing fluency in the primary sample.

TABLE 22
Cell Means for Processing Fluency in the Primary Sample

		Time Horizon		
Risk Presentation		**Distant Future**	**Near Future**	**Row Total**
Qualitative Hybrid	Mean	5.42	5.24	5.33
	Std. Dev	(1.12)	(1.02)	(1.07)
	Sample Size	$n = 44$	$n = 48$	$n = 92$
Quantitative	Mean	5.12	5.60	5.36
	Std. Dev	(1.08)	(1.01)	(1.07)
	Sample Size	$n = 50$	$n = 51$	$n = 101$
Column Total	Mean	5.26	5.43	5.35
	Std. Dev	(1.10)	(1.03)	(1.07)
	Sample Size	$n = 94$	$n = 99$	$n = 193$

Figure 25 compares the average subjective feelings of processing fluency in each of the primary sample's treatment groups to the construal level scores of the corresponding treatment groups in the secondary sample. If construal level is associated with participants' behavior in the primary sample, then high levels of abstract thinking (i.e., abstract construal cues are more dominant) should be observed in the secondary sample when high processing fluency is observed in the primary sample, and vice versa.

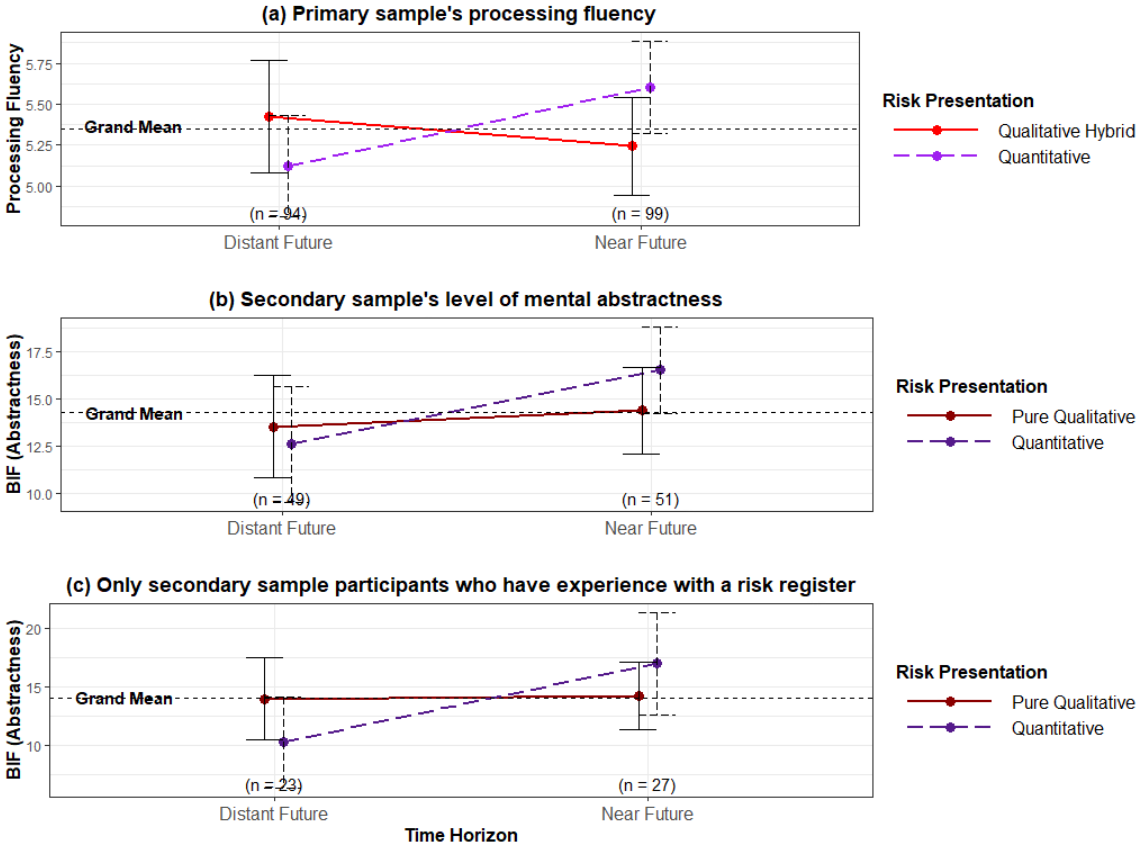
FIGURE 25
Relationship Between Processing Fluency (in the Primary Sample) and Construal Level (in the Secondary Sample)



Such a relationship does appear to exist between construal level and processing fluency in the sample data. In Figure 25, the pattern of mean processing fluency across treatment groups in the primary sample is similar to the pattern of mean construal level across treatment groups in the secondary sample. For example, the Quantitative/Distant Future treatment group has the lowest processing fluency and the lowest construal level, whereas the Quantitative/Near Future treatment group has the highest processing fluency and the highest construal level.

Figure 26 provides a different perspective on how presentation format and time frame similarly affect processing fluency in the primary sample and construal level in the secondary sample.

FIGURE 26
Effect of Time Horizon and Presentation Format on Processing Fluency (in the Primary Sample) and Construal Level (in the Secondary Sample)



ANOVA results in Table 23, Panel A, indicate a significant interaction between presentation format and time horizon, affecting processing fluency for the primary sample, $F(1, 189) = 4.72$, $p = .031$. Similarly, Panel C shows that this interaction has a marginally significant effect on construal level for the secondary subsample with risk register experience, $F(1, 46) = 3.55$, $p = .066$ (this is marginally significant despite a small sample size which makes detecting a statistically significant effect more difficult).

The interaction was not significant for the full secondary sample in Panel B. Levene's test for homogeneity of variance indicated that the assumption of equal variances was met for all groups being compared in Table 23.

TABLE 23
2x2 ANOVA Summary Tables for Processing Fluency in the Primary Sample and Construal Level in the Secondary Sample

Panel A: Processing Fluency: Primary Sample

Source	S.S.	*df*	*F*-Ratio	*p*-value
Presentation Format	0.04	1	0.03	0.860
Time Horizon	1.08	1	0.97	0.326
Presentation Format * Time Horizon	5.28	1	4.72	0.031
Error	211.31	189		

R-squared = 0.031, Adjusted *R*-squared = 0.015.

Panel B: Construal Level: Full Secondary Sample (*n* = 100)

Source	S.S.	*df*	*F*-Ratio	*p*-value
Presentation Format	9.06	1	0.23	0.632
Time Horizon	141.10	1	3.60	0.061
Presentation Format * Time Horizon	58.57	1	1.49	0.225
Error	3,764.33	96		

R-squared = 0.051, Adjusted *R*-squared = 0.022

Panel C: Construal Level: Only Participants with Experience Using a Risk Register (*n* = 50)

Source	S.S.	*df*	*F*-Ratio	*p*-value
Presentation Format	2.77	1	0.08	0.777
Time Horizon	139.22	1	4.08	0.049
Presentation Format * Time Horizon	121.09	1	3.55	0.066
Error	1,570.56	46		

R-squared = 0.115, Adjusted *R*-squared = 0.057

As a follow-up test, I performed a contrast between the Quantitative/Distant Future and Quantitative/Near Future treatment groups because they had the lowest and highest mean processing fluency scores, respectively, in the primary sample and the lowest and highest mean abstractness scores, respectively, in the secondary sample. For

each sample, I compared the mean of the Quantitative/Distant Future treatment group with the mean of the Quantitative/Near Future treatment group. The difference in processing fluency was significant in the primary sample (0.48, SE = 0.21), $t(189) = 2.29$, $p = .023$ (two-sided, unadjusted). The corresponding difference in mental abstractness was significant in the full secondary sample (3.91, SE = 1.81), $t(96) = 2.16$, $p = .033$ (two-sided, unadjusted), as well as in the secondary subsample of participants with experience using a risk register (6.75, SE = 2.77), $t(46) = 2.44$, $p = .019$ (two-sided, unadjusted).

The results in this subsection connect construal levels to the tests of moderated serial mediation in the previous subsection, which indicated that time frame moderates the indirect effect of presentation format on propensity to challenge, operating first through processing fluency and then through perceived reliability. The tests in this subsection suggest that participants' feelings of processing fluency were related to their construal levels, and that their construal levels were influenced by my experimental manipulations.

Supplementary analysis of moderated mediation: the effect of industry type. Exploratory data analysis in a previous subsection expanded on the tests of H1 and H2 to discover a significant three-way interaction between *Industry Type* (financial versus non-financial), *Presentation Format,* and *Time Horizon*, and a marginally significant three-way interaction between *Industry Type*, *Presentation Format* and *Numeracy*. This subsection extends the tests of moderated mediation in H3 to show that *Industry Type* moderates the indirect relationship between report presentation format and propensity to challenge the risk self-assessment report, operating through processing fluency and

perceived reliability of the risk information. The moderating effects of *Numeracy* and *Time Horizon* noted in tests of H3 are not diminished by also including *Industry Type* in the serial mediation model.

The PROCESS tool which I used to test H3 with a set of OLS equations, can only accommodate up to two moderators simultaneously (Hayes, 2022). Therefore, I specified a covariance-based structural equation model (SEM) using maximum likelihood estimation with Mplus to evaluate the indirect effect of *Presentation Format* on *Propensity to Challenge* via *Processing Fluency* and *Perceived Reliability*, conditional on three moderators: *Industry Type*, *Time Horizon*, and *Numeracy*. Table 24 presents path coefficients and standard errors from the results of the SEM.[39] Including *Quantitative Enthusiasm* and *Expertise* in the model as covariates (untabulated) does not change any inferences.

I evaluated the model's goodness of fit using multiple indices. The chi-square test of model fit was not significant, χ^2 (2) = 2.11, p = 0.348, indicating that the model's estimated covariance matrix fit the data well. As alternative measures of model fit, I evaluated the root mean square error of approximation (RMSEA), the comparative fit index (CFI), the Tucker Lewis index (TLI), and the standardized root mean square residual (SRMR). The RMSEA was .02, suggesting a very close fit based on an upper threshold of .08 (Browne & Cudeck, 1992; Steiger, 1990). The CFI and TLI values of

[39] I first specified an untabulated model which included all three-way interactions (and their related lower order terms): *Presentation Format * Time Horizon * Numeracy*; *Presentation Format * Time Horizon * Industry Type; Presentation Format * Numeracy * Industry Type.* The index of moderated-moderated mediation (Hayes, 2018) was significant only for the *Presentation Format * Time Horizon * Industry Type* interaction via *Perceived Reliability* and there was no evidence of any direct effects of the three-way interactions. Therefore, to simplify analysis and interpretation, I constrained the model to a single three-way interaction: *Presentation Format * Time Horizon * Industry Type* through *Perceived Reliability*.

1.00 and 0.99, respectively, indicated good model fit (Bentler, 1990). The SRMR of less than 0.01 also suggested a good fit (Hu & Bentler, 1999). Taken together, these measurements indicate an excellent fit.

TABLE 24
SEM Coefficients (Standard Error) for a Model of the Effect of Risk Presentation Format on Propensity to Challenge the Risk Self-Assessment

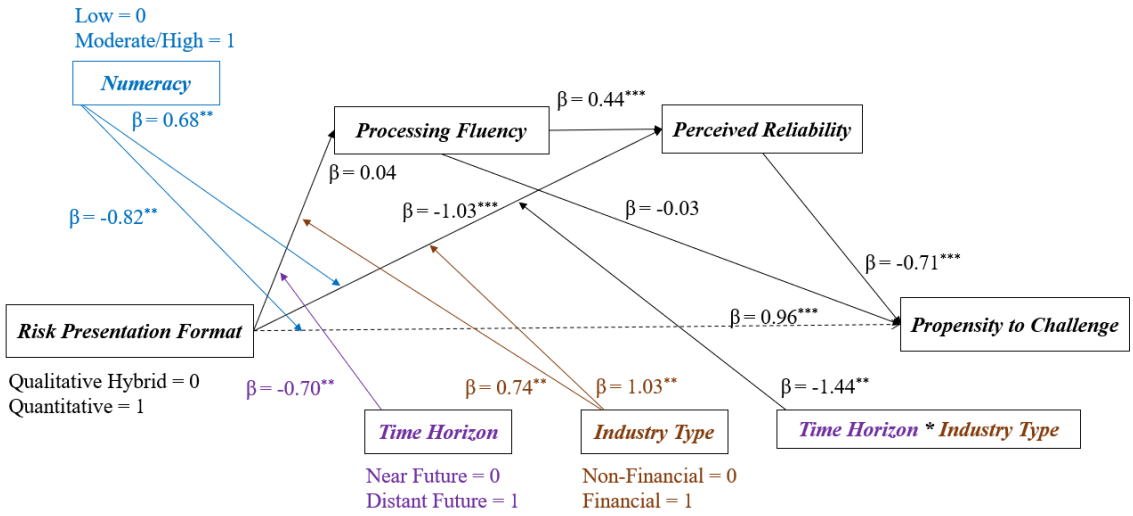
	MEDIATOR	MEDIATOR	OUTCOME
	Processing Fluency	**Perceived Reliability**	**Propensity to Challenge**
Constant	5.18***	3.88***	6.41***
	(0.32)	(0.49)	(0.76)
Presentation Format	0.04	-1.03***	0.96***
	(0.34)	(0.30)	(0.35)
Numeracy	0.17	-0.99***	0.30
	(0.33)	(0.29)	(0.35)
Time Horizon	0.43	-0.71**	0.19
	(0.34)	(0.32)	(0.35)
Industry Type	0.05	-0.76**	-0.20
	(0.33)	(0.32)	(0.35)
Presentation Format * Numeracy	0.01	0.68**	-0.82**
	(0.32)	(0.31)	(0.34)
Presentation Format * Time Horizon	-0.70**	0.69	-0.35
	(0.32)	(0.42)	(0.36)
Presentation Format * Industry Type	0.74**	1.03**	0.12
	(0.32)	(0.44)	(0.34)
Numeracy * Time Horizon	-0.06	0.41	0.32
	(0.32)	(0.32)	(0.34)
Numeracy * Industry Type	-0.21	0.30	-0.10
	(0.31)	(0.31)	(0.37)
Time Horizon * Industry Type	-0.47	0.65	0.21
	(0.31)	(0.47)	(0.35)
Pres. Format * Time H. * Industry Type		-1.44**	
		(0.62)	
Processing Fluency		0.44***	-0.03
		(0.08)	(0.09)
Perceived Reliability			-0.71***
			(0.13)
n	193	193	193
R-squared	0.08	0.24	0.42

***, **, * Indicates significance of coefficients at $p < 0.01$, $p < 0.05$, and $p < 0.10$, respectively.

Figure 27, Panel A, represents the moderated serial mediation model depicting the paths between the variables and the estimated path coefficients. Figure 27, Panel B, and Table 25 present the results of tests for conditional indirect effects using 5,000 bootstrapped resamples of the data with replacement to estimate 95 percent confidence intervals.

FIGURE 27
Moderated Serial Mediation Model Including Industry Type as a Moderator

Panel A: Path Diagram[a]



***, **, * Indicates significance of coefficients at $p < 0.01$, $p < 0.05$, and $p < 0.10$, respectively.
[a] Moderator path coefficients are displayed only for significant conditional effects.

Panel B: Indices of Moderated Mediation[b]

PATH		95% CI EXCLUDES ZERO
Presentation Format → *Perceived Reliability* → *Propensity to Challenge*		
	INDEX OF MODERATED-MODERATED MEDIATION (three-way interaction with *Presentation Format*)	
Time Horizon* * *Industry Type	**(-1.44) (-0.71) = 1.03**	**YES [0.16, 1.89]**
	INDEX OF CONDITIONAL MODERATED MEDIATION (two-way interaction of *Industry Type* with *Presentation Format*, conditional on value of *Time Horizon (1 or 0)* and holding *Numeracy* constant)	
Distant Future Time Horizon* * *Industry Type	[(1.03) (-0.71)] + [(-1.44)(-0.71) (1)] = 0.29	NO [-0.36, 1.01]
Near Future Time Horizon* * *Industry Type	**[(1.03) (-0.71)] + [(-1.44)(-0.71) (0)] = -0.73**	**YES [-1.31, -0.18]**
	INDEX OF PARTIAL MODERATED MEDIATION (two-way interaction with *Presentation Format*, holding other moderators constant)	
Numeracy	**(0.68) (-0.71) = -0.49**	**YES [-1.01, -0.06]**
Presentation Format → *Processing Fluency* → *Perceived Reliability* → *Propensity to Challenge*		
	INDEX OF PARTIAL MODERATED MEDIATION (two-way interaction with *Presentation Format*, holding other moderators constant)	
Time Horizon	**(-0.70) (0.44) (-0.71) = 0.22**	**YES [0.03, 0.45]**
Industry Type	**(0.74) (0.44) (-0.71) = -0.23**	**YES [-0.45, -0.03]**
Numeracy	(-0.01) (0.44) (-0.71) = < 0.01	NO [-0.21, 0.21]

[b] Conditional indirect effects through Processing Fluency as the sole mediator are not significant; therefore, the related indices for that path are not displayed.

Figure 27, Panel B and Table 25 display evidence that *Industry Type*, *Time Horizon*, and *Numeracy* moderate the indirect effects of *Presentation Format* on *Propensity to Challenge* via two paths. The direction (i.e., sign) of the moderation indices is determined by the coding scheme for dichotomous variables, as detailed in Figure 27, Panel A.

The first path, *Presentation Format* → *Perceived Reliability* → *Propensity to Challenge,* has a significant three-way interaction with *Industry Type* * *Time Horizon* (index of moderated-moderated mediation,[40] 1.03, 95% CI [0.16, 1.89]), within which the moderating effect of *Industry Type* is strongest when *Time Horizon* is the near future (index of conditional moderated mediation, -0.73, 95% CI [-1.31, -0.18]). The first path also has a significant two-way interaction with *Numeracy* (index of partial moderated mediation, -0.49, 95% CI [-1.01, -0.06]). The second path, *Presentation Format* → *Processing Fluency* → *Perceived Reliability* → *Propensity to Challenge*, has significant two-way interactions with *Time Horizon* and *Industry Type* (indices of partial moderated mediation, 0.22, 95% CI [0.03, 0.45], and -0.23, 95% CI [-0.45, 0.03], respectively).

In the first path (mediation through *Perceived Reliability*), the significant positive index of moderation-moderated mediation for *Industry Type* * *Time Horizon* indicates that, holding numeracy constant, the extent to which industry type affects a participant's perception of the reliability of quantitative risk information, and their resulting propensity to challenge it relative to qualitative-hybrid risk information, depends on the time horizon of the risk being evaluated. Relatedly, there is a significant negative index of conditional moderated mediation for *Industry Type* when *Time Horizon* is *Near Future* and a non-significant index when *Time Horizon* is *Distant*

[40] Hayes (2018) introduced the *index of moderated-moderated mediation* to quantify how the linear relationship between a moderator and an indirect effect changes when a second moderator changes by one unit (i.e., a three-way interaction). Hayes (2018) also introduced the *index of conditional moderated mediation* as the next analytical step after establishing that a significant moderated-moderated mediation exists. The index of conditional moderated mediation quantifies the linear relationship between a moderator and an indirect effect at a given value of the second moderator.

Future. These conditional indices indicate that, holding numeracy constant, a change from a qualitative-hybrid to a quantitative presentation format is indirectly associated with a lower propensity to challenge in participants from financial industries compared to those from non-financial industries, but only when the risk being evaluated is in the near future. This finding implies that perceptions of reliability underlie my earlier observation in the exploratory data analysis subsection that when risk information was presented in a quantitative format, participants from financial industries had a significantly lower propensity to challenge it in a near future context than a distant future context, relative to participants from non-financial industries, who behaved consistently across time horizons when faced with a quantitative format.

Also, in the first path, a significant negative index of partial moderated mediation for *Numerac*y indicates that when participants are evaluating risk in the same time horizon and come from the same industry type (i.e., holding both variables constant), a change from a qualitative-hybrid to a quantitative presentation format is indirectly associated with a lower propensity to challenge in participants who are more numerate compared to those who are less numerate. This happens (at least partly) because the more numerate participants perceive a quantitative report format to be more reliable than less numerate participants do.

In the second path (serial mediation), when participants are evaluating risk in the same time horizon, and they are of equal numeracy (i.e., holding both variables constant), the significant negative index of partial moderated mediation for *Industry Type* indicates that a change from a qualitative-hybrid to a quantitative presentation format is indirectly associated with a lower propensity to challenge in participants from

financial industries compared to those from non-financial industries. Conversely, when participants are of equal numeracy and come from the same industry type (i.e., holding both variables constant), the significant positive index of partial moderated mediation for *Time Horizon* indicates that a change from a qualitative-hybrid to a quantitative presentation format is indirectly associated with a higher propensity to challenge in participants who are evaluating risk in the distant future compared to those evaluating risk in the near future. In both cases, this happens (at least partly) because participants experience less or more difficulty processing the risk information, which they then perceive as less or more reliable. Table 25 presents the results of probing conditional indirect effects at various levels of the moderators.

TABLE 25
Conditional Indirect Effects of Risk Presentation Format on Propensity to Challenge the Risk Self-Assessment (Including Industry Type as a Moderator)

Presentation Format → Processing Fluency → Propensity to Challenge

Conditional indirect effects:

			Bootstrapped		
			Estimate	**C.I.**	**Significance**
Industry	*Numeracy*	*Time Horizon*			
Non-Financial	Low	Near	*> -0.01*	*(-0.09, 0.06)*	*NO*
Non-Financial	Low	Distant	*0.02*	*(-0.11, 0.18)*	*NO*
Non-Financial	Mod/High	Near	*> -0.01*	*(-0.08, 0.05)*	*NO*
Non-Financial	Mod/High	Distant	*0.02*	*(-0.11, 0.17)*	*NO*
Financial	Low	Near	*-0.02*	*(-0.20, 0.12)*	*NO*
Financial	Low	Distant	*> -0.01*	*(-0.07, 0.12)*	*NO*
Financial	Mod/High	Near	*-0.02*	*(-0.19, 0.12)*	*NO*
Financial	Mod/High	Distant	*> -0.01*	*(-0.06, 0.08)*	*NO*

Presentation Format → Perceived Reliability → Propensity to Challenge

Conditional indirect effects:

			Bootstrapped		
			Estimate	**C.I.**	**Significance**
Industry	*Numeracy*	*Time Horizon*			
Non-Financial	**Low**	**Near**	***0.73***	***(0.33, 1.20)***	***YES***
Non-Financial	Low	Distant	*0.24*	*(-0.25, 0.80)*	*NO*
Non-Financial	Mod/High	Near	*0.25*	*(-0.17, 0.66)*	*NO*
Non-Financial	Mod/High	Distant	*-0.24*	*(-0.80, 0.28)*	*NO*
Financial	Low	Near	*< 0.01*	*(-0.45, 0.57)*	*NO*
Financial	**Low**	**Distant**	***0.54***	***(0.05, 1.16)***	***YES***
Financial	**Mod/High**	**Near**	***-0.48***	***(-1.00, -0.03)***	***YES***
Financial	Mod/High	Distant	*-0.05*	*(-0.47, 0.55)*	*NO*

Presentation Format → Processing Fluency → Perceived Reliability → Propensity to Challenge

Conditional indirect effects:

			Bootstrapped		
			Estimate	**C.I.**	**Significance**
Industry	*Numeracy*	*Time Horizon*			
Non-Financial	Low	Near	*-0.01*	*(-0.25, 0.20)*	*NO*
Non-Financial	Low	Distant	*0.20*	*(>-0.01, 0.44)*	*NO*
Non-Financial	Mod/High	Near	*-0.02*	*(-0.22, 0.17)*	*NO*
Non-Financial	**Mod/High**	**Distant**	***0.20***	***(0.03, 0.42)***	***YES***
Financial	**Low**	**Near**	***-0.24***	***(-0.48, -0.04)***	***YES***
Financial	Low	Distant	*-0.03*	*(-0.24, 0.20)*	*NO*
Financial	**Mod/High**	**Near**	***-0.24***	***(-0.47, -0.06)***	***YES***
Financial	Mod/High	Distant	*-0.03*	*(-0.23, 0.18)*	*NO*

Table 26 presents the results of probing conditional direct effects at various levels of the moderators. The SEM results in Table 26 suggest that only *Numeracy* moderates the direct effect of *Presentation Format* on *Propensity to Challenge*.

Regardless of industry type and the time horizon being considered, participants who are low in numeracy have a significantly higher propensity to challenge a risk self-assessment when the presentation format is quantitative than when it is qualitative-hybrid.

TABLE 26
Conditional Direct Effect of Risk Presentation Format on Propensity to Challenge the Risk Self-Assessment (Including Industry Type as a Moderator)

Conditional direct effects

Industry	Numeracy	Time Horizon	Estimate	*p*-value	C.I.	Significance
Non-Financial	**Low**	**Near**	**0.96**	**0.006**	**(0.28, 1.64)**	***YES***
Non-Financial	Low	Distant	0.61	0.099	(-0.11, 1.34)	*NO*
Non-Financial	Mod/High	Near	0.15	0.651	(-0.48, 0.78)	*NO*
Non-Financial	Mod/High	Distant	-0.20	0.525	(-0.82, 0.44)	*NO*
Financial	**Low**	**Near**	**1.08**	**0.005**	**(0.38, 1.89)**	***YES***
Financial	**Low**	**Distant**	**0.73**	**0.041**	**(0.03, 1.46)**	***YES***
Financial	Mod/High	Near	0.27	0.480	(-0.44, 1.04)	*NO*
Financial	Mod/High	Distant	-0.08	0.798	(-0.72, 0.57)	*NO*

Discussion

Summary of Findings

In this study I extended lines of research undertaken on risk management behavior in a professional setting (Fehrenbacher et al., 2022; Liu & Wong-On-Wing, 2021; Stoel et al., 2017) by examining the role of report presentation format (qualitative-hybrid versus quantitative), the time frame of risk (distant future versus near future), and numeracy (low, moderate, or high) in influencing corporate risk managers' propensity to challenge risk information. I also investigated a potential indirect mechanism though which this influence operates: more abstract or more concrete mental construal triggered by specific combinations of presentation format, time horizon and numeracy, which affect feelings of processing fluency, which then affect perceptions of the report's

reliability. Although industry type (financial versus non-financial) was not a planned variable in the study design, I observed some interesting behavior related to it.

Consistent with my predictions, I found significant indirect effects of the report presentation format on participants' propensity to challenge the risk information through subjective feelings of processing fluency and perceptions of report reliability. These effects were moderated by time frame, numeracy, and—although I did not predict it—industry type.

Contrary to my predictions, I did not find a significant difference in the propensity to challenge the risk information between treatment groups which were exposed to a combination of variables intended to activate more abstract mental construal and those exposed to a combination of variables intended to activate more concrete mental construal. However, a second experiment designed specifically to measure construal levels in the treatment groups provided modest evidence that my experimental manipulations affected construal levels and that construal levels were related to processing fluency, which indirectly affected propensity to challenge the risk information.

My hypothesis tests, data visualization, exploratory data analyses, and supplementary moderated mediation analysis collectively suggest that numeracy, time frame, and industry type interacted with report presentation format in various ways to influence participants' propensity to challenge the risk information. On average, participants were more inclined to challenge risk information involving the distant future than the near future. Less numerate participants were more likely to challenge a quantitative risk presentation than a qualitative-hybrid presentation, with this tendency

stronger for risks in the distant future. In addition, the reaction of less numerate participants to both presentation formats was more extreme than that of their more numerate counterparts. Controlling for numeracy and industry type, participants who were considering the distant future along with a quantitative presentation experienced greater difficulty processing the information, which they then perceived as less reliable and were more willing to challenge. Controlling for time horizon and industry type, less numerate participants perceived a quantitative report format to be less reliable than more numerate participants did and were more willing to challenge it.

My analysis also uncovered interesting differences between financial and non-financial industry participants. Controlling for numeracy, participants from non-financial industries perceived a quantitative risk presentation to be less reliable than a qualitative-hybrid presentation and were, therefore, more prone to challenge it regardless of the time horizon. In comparison, participants from financial industries exhibited this behavior only when risk was in the distant future. Controlling for numeracy and time horizon, participants from non-financial industries experienced greater difficulty processing a quantitative presentation, which they then perceived as less reliable and were more likely to challenge. Regarding numeracy, both financial and non-financial industry participants with low numerical ability showed a greater inclination to challenge a quantitative report than a qualitative-hybrid report. However, this response was much more pronounced in non-financial industry participants, possibly because of their consistent behavior across time horizons compared to financial industry participants who tended to react strongly to a quantitative format only when risks were in the distant future.

Implications for Research and Practice

This study contributes to risk management literature and practice in several ways. It responds directly to Fehrenbacher et al.'s (2022) call for research on risk estimation when risks are considered relatively unlikely and when strategic risk factors are considered in long-term planning. It also responds to Stoel et al.'s (2017) call for research on whether some risk managers are predisposed to expect quantitative information and the effects on risk judgment when qualitative and quantitative risk information is combined.

The study extends both Fehrenbacher et al. (2022) and Stoel et al. (2017) by considering numeracy and time frame as additional factors that may influence the judgment of professional risk managers, and by combining less salient quantitative risk information with more salient qualitative risk information to reflect common ERM practice. The behavior of less numerate participants in this study is congruent with Stoel et al. (2017) and suggests that numeracy may have influenced their results as well. Stoel et al. (2017), building on Kadous, Koonce, and Towry (2005), discovered that risk managers have more confidence in information supporting strategic risks when the information is qualitative than when it is quantitative. Stoel et al. (2017) relied on Vessey's (1991) cognitive fit theory to explain their findings, arguing that managers mistrust quantified information about strategic risks because it is more precise than can reasonably be expected for the subjective nature of the risk.

This study also adds to the literature on the effect of numeracy on judgment and decision making in a broader business context (Elliott et al., 2017; Henry & Peytcheva, 2018; Savage & van Allen, 2002; Zhang et al., 2024). Consistent with Elliott et al.

(2017), less numerate participants in this study were more sensitive to presentation effects (Peters, 2012). Contrary to Elliott et al. (2017), I found no evidence that numeracy moderated the indirect effect of presentation format on the decision variable thorough processing fluency.[41]

Less numerate participants reacted more intensely to the presentation format, expressing more skepticism toward a quantified format and more confidence in a qualitative-hybrid format than their more numerate peers. The similarity of demographic and professional profiles between the low numeracy subsample and the main sample was surprising. Professionally certified accountants who have a strong presence in the risk management field (Hayne & Free, 2014) made up 28.2% of the low numeracy subsample, mirroring 28.5% in the full sample. Relatedly, Elliott et al.'s (2017) business student participants, who had completed an average of nine accounting courses and two finance courses, showed numeracy levels comparable to my professional participants. Although the external validity of experiments is inherently limited, this combination of observations suggests that a meaningful proportion of experienced risk managers may be low in numeracy and, therefore, overly sensitive to irrelevant framing and formatting.

These findings on numeracy highlight the importance of striking a balance in an organization's internal risk communication by prominently displaying both qualitative descriptions and quantitative measures where possible. A balanced approach can help

[41] Whereas I tested moderated-mediation in the entire sample, Elliott et al. (2017) split the sample into a high numeracy subsample and a low numeracy subsample, ran separate path analyses models for the subsamples, and then compared the significance levels of the path through processing fluency in each subsample. Hayes (2022: 280) strongly discourages subsample analysis in favor of formal tests of moderation in the entire sample: "Statistical significance in one group but not in the other does not imply a difference between the two groups in the effect of X. Furthermore, statistical significance in both groups does not imply no difference between them. If your question asks about moderation, you need to conduct a formal test of the difference between differences. Subgroups analysis does not accomplish this."

accommodate varying levels of numeracy among employees across different departments and reduce the potential for bias in risk-related decisions. Furthermore, since cognitive diversity in executive teams has been shown to improve complex decisions in uncertain environments through constructive disagreements of diverse perspectives (Olson, Parayitam, & Bao, 2007), my findings highlight the potential importance of diversity in numerical ability so that dissenting (less numerate) and stabilizing (more numerate) voices are involved in decisions about quantified ambiguous risks. This implication is also supported by research evidence that numerical ability is not synonymous with general intelligence, a complex and multi-dimensional construct (Peters et al., 2006; Visser, Ashton, & Vernon, 2006).

On the whole, participants experienced more cognitive discomfort while processing risk information involving the distant future than the near future. This could be a symptom of the fact that most corporate managers, especially in the United States, are chronic short-term thinkers (Souder & Bromiley, 2012) and may set the tone for risk managers in their organizations. If so, it implies that organizations could benefit from training programs and decision aids (see Hubbard, 2020) that specifically focus on helping corporate managers to be more comfortable assessing ambiguous risks with long time frames.

Limitations and Opportunities for Future Research

This study has several limitations. First, the combined effect of multiple construal cues is difficult to predict (Soderberg et al., 2015) and difficult to measure (Benschop et al., 2021; Trautmann, 2019). It is possible that my manipulations evoked unintended combinations of abstract and concrete mental cues. In addition, participants completed

the online questionnaire in an unsupervised environment outside the laboratory. Pre-task construal mindsets and subjective feelings of fluency have been shown to carry over to subsequent unrelated tasks (Alter & Oppenheimer, 2009; Benschop et al., 2021; Fehrenbacher et al., 2021). Prior to taking the questionnaire, participants may have encountered stimuli that influenced their construal mindsets or general perceptions of cognitive fluency and thereby confounded the results of the experiment. It is also possible that other, more powerful, cognitive processes were at work. Future research is needed to untangle the effect of multiple construal cues on risk judgment.

Second, it is possible that some people exposed to the distant future manipulation misinterpreted the experimental task and evaluated risk for the entire five-year period up to and including 2027 instead of the one-year period during 2027. This may help explain why participants, on average, were more skeptical when risk was situated in the distant future. The likelihood of an event with fixed magnitude should be perceived as higher over a longer period than a shorter period, and participants evaluating a risk self-assessment over the longer period should correspondingly be more willing to challenge it. It is also possible that many people (understandably) judged the likelihood and impact of ESG slip-ups and technology-enabled competition to be greater in the distant future than in the near future. In any case, these possibilities do not account for the consistent behavior of non-financial industry participants across time frames when faced with a quantitative presentation format. Future research on the effects of temporal distance on risk judgment in a professional setting should consider these potential weaknesses in the study's design and find ways to reduce them.

Third, although I attempted to provide an equal amount of information about the risks in both presentation formats, it is possible that participants reacted to unintended differences in information content. Unlike participants exposed to the qualitative-hybrid presentation format, participants exposed to the quantitative presentation format did not have access to a less salient exhibit that mapped qualitative risk terms to quantitative thresholds.[42] Any replication of this study should consider providing the less salient mapping exhibit to participants who evaluate a quantitative report. In any case, even if participants were reacting to unintended differences in report content, it is noteworthy that the reactions were stronger in less numerate participants.

Finally, the disproportionate influence of non-financial industry participants makes it more difficult to generalize the results of this study to all risk managers. Since regulated financial industries have more mature and more standardized risk management practices (Power et al., 2013), it is possible that the reactions of participants from non-financial industries reflected their lack of familiarity with some concepts like scenario analysis and stress testing, which were mentioned in the case materials. Nevertheless, the actual risks in the self-assessment report were generic risks common to all industries; therefore, additional research is necessary to clarify the influence of industry type on risk judgment.

Despite these limitations, the study contributes important empirical evidence about how information format, time frame, and numerical ability can affect managerial decisions.

[42] Participants in Stoel et al. (2017) and Liu and Wong-on-Wing (2021) would have suffered from an even greater difference in information content since the qualitative presentation format in both studies did not provide any link to the corresponding quantitative information and vice versa.

CHAPTER 5: GENERAL CONCLUSION

Implications for Practice

This research has several implications for practice. Findings from the qualitative Study 1 indicate that, when evaluating and making decisions about complex emerging risks, organizations must balance the contributions of front-line business experts and the contributions of other participants with less market expertise and fewer direct commercial incentives. In attempting to diversify risk committees by seeking representation from multiple business units, organizations may unintentionally end up with less diverse risk information and fewer decision options because too many group members share a similar mental model or because the balance of power is tipped too far toward front-line group members. As facilitators of the risk assessment process, risk managers act as gatekeepers and perform some initial screening to distill data gathered during the scanning phase. To a large extent, they determine which risk information is attended to by risk committees and other executive teams, where it is then further filtered by the group consensus frame. If risk managers pre-filter risk information—either to conform with the risk perceptions of front-line executives out of weakness or because they already share the same mental model of emerging risks—then the range of potential risks attended to may be narrowed considerably. This filtering can also limit the interpretation of these risks and reduce the variety of alternative responses considered.

The finding from Study 2 that positive framing compromises the objectivity of professional participants who assess risk in their day-to-day work has implications for whoever is responsible for the strategic opportunities inherent in emergent organizational risks. Risk managers may be given this responsibility in an effort to modernize the Three

Lines of Defense model. If so, organizations should be aware of the potential cognitive bias introduced when evaluating an opportunity and should take measures to neutralize the bias (e.g., by having risk managers review the full spectrum of downside possibilities associated with the opportunity). Organizations should also be sensitive to the potential negative influence of group affiliation on a risk manager's objectivity. The audit literature has shown that making professional values salient can act as a safeguard. Highlighting the value of objectivity in internal risk management policies and training may serve this purpose. In addition, although a common functional background is thought to reduce the quality of decision making in executive teams, my results suggest that a shared functional background does not compromise the objectivity of an individual who is evaluating another individual's risk assessment. This implies that organizations may benefit from recruiting risk managers with significant first-line or other inside business experience and knowledge because they may be just as unbiased as the risk managers who are more removed from the business units while being more capable of informed discussions, debates, and judgments about complex strategic risks.

The results of Study 3 highlight the need to integrate both qualitative descriptions and quantitative measures in internal risk communication to accommodate varying levels of numeracy among employees across different departments and reduce the potential for bias in risk-related decisions. The results also highlight the potential importance of numerical ability as an aspect of cognitive diversity in organizational decisions about ambiguous risks. Since numerical ability is distinct from general intelligence, including people with different numerical abilities may improve decisions through the introduction of diverse viewpoints. The findings also suggest that organizations may benefit from

training programs and decision aids to help corporate managers become more comfortable assessing ambiguous risks with distant time frames.

Collectively, the studies imply that effective risk decision-making bodies should not only have representation from various business units (as is evident in the organizations from Study 1) but also diversity in members' mental models (as evidenced by the biasing effects of shared social identity in Study 2) and diversity in numerical aptitude (as evidenced by the difference in skepticism of low and high numeracy participants toward quantitative risk information in Study 3).

Implications for Research

Overall, this dissertation responds to calls for more behavioral ERM research (Bromiley et al., 2015; Crawford & Jabbour, 2023; De Nederlandsche Bank, 2015; Sax & Andersen, 2020), including the integration of risk management with business planning (Viscelli et al., 2017, 2016; Van der Stede, 2011) and the effectiveness of the Three Lines model (Davies & Zhivitskaya, 2018; Power et al., 2013; Sax & Andersen, 2020).

Study 1 contributes to the literature on ERM by applying a broad analytical perspective, sensemaking, to a topic that has been studied primarily by accounting and finance scholars through the lenses of agency theory and institutional theory (Bromiley et al., 2015). It also contributes to the sensemaking literature by responding to Maitlis and Christianson's (2014) call for more research on the relationship between sensemaking and key team processes such as strategic decision-making.

Study 2 responds to calls for more research on the extent to which risk is a downside-only concept and on the unsubstantiated links between ERM and strategy (Bromiley et al., 2015; Viscelli et al., 2017). It provides evidence that the biasing effects

of frame and social identity which have been observed in professional auditors (Mock & Fukukawa, 2016; Stefaniak et al., 2012), carry over to a risk management context.

Study 3 builds upon ERM research by Fehrenbacher et al. (2022) and Stoel et al. (2017), establishing numeracy and time frame as additional factors that influence professional risk managers' judgment. The study also combines less salient quantitative risk information with more salient qualitative risk information to reflect common practice in the field, in contrast to previous studies that focused on the effect of either one or the other.

Limitations

This research is subject to several limitations, the following being the most significant. First, the experimental studies use mid-level managers to test observations from interviews with C-suite executives in the exploratory qualitative study. Although the qualitative study provides rare and valuable evidence about the lived experience of risk executives, it is possible that these two populations have different perspectives on risk due to their different organizational roles and responsibilities. If so, the conclusions that I draw from synthesizing the findings could be less persuasive.

Second, by focusing on the insurance industry in Study 1, the generalizability of some qualitative findings to other industries may be limited. On the one hand, because of the broad protection it provides to firms in all industries, the insurance industry as a whole is keenly aware of the entire spectrum of emerging risks. An insurance company is an extreme example of an organization focused on risk assessment and risk management. To the extent that all organizations have to manage risk and make sense of it, insurance companies are positioned especially well to make visible key processes that are hard to

see in other organizations. However, on the other hand, because of the industry's specialized risk assessment skills and regulatory incentives, an insurance company's ability to evaluate and respond to emerging risks is unlikely to be replicated to the same degree in a non-financial firm. Additional future research should investigate how managers in non-financial organizations evaluate and respond to emerging risks.

Third, although over 80% of participants in Study 2 assessed risk in their daily work, they were not risk managers. Since the findings are based on their perceptions of what a hypothetical chief risk officer would do in the experimental scenarios, the results may reflect weaknesses in the scenario descriptions. A future study with actual risk managers may yield different results.

Fourth, manipulation checks in Study 2 indicated that my attempt to trigger shared social identity through a shared functional background did not work, yet shared social identity was triggered and did have a significant effect on objectivity in the direction predicted. If functional background did not cause the observed variation in shared social identity among participants, what did? Similarly, the frame manipulation check was unsuccessful, yet Frame had a significant effect on Objectivity. These outcomes are puzzling and raise concerns about the study's internal validity. To avoid this concern in any replication of the study, the manipulations should be tested more rigorously before implementation. Relatedly, future research should establish the antecedents of shared social identity in a risk management context.

Fifth, my measurement of objectivity in Study 2 assumes that disagreement with a business unit manager is evidence of objectivity. This is a crude measure since, in practice, a business unit manager's risk assessment will often be credible, and an

objective risk manager will agree. Nonetheless, the measure seems adequate for this study because it indicates the inclination of a risk manager to agree with a business manager when there is limited and ambiguous information about the risk.

Sixth, a few outlying participant responses in Study 2 affected the statistical assumptions upon which some of my inferential tests were based. Although additional analysis suggested that my conclusions were robust to the violation of these assumptions, it is possible that more sophisticated remedial techniques could have produced different results.

Seventh, regarding Study 3, it has been well-documented that the combined effect of multiple construal cues is difficult to predict and measure. It is possible that my manipulations evoked unintended combinations of abstract and concrete mental cues. In addition, prior to taking the online questionnaire, participants may have encountered stimuli that influenced their construal mindsets or general perceptions of cognitive fluency and thereby confounded the results of the experiment. It is also possible that other, more powerful, cognitive processes were at work. Future research is needed to untangle the effect of multiple construal cues on risk judgment.

Eighth, it is possible that some participants in Study 3 who were exposed to the distant future manipulation judged (understandably) the likelihood and impact of ESG and technology risks to be greater in the distant future than in the near future. This may help explain why participants, on average, were more skeptical when risk was situated in the distant future. In any case, this possibility does not account for the consistent behavior of non-financial industry participants across time frames when faced with a quantitative presentation format. Future research on the effects of temporal distance on risk judgment

in a professional setting should consider this potential weakness in the study's design and find ways to reduce it.

Finally, although I attempted in Study 3 to provide an equal amount of information about the risks in both presentation formats, it is possible that participants reacted to unintended differences in information content. In any case, even if participants were reacting to unintended differences in report content, it is noteworthy that the reactions were stronger in less numerate participants.

Conclusion

The three complementary studies in this dissertation investigated how risk managers assess ambiguous emerging exposures which lie at the intersection of measurable risk and unmeasurable uncertainty. The exploratory qualitative study provided insights into poorly understood behavioral aspects of the risk management process, such as risk judgments in groups, the level of quantification in ERM, and how managers attempt to link ERM to strategy. The results of the qualitative study informed two subsequent quantitative experimental studies designed to probe deeper into insights from the qualitative study, specifically concerning the effects on a risk manager's judgment of risk framing, shared social identity, risk quantification, and the time-horizon of risk. The combination of quantitative and qualitative research methods in this dissertation allowed for a more comprehensive understanding of the perceptions and performance of the risk professionals who represent a second line of defense in the popular Three Lines model of risk governance.

APPENDIX A
Interview Protocol

Question 1: Please tell me about yourself.
Sample probing questions:

- *Can you tell me about your background and experience?*
- *How long have you been in your current role?*

Question 2: Please tell me about a recent experience when information about an emerging risk was obtained during the risk assessment process and then was incorporated into the business planning process.
Sample probing questions:
Risk assessment:

- *How do you define an emerging risk?*
- *How did you identify the emerging risk?*
- *What was the main challenge you faced when assessing the emerging risk?*
- *How did you measure the emerging risk (e.g., quantitative, qualitative)?*
- *How did you decide whether a risk was too far in the future to worry about?*
- *How were conflicting views or judgements resolved during the risk assessment process?*

Planning:

- *How did you make the link between risk assessment stage and business planning stage (e.g., formal, informal)?*
- *Could you briefly describe the business planning process?*
- *What was your business planning horizon (i.e., how far out did you plan)?*
- *What role did scenarios/sensitivities/simulations have in planning for emerging risk?*
- *How did you distinguish extreme scenarios worth considering from ones that were too strange or ridiculous?*
- *How were conflicting views or judgements resolved during the planning process?*
- *What benefits, if any, did you experience or observe from integrating this emerging risk?*
- *What costs, if any, did you experience or observe from integrating this emerging risk?*

Question 3: Please tell me about a recent experience when information about an emerging risk was obtained during the risk assessment process but was not used in the business planning process.
Sample probing questions:

- *Same probes as "Risk assessment" section of question 2.*
- *For "Planning", probe to get specific reasons for the break between assessment and planning.*
- *What costs, if any, did you experience or observe from not integrating this emerging risk?*
- *What benefits, if any, did you experience or observe from not integrating this emerging risk?*

Question 4: How did the concept of risk appetite fit into your experience with these emerging risks?
Sample probing questions:

- *What does risk appetite mean to you?*
- *How did the organization determine its appetite for the emerging risks that we have been discussing?*
- *How did the risk appetites of individual managers matter, if at all?*
- *How did authoritative guidance (e.g., regulator, rating agency) affect risk appetite?*
- *What sorts of challenges have you experienced or observed when applying the risk appetite?*

APPENDIX B
Experimental Instrument

Screening questions:

What is your highest level of education?

	No College	Some College	Bachelor's degree	Master's degree	Doctoral degree
Education	O	O	O	O	O

How many years of business experience do you have?

	< 5	6–10	11–15	16–20	> 20
Years of work experience in business	O	O	O	O	O

Which of these choices best describes the industry that you work in?

- O Accounting Firms
- O Banking
- O Insurance
- O Credit Unions
- O Investment Services
- O Stock Brokerage
- O Credit Card Company
- O Private Equity
- O Venture Capital
- O Other Financial Services
- O Other Non-financial Industry

Which of the following skills do you use in your day-to-day work? Select all that apply.

- ☐ interpreting quantitative analysis
- ☐ preparing quantitative analysis
- ☐ assessing risk
- ☐ communicating with senior managers
- ☐ None of these skills are used in my day-to-day work

For the purpose of this study, please assume the role of Pat, Chief Risk Officer of XYZ Indemnity Corp. Please base your responses only on the information provided in the case materials. There are no right or wrong answers. Review the background information carefully before looking at the questions, and please complete the materials in one sitting.

XYZ Indemnity Corp. Overview
XYZ is a mid-size, publicly traded insurance company headquartered in the USA with several international subsidiaries and branch offices. XYZ operates in the property and casualty insurance market.

[Blue font indicates substitute text for CRO background]

Risk Management at XYZ
Pat is XYZ's Chief Risk Officer and reports directly to the Chief Executive Officer with a dotted line to the Risk Committee of the board of directors. Pat's risk management team monitors XYZ's risk-taking activities against internal guidelines and external regulations. A key responsibility of the risk management team is to challenge whether business unit managers have adequately considered all relevant risks to their business and implemented appropriate responses. To preserve their objectivity, members of the small risk management team do not make any underwriting or operating management decisions.

Pat originally joined XYZ as an [internal auditor / underwriting analyst] and had planned a career in [audit / underwriting] with the hope of someday running [an internal audit department / an underwriting business unit]. After being promoted to senior [audit and compliance / underwriting] roles, Pat was offered the Chief Risk Officer position. Pat gets a lot of satisfaction from helping the business units to [control their risks / achieve their strategic objectives] and from being seen as a [risk advisor / business partner] by the business unit leaders.

Pat's Compensation
Pat's compensation includes a base salary and a cash bonus awarded annually to executives if XYZ's return-on-equity meets or exceeds a benchmark.

Specialty Insurance Business Unit
Morgan is the underwriting executive in charge of XYZ's Specialty Insurance business unit which offers commercial insurance coverage for highly specialized risks that are not covered by standard insurance policies. Like Pat, Morgan reports directly to the Chief Executive Officer. Pat and Morgan are both members of the executive team and Pat believes they have a good relationship.

New Cyber Insurance Product Line
Morgan has proposed a new cyber insurance product line to protect businesses against damages which are the direct result of a data breach or cyber-attack. This coverage includes the costs to repair software, replace lost or stolen data, handle public relations, replace lost income, and defend against third-party lawsuits. Cyber insurance is an

immature market which Standard & Poor's expects to grow at nearly 30% annually for the near future.

Morgan's cyber business plan exposes 5% of XYZ's total equity capital to cyber risk. That is the maximum allowable exposure for a single product line according to XYZ's formal risk guidelines. The business plan estimates an attractive return on this exposed capital – 15% annually over ten years – which, if achieved, would comfortably exceed XYZ's minimum requirements.

Discussions among the executive team have focused on the following three things:

[Purple font indicates substitute text for negative frame]

1. [If / Even if] XYZ enters cyber now, it [could / might not] capture enough market share before competitors pile in. It [could also / also might not] learn and adapt [quickly / quickly enough] as it gains experience with cyber risks.

2. Premiums can't be set using traditional actuarial methods because there isn't enough historical cyber claims data. Instead, Morgan's underwriters must price the business by developing a catalogue of [analogous / hypothetical] claims scenarios in place of [historic / real] data. And since premiums are set annually, they [can always be adjusted / can't be adjusted until] next year if XYZ gets them wrong.

3. In a worst-case loss scenario XYZ would [still have 95% / lose 5%] of its equity capital, which is a significant amount.

So, although there is some [downside / upside], there are plenty of reasons for everyone to be [excited / nervous] about implementing this business plan.

Pat's Decision

The Risk Committee of XYZ's board of directors must approve all new lines of business. It has asked Pat to recommend whether or not to implement Morgan's cyber insurance business plan.

Do you think Pat will recommend implementing Morgan's cyber insurance business plan?

- ○ Yes
- ○ No

How confident are you that Pat will recommend implementing Morgan's cyber insurance business plan?

	Certainly WON'T		Certainly WILL
	0	50	100
Move the circle		O	

Write down which factors Pat would consider when deciding what to do.

To what extent do you agree with the following statements?

	Strongly agree	Agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Disagree	Strongly disagree
Cyber risk is an overall positive thing for XYZ	O	O	O	O	O	O	O
Cyber insurance is a good business opportunity for XYZ	O	O	O	O	O	O	O
XYZ should be worried about entering the cyber insurance market	O	O	O	O	O	O	O

Please select the appropriate response.

	1	2	3	4	5	6	7
Which number is the sum of three and four? This item is just checking whether people are paying attention when they answer. Thank you for being diligent.	O	O	O	O	O	O	O

To what extent do you agree with the following statements?

	Strongly agree	Agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Disagree	Strongly disagree
Pat feels strong ties to the business units	O	O	O	O	O	O	O
Pat sees self as a member of the business units	O	O	O	O	O	O	O
Pat identifies with the business units	O	O	O	O	O	O	O

What is your gender?

- O Male
- O Female
- O Non-binary / third gender
- O Prefer not to say

To which age group do you belong?

	18–27	28–37	38–47	48–57	58+
Age group	O	O	O	O	O

APPENDIX C
Additional Tables and Figures

TABLE C1
Comparison of Numeracy Performance with Elliott et al. (2017)

Questions asked in this study	**% correct**	**Corresponding questions in Elliott et al. (2017)**	**% correct**
In a raffle, the chances of winning $10 are 1%. How many people would win $10 if 10,000 people each buy one raffle ticket? a.1 person out of 10,000; b. 10 people out of 10,000; **c. 100 people out of 10,000**; d. 990 people out of 10,000; e. None of the above; f. Don't know	66.8%	In a raffle, the chances of winning $10 are 1%. How many people would win $10 if 1,000 people each buy one raffle ticket? a. 1 person out of 1,000; **b. 10 people out of 1,000**; c. 100 people out of 1,000; d. 990 people out of 1,000; e. None of the above; f. Don't know	78.5%
The chance of winning a vacation in a sweepstakes is 1 in 1,000. What percent of tickets win a vacation? a. 0.001%; **b. 0.1%**; c. 1%; d. 10%; e. None of the above; f. Don't know	46.6%	The chance of winning a vacation in a sweepstakes is 1 in 1,000. What percent of tickets win a vacation? a. 0.001%; **b. 0.1%**; c. 1%; d. 10%; e. None of the above; f. Don't know	53.1%
If we roll a five-sided die 500 times, on average, how many times would this die show an odd number (1, 3, or 5)? b. 50 out of 500 throws; b. 200 out of 500 throws; c. 250 out of 500 throws; **d. 300 out of 500 throws**; e. None of the above; f. Don't know	47.7%	If we roll a five-sided die 50 times, on average, how many times would this die show an odd number (1, 3, or 5)? a. 5 out of 50 throws; b. 20 out of 50 throws; c. 25 out of 50 throws; **d. 30 out of 50 throws**; e. None of the above; f. Don't know	55.4%
Out of 1,000 individuals in a village, 500 are members of a club. Out of these 500 members in the club, 300 are men. Out of the 500 individuals that are not in the club, 100 are men. What is the probability that a randomly drawn man is a member of the club? a. 40%; b. 60%; **c. 75%**; d. 80%; e. None of the above; f. Don't know	17.1%	Out of 1,000 individuals in a village, 500 are members of a club. Out of these 500 members in the club, 100 are men. Out of the 500 individuals that are not in the club, 300 are men. What is the probability that a randomly drawn man is a member of the club (please indicate the probability in %)? a. 10%; b. 20%; **c. 25%**; d. 40%; e. None of the above; f. Don't know	32.8%
If we roll a 6-sided loaded die, the probability that the die shows a 6 is three times as high as the probability of each of the other numbers. On average, out of 80 throws, how many times would the die show the number 6? a. 20 out of 80 throws; b. 24 out of 80 throws; **c. 30 out of 80 throws**; d. 40 out of 80 throws; e. None of the above; f. Don't know	27.5%	If we roll a 6-sided loaded die, the probability that the die shows a 6 is twice as high as the probability of each of the other numbers. On average, out of these 70 throws, how many times would the die show the number 6? **a. 20 out of 70 throws**; b. 23 out of 70 throws; c. 35 out of 70 throws; d. 40 out of 70 throws; e. None of the above; f. Don't know	24.9%

FIGURE C1
Distribution of Numeracy Scores

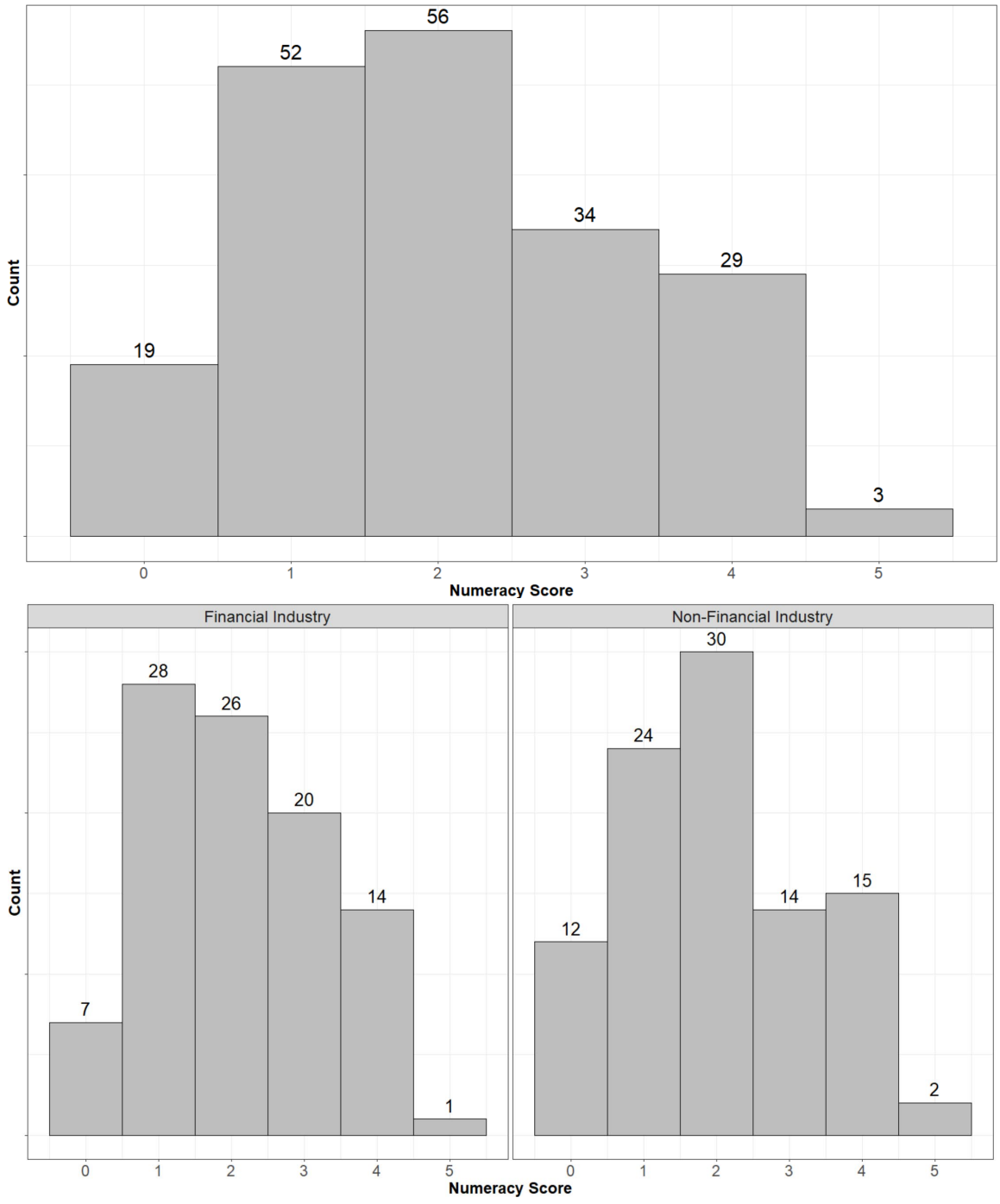


TABLE C2
Profile of the 71 Participants with Low Numeracy Scores (0 and 1)

Panel A: Professional Profile

	$N = 71$ [1]
Position	
Partner or Owner	11 (15.5%)
Executive	18 (25.4%)
Manager	37 (52.1%)
Staff	5 (7.0%)
Work Experience	
< 5	3 (4.2%)
5–10	13 (18.3%)
11–15	17 (23.9%)
16–20	11 (15.5%)
> 20	27 (38.0%)
Have used a Risk Register	
Yes	51 (71.8%)
No	16 (22.5%)
Not sure	4 (5.6%)

[1] *n* (%)

Panel B: Certificates and Licenses

Professional Certification	Count	Percentage
None	20	(28.2%)
PRM (Professional Risk Manager)	18	(25.4%)
CRMP (Certified Risk Management Professional)	17	(23.9%)
FRM (Financial Risk Manager)	15	(21.1%)
CPA (Certified Public Accountant)	13	(18.3%)
CMA (Certified Management Accountant)	7	(9.9%)
CIA (Certified Internal Auditor)	6	(8.5%)
CFA (Chartered Financial Analyst)	5	(7.0%)
Other	3	(4.2%)

Several participants indicated that they hold more than one professional certification. Therefore, the totals for count and percentage exceed 100% of the sample.

Panel C: General Demographic Information

	$N = 71$[1]
Industry	
Non-Financial Industry	36 (50.7%)
Other Financial Services	13 (18.3%)
Accounting Firms	11 (15.5%)
Banking	8 (11.3%)
Insurance	3 (4.2%)
Education	
Bachelor's degree	37 (52.1%)
Master's degree	19 (26.8%)
Some College	11 (15.5%)
Doctoral degree	2 (2.8%)
No College	2 (2.8%)
Age	
18–27	4 (5.6%)
28–37	21 (29.6%)
38–47	21 (29.6%)
48–57	13 (18.3%)
58+	12 (16.9%)
Gender	
Male	36 (50.7%)
Female	35 (49.3%)

[1] *n* (%)

TABLE C3
2x2x3x2 ANOVA/ANCOVA Summary Tables for Propensity to Challenge the Risk Self-Assessment

Panel A: ANOVA Model (Including Industry Type)

Source	S.S.	*df*	*F*-Ratio	*p*-value
Presentation Format	3.75	1	1.86	0.175
Time Horizon	13.78	1	6.84	0.010
Numeracy	3.69	2	0.92	0.402
Industry Type	0.73	1	0.36	0.548
Presentation Format * Time Horizon	0.06	1	0.03	0.859
Presentation Format * Numeracy	13.91	2	3.45	0.034
Time Horizon * Numeracy	4.47	2	1.11	0.332
Presentation Format * Industry Type	1.06	1	0.52	0.470
Time Horizon * Industry Type	2.50	1	1.24	0.267
Numeracy * Industry Type	0.45	2	0.11	0.893
Presentation Format * Time Horizon * Numeracy	4.80	2	1.19	0.306
Presentation Format * Time Horizon * Industry Type	12.78	1	6.34	0.013
Presentation Format * Numeracy * Industry Type	10.00	2	2.48	0.087
Time Horizon * Numeracy * Industry Type	1.98	2	0.49	0.613
Presentation Format * Time Horizon * Numeracy * Industry Type	0.90	2	0.22	0.800
Error	340.76	169		

R-squared = 0.187, Adjusted *R*-squared = 0.077.

Panel B: ANCOVA Model with Influential Covariates

Source	S.S.	df	F-Ratio	p-value
Quantitative Enthusiasm	14.56	1	7.76	0.006
Expertise	13.35	1	7.11	0.008
Presentation Format	2.66	1	1.42	0.236
Time Horizon	10.92	1	5.82	0.017
Numeracy	3.37	2	0.90	0.409
Industry Type	0.01	1	0.01	0.938
Presentation Format * Time Horizon	0.00	1	0.00	0.986
Presentation Format * Numeracy	15.30	2	4.07	0.019
Time Horizon * Numeracy	2.99	2	0.80	0.453
Presentation Format * Industry Type	0.31	1	0.16	0.687
Time Horizon * Industry Type	3.87	1	2.06	0.153
Numeracy * Industry Type	0.41	2	0.11	0.898
Presentation Format * Time Horizon * Numeracy	3.56	2	0.95	0.390
Presentation Format * Time Horizon * Industry Type	9.93	1	5.29	0.023
Presentation Format * Numeracy * Industry Type	11.07	2	2.95	0.055
Time Horizon * Numeracy * Industry Type	0.98	2	0.26	0.771
Presentation Format * Time Horizon * Numeracy * Industry Type	1.50	2	0.40	0.672
Error	313.51	167		

R-squared = 0.252, Adjusted *R*-squared = 0.14.

TABLE C4
Reconciliation of Completed Responses to Final Sample and Related Effect on Results

Moderated mediation (H3 and supplemental analysis). Indices are from the model with 3 moderators.

				2x2x3	**ANOVA**	**2x2x3x2**	**ANOVA**	**via Perceived Reliability**		**Serially via Proc. Fluency and Perceived Reliability**		**Direct Moderation**
		H1 Support	**H2 Support**	Time Horizon	Pres. Format * Num	Pres. Format * Time H. * Industry	Pres. Format * Num	Numeracy	Industry Type	Time Horizon	Industry Type	Numeracy
Completed responses	**229**	No	No	p = .104	**p = .044**	p = .057	p = .089	No, -0.41 [-0.87, 0.01]	No, -0.28 [-0.86, 0.36]	No, 0.18 [-0.04, 0.40]	No, -0.19 [-0.42, 0.02]	No, p = 0.147
Exclude:												
Nonsense free text response	-5											
Did not understand task	-2											
Chose maximum value for all scales	-3											
Inappropriate job title	-3											
Subtotal before removing speeders/laggards	**216**	No	No	**p = .018**	**p = .024**	**p = .026**	p = .063	**Yes, -0.44 [-0.95, -0.03]**	No, -0.42 [-1.00, 0.21]	No, 0.14 [-0.05, 0.35]	No, -0.19 [-0.40, 0.01]	No, p = 0.126
Speeders < 5 minutes	-20											
Laggards > 60 minutes	-3											
Final sample	**193**	No	No	**p = .027**	**p = .006**	**p = .013**	**p = .034**	**Yes, -0.49 [-1.01, -0.06]**	**Yes, -0.73 [-1.31, -0.18]**	**Yes, 0.22 [0.03, 0.45]**	**Yes, -0.23 [-0.45, -0.03]**	**Yes, p = 0.023**
Knowledge-testing score < 75% or N/A	-55											
Highly skilled participants	**138**	No	No	**p = .022**	**p = .013**	p = .314	**p = .037**	**Yes, -0.58 [-1.24, -0.09]**	**Yes, -0.71 [-1.37, -0.09]**	**Yes, 0.31 [0.09, 0.63]**	**Yes, -0.25 [-0.54, -0.03]**	**Yes, p = 0.040**

APPENDIX D
Experimental Instrument

Question numbers below represent the order in which the questions are presented to participants. However, participants do not see the question numbers or the bold underlined section headings as part of the survey. Sources for the questions, if applicable, are in brackets (and are not provided to survey participants).

Two instruments were administered. Both are reproduced in this document.

1) The primary survey instrument was administered to the main sample of participants (practicing risk managers).

2) A secondary sample of similar but more accessible participants (businesspeople who assess risk in their day-to-day work) received a modified version of the primary instrument designed to check only the effectiveness of experimental manipulations and to measure the corresponding mindset (construal level) evoked in participants. Doing this separately from the main sample allows me to test the process mechanism without making the surveys too long for participants. It also reduces the chance of unintentionally influencing the outcome variables measured in the primary survey.

**********START OF PRIMARY SURVEY**********

<u>Screening questions for primary sample</u>

[*Source: Questions 1 and 2 from* (Weisner, 2015b)]

1. Are you currently employed in a position that requires you to make decisions associated with organizational risk management?

Multiple choice: **Yes**; No

2. Do you have at least 2 years' experience with making organizational risk management decisions?

Multiple choice: **Yes**; No

3. Some questions in this survey are not suitable for viewing on a mobile phone. Please continue only if you are using a desktop computer or large tablet device.

Checkbox: I am using a desktop or tablet for this survey

4. Which of the following are valid risk management responses when a risk has been identified?

Select the best answer or best combination of answers (you can choose more than one).

Multiple choice:

a. Accept/Retain the risk; b. Transfer the risk (e.g., purchase an insurance policy); c. Avoid the risk; d. Reduce/Mitigate the risk; **e. All of the above**; f. None of the above; g. Not sure

Experimental Scenario

For this study, please imagine that you are a risk manager in the Enterprise Risk Management (ERM) department of XYZ Indemnity Corp.

XYZ Indemnity Corp. Overview

XYZ is a mid-size, publicly traded insurance company with several international subsidiaries and branch offices. XYZ operates in the property and casualty insurance market.

Enterprise Risk Management at XYZ

The ERM department monitors XYZ's risk-taking activities against internal guidelines and external regulations. A key responsibility of the ERM department is to challenge whether business unit managers have adequately considered all relevant risks to their business.

Assessment of Business Risks in the [Immediate Future /*Distant Future*]

In connection with XYZ's **[**short-term / *long-term*] business planning process, each business unit performs a self-assessment of the business risks inherent in its strategic plan and prioritizes the risks in the **[**immediate future / *distant future*] that are most deserving of management attention and resources. The relative importance of each **[**short-term / *long-term*] risk is determined by estimating its likelihood of occurring and the financial impact if it did materialize.

Measuring Complex Risks

The evaluation of strategic business risks is subjective because many of the risks are complex and difficult to measure. For these risks, the self-assessment focuses on "realistic worst case" outcomes, which XYZ defines as outcomes that are pessimistic enough to have a low chance of occurring in any particular year but reasonable enough to be believable.

When historic data is sparse or not representative of the future, a business unit's risk assessment is informed by scenario analysis, stress testing, and expert judgment. These techniques supplement historic data with educated guesses about the likelihood and severity of risk events.

Your Task

Since your role as risk manager includes constructively challenging the business managers' views of risk, you have been assigned a portion of XYZ's **[**short-term / *long-term*] risk self-assessment report for your careful review before the report is finalized and sent to the board of directors.

The report covers the risks anticipated in **[**Year 1 / *Year 5*] of the business plan, which means that the reported likelihood and impact of each risk is for the **[**one-year period in 2023 / *one-year period in 2027*]**.**

Your assigned portion is an excerpt from the full risk report. Please review your portion of the report carefully and then answer the questions which follow.

Instructions

The self-assessed risks are displayed on the following screens. You will be asked to evaluate three risks individually and then all three risks collectively.

Please answer the questions based only on the information provided in these study materials. **Do not worry if you feel that you have minimal information because the study is simply interested in your intuitive judgment based on the information available.** There are no correct or incorrect responses.

Additional Instructions *for Hybrid Condition Only*

Business managers determined the financial impact and likelihood of each risk for 2023 [*2027*] using the guidelines below. Please review them before continuing. If necessary, you can return to this screen at any time by clicking the back arrow at the bottom of a page.

Annual Financial Impact	***Annual Occurrence Likelihood***
Minor: 5% ($11m) reduction in planned pre-tax income	*Rare: 2% chance per year (i.e., once in 50 years)*
Moderate: 25% ($55m) reduction in planned pre-tax income	*Unlikely: 10% chance per year (i.e., once in 10 years)*
Major: 55% ($121m) reduction in planned pre-tax income	*Possible: 20% chance per year (i.e., once in 5 years)*
Severe: 95% ($209m) reduction in planned pre-tax income	*Likely: 66% chance per year (i.e., once in 1.5 years)*
Extreme: 200% ($440m) reduction in planned pre-tax income	*Frequent: 100% chance per year (once every year)*

RISK #1:

Excerpt from Risk Self-Assessment Report
for the One-Year Period in [2023 */ 2027*]

a) Quantitative condition

	Realistic Worst Case* [during **2023 /** *during **2027***]	
Risk Description	Annual Financial Impact	Annual Occurrence Likelihood
Shifts in stakeholder expectations XYZ may be unable to satisfy shifting stakeholder demands and expectations regarding environmental, social and governance ("ESG") practices, which could affect XYZ's ability to attract and retain customers, employees, and investors.	**55% ($121m)** reduction in planned pre-tax income	**2%** (i.e., once in 50 years)

* Pessimistic enough to have a low chance of occurring in any particular year but reasonable enough to be believable. When historic data is sparse or not representative of the future, the risk assessment is informed by scenario analysis, stress testing, and expert judgment.

b) Qualitative condition

Risk Description	Realistic Worst Case* [during **2023 /** *during **2027***] Annual Financial Impact [a]	Annual Occurrence Likelihood [b]
Shifts in stakeholder expectations XYZ may be unable to satisfy shifting stakeholder demands and expectations regarding environmental, social and governance ("ESG") practices, which could affect XYZ's ability to attract and retain customers, employees, and investors.	**Major**	**Rare**

* Pessimistic enough to have a low chance of occurring in any particular year but reasonable enough to be believable. When historic data is sparse or not representative of the future, the risk assessment is informed by scenario analysis, stress testing, and expert judgment.

[a] *Impact scoring benchmarks (reduction in planned pre-tax income): Minor < Moderate < Major < Severe < Extreme*
[b] *Likelihood scoring benchmarks: Rare < Unlikely < Possible < Likely < Frequent*

c) Hybrid condition

[Note: The Hybrid exhibit is identical to the Qualitative exhibit. However, participants in the Hybrid condition can review a mapping of qualitative scores to quantitative scores on the "Instructions" screen preceding these risk exhibits, whereas participants in the Qualitative and Quantitative conditions cannot.]

RISK #1 Question

Measure of Propensity to Challenge the self-assessment

[*Source: adapted from Professional Skepticism measured in Backof et al., 2018; Griffith et al., 2015*]

1. How confident are you that the business's self-assessment is a reasonable estimate of this risk [during 2023 / *during 2027*]?

   (0: lowest confidence and 10: highest confidence)

RISK #2:

Excerpt from Risk Self-Assessment Report
for the One-Year Period in [2023 */ 2027*]

a) Quantitative condition

Risk Description	Realistic Worst Case* [during **2023 /** *during **2027***] Annual Financial Impact	Annual Occurrence Likelihood
Succession challenges Departure of key underwriting personnel in a tightening talent market may limit XYZ's ability to achieve strategic objectives.	**5% ($11m)** reduction in planned pre-tax income	**66%** (i.e., once in 1.5 years)

* Pessimistic enough to have a low chance of occurring in any particular year but reasonable enough to be believable. When historic data is sparse or not representative of the future, the risk assessment is informed by scenario analysis, stress testing, and expert judgment.

b) Qualitative condition

Risk Description	Realistic Worst Case* [during **2023 /** *during **2027***] Annual Financial Impact [a]	Annual Occurrence Likelihood [b]
Succession challenges Departure of key underwriting executives in a tightening talent market may limit XYZ's ability to achieve strategic objectives.	**Minor**	**Likely**

* Pessimistic enough to have a low chance of occurring in any particular year but reasonable enough to be believable. When historic data is sparse or not representative of the future, the risk assessment is informed by scenario analysis, stress testing, and expert judgment.

[a] Impact scoring benchmarks (reduction in planned pre-tax income): Minor < Moderate < Major < Severe < Extreme
[b] Likelihood scoring benchmarks: Rare < Unlikely < Possible < Likely < Frequent

c) Hybrid condition

[Note: The Hybrid exhibit is identical to the Qualitative exhibit. However, participants in the Hybrid condition can review a mapping of qualitative scores to quantitative scores on the "Instructions" screen preceding these risk exhibits whereas participants in the Qualitative and Quantitative conditions cannot.]

RISK #2 Question

Measure of Propensity to Challenge the self-assessment

2. How confident are you that the business's self-assessment is a reasonable estimate of this risk [during 2023 / *during 2027*]?

   (0: lowest confidence and 10: highest confidence)

RISK #3:

Excerpt from Risk Self-Assessment Report
for the One-Year Period in [2023 */ 2027*]

a) Quantitative condition

Risk Description	Realistic Worst Case* [during **2023 /** ***during 2027***] Annual Financial Impact	Annual Occurrence Likelihood
Disruptive competition Rapid speed of disruptive "InsurTech" innovations enabled by advanced technology may outpace XYZ's ability to compete in certain insurance segments.	**25% ($55m)** reduction in planned pre-tax income	**20%** (i.e., once in 1.5 years)

* Pessimistic enough to have a low chance of occurring in any particular year but reasonable enough to be believable. When historic data is sparse or not representative of the future, the risk assessment is informed by scenario analysis, stress testing, and expert judgment.

b) Qualitative condition

Risk Description	Realistic Worst Case* [during **2023 /** ***during 2027***] Annual Financial Impact [a]	Annual Occurrence Likelihood [b]
Disruptive competition Rapid speed of disruptive "InsurTech" innovations enabled by advanced technology may outpace XYZ's ability to compete in certain insurance segments.	**Moderate**	**Possible**

* Pessimistic enough to have a low chance of occurring in any particular year but reasonable enough to be believable. When historic data is sparse or not representative of the future, the risk assessment is informed by scenario analysis, stress testing, and expert judgment.

[a] *Impact scoring benchmarks (reduction in planned pre-tax income): Minor < Moderate < Major < Severe < Extreme*
[b] *Likelihood scoring benchmarks: Rare < Unlikely < Possible < Likely < Frequent*

c) Hybrid condition

[Note: The Hybrid exhibit is identical to the Qualitative exhibit. However, participants in the Hybrid condition can review a mapping of qualitative scores to quantitative scores on the "Instructions" screen preceding these risk exhibits whereas participants in the Qualitative and Quantitative conditions cannot.]

RISK #3 Question

Measure of Propensity to Challenge the self-assessment

3. How confident are you that the business's self-assessment is a reasonable estimate of this risk [during 2023 / *during 2027*]?

(0: lowest confidence and 10: highest confidence)

OVERALL EXHIBIT:

Excerpt from Risk Self-Assessment Report
for the One-Year Period in [2023 */ 2027*]

a) Quantitative condition

	Realistic Worst Case* [during **2023 /** *during **2027***]	
Risk Description	Annual Financial Impact	Annual Occurrence Likelihood
Shifts in stakeholder expectations XYZ may be unable to satisfy shifting stakeholder demands and expectations regarding environmental, social and governance ("ESG") practices, which could affect XYZ's ability to attract and retain customers, employees, and investors.	**55% ($121m)** reduction in planned pre-tax income	**2%** (i.e., once in 50 years)
Succession challenges Departure of key underwriting personnel in a tightening talent market may limit XYZ's ability to achieve strategic objectives.	**5% ($11m)** reduction in planned pre-tax income	**66%** (i.e., once in 1.5 years)
Disruptive competition Rapid speed of disruptive "InsurTech" innovations enabled by advanced technology may outpace XYZ's ability to compete in certain insurance segments.	**25% ($55m)** reduction in planned pre-tax income	**20%** (i.e., once in 5 years)

* Pessimistic enough to have a low chance of occurring in any particular year but reasonable enough to be believable. When historic data is sparse or not representative of the future, the risk assessment is informed by scenario analysis, stress testing, and expert judgment.

b) Qualitative condition

Risk Description	Realistic Worst Case* [during **2023 /** *during **2027***] Annual Financial Impact [a]	Annual Occurrence Likelihood [b]
Shifts in stakeholder expectations XYZ may be unable to satisfy shifting stakeholder demands and expectations regarding environmental, social and governance ("ESG") practices, which could affect XYZ's ability to attract and retain customers, employees, and investors.	**Major**	**Rare**
Succession challenges Departure of key underwriting executives in a tightening talent market may limit XYZ's ability to achieve strategic objectives.	**Minor**	**Likely**
Disruptive competition Rapid speed of disruptive "InsurTech" innovations enabled by advanced technology may outpace XYZ's ability to compete in certain insurance segments.	**Moderate**	**Possible**

* Pessimistic enough to have a low chance of occurring in any particular year but reasonable enough to be believable. When historic data is sparse or not representative of the future, the risk assessment is informed by scenario analysis, stress testing, and expert judgment.

[a] *Impact scoring benchmarks (reduction in planned pre-tax income): Minor < Moderate < Major < Severe < Extreme*
[b] *Likelihood scoring benchmarks: Rare < Unlikely < Possible < Likely < Frequent*

c) Hybrid condition

[Note: The Hybrid exhibit is identical to the Qualitative exhibit. However, participants in the Hybrid condition can review a mapping of qualitative scores to quantitative scores on the "Instructions" screen preceding these risk exhibits whereas participants in the Qualitative and Quantitative conditions cannot.]

OVERALL Questions

Measure of Propensity to Challenge the self-assessment

4. Overall, how confident are you that the risk self-assessment report presents a reasonable estimate of these risks [during 2023 / during 2027]?

(0: lowest confidence and 10: highest confidence)

Measure of perceived Reliability of risk report

[*Source: as measured by Rennekamp, 2012; Elliott et al., 2017*]

5. Overall, I felt like I could rely on the information in the risk self-assessment report.
(1 = Disagree strongly; to 7 = Agree strongly)

Free-form explanation

6. Please tell us the main reasons for your answers above.

Measure of perceived Processing Fluency

[*Source: as measured by*(Elliott et al., 2017; Liu & Wong-On-Wing, 2021)*; Elliott et al., 2017*]

The information provided in the risk report…

7. …was easy to process
(1 = Disagree strongly; to 7 = Agree strongly)

8. …was difficulty to understand
(1 = Disagree strongly; to 7 = Agree strongly)

9. …felt easy to read
(1 = Disagree strongly; to 7 = Agree strongly)

Transition statement

You are more than half of the way through! Thank you for being diligent.

The remaining set of questions is unrelated to the XYZ risk management task.

Measure of risk aversion

[*Source: as measured by* (Bodnar et al., 2019; Graham et al., 2013)]

10. Suppose you are the only income earner in your family. Your current annual income is $X. Your doctor recommends you move because of allergies. You have to choose between two possible jobs (choose one):
(a) 100% chance that the job pays $X for life.
(b) 50% chance that the job pays $2X for life and 50% chance that the job pays 2/3 of $X for life.

If the respondent picked (a), the survey continues to ask:

11. Which job would you choose if the choices were instead:
(c) 100% chance that the job pays $X for life.
(d) 50% chance that the job pays $2X for life and 50% chance that the job pays 4/5 of $X for life.

If the respondent picked (b), the survey continues to ask:

Which job would you choose if the choices were instead:

(e) 100% chance that the job pays $X for life.

(f) 50% chance that the job pays $2X for life and 50% chance that the job pays 1/2 of $X for life.

Measure of Quantitative Orientation

12. Quantitative risk information is better for making decisions than qualitative risk information.

(1 = Disagree strongly; to 7 = Agree strongly)

Measure of Statistical Numeracy

[*Source: adapted from* (Elliott et al., 2017)]

Please complete the following five questions without referring to other materials. You may use a calculator if you need to.

13. In a raffle, the chances of winning $10 are 1%. How many people would win $10 if 10,000 people each buy one raffle ticket??

a. 1 person out of 10,000; b. 10 people out of 10,000; c. **100 people out of 10,000**; d. 990 people out of 10,000; e. None of the above; f. Don't know

14. The chance of winning a vacation in a sweepstakes is 1 in 1,000. What percent of tickets win a vacation?

a. 0.001%; **b. 0.1%**; c. 1%; d. 10%; e. None of the above; f. Don't know

15. If we roll a five-sided die 500 times, on average how many times would this die show an odd number (1, 3, or 5)?

b. 50 out of 500 throws; b. 200 out of 500 throws; c. 250 out of 500 throws; **d. 300 out of 500 throws**; e. None of the above; f. Don't know

16. Out of 1,000 individuals in a village, 500 are members of a club. Out of these 500 members in the club, 300 are men. Out of the 500 individuals that are not in the club, 100 are men. What is the probability that a randomly drawn man is a member of the club?

a. 40%; b. 60%; **c. 75%;** d. 80%; e. None of the above; f. Don't know

17. If we roll a 6-sided loaded die, the probability that the die shows a 6 is three times as high as the probability of each of the other numbers. On average, out of 80 throws, how many times would the die show the number 6?

a. 20 out of 80 throws; b. 24 out of 80 throws; **c. 30 out of 80 throws**; d. 40 out of 80 throws; e. None of the above; f. Don't know

Demographic Questions

[*Source: Questions 18 from* (Weisner, 2015b)]

18. Have you ever used a checklist or risk register which lists various risk factors and asks you to make a judgment about the likelihood that those risks will materialize

(e.g., the checklist or risk register may ask you to rate each risk as “unlikely”, “likely”, “frequent”, “rare”, etc.; alternatively, the checklist or risk register may similarly ask you for a percentage likelihood)?

Multiple choice: Yes; No; Not sure

19. Please indicate your amount of actual, real-life experience evaluating at least one of the specific risks addressed in the XYZ report.

(0: no experience evaluating any of these specific risks and 10: extensive experience evaluating one or more of these specific risks)

20. Which of these choices best describes the industry that you work in?

Multiple choice: Non-Financial industry; Accounting Firms; Banking; Insurance; Other Financial Services

21. What is your current (or most recent) position or job title? Do not identify your employer.

22. Which professional certifications do you hold that are relevant for risk management? Select all that apply.

Multiple choice: CPA (Certified Public Accountant); CIA (Certified Internal Auditor); CMA (Certified Management Accountant); CFA (Chartered Financial Analyst); FRM (Financial Risk Manager); PRM (Professional Risk Manager); CRMP (Certified Risk Management Professional); None; Other (please specify)

23. Have you ever participated in a similar survey in which you were asked to assume the role of a risk manager in a fictitious company?

Multiple choice: Yes; No; Not sure

24. What is your gender?

Multiple choice: Male; Female; Neither of the above; Prefer not to say

25. To which age group do you belong?

Multiple choice: 18-27; 28-37; 38-47; 48-57; 58+

26. What is your highest level of education?

Multiple choice: No College; Some College; Bachelor’s degree; Master’s degree; Doctoral degree

27. How many years of business work experience do you have?

Multiple choice: <5; 5-10; 11-15; 16-20; >20

**********END OF PRIMARY SURVEY**********

**********START OF SECONDARY SURVEY**********

The secondary sample of similar but more accessible participants (businesspeople who assess risk in their day-to-day work) will receive a modified version of the primary instrument designed to check only the effectiveness of experimental manipulations and to measure the corresponding mindset (construal level) evoked.

Screening questions for secondary sample

1. What is your highest level of education?

   Multiple choice: No College; Some College; **Bachelor's degree; Master's degree; Doctoral degree**

2. How many years of business work experience do you have?

   Multiple choice: <5; **5-10; 11-15; 16-20; >20**

3. Some questions in this survey are not suitable for viewing on a mobile phone. Please continue only if you are using a desktop computer or large tablet device.

   Checkbox: I am using a desktop or tablet for this survey

Experimental Scenario

[*The same scenarios are presented as in the primary experiment*]

Instructions

The self-assessed risks are displayed on the following screens. You will be shown three risks individually and then all three risks collectively, followed by some questions about how you perceive the reported information.

RISK #1, RISK#2, RISK#3, and Overall exhibits

[*The same risk exhibits are presented as in the primary experiment. Unlike the primary experiment, participants in this secondary sample are not asked any questions about the individual exhibits. Participants only observe the exhibits and then are asked the questions below after the overall (final) exhibit has been presented.*]

Questions to check manipulation of report format

4. The essential information about each risk's Financial Impact and Occurrence Likelihood is expressed by the report....

   Multiple choice: in numbers mostly; in words mostly; not sure

5. Which point on this scale best describes the reported information about Financial Impact and Occurrence Likelihood of the risks?

   (1 = Very Quantitative; to 7 = Very Qualitative)

Questions to check manipulation of time horizon

6. XYZ's risk self-assessment report addresses risks that may occur in the...

Multiple choice: near future; distant future; not sure

7. Which point on this scale best describes the risks in XYZ's self-assessment report? (1 = near future; to 7 = Distant future)

Transition statement

You are about halfway through! Thank you for being diligent.

The remaining set of questions is unrelated to the XYZ risk management task.

Measure of Construal Level (i.e., abstraction)

[*Source: widely used Behavioral Identification scale from Vallacher & Wegner, 1989*]

We have listed several different activities below.

Please choose one of the two alternative descriptions of each activity that fits best with how you would describe the activity. There is no right or wrong answer.

1. Making a list a. Getting organized b. Writing things down	2. Reading a. Following lines of print b. Gaining knowledge
3. Joining the Army a. Helping the Nation's defense b. Signing up	4. Washing clothes a. Removing odors from clothes b. Putting clothes into the machine
5. Picking an apple a. Getting something to eat b. Pulling an apple off a branch	6. Chopping down a tree a. Wielding an axe b. Getting firewood
7. Measuring a room for carpeting a. Getting ready to remodel b. Using a yardstick	8. Cleaning the house a. Showing one's cleanliness b. Vacuuming the floor
9. Painting a room a. Applying brush strokes b. Making the room look fresh	10. Paying the rent a. Maintaining a place to live b. Writing a check
11. Caring for houseplants a. Watering plants b. Making the room look nice	12. Locking a door a. Putting a key in the lock b. Securing the house
13. Voting a. Influencing the election b. Marking a ballot	14. Climbing a tree a. Getting a good view b. Holding on to branches
15. Filling out a personality test a. Answering questions b. Revealing what you're like	16. Toothbrushing a. Preventing tooth decay b. Moving a brush around in one's mouth
17. Taking a test a. Answering questions b. Showing one's knowledge	18. Greeting someone a. Saying hello b. Showing friendliness

19. Resisting temptation a. Saying "no" b. Showing moral courage	20. Eating a. Getting nutrition b. Chewing and swallowing
21. Growing a garden a. Planting seeds b. Getting fresh vegetables	22. Traveling by car a. Following a map b. Seeing countryside
23. Having a cavity filled a. Protecting your teeth b. Going to the dentist	24. Talking to a child a. Teaching a child something b. Using simple words
(***Attention check***) 25. Paying attention to the survey a. leave this blank if you're awake b. If you're awake, leave this blank too	26. Pushing a doorbell a. Moving a finger b. Seeing if someone's home

Demographic Questions

[*The same demographic questions as in the primary experiment*]

**********END OF SECONDARY SURVEY**********

REFERENCES

Agarwal, R., & Helfat, C. 2009. Strategic renewal of organizations. ***Organization Science***, 20(2): 281–293.

Aguilar, F. 1967. ***Scanning the business environment***. New York: Macmillan.

Allan, N., Cantle, N., Godfrey, P., & Yin, Y. 2013. A review of the use of complex systems applied to risk appetite and emerging risks in ERM practice. ***British Actuarial Journal***, 18(01): 163–234.

Allianz. 2018. ***Allianz Risk Barometer—Top business risks for 2018***. https://commercial.allianz.com/news-and-insights/reports.html.

Allianz. 2023. ***Allianz Risk Barometer—Identifying the major business risks for 2023***. https://commercial.allianz.com/news-and-insights/reports/allianz-risk-barometer.html.

Alter, A. L. 2007. Overcoming intuition: Metacognitive difficulty activates analytic reasoning. ***Journal of Experimental Psychology: General***, 136(4): 569.

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

Alter, A. L., & Oppenheimer, D. M. 2008. Effects of fluency on psychological distance and mental construal (or Why New York is a large city, but New York is a civilized jungle). ***Psychological Science***, 19(2): 161–167.

Alter, A. L., & Oppenheimer, D. M. 2009. Uniting the tribes of fluency to form a metacognitive nation. ***Personality and Social Psychology Review***, 13(3): 219–235.

Andersen, T. J., Sax, J., & Giannozzi, A. 2022. Conjoint effects of interacting strategy-making processes and lines of defense practices in strategic Risk Management: An empirical study. ***Long Range Planning***, 55(6): 102164.

Andersen, T. J., & Young, P. C. 2020. ***Strategic risk leadership: Engaging a world of risk, uncertainty, and the unknown***. Routledge.

Ansoff, H. I. 1980. Strategic issue management. ***Strategic Management Journal***, 1(2): 131–148.

Arena, M., Arnaboldi, M., & Azzone, G. 2010. The organizational dynamics of enterprise risk management. ***Accounting, Organizations and Society***, 35(7): 659–675.

Ashforth, B. E., & Mael, F. 1989. Social Identity Theory and the Organization. ***The Academy of Management Review***, 14(1): 20–39.

Backof, A. G., Bamber, E. M., & Carpenter, T. D. 2016. Do auditor judgment frameworks help in constraining aggressive reporting? Evidence under more precise and less precise accounting standards. ***Accounting, Organizations and Society***, 51: 1–11.

Backof, A. G., Carpenter, T. D., & Thayer, J. 2018. Auditing complex estimates: How do construal level and evidence formatting impact auditors' consideration of inconsistent evidence? ***Contemporary Accounting Research***, 35(4): 1798–1815.

Bamber, E. M., & Iyer, V. M. 2007. Auditors' Identification with Their Clients and Its Effect on Auditors' Objectivity. ***AUDITING: A Journal of Practice & Theory***, 26(2): 1–24.

Barney, J. 1991. Firm resources and sustained competitive advantage. ***Journal of Management***, 17(1): 99–120.

Bauer, T. D. 2015. The Effects of Client Identity Strength and Professional Identity Salience on Auditor Judgments. ***The Accounting Review***, 90(1): 95–114.

Beasley, M., Branson, B., & Pagach, D. 2015. An analysis of the maturity and strategic impact of investments in ERM. ***Journal of Accounting and Public Policy***, 34(3): 219–243.

Benschop, N., Nuijten, A. L. P., Keil, M., Rohde, K. I. M., Lee, J. S., et al. 2021. Construal level theory and escalation of commitment. ***Theory and Decision***, 91(1): 135–151.

Bentler, P. M. 1990. Comparative fit indexes in structural models. ***Psychological Bulletin***, 107(2): 238–246.

Bettis, R. A., & Hitt, M. A. 1995. The new competitive landscape. ***Strategic Management Journal***, 16(S1): 7–19.

Bhattacharjee, S., & Owen Brown, J. 2018. The impact of management alumni affiliation and persuasion tactics on auditors' internal control judgments. ***Accounting Review***, 93(2): 97–115.

Bodnar, G. M., Giambona, E., Graham, J. R., & Harvey, C. R. 2019. A view inside corporate risk management. ***Management Science***, 65(11): 5001–5026.

Bogodistov, Y., & Wohlgemuth, V. 2017. Enterprise risk management: A capability-based perspective. ***The Journal of Risk Finance***, 18(3): 234–251.

Borsa, L., Frank, P., & Doran, H. 2014. ***How can resilience prepare companies for environmental and social change?*** PwC. Resilence - A journal of strategy and risk.

Boulton, J., Allen, P., & Bowman, C. 2015. ***Embracing complexity: Strategic perspectives for an age of turbulence***. Oxford University Press.

Brazel, J. F., Leiby, J., & Schaefer, T. J. 2022. Do Rewards encourage professional skepticism? It depends. ***The Accounting Review***, 97(4): 131–154.

Brewer, M. B. 1999. The psychology of prejudice: Ingroup love or outgroup hate? ***Journal of Social Issues***, 55(3): 429–444.

Bromiley, P., McShane, M., Nair, A., & Rustambekov, E. 2015. Enterprise risk management: Review, critique, and research directions. ***Long Range Planning***, 48(4): 265–276.

Bromiley, P., Rau, D., & McShane, M. K. 2016. Can strategic risk management contribute to enterprise risk management? A strategic management perspective. In T. J. Andersen (Ed.), ***Routledge companion on strategic risk management***: 140–156. Routledge.

Broughton, K. 2020, February 4. COSO warns of the downside of siloing risk managers. ***Wall Street Journal***. https://www.wsj.com/articles/coso-warns-of-the-downside-of-siloing-risk-managers-11580856142.

Browne, M. W., & Cudeck, R. 1992. Alternative ways of assessing model fit. ***Sociological Methods & Research***, 21(2): 230–258.

Budescu, D. V., Por, H.-H., & Broomell, S. B. 2012. Effective communication of uncertainty in the IPCC reports. ***Climatic Change***, 113(2): 181–200.

Burt, I., & Libby, T. 2021. Organizational identity, professional identity salience and internal auditors' assessments of the severity of internal control concerns. ***Managerial Auditing Journal***, 36(4): 513–534.

Casualty Actuarial Society. n.d. ***What is a property and casualty actuary?*** https://www.casstudentcentral.org/about-our-profession/what-is-a-property-and-casualty-actuary, April 10, 2022.

Chaiken, S. 1980. Heuristic versus systematic information processing and the use of source versus message cues in persuasion. ***Journal of Personality and Social Psychology***, 39(5): 752–766.

Chambers, A. 2013. Maginot line, Potemkin village, Goodhart's law? Third Line of Defense – Second Thoughts' (Part 1). ***Internal Auditing***, 15–24.

Chang, C. J., Yen, S.-H., & Duh, R.-R. 2002. An empirical examination of competing theories to explain the framing effect in accounting-related decisions. ***Behavioral Research in Accounting***, 14(1): 35–64.

Charmaz, K. 2014. ***Constructing grounded theory***. Sage.

Cohen, J., Krishnamoorthy, G., & Wright, A. 2017. Enterprise risk management and the financial reporting process: The experiences of audit committee members, CFOs, and external auditors. ***Contemporary Accounting Research***, 34(2): 1178–1209.

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

Committee of Sponsoring Organizations of the Treadway Commission (COSO). 2012. ***Risk Assessment in Practice***. https://www.coso.org/Shared%20Documents/COSO-ERM-Risk-Assessment-in-Practice-Thought-Paper-October-2012.pdf.

Corbin, J., & Strauss, A. 2015. ***Basics of qualitative research: Techniques and procedures for developing grounded theory*** (4th ed.). SAGE Publications.

Corner, P., Kinicki, A. J., & Keats, B. W. 1994. Integrating organizational and individual information processing perspectives on choice. ***Organization Science***, 5(3): 294–308.

COSO. 2015. ***Leveraging COSO across the three lines of defense***. The Institute of Internal Auditors.

COSO. 2017. ***Enterprise risk management—Integrating with strategy and performance***. https://www.coso.org/enterprise-risk-management.

COSO. 2018. ***Enterprise risk management: Applying enterprise risk management to environmental, social and governance-related risks***. https://www.wbcsd.org/Programs/Redefining-Value/Making-stakeholder-capitalism-actionable/Enterprise-Risk-Management/Resources/Applying-Enterprise-Risk-Management-to-Environmental-Social-and-Governance-related-Risks.

COSO. 2020. Creating and protecting value: Understanding and Implementing Enterprise Risk Management. ***The Committee of Sponsoring Organizations' (COSO)***. https://www.coso.org/creating-and-protecting.

CPA Canada. 2020. ***Enterprise risk management: A practical approach to managing risks for small- to medium-sized organizations***. CPA Canada.

Crawford, J., & Jabbour, M. 2023. The relationship between enterprise risk management and managerial judgement in decision-making: A systematic literature review. ***International Journal of Management Reviews***, Online Early(n/a): 1–27.

CRO Forum. 2018. ***Emerging risks initiative: Major trends and emerging risk radar, April 2018 update***. https://www.thecroforum.org/emerging-risk-initiative-major-trends-and-emerging-risk-radar-2022-update/.

CRO Forum. 2021. ***The Three Lines Model***. https://www.thecroforum.org/the-three-lines-model/.

Cyert, R. M., & March, J. G. 1963. ***A behavioral theory of the firm***. Prentice-Hall. https://doi.org/10.1017/CBO9781107415324.004.

Daft, R. L., & Weick, K. E. 1984. Toward a model of organizations as interpretation systems. ***Academy of Management Review***, 9(2): 284–295.

Davies, H., & Zhivitskaya, M. 2018. Three lines of defence: A robust organising framework, or just lines in the sand? ***Global Policy***, 9: 34–42.

De Nederlandsche Bank. 2015. Supervision of behaviour and culture: Foundations, practice & future developments. ***De Nederlandsche Bank***. https://www.dnb.nl/media/1gmkp1vk/supervision-of-behaviour-and-culture_tcm46-380398-1.pdf.

Deloitte. 2013. Balancing the risk-return equation. ***Deloitte***. https://www2.deloitte.com/in/en/pages/governance-risk-and-compliance/articles/balancing-the-risk-return-equation.html.

Deloitte. 2018. Deloitte Global risk management survey, 11th edition (2018): Reimagining risk management to mitigate looming economic dangers and nonfinancial risks. ***Deloitte***. https://www2.deloitte.com/content/dam/insights/us/articles/4222_Global-risk-management-survey/DI_global-risk-management-survey.pdf.

Deloitte. 2021. ***CROs of the Future: Strategists, Visionaries, Influencers, Future CEOs***. https://deloitte.wsj.com/riskandcompliance/2021/01/26/cros-of-the-future-strategists-visionaries-influencers-future-ceos/.

DiMaggio and Powell. 1983. The Iron Cage Revisited: Institutional Isomorphism and Collective Rationality in Organizational Fields. ***American Sociological Review***, 48(2): 147–160.

Douglas, M., & Wildavsky, A. 1983. ***Risk and Culture***. University of California Press.

Durand, R. 2003. Predicting a firm's forecasting ability: The roles of organizational illusion of control and organizational attention. ***Strategic Management Journal***, 24(9): 821–838.

Edmondson, A. C., & McManus, S. E. 2007. Methodological fit in management field research. ***Academy of Management Review***, 32(4): 1246–1264.

Eilifsen, A., Hamilton, E. L., & Messier, W. F. 2021. The importance of quantifying uncertainty: Examining the effects of quantitative sensitivity analysis and audit materiality disclosures on investors' judgments and decisions. ***Accounting, Organizations and Society***, 90: 101169.

EIOPA. 2017. EIOPA supervisory assessment of the own risk and solvency assessment-first experiences. ***European Insurance and Occupational Pensions Authority***. https://www.eiopa.europa.eu/publications/eiopa-supervisory-assessment-own-risk-and-solvency-assessment_en.

Eisenhardt, K. M. 1989. Agency Theory: An Assessment and Review. ***The Academy of Management Review***, 14(1): 57.

Eisenhardt, K. M., & Zbaracki, M. J. 1992. Strategic decision making. ***Strategic Management Journal***, 13(52): 17–37.

Elliott, W. B., Grant, S. M., & Rennekamp, K. M. 2017. How Disclosure Features of Corporate Social Responsibility Reports Interact with Investor Numeracy to Influence Investor Judgments. ***Contemporary Accounting Research***. https://doi.org/10.1111/1911-3846.12302.

EY. 2017. ***Insurance CRO Survey 2107***.

EY. 2018. ***EY 2017 North America Insurance CRO Survey—Shifting from defense to offense***. Ernst & Young Global Limited.

EY. 2019. ***EY European Insurance CRO Survey 2018***. EYGM Limited. ey.com / fsminds.

Fehrenbacher, D., Sutton, S., & Weisner, M. 2022. Spatial distance and risk category effects in enterprise risk management practice. ***Journal of Management Accounting Research***, 34(3): 119–139.

Fehrenbacher, D., Triki, A., & Weisner, M. 2021. Can multitasking influence professional scepticism? ***Accounting & Finance***, 61(1): 1277–1306.

Financial Conduct Authority (UK). 2013. ***The FCA's response to the Parliamentary Commission on Banking Standards***.

Finucane, M. L., Alhakami, A., Slovic, P., & Johnson, S. M. 2000. The affect heuristic in judgments of risks and benefits. ***Journal of Behavioral Decision Making***, 13(1): 1–17.

Finucane, M. L., Slovic, P., Mertz, C. K., Flynn, J., & Satterfield, T. A. 2000. Gender, race, and perceived risk: The "white male" effect. ***Health, Risk & Society***, 2(2): 159–172.

Fox, C. 2018. ***Enterprise risk management's wakeup call 10 years after***. Risk and Insurance Management Society, Inc. (RIMS). https://www.rims.org/about-us/newsroom/rims-report-enterprise-risk-management-s-wakeup-call-10-years-after.

Fraser, J., Quail, R., & Simkins, B. 2021. ***Enterprise Risk Management: Today's Leading Research and Best Practices for Tomorrow's Executives***. John Wiley & Sons.

Fujita, K., Trope, Y., & Liberman, N. 2015. On the psychology of near and far: A construal level theoretic approach. In G. Keren & G. Wu (Eds.), ***The Wiley Blackwell Handbook of Judgment and Decision Making***: 404–430.

Fukukawa, H., & Mock, T. J. 2011. Audit Risk Assessments Using Belief versus Probability. ***AUDITING: A Journal of Practice & Theory***, 30(1): 75–99.

Fukukura, J., Ferguson, M. J., & Fujita, K. 2013. Psychological distance can improve decision making under information overload via gist memory. ***Journal of Experimental Psychology: General***, 142(3): 658–665.

Ganzin, M., Islam, G., & Suddaby, R. 2020. Spirituality and entrepreneurship: The role of magical thinking in future-oriented sensemaking. ***Organization Studies***, 41(1): 77–102.

Gavetti, G., Levinthal, D., & Ocasio, W. 2007. Neo-Carnegie: The Carnegie School's past, present, and reconstructing for the future. ***Organization Science***, 18(3): 523–536.

Gendron, Y., Brivot, M., & Guénin-Paracini, H. 2016. The construction of risk management credibility within corporate boardrooms. ***European Accounting Review***, 25(3): 549–578.

Gephart, R. P., Topal, C., & Zhang, Z. 2010. Future-oriented sensemaking: Temporalities and institutional legitimation. In S. Maitlis & T. Hernes (Eds.), ***Process, sensemaking, and organizing***: 275–312. Oxford University Press.

Gilovich, T., Kerr, M., & Medvec, V. H. 1993. Effect of Temporal Perspective on Subjective Confidence. ***Journal of Personality and Social Psychology***, 64(4): 552–560.

Giovannoni, E., Quarchioni, S., & Riccaboni, A. 2016. The role of roles in risk management change: The case of an Italian bank. ***European Accounting Review***, 25(1): 109–129.

Gletsu, C. D. 2020. Planning for Emerging Risks: How insurance industry managers evaluate and respond. ***Case Western Reserve University, Unpublished Manuscript***.

Goretzki, L., & Messner, M. 2016. Coordination under uncertainty A sensemaking perspective on cross-functional planning meetings. ***Qualitative Research in Accounting and Management***, 13(1): 92–126.

Graham, J. R., Harvey, C. R., & Puri, M. 2013. Managerial attitudes and corporate actions. ***Journal of Financial Economics***, 109(1): 103–121.

Griffith, E. E., Hammersley, J. S., Kadous, K., & Young, D. 2015. Auditor Mindsets and Audits of Complex Estimates. ***Journal of Accounting Research***, 53(1): 49–77.

Guggenmos, R. D., & Van der Stede, W. A. 2020. The Effects of Creative Culture on Real Earnings Management. ***Contemporary Accounting Research***, 37(4): 2319–2356.

Hair, J., Black, W., Babin, B., & Anderson, R. 2019. ***Multivariate Data Analysis*** (8th ed.). Cengage.

Hauser, D. J., Ellsworth, P. C., & Gonzalez, R. 2018. Are Manipulation Checks Necessary? ***Frontiers in Psychology***, 9(JUN). https://doi.org/10.3389/FPSYG.2018.00998.

Hayes, A. F. 2018. Partial, conditional, and moderated moderated mediation: Quantification, inference, and interpretation. ***Communication Monographs***, 85(1): 4–40.

Hayes, A. F. 2022. ***Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-Based Approach*** (3rd ed.). Guilford Press.

Hayes, A. F., & Rockwood, N. J. 2020. Conditional Process Analysis: Concepts, Computation, and Advances in the Modeling of the Contingencies of Mechanisms. ***American Behavioral Scientist***, 64(1): 19–54.

Hayne, C., & Free, C. 2014. Hybridized professional groups and institutional work: COSO and the rise of enterprise risk management. ***Accounting, Organizations and Society***, 39(5): 309–330.

Henry, E., & Peytcheva, M. 2018. Earnings-Announcement Narrative and Investor Judgment. ***Accounting Horizons***, 32(3): 123–143.

Hogg, M. A., & Terry, D. J. 2000. Social Identity and Self-Categorization Processes in Organizational Contexts. ***The Academy of Management Review***, 25(1): 121–140.

Hoos, F., Messier, W. F., Smith, J. L., & Tandy, P. R. 2018. An experimental investigation of the interaction effect of management training ground and reporting lines on internal auditors' objectivity. ***International Journal of Auditing***, 22(2): 150–163.

Hu, L. T., & Bentler, P. M. 1999. Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. ***Structural Equation Modeling***. https://doi.org/10.1080/10705519909540118.

Hubbard, D. W. 2020. ***The Failure of Risk Management: Why It's Broken and How to Fix It*** (2nd ed.). Wiley.

IAIS. 2019. ***Insurance Core Principles and Common Framework for the Supervision of Internationally Active Insurance Groups***. https://www.iaisweb.org/activities-topics/standard-setting/icps-and-comframe/.

IAIS. 2021a, June 23. ***Application Paper on Supervision of Control Functions***. https://www.fsb.org/2021/06/application-paper-on-supervision-of-control-functions/.

IAIS. 2021b. ***Resolution of public consultation comments on Application Paper on Supervision of Control Functions***. International Association of Insurance Supervisors.

Institute of Internal Auditors. 2019. ***Three lines of defense: Report on the public exposure findings June–September 2019***. https://iia-p.org/wp-content/uploads/2016/03/3LOD_IIA-Exposure-Draft-Document_06202019.pdf.

Institute of Internal Auditors. 2020. ***The IIA's Three Lines model. An update the Three Lines of Defense***. https://www.theiia.org/en/content/position-papers/2020/the-iias-three-lines-model-an-update-of-the-three-lines-of-defense/.

IRGC. 2015. ***Guidelines for Emerging Risk Governance***. Lausanne: International Risk Governance Council (IRGC). www.irgc.org.

ISO. 2018. ***ISO 31000 Risk management—Principles and guidelines***. Geneva, Switzerland: ISO.

Ittner, C. D., & Keusch, T. 2016. Incorporating risk considerations into planning and control systems: The influence of risk management value creation objectives. In M. Woods & P. Linsley (Eds.), ***The Routledge companion to accounting and risk***: 150–171.

Ittner, C. D., & Michels, J. 2017. Risk-based forecasting and planning and management earnings forecasts. ***Review of Accounting Studies***, 22(3): 1005–1047.

Jabbour, M., & Abdel-Kader, M. 2015. Changes in capital allocation practices—ERM and organisational change. ***Accounting Forum***, 39(4): 295–311.

Jabbour, M., & Abdel-Kader, M. 2016. ERM adoption in the insurance sector. ***Qualitative Research in Accounting & Management***, 13(4): 472–510.

Janis, I. L. 1982. ***Groupthink: Psychological studies of policy decisions and fiascoes*** (2nd ed.). Boston: Houghton Mifflin.

Jemaa, F. 2022. Recoupling work beyond COSO: A longitudinal case study of Enterprise-wide Risk Management. ***Accounting, Organizations and Society***, 103: 101369.

Johnson, R. B., & Onwuegbuzie, A. J. 2004. Mixed methods research: A research paradigm whose time has come. ***Educational Researcher***, 33(7): 14–26.

Jollineau, S. J., & Bowen, R. M. 2023. A Practical Guide to Using Path Analysis: Mediation and Moderation in Accounting Research. ***Journal of Financial Reporting***, 8(1): 11–40.

Jordan, S., Jørgensen, L., & Mitterhofer, H. 2013. Performing risk and the project: Risk maps as mediating instruments. ***Management Accounting Research***, 24: 156–174.

Jordan, S., Mitterhofer, H., & Jørgensen, L. 2018. The interdiscursive appeal of risk matrices: Collective symbols, flexibility normalism and the interplay of 'risk' and 'uncertainty.' ***Accounting, Organizations and Society***, 67(May 2018): 34–55.

Judd, C. M., McClelland, G. H., & Ryan, C. S. 2017. ***Data Analysis: A Model Comparison Approach To Regression, ANOVA, and Beyond, Third Edition*** (3rd ed.). New York: Routledge. https://doi.org/10.4324/9781315744131.

Kachelmeier, S. J., & Van Landuyt, B. W. 2017. Prompting the Benefit of the Doubt: The Joint Effect of Auditor-Client Social Bonds and Measurement Uncertainty on Audit Adjustments. ***Journal of Accounting Research***. https://doi.org/10.1111/1475-679X.12171.

Kadous, K., Koonce, L., & Towry, K. 2005. Quantification and Persuasion in Managerial Judgment. ***Contemporary Accounting Research***, 22(3): 643–686.

Kadous, K., & Zhou, Y. D. 2017. Maximizing the contribution of JDM-style experiments in accounting. ***The Routledge companion to behavioural accounting research***: 175–192. Routledge.

Kahan, D. M., Peters, E., Dawson, E. C., & Slovic, P. 2017. Motivated numeracy and enlightened self-government. ***Behavioural Public Policy***, 1(1): 54–86.

Kahneman, D. 2011. ***Thinking, Fast and Slow***. Farrar, Straus and Giroux.

Kahneman, D., & Lovallo, D. 1993. Timid choices and bold forecasts: A cognitive perspective on risk taking. ***Management Science***, 39(1): 17–31.

Kahneman, D., & Tversky, A. 1979. Prospect Theory: An Analysis of Decision under Risk. ***Econometrica***, vol. 47: 263–292.

Kay, J. 2020. ***Radical Uncertainty***. no. 22, The European Money and Finance Forum. https://www.suerf.org/suerf-policy-brief/16053/radical-uncertainty.

Kay, J., & King, M. 2020. ***Radical Uncertainty: Decision-making beyond the numbers.*** WW Norton & Company.

Kelton, A. S., Pennington, R. R., & Tuttle, B. M. 2010. The effects of information presentation format on judgment and decision making: A review of the information systems research. ***Journal of Information Systems***, 24(2): 79–105.

Keynes, J. M. 1921. ***A Treatise on Probability***. Macmillan and Company.

Khorsandi, J., & Aven, T. 2014. A risk perspective supporting organizational efforts for achieving high reliability. ***Journal of Risk Research***, 17(7): 871–884.

Kline, R. B. 2015. Principles and practice of structural equation modelling (4th ed.). ***Methodology in the Social Sciences***.

Knight, F. H. 1921. ***Risk, Uncertainty, and Profit***. Hart, Schaffner & Marx.

Kotchetova, N., & Salterio, S. 2008. Judgment and Decision-making Accounting Research: A Quest to Improve the Production, Certification, and use of Accounting Information. ***Blackwell Handbook of Judgment and Decision Making***, (January 2008): 547–566.

Lee, A. Y., Keller, P. A., & Sternthal, B. 2010. Value from regulatory construal fit: The persuasive impact of fit between consumer goals and message concreteness. ***Journal of Consumer Research***, 36(5): 735–747.

Lee, J. S., Keil, M., & Shalev, E. 2019. Seeing the Trees or the Forest? The Effect of IT Project Managers' Mental Construal on IT Project Risk Management Activities. ***Information Systems Research***, 30(3): 1051–1072.

Lee, L. S., & Green, E. 2015. Systems thinking and its implications in enterprise risk management. ***Journal of Information Systems***, 29(2): 195–210.

Lermer, E., Streicher, B., Sachs, R., Raue, M., & Frey, D. 2015. The effect of construal level on risk-taking. ***European Journal of Social Psychology***, 45(1): 99–109.

Levin, I. P., Schneider, S. L., & Gaeth, G. J. 1998. All Frames Are Not Created Equal: A Typology and Critical Analysis of Framing Effects. ***Organizational Behavior and Human Decision Processes***. https://doi.org/10.1006/obhd.1998.2804.

Liberman, N., Sagristano, M. D., & Trope, Y. 2002. The effect of temporal distance on level of mental construal. ***Journal of Experimental Social Psychology***, 38: 523–534.

Liberman, N., Trope, Y., & Stephan, E. 2007. Psychological distance. In A. W. Kruglanski & E. T. Higgins (Eds.), ***Social Psychology: Handbook of Basic Principles, Volume 2***: 353–383. New York: Guilford Press.

Lichtenstein, S., & Fischhoff, B. 1977. Do those who know more also know more about how much they know? ***Organizational Behavior and Human Performance***, 20(2): 159–183.

Lim, C. Y., Woods, M., Humphrey, C., & Seow, J. L. 2017. The paradoxes of risk management in the banking sector. ***British Accounting Review***, 49(1): 75–90.

Liu, X., & Wong-On-Wing, B. 2021. The role of construal alignment in enterprise risk management—The role of construal alignment in enterprise risk management. ***Journal of Information Systems***, 36(1): 39–52.

Lundqvist, S. A. 2015. Why firms implement risk governance – Stepping beyond traditional risk management to enterprise risk management. ***Journal of Accounting and Public Policy***, 34(5): 441–466.

Mael, F., & Ashforth, B. E. 1992. Alumni and their alma mater: A partial test of the reformulated model of organizational identification. ***Journal of Organizational Behavior***, 13: 103–123.

Maglio, S. J., Trope, Y., & Liberman, N. 2013. Distance from a distance: Psychological distance reduces sensitivity to any further psychological distance. ***Journal of Experimental Psychology: General***, 142(3): 644–657.

Maitlis, S., & Christianson, M. 2014. Sensemaking in organizations: Taking stock and moving forward. ***The Academy of Management Annals***, 8(1): 57–125.

Maitlis, S., & Lawrence, T. B. 2007. Triggers and enablers of sensegiving in organizations. ***Academy of Management Journal***, 50(1): 57–84.

March, J. G., & Shapira, Z. 1987. Managerial perspectives on risk and risk taking. ***Management Science***, 33(11): 1404–1418.

Marsh & McLennan. 2016. ***The emerging risks quandary***. Marsh & McLennan Companies, Inc.

Marsh & McLennan. 2017. 2017 AFP risk survey. ***Marsh & McLennan***. https://www.marsh.com/pr/en/industries/financial-institutions/insights/associations-for-finance-professionals-2017-risk-survey.html.

Marsh & McLennan. 2018. 2018 AFP risk survey. ***Marsh & McLennan***. https://www.marsh.com/ph/migrated-articles/2018-afp-risk-survey-report.html.

Marsh & McLennan & Association for Financial Professionals. 2020. 2020 AFP risk survey. ***Marsh & McLennan***. https://www.marshmclennan.com/insights/publications/2020/february/2020-afp-risk-survey.html.

McCafferty, J. 2019, December. Is the three lines of defense model outdated? ***Internal Audit 360***. https://internalaudit360.com/is-the-three-lines-of-defense-model-outdated/.

McKinsey. 2018. Expanding horizons for risk management in pharma. ***McKinsey Insights***. https://www.mckinsey.com/business-functions/risk/our-insights/expanding-horizons-for-risk-management-in-pharma.

McKinsey. 2022. Organizational ambidexterity in an age of volatility. ***McKinsey Quarterly***, (4). https://www.mckinsey.com/capabilities/strategy-and-corporate-finance/our-insights/strategic-courage-in-an-age-of-volatility.

McShane, M. 2018. Enterprise risk management: History and a design science proposal. ***The Journal of Risk Finance***, 19(2): 137–153.

Meidell, A., & Kaarbøe, K. 2017. How the enterprise risk management function influences decision-making in the organization – A field study of a large, global oil and gas company. ***The British Accounting Review***, 49(1): 39–55.

Meyer, J. W., & Rowan, B. 1977. Institutionalized Organizations: Formal Structure as Myth and Ceremony. ***American Journal of Sociology***, 83(2): 340–363.

Mikes, A. 2009. Risk management and calculative cultures. ***Management Accounting Research***, 20(1): 18–40.

Mikes, A. 2010. Becoming the lamp bearer: The emerging roles of the Chief Risk Officer. In J. Fraser & B. J. Simkins (Eds.), ***Enterprise risk management: Today's leading research and best practices for tomorrow's executives***: 71–86. Wiley.

Mikes, A. 2011. From counting risk to making risk count: Boundary-work in risk management. ***Accounting, Organizations and Society***, 36(4–5): 226–245.

Mitchell, T. R., Thompson, L., Peterson, E., & Cronk, R. 1997. Temporal adjustments in the evaluation of events: The "'rosy view.'" ***Journal of Experimental Social Psychology***, 33: 421–448.

Mock, T. J., & Fukukawa, H. 2016. Auditors' Risk Assessments: The Effects of Elicitation Approach and Assertion Framing. ***Behavioral Research in Accounting***, 28(2): 75–84.

Mont, J. 2015, February. What critics say on Three Lines of Defense. ***Compliance Week***. https://www.complianceweek.com/what-critics-say-on-three-lines-of-defense/3392.article.

Motyka, S., Suri, R., Grewal, D., & Kohli, C. 2016. Disfluent vs. fluent price offers: Paradoxical role of processing disfluency. ***Journal of the Academy of Marketing Science***, 44(5): 627–638.

Mousavi, S., & Gigerenzer, G. 2014. Risk, uncertainty, and heuristics. ***Journal of Business Research***, 67(8): 1671–1678.

Nair, A., Rustambekov, E., McShane, M., & Fainshmidt, S. 2014. Enterprise risk management as a dynamic capability: A test of its effectiveness during a crisis. ***Managerial and Decision Economics***, 35(8): 555–566.

National Association of Insurance Commissioners. 2017. ***NAIC own risk and solvency assessment (ORSA) guidance manual***. http://store.naic.org.

Nicholson, N., Soane, E., Fenton-O'Creevy, M., & Willman, P. 2005. Personality and domain-specific risk taking. ***Journal of Risk Research***, 8(2): 157–176.

Nickerson, R., S. 1998. Confirmation Bias: A Ubiquitous Phenomenon in Many Guises. ***Review of General Psychology***, 2(2). https://journals.sagepub.com/doi/abs/10.1037/1089-2680.2.2.175.

Nisan, M. 1972. Dimension of time in relation to choice behavior and achievement orientation. ***Journal of Personality and Social Psychology***, 21(2): 17–182.

Nocco, B. W., & Stulz, R. 2006. Enterprise risk management: Theory and practice. ***Journal of Applied Corporate Finance***, 18(4): 8–20.

North American CRO Council. 2016. ***Comment letter on Federal Reserve Board's Notice of Proposed Rulemaking on Enhanced Prudential Standards for Insurance Systemically Important Financial Institutions***. https://www.federalreserve.gov/SECRS/2023/March/20230327/R-1786/R-1786_012323_146254_529481895880_1.pdf.

Nunnally, J. C. 1978. ***Phychometric theory.*** (2nd ed.). McGraw Hill.

Nussbaum, S., Liberman, N., & Trope, Y. 2006. Predicting the near and distant future. ***Journal of Experimental Psychology: General***, 135(2): 152–161.

Ocasio, W. 1997. Towards an attention-based view of the firm. ***Strategic Management Journal***, 18(S1): 187–206.

Olson, B. J., Parayitam, S., & Bao, Y. 2007. Strategic Decision Making: The Effects of Cognitive Diversity, Conflict, and Trust on Decision Outcomes. ***Journal of Management***, 33(2): 196–222.

O'Reilly, C. A., Chatman, J., & Caldwell, D. F. 1991. People and Organizational Culture: A Profile Comparison Approach to Assessing Person- Organization Fit. ***The Academy of Management Journal***, 34(3): 487–516.

Orton, J. D., & Weick, K. E. 1990. Loosely coupled systems: A reconceptualization. ***Academy of Management Review***, 15(2): 203–223.

Packard, M. D., & Clark, B. B. 2020. On the Mitigability of Uncertainty and the Choice between Predictive and Nonpredictive Strategy. ***Academy of Management Review***, 45(4): 766–786.

Pagach, D., & Warr, R. 2011. The characteristics of firms that hire chief risk officers. ***Journal of Risk and Insurance***, 78(1): 185–211.

Palan, S., & Schitter, C. 2018. Prolific.ac—A subject pool for online experiments. ***Journal of Behavioral and Experimental Finance***, 17: 22–27.

Palermo, T., Power, M., & Ashby, S. 2017. Navigating institutional complexity: The production of risk culture in the financial sector. ***Journal of Management Studies***, 54(2): 154–181.

Parliamentary Commission on Banking Standards. 2013. ***Report of the Parliamentary Commission on Banking Standards***, vol. I.

Perrow, C. 1999. ***Normal Accidents: Living with high risk technologies*** (Updated Edition). Princeton University Press.

Peters, E. 2012. Beyond comprehension: The role of numeracy in judgments and decisions. ***Current Directions in Psychological Science***, 21(1): 31–35.

Peters, E., Västfjäll, D., Slovic, P., Mertz, C. K., Mazzocco, K., et al. 2006. Numeracy and Decision Making. ***Psychological Science***, 17(5): 407–413.

Petty, R. E., & Cacioppo, J. T. 1986. The Elaboration Likelihood Model of persuasion. (L. Berkowitz, Ed.)***Advances in Experimental Social Psychology***. New York, NY: Academic Press. https://doi.org/10.1016/S0065-2601(08)60214-2.

Piercey, M. D. 2023. "Throw it in as a Covariate?" Common Problems Using Measured Control Variables in Experimental Research. ***AUDITING: A Journal of Practice & Theory***, 42(2): 183–205.

Pooser, D. M., & Walker, P. L. 2015. Own risk and solvency assessment: Origins and implications for enterprise risk management. ***Journal of Insurance Regulation***, 34(9): 1–19.

Power, M. 2004. The risk management of everything. ***The Journal of Risk Finance***, 5(3): 58–65.

Power, M. 2007. ***Organized uncertainty: Designing a world of risk management***. Oxford University Press.

Power, M. 2013. The apparatus of fraud risk. ***Accounting, Organizations and Society***, 38(6–7): 525–543.

Power, M., Ashby, S., & Palermo, T. 2013. ***Risk culture in financial organisations: A research report***.

Preacher, K. J., & Hayes, A. F. 2008. Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. ***Behavior Research Methods***, 40(3): 879–891.

Project Management Institute. 2017. ***A guide to the Project Management Body of Knowledge (PMBOK guide)*** (6th ed.). Project Management Institute.

Protiviti, & NC State ERM Initiative. 2022. ***2022 and 2031 Executive Perspectives on Top Risks***. https://www.protiviti.com/US-en/insights/protiviti-top-risks-survey.

PwC. 2018a. ***A new risk governance model for the insurance industry Part 1: The case for improvement***. PwC.

PwC. 2018b. ***A new risk governance model for the insurance industry Part 2 – Improving the three lines of defense model***.

R Core Team. 2023. ***R: A language and environment for statistical computing***. Vienna, Austria: R Foundation for Statistical Computing. http://www.R-project.org.

Rahimi-Golkhandan, S., Garavito, D. M. N., Reyna-Brainerd, B. B., & Reyna, V. F. 2017. A Fuzzy-Trace Theory of Risk and Time Preferences in Decision Making: Integrating Cognition and Motivation. In J. Stevens (Ed.), ***Impulsivity. Nebraska Symposium on Motivation***. Springer.

Randel, A. E., & Jaussi, K. S. 2003. Functional Background Identity, Diversity, and Individual Performance in Cross-Functional Teams. ***The Academy of Management Journal***, 46(6): 763–774.

Rasso, J. T. 2015. Construal instructions and professional skepticism in evaluating complex estimates. ***Accounting, Organizations and Society***, 46: 44–55.

Raue, M., Lermer, E., & Streicher, B. 2018. ***Psychological Perspectives on Risk and Risk Analysis***. Cham, Switzerland: Springer.

Renn, O. 2008. ***Risk Governance: Coping with Uncertainty in a Complex World***. London: Routledge.

Rennekamp, K. 2012. Processing Fluency and Investors' Reactions to Disclosure Readability. ***Journal of Accounting Research***. https://doi.org/10.1111/j.1475-679X.2012.00460.x.

Rerup, C. 2009. Attentional triangulation: Learning from unexpected rare crises. ***Organization Science***, 20(5): 876–893.

Reyna, V. F., Nelson, W. L., Han, P. K., & Dieckmann, N. F. 2009. How Numeracy Influences Risk Comprehension and Medical Decision Making. ***Psychological Bulletin***, 135(6): 943–973.

RIMS. 2020. Pivoting from ERM to SRM. ***RIMS—the risk management society***. https://www.rims.org/about-us/newsroom/news/rims-report-pivoting-from-erm-to-srm.

RIMS. 2022. RIMS-certified risk management professional study guide. ***RIMS—the risk management society***. https://www.rims.org/docs/default-source/default-document-library/certification/2022-rims-crmp-study-guide.pdf.

Rittel, H. W. J., & Webber, M. M. 1973. Dilemmas in a general theory of planning. ***Policy Sciences***, 4(2): 155–169.

Sachs, R. 2018. Risk and uncertainty in the insurance industry. ***Psychological perspectives on risk and risk analysis: Theory, models, and applications***: 329–344. Cham, Switzerland: Springer.

Saldaña, J. 2016. ***The coding manual for qualitative researchers***. Sage.

Savage, S., & van Allen, M. 2002. Accounting for Uncertainty. ***Journal of Portfolio Management***, 29(1): 31–39.

Savitsky, K., Medvec, V. H., Charlton, A. E., & Gilovich, T. 1998. "What, Me Worry?": Arousal, Misattribution, and the Effect of Temporal Distance on Confidence. ***Personality and Social Psychology Bulletin***, 24(5): 529–536.

Sax, J., & Andersen, T. J. 2018. Making risk management strategic: Integrating enterprise risk management with strategic planning. ***European Management Review***, 16(3): 719–740.

Sax, J., & Andersen, T. J. 2020. ***Strategic risk management: A research overview***. Abingdon, Oxon: Routledge.

Schwartz, L. M., Woloshin, S., Welch, H. G., & Black, W. C. 1997. The Role of Numeracy in Understanding the Benefit of Screening Mammography. ***Annals of Internal Medicine***, 127(11): 966–972.

Schwarz, N. 2012. Feelings-as-information theory. In P. Van Lange, A. Kruglanski, & E. T. Higgins (Eds.), ***Handbook of Theories of Social Psychology: Volume 1***: 289–308. Sage.

Segal, S. 2011. ***Corporate Value of Enterprise Risk Management: The Next Step in Business Management***. Hoboken, New Jersey: Wiley.

Shalev, E., Keil, M., Lee, J. S., & Ganzach, Y. 2014. Optimism bias in managing IT project risk: A construal level theory perspective. ***Proceedings of the European Conference on Information Systems***. Tel Aviv.

Shefrin, H. 2016. ***Behavioral Risk Management***. New York: Palgrave MacMillan.

Simon, H. A. 1947. ***Administrative behavior: A study of decision-making processes in administrative organization***. Macmillan. https://doi.org/10.2307/2144907.

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., Malmfors, T., Krewski, D., Mertz, C. K., Neil, N., et al. 1995. Intuitive Toxicology. II. Expert and Lay Judgments of Chemical Risks in Canada. ***Risk Analysis***, 15(6): 661–675.

Soderberg, C. K., Callahan, S. P., Kochersberger, A. O., Amit, E., & Ledgerwood, A. 2015. The effects of psychological distance on abstraction: Two meta-analyses. ***Psychological Bulletin***, 141(3): 525–548.

Souder, D., & Bromiley, P. 2012. Explaining temporal orientation: Evidence from the durability of firms' capital investments. ***Strategic Management Journal***, 33(5): 550–569.

Sposito, V., Hand, M., & Skarpness, B. 1983. On the Efficiency of Using the Sample Kurtosis in Selecting Optimal LP Estimators. ***Communications in Statistics - Simulation and Computation***. https://doi.org/10.1080/03610918308812318.

St. John's University & Protiviti. 2015. ***The Journey to ORSA Begins: Assessing the Results of the 2015 ORSA survey***. https://www.protiviti.com/US-en/insights/journey-orsa-begins.

Standard & Poors. 2019. ***Standard & Poor's general insurance rating methodology***. https://www.standardandpoors.com/en_US/web/guest/article/-/view/sourceId/7954499.

Stefaniak, C. M., Houston, R. W., & Cornell, R. M. 2012. The Effects of Employer and Client Identification on Internal and External Auditors' Evaluations of Internal Control Deficiencies. ***AUDITING: A Journal of Practice & Theory***, 31(1): 39–56.

Steiger, J. H. 1990. Structural Model Evaluation and Modification: An Interval Estimation Approach. ***Multivariate Behavioral Research***. https://doi.org/10.1207/s15327906mbr2502_4.

Stoel, M. D., Ballou, B., & Heitger, D. L. 2017. The impact of quantitative versus qualitative risk reporting on risk professionals' strategic and operational risk judgments. ***Accounting Horizons***, 31(4): 53–69.

Sung, B., Vanman, E. J., & Hartley, N. 2022. Revisiting (dis)fluency: Metacognitive difficulty as a novelty cue that evokes feeling-of-interest. ***Psychology & Marketing***, 39(8): 1451–1466.

Tajfel, H., & Turner, J. C. 1985. The Social Identity Theory of Intergroup Behavior. In and W. G. A. Worchel, S. (Ed.), ***Psychology on Intergroup Relations*** (2nd ed.). Chicago: Nelson-Hall. https://doi.org/10.4324/9780203505984-16.

TCFD. 2017. Recommendations of the Task Force on Climate-related Financial Disclosures. ***Financial Stability Board***. https://www.fsb.org/2017/06/recommendations-of-the-task-force-on-climate-related-financial-disclosures-2/.

Teece, D. J. 2007. Explicating dynamic capabilities: The nature and microfoundations of (sustainable) enterprise performance. ***Strategic Management Journal***, 28(13). https://onlinelibrary.wiley.com/doi/abs/10.1002/smj.640.

Teece, D. J., Pisano, G., & Shuen, A. 1997. Dynamic Capabilities and Strategic Management. ***Strategic Management Journal***, 18(7): 509–533.

Tekathen, M., & Dechow, N. 2013. Enterprise risk management and continuous re-alignment in the pursuit of accountability: A German case. ***Management Accounting Research***, 24: 100–121.

The Risk Coalition. 2020. Raising the bar. ***Raising the Bar: Principles-based guidance for board risk committees and risk functions in the UK Financial Services sector***. The Risk Coalition.

Thorne, R. 2012, August 2. Accountancy: 'You don't have to be good at maths.' ***The Independent***. https://www.independent.co.uk/student/into-university/accountancy-you-don-t-have-to-be-good-at-maths-8001695.html.

Trautmann, S. T. 2019. Distance from a distance: The robustness of psychological distance effects. ***Theory and Decision***, 87(1): 1–15.

Tripp, M. H., Chan, C., Haria, S., Hilary, N., Morgan, K., et al. 2008. Enterprise Risk Management From the General Insurance Actuarial Perspective. ***British Actuarial Journal***, 14(3): 433–541.

Tropp, L. R., & Wright, S. C. 2001. Ingroup Identification as the Inclusion of Ingroup in the Self. ***Personality and Social Psychology Bulletin***, 27(5): 585–600.

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

Vallacher, R. R., & Wegner, D. M. 1989. Levels of Personal Agency: Individual Variation in Action Identification. ***Journal of Personality and Social Psychology***, 57(4): 660–671.

Van der Stede, W. A. 2011. Management Accounting Research in the Wake of the Crisis: Some Reflections. ***European Accounting Review***, 20(4): 605–623.

Vessey, I. 1991. Cognitive Fit: A Theory-Based Analysis of the Graphs Versus Tables Literature. ***Decision Sciences***. https://doi.org/10.1111/j.1540-5915.1991.tb00344.x.

Viscelli, T. R., Beasley, M. S., & Hermanson, D. R. 2016. Research insights about risk governance. ***SAGE Open***, 6(4): 215824401668023.

Viscelli, T. R., Hermanson, D. R., & Beasley, M. S. 2017. The integration of ERM and strategy: Implications for corporate governance. ***Accounting Horizons***, 31(2): 69–82.

Visser, B. A., Ashton, M. C., & Vernon, P. A. 2006. Beyond g: Putting multiple intelligences theory to the test. ***Intelligence***, 34(5): 487–502.

Wakslak, C., & Trope, Y. 2009. The Effect of Construal Level on Subjective Probability Estimates. ***Psychological Science***, 20(1): 52–58.

Wallsten, T. S., Budescu, D. V., Rapoport, A., Zwick, R., & Forsyth, B. 1986. Measuring the vague meanings of probability terms. ***Journal of Experimental Psychology: General***, 115(4): 348–365.

Weick, K. E. 1995. ***Sensemaking in organizations***. Thousand Oaks CA: Sage.

Weick, K. E., Sutcliffe, K. M., & Obstfeld, D. 1999. Organizing for high reliability: Processes of collective mindfulness. ***Research In Organizational Behavior***, 1: 81–123.

Weick, K. E., Sutcliffe, K. M., & Obstfeld, D. 2005. Organizing and the process of sensemaking. ***Organization Science***, 16(4): 409–421.

Weinstein, N. D. 1980. Unrealistic optimism about future life events. ***Journal of Personality and Social Psychology***, 39(5): 806–820.

Weisner, M. M. 2015a. Using construal level theory to motivate accounting research: A literature review. ***Behavioral Research in Accounting***. https://doi.org/10.2308/bria-51063.

Weisner, M. M. 2015b. ***Three studies examining the effects of psychological distance on judgment and decision making in accounting***. Doctoral dissertation, University of Central Florida. https://stars.library.ucf.edu/etd/1316.

World Economic Forum. 2018. ***The Global Risks Report 2018***. http://wef.ch/risks2018.

World Economic Forum. 2023. ***Global Risks Report 2023***. https://www.weforum.org/reports/global-risks-report-2023/.

Zhang, Y., Seufert, J., & Dellaportas, S. 2024. Probability estimation in accounting: Subjective numeracy matters. ***Journal of Applied Accounting Research***, 25(1): 60–80.

Zhao, X., Lynch, J. G., & Chen, Q. 2010. Reconsidering Baron and Kenny: Myths and Truths about Mediation Analysis. ***Journal of Consumer Research***, 37(2): 197–206.