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ORIGINAL ARTICLE

Using Storytelling to Promote Organizational Resilience: An Experimental Study of Different Forms of Risk Communication

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Abstract In this experimental study, we compare the influence of risk communication in the form of stories versus statistics on the level of investment in a resilience-promoting activity. We also analyze how this influence interacts with time gap and with an individual's preferences for risk and numbers. The results indicate that individuals invest more in a resilience-promoting activity when communication comes as a story. This finding holds irrespective of an individual's risk preference. The results did not confirm the expectation that communication in story form leads to a more enduring effect than communication in statistical form. The expectation that the preference for numbers influences the effectiveness of a specific communication form was also not confirmed.

Keywords Storytelling · Risk Communication · Organizational Resilience · Risk Management · Experiment

JEL D81 · D83 · G32

1 Introduction

A consultant hired to work with top management to promote innovation in a large manufacturing company asked about the climate for risk-taking. The managers shook their heads. 'Our new CEO,' they told her, 'has talked a good

Availability of data and material The dataset from this study and the set of instructions for the experimental task are available from the authors upon request.

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> game ever since he came in four years ago; he says he wants us to take risks—but you really can't.' Pressed for evidence, the managers recounted several stories about specific employees whose careers had derailed after they took risks. However, every single story was at least eight years old, predating the current CEO's tenure. The sad tales about the dangers of risk-taking had not been replaced in the corporate lore with any positive stories. The CEO was unaware of the powerful myths still lurking in the organizational culture—and influencing current behavior (Swap et al. 2001, pp. 105–106).

This quotation illustrates the power of stories when it comes to organizational risk-taking. In our experimental study, we show that stories can help promote organizational resilience (Duchek 2020; Wieland and Durach 2021), as they are a form of communication that fits the needs of resilience management.

So far, the literature has offered no generally accepted definition of organizational resilience. However, recent conceptualizations agree that the capabilities of anticipating serious events, coping with them, and adapting to them build cornerstones of organizational resilience (Duchek 2020; Wieland and Durach 2021). Building organizational resilience, in turn, requires an awareness of vulnerable critical functions and processes and the impact of potential events (Chen et al. 2021; Hillmann and Guenther 2021; Lee et al. 2013) as well as sense-making and preparedness (Conz and Magnani 2020; Evenseth et al. 2022; Hillmann and Guenther 2021; Zebrowski 2019). Concepts of organizational resilience consider communication a key factor for developing these capabilities and characteristics (Ishak and Williams 2018; Lee et al. 2013; Lengnick-Hall et al. 2011; Zebrowski 2019). Several researchers have argued that, by creating greater awareness, risk communication can help promote organizational resilience (Brown et al. 2017; Chen et al. 2021; Duchek 2020; Kaplan and Mikes 2016; Lee et al. 2013; Mikes and Kaplan 2015; Power et al. 2013; Sinha and Arena 2020). The role of communication is also acknowledged in standards on organizational resilience; for example, the British Standards Institution considers communication relevant for setting direction and developing adaptive capacity (BSI 2014).

Notwithstanding the apparent consensus on the importance of communication for the promotion of organizational resilience, how to communicate has not been specified in concepts of organizational resilience. However, the importance of developing and using new forms of risk communication has been acknowledged (Stoel et al. 2017), and for instance Mikes (2011) calls for innovative ways of communicating, such as "scenario-thinking, war-gaming, and playing the devil's advocate." A growing number of papers likewise seek new forms of risk communication (Giovannoni et al. 2014; Hall et al. 2015; Mikes 2011; Mikes and Kaplan 2015; Pirson and Turnbull 2011; Tekathen and Dechow 2013; Viscelli et al. 2017).

Storytelling is a specific form of communication that offers some advantages over other forms, as confirmed by empirical evidence (Adaval and Wyer 1998; Cox and Cox 2001; van Laer 2014). Connecting these advantages to the capabilities and characteristics of organizational resilience, a multifaceted potential for risk communication and promotion of organizational resilience can be identified. Stories make information more available (Kazoleas 1993; Schank 1995; Schank and

Berman 2002), they produce more emotions than, for example, statistics and thus make information more retrievable (Swap et al. 2001). These features create the potential for fostering sustained risk awareness, that is, for the envisioning of complex risk factors as called for by Mikes (2011), and thus for building organizational preparedness, which supports anticipation, coping, and adaptation capabilities. More specifically, stories are more effective when a message is preference-inconsistent (Slater and Rouner 1996), which is particularly relevant for resilience management, because it addresses risks with potentially serious impacts that will be preference-inconsistent in many instances.

Furthermore, stories can generate commitment (McCarthy 2008), and commitment to resilience in the advent of adverse events is a distinguishing feature of high-reliability organizations (Weick and Sutcliffe 2007). Finally, by prompting sensemaking (Boje 1991) and easier retrieval (Swap et al. 2001) and conveying an organization's values, code of conduct, culture, and tacit knowledge to its members and, in particular, to newcomers (Martin 2016; Statler and Oliver 2016; Swap et al. 2001), stories can enable interpretation of unprecedented events and constructive and flexible problem solving in line with the aims of the organization (Lengnick-Hall et al. 2011). Furthermore, these features of storytelling enable learning. Promotion of learning fosters the adaptive capacity of an organization (Evenseth et al. 2022), another cornerstone of its resilience.

Empirical research on the effects of storytelling on organizational resilience is very limited. Haloub et al. (2022) show that entrepreneurial storytelling attracts investors and makes firms more resilient. Furthermore, some studies find benefits of storytelling for community resilience in relation to disasters (Nagamatsu et al. 2021; Spialek and Houston 2018; Spialek et al. 2016) and ecosystem change (Daigle et al. 2019). However, few studies address the effects of storytelling on organizational resilience, and no experimental study we're aware of compares storytelling with other forms of communication. We address this gap in current research because potential findings are relevant for communicating risks to promote organizational resilience.

In our experimental study, we compare the effects of risk communication in the story and statistical forms on organizational resilience. We hypothesize that individuals invest more in an activity to promote resilience when they read a story about a risk versus reading statistics about it. We also investigate the influence of a time gap between the communication and subsequent action. This is relevant, as a communicated risk factor should be considered when making decisions and not only immediately after being communicated; it needs to be remembered and considered over longer periods to promote resilience. Therefore we analyze whether storytelling increases the ease of retrieval of the risk information, resulting in a long-term behavioral change.

Another pertinent nuance is that the recipient of a message might be more comfortable with quantitative or narrative forms of communication, and thus her or his personality traits might influence the effectiveness of a communication form. Mikes (2009), for instance, states that the effectiveness of different tools (such as communication instruments) may depend on individuals' or organizations' preferences. Therefore we also investigate two individual personality traits of decision-

makers—risk preference and preference for numbers—that may influence receivers' openness to different forms of communication (Mikes 2009, 2011; Stoel et al. 2017).

The results show that storytelling can persuade individuals to invest in a resilience-promoting activity. Furthermore, they illuminate the fact that, when individuals receive information in form of a story, the influence of their risk preference on level of investment in a resilience-promoting activity is neutralized. Specifically, even individuals with a high risk preference invest more in a resilience-promoting activity when receiving information in a story. These results show that an organization can use storytelling to align an individual's risk-related behavior with the organization's risk appetite, irrespective of someone's risk preferences.

The study makes several contributions to research and practice. It is the first experimental study to address the effectiveness of storytelling for communicating organizational risks. It investigates the effects on a resilience-promoting activity as a proxy for organizational resilience and thus provides novel empirical evidence for conceptual claims that communication can promote organizational resilience (Brown et al. 2017; Chen et al. 2021; Duchek 2020; Kaplan and Mikes 2016; Lee et al. 2013; Mikes and Kaplan 2015; Power et al. 2013; Sinha and Arena 2020). It also compares storytelling as an innovative form of risk communication to statistics as an established form of risk communication and provides empirical grounds for innovation in risk communication, as called for by several authors (Giovannoni et al. 2014; Hall et al. 2015; Mikes 2011; Mikes and Kaplan 2015; Pirson and Turnbull 2011; Tekathen and Dechow 2013; Viscelli et al. 2017). It demonstrates that storytelling can contribute to the toolbox for risk communication in organizations striving to become more resilient. Finally, the study provides novel evidence on the interaction effects of communication form and personality traits, which has not been investigated and is relevant for the use of storytelling in risk communication.

2 Background and Hypotheses

2.1 Form of Risk Communication and Investment in Organizational Resilience

Risk communication relates in this study to any exchange of risk-relevant information in organizations. Information can be transferred, for instance, using didactic or expository texts, lists, stories, graphics, and numerical evidence (Greene and Brinn 2003; Kreuter et al. 2010). Risk communication inside organizations tends to be analytical and data-driven. Most information is conveyed using statistics and appeals to reason to motivate behavioral changes (Hall et al. 2015; Huber and Scheytt 2013; March and Shapira 1987; Mikes 2009, 2011; Pidun et al. 2017; Power 2009; Stulz 2009). However, this quantitative way of communicating might not always work. In this context, Mikes (2009) states: "The spectrum of techniques ranges from statistical loss estimating tools, shrouded in analytical mystique to more descriptive, judgmental 'mappings' of risks into probability-impact matrices" (Mikes 2009, p. 20). As Mikes implies, a quantitative approach to communication might lead to the perception of risk management as a black box and therefore may be unlikely to be understood by individuals and to shape their behavior. In a case study conducted by

Hall et al. (2015), a bank was failing to communicate its risk management practices to its workforce as the communications were "too abstract, technical and unfamiliar to the business lines" (Hall et al. 2015, p. 18). Hall et al. (2015) conclude that it is not the accuracy of information but its communicability that determines whether it will become influential within an organization. Thus the dominant form of risk communication—quantitative data—might not always work and might even hinder risk management from contributing to organizational resilience.

Arena et al. (2017) stress the importance of risk talks in organizations. Stoel et al. (2017) likewise highlight that strategic risk factors, which are the focus of resilience management, should be communicated in a qualitative risk report. However, these studies do not provide concrete information on how the risk talk or the report should be designed. A detailed analysis of a communication instrument is conducted by Jordan et al. (2013) and Jordan et al. (2018). Their studies examine the usefulness of a risk matrix, a communication tool that is already widely applied in risk management. Mikes (2011) demands innovative ways of communication such as "scenario-thinking, war-gaming, and playing the devil's advocate" (Mikes 2011, p. 243). However, so far, no study has investigated the use of storytelling in the risk communication context.

Therefore we compare two forms of communication—stories and statistics—in our experimental study. Storytelling is regarded as it is a new form of corporate communication and offers various advantages. It is a narrative form, which helps individuals make sense of events (Gabriel 2000; Martin 2016; Weick 2007). According to Gabriel (2000), "stories are narratives with plots and characters, generating emotion in narrator and audience, through a poetic elaboration of symbolic material" (Gabriel 2000, p. 239). Thus storytelling includes characters that may experience certain situations a reader or listener can identify with.

Statistics, in contrast, are more abstract and communicate facts, rather than poetic or symbolic material. Statistics usually present information for a population, such as the number of deaths per year from a health hazard. Thus, from an objective point of view, statistics include more information but of a more general kind (Baesler and Burgoon 1994).

For developing our first hypothesis, we will draw on the theory of narrative transportation, the social cognitive theory, and the results of a study conducted by Slater and Rouner (1996). Consistent with the theory of narrative transportation, we argue that communication in story form triggers narrative processing (Green and Brock 2000). Information conveyed this way is structured temporally and causally, and it corresponds to an individual's natural way of processing information. Because of this, information transferred narratively is easily absorbed and understood; the recipient considers the story as a whole as well as its persuasiveness (Bruner 1986; Escalas 1998). Narrative processing leads to attitude changes through narrative transportation. The state of transportation can be characterized by a "melding of attention, imagery, and feelings" (Green and Brock 2000, p. 701). In this state, engagement increases, as the recipient is immersed in the story (van Laer et al. 2014). The reader can then relive the story and extract meaning from it, which prompts sense-making, and thus enables the interpretation of unprecedented situations and constructive problem solving (Lengnick-Hall et al. 2011). What's more, the writer

and reader form a strong connection, and thus the reader might care for the story's characters. This immersion leads to less skepticism regarding the transferred information (Green and Brock 2000), which in turn may increase the commitment to resilience. When receiving risk information in story form, it is expected that the recipient will then invest more in a resilience-promoting activity.

Receiving information in quantitative forms (e.g., statistics) triggers argument-based processing (Escalas 2004). In argument-based processing, information is analyzed, and each argument is evaluated for its persuasiveness. Argument-based processing is a more piecemeal-way of processing information: the receiver analyzes various pieces of the information in terms of verifiability or falsifiability (Bruner 1986). With performing argument-based processing, logic and critical analysis can produce the desired change of attitude. Green and Brock (2000) explain the situation this way: analytical "elaboration leads to attitude change via logical consideration and evaluation of arguments" (Green and Brock 2000, p. 702). Individuals, in effect, reach a conclusion by adding up the persuasive power of each argument and calculating a mean value. However, one false statement can lead to the rejection of the whole argument (Gilliam and Flaherty 2015). In argument-based processing, individuals who receive a risk message might be more likely to scrutinize each argument, which is more likely to result in counter-arguing. Thus, when receiving risk information in statistical form, individuals may be more likely to counter-argue, and thus communicated risk information may be less likely to result in an investment in a resilience-promoting activity.

The idea of the social cognitive theory is that an individual observes someone else's behavior and the consequences of that behavior (Bandura 1977). The observer internalizes the behavior and consequences. When the individual likes the consequences, he or she is motivated to behave similarly. When the individual does not, he or she will not behave similarly. For instance, if someone is rewarded or punished for a behavior, this will influence whether that person wants to replicate the behavior. More generally, individuals learn new behaviors not only by trying them on their own but also by observing others and imitating. According to the social cognitive theory, learning is more likely to occur when there is an identification between the model and the observer. If learning occurs, this fosters the adaptive capacity of an organization (Evenseth et al. 2022).

The concept of self-efficacy is a central concept in the social cognitive theory. Self-efficacy is defined as "people's judgments of their capabilities to organize and execute courses of action required to attain designated types of performances" (Bandura 1977, p. 391). Following from this view, self-efficacy relates to an individual's belief that he or she can master tasks or challenges. It is not a passive, static trait but a dynamic set of self-beliefs.

When communicating risk factors, individuals must understand how to address the root causes of that risk factor. In this context, a message in form of a statistic can explain which activities should be taken. Stories, for their part, can be surrogates for direct experience and can describe a behavior and its consequences (Bruner 1990; Polkinghorne 1988; Stephens et al. 2010). A story can illustrate how risk factors should be handled, which activities of organizational resilience management should be performed, and how. A story may therefore be better able to communicate

activities of resilience management than statistics and may lead to a higher self-efficacy. That higher self-efficacy then may result in greater investment in a resilience-promoting activity.

An experimental study conducted by Slater and Rouner (1996) shows that the potential advantage of a form of communication may depend on the message's congruency with the recipient's initial position. Slater and Rouner (1996) found that statistics are especially persuasive when the information transferred in a message is consistent with the preferences of the recipient. Stories, in contrast, are more effective when information transferred does not correspond to the recipient's previous views. De Wit et al. (2008) use these results in their study to analyze which form of communication results in a greater intention to obtain a vaccination. The authors argue that health risk messages present threats to individuals and are preference-inconsistent, and they find that a story better conveys the need to obtain a vaccination. This comports with various other studies that have found that storytelling, compared to communication in numerical form, better shapes health risk prevention (Costantino and Malgady 1994; de Wit et al. 2008; Kreuter et al. 2010; Larkey and Gonzalez 2007). Organizational risks will also be perceived as a threat by members of the organization if they can be negatively impacted by these risks personally. Thus, in many cases, this information about organizational risks may also be preference-inconsistent. Therefore, following from the results of Slater and Rouner (1996), when communicating risk information that is preference-inconsistent, stories may be more likely to persuade someone to invest in a resilience-promoting activity.

Considering these arguments, we expect that individuals will invest more in an activity to promote resilience when the form of communication is a story versus a statistic. Our first hypothesis is stated as follows.

H1 When the form of communication is a story, individuals will invest more in a resilience-promoting activity, as compared to when the form of communication is a statistic.

2.2 The Role of a Time Gap Between Risk Communication and Investment in Organizational Resilience

We also expect that a time gap between the communication of risk information and the investment in a resilience-promoting activity will influence the level of investment. After a certain period, not all of the communicated risk information can be retrieved: The ease of retrieval decreases with time for all forms of communication (i.e., story or statistic). Simply put, people forget. Lower ease of retrieval is expected to translate into a decrease in the level of investment in organizational resilience (Loftus and Loftus 1980). Even though a decrease in the level of investment in organizational resilience is expected, regardless of the form of communication, the degree of the decrease should differ for a story versus a statistic, given the realities of elaborative encoding, results from memory systems research, and the availability heuristic.

Concerning the elaborative encoding, individuals will remember newly absorbed information better when they can integrate it into their knowledge (Schacter 1996).

In a medical setting, Norman and Brooks (1997) found that the ability to remember stories influences the work of clinicians. They argue that clinicians often use memories of prior cases, rather than analytical causal rules, for diagnoses. The prior cases—stories in memory—are more easily recalled than abstract information. Moreover, stories of cases (involving certain patients) are often vividly remembered by a clinician decades later (Norman and Brooks 1997). Some studies have established the idea that stories produce better retrieval and can be easier to remember when making a decision (Forman 2013; Schank 1995; Schank and Berman 2002). Transferring this scenario to risk communication in organizations, the ease of retrieving a story may be higher compared to a statistic.

Memory systems research distinguishes episodic and semantic memory. Episodic memory refers to personal experiences, whereas the semantic memory refers to knowledge about rules and facts (Tulving 1972). Episodic memory is thought to reside in the brain longer than semantic memory. Stories elicit mental imagery and are surrogates for direct experience. Information conveyed in story form can be stored in memory as a personal experience and thus as an episodic memory. The statistical form of communication is argument-based, and each argument is first analyzed and then may be stored in memory. Statistical arguments are stored as semantic memory. Episodic memory is known to be stored in memory longer, and its ease of retrieval is higher over longer periods, compared to semantic memory (Moll and Miikkulainen 1997; Tulving 1972). Therefore stories are likely to lead to a higher ease of retrieval.

Concerning the availability heuristic, individuals tend to judge an event as more important and more likely when information about it is more readily retrievable from memory (Tversky and Kahneman 1982). During decision-making, information that is retrieved easily is used preferentially. Therefore, following the availability heuristic, as stories are retrieved more easily from memory than statistical information, the information they convey will be judged as more important. As Swap et al. (2001) state: "If information is expressed in memorable form, it will more likely influence attitudes and behavior" (Swap et al. 2001, p. 601).

The arguments above indicate that the effect of the time elapsed on the level of investment in organizational resilience should lessen when information is provided in a story compared to statistics.

H2 For all forms of communication (story or statistic), an individual's investment in a resilience-promoting activity will decrease with the time gap since communication of risk information; the decrease will be lower when the form of communication is a story compared to when it is a statistic.

2.3 The Influence of Personality Traits on the Effect of Form of Risk Communication on Investment in Organizational Resilience

2.3.1 Risk Preferences

Risk preferences are an individual's willingness to take risks (Helfinstein et al. 2014; Mata et al. 2018; Schildberg-Hörisch 2018; Zhang et al. 2014). These preferences

vary for individuals. A high risk preference refers to "the tendency to engage in behaviors or activities that involve higher variance in returns" (Mata et al. 2018, p. 156). An individual with a high risk preference may underestimate the risks associated with a situation and may overestimate the likelihood of a gain (Brockhaus 1980). Thus a high risk preference is expected to result in a lower level of investment in a resilience-promoting activity as individuals might not assess risks—or negative results in general—as such so quickly. A low risk preference, in contrast, refers to the tendency to engage in behaviors or activities that involve lower variance in returns. A more risk-averse decision-maker will weigh negative results more than positive ones (Keil et al. 2000). Therefore an individual with a low risk preference will likely invest more in a resilience-promoting activity.

With regard to the interplay of risk preferences with the form of communication, the form of communication may interact on the effect of risk preferences on investments in resilience-promoting activities. Communication in statistics will likely reinforce the above mentioned effects of the risk preferences, whereas stories will likely lead to investments in resilience-promoting activities, independent of risk preferences; i.e. it is expected to align individuals' behavior regardless of risk preferences. We expect this as the two forms of communication differ in their concreteness (Baesler and Burgoon 1994). A concrete form of information is expected to result in less variation in interpretation of information (Fliessbach et al. 2006; Holcomb et al. 1999; Xiao et al. 2012). In this context, one should be aware that statistics can be interpreted or perceived differently by individuals. Some individuals, for instance, might evaluate a probability of 20% of a risk as high, and some might evaluate this probability as low. The interpretation might depend on an individual's experiences and personality traits or on the potential loss due to a risk in relation to the total assets of an individual. The statistical form of communication provides scope for subjective assessments; thus the effect of an individual's risk preference (high or low) is reinforced. As a result, we expect that the level of investment in a resilience-promoting activity is influenced by the risk preference of an individual in that the statistical form of communication will lead to more (less) investment in a resilience-promoting activity, when the individual has a low (high) risk preference.

Storytelling is considered a concrete form of communication that, for instance, can contain characters who experience certain situations. It can describe the behavior of individuals and the consequences of their behavior. Therefore the understanding of information conveyed in a story should be similar for different recipients of the story, assuming the described consequences are clear and specified. Thus an individual's risk preference should not interfere with the interpretation of the story. Furthermore, stories increase the imaginative power of people in specific situations. The recipient can relive a situation as it is described, which should increase the level of investment in a resilience-promoting activity, independent of that individual's risk preference. This leads to our Hypothesis 3.

H3 When the form of communication is a statistic, individuals will invest more (less) in a resilience-promoting activity when their risk preference is low (high), whereas when the form of communication is a story, the risk preference of an individual has no effect on the investment in a resilience-promoting activity.

2.3.2 Preference for Numbers

Preference for numbers refers to the personality trait favoring the quantitative presentation of information and the perception of oneself as having mathematical skills (Fagerlin et al. 2007). Individuals might prefer to receive information in a form that suits their personality traits. For instance, some pay more attention to numbers and prefer using them as a basis for decision-making. Furthermore, individuals who are accustomed to receiving numerical information might expect information in that form. Thus, for these people, the ability and motivation to process information might be higher for quantitative information. Decisions of less numerate individuals are based more on qualitative sources of information. Thus, when receiving information in story form, these people might have a higher ability and motivation to process the information (Peters et al. 2007).

In this context, the elaboration likelihood model of communication by Petty and Cacioppo (1986) is relevant. The model describes the impact of persuasive communication on recipients' attitudes. In this model, a recipient's motivation and ability to process information determine the elaboration likelihood. Specifically, a higher motivation and a higher ability to process information increase an individual's likelihood to evaluate specific information intensively. Therefore the higher elaboration likelihood is expected to lead to a longer-lasting change of attitude. Attitude is defined in the model as a general evaluation that an individual has of herself or himself, other people, objects, and issues. This evaluation influences and guides an individual's behavior (Petty and Cacioppo 1986).

Transferring this concept to the present study, numerate individuals are more motivated and better able to process quantitative information. Therefore conveying quantitative information to them is expected to lead to a higher elaboration likelihood and an attitude change.

Individuals with a low preference for numbers are expected to be more motivated and better able to process information in story form (Petty and Cacioppo 1986). Thus conveying information to them in this form might be more likely to lead to attitude changes. Considering these points, Hypothesis 4 is formulated as follows.

H4 When the form of communication is a story (statistic), individuals will invest more (less) in a resilience-promoting activity when they have a low preference for numbers, compared to when they have a high preference for numbers.

3 Research Design

3.1 Experimental Design

The experiment employs a mixed factorial design ($2 \times 2 + 1$). The form of communication is manipulated between-subjects (story and statistic). The time gap variable is obtained within-subjects at two different times (immediate and after one week). For H3, the form of communication (story versus statistic) is manipulated, and the individual's risk preference is measured. To analyze H4, the form of communication

(story versus statistic) is manipulated and an individual's preference for numbers is measured on a seven-point Likert scale. Furthermore, a control group is added. The experimental design includes one dependent variable, which is the level of investment in a resilience-promoting activity.

The present study is set in a fictitious firm called *Future Corp*. The firm is in the aerospace industry, manufacturing airplanes, helicopters, and booster rockets. Participants are informed that they are the department manager of research and development, responsible for a team of 25 employees in the division of booster rockets and they must guide and train the employees. The risk factor is a cyber incident.[1]

3.2 Dependent Variable

To operationalize organizational resilience, we choose a feature of a resilient organization (Ruiz-Martin et al. 2018), namely the willingness to invest in a resilience-promoting activity. The dependent variable investment in a resilience-promoting activity is an indicator of this feature that is operationalized in this scenario by the number of training hours participants invest in reducing the likelihood of a cyber incident caused by employees (Rohmann and Wirnsperger 2017).

In general, the appropriate risk appetite depends on the organization. In the underlying scenario, more training hours can lead to a lower probability of the cyber incident. Participants who book more hours increase their investment because doing so decreases the likelihood of cyber incidents. But more training hours comes at a cost, as the maximum compensation that can be earned by a participant decreases due to the increase in training hours booked.

To operationalize the dependent variable and to be able to see reactions to the risk of a cyber incident, a task from Hannan et al. (2005) was adopted for the underlying case.[2] The task was adopted to analyze responses to information provided in different communication forms.

3.3 Independent Variables

3.3.1 Form of Communication

Two forms of communication are analyzed: storytelling and statistics. A control group is part of the study, and, unlike the treatment groups, the control group does not receive specific information about cyber incidents. The control group exists to

[1] A cyber incident is chosen as the risk factor in this setting for two reasons. First, cyber incidents are often caused by employees' behavior (e.g., mistakes) (Hubmann et al. 2017). Therefore, in this setting, a behavior can be analyzed. Furthermore, cyber incidents are the number one emerging risk in recent years. Therefore this is a scenario of increasing importance and relevance (Hubmann et al. 2017; PwC 2015; Rohmann and Wirnsperger 2017).

[2] In the basic scenario of their study, Hannan et al. (2005) analyze the impact of bonus and penalty contracts on effort level and contract choices. This kind of task has been used many times in research (e.g., Choi 2014).

ensure that each participant's behavior can be traced to the manipulation and not to the setting of the experiment.

Four different aspects had to be considered when designing the manipulation. (1) Both forms of communication (story and statistics) needed to carry the same information regarding the risk of cyber incidents. (2) The line of argumentation needed to be the same for both groups. (3) The word count needed to be the same for both types of communication. (4) The textual elements needed to provide the same information at the beginning and end of the message across communication forms. The two forms of communication (story and statistics)—divided into the specific line of argumentation—can be found in Appendix A.

1. The first aspect is that both forms of communication (storytelling and statistics) needed to carry the same information regarding the risk of cyber incidents (Baesler and Burgoon 1994; Dunlop et al. 2009; Greene and Brinn 2003; Kearney and De Young 1995; Lochbuehler et al. 2010). However, the information would be conveyed in either story or statistical form. A story transmits the information by representing temporal and causal sequences, characters, and a plot. Individuals in the storytelling group are informed about a cyber incident that occurred at *Air Group*, a competitor of *Future Corp*. Participants are told the incident occurred because a manager used a USB stick he received externally, which was infected with a Trojan. The Trojan allowed a hacker to enter the internal computer system, which led to the publication of sensitive data. The statistical form of communication transmits the information by representing statistics about the increasing risk of cyber incidents. Individuals in the statistical group are informed about the probability of cyber incidents and the average amount of damage. Furthermore, individuals are made aware of the three main causes of cyber incidents. Finally, they are told the different consequences of cyber incidents.[3]
2. Another point mentioned in the literature is that the line of arguments should be the same for both groups (Baesler and Burgoon 1994; Cox and Cox 2001; Dunlop et al. 2009; Greene and Brinn 2003). Hence both forms of communication include the same arguments in the present study: an introduction, the relevance of the risk factor, the causes, and the consequences.
3. In addition, the word count should be the same for both types of communication (Allen et al. 2000; Banerjee and Greene 2012; Cox and Cox 2001; de Wit et al. 2008; Lochbuehler et al. 2010; Watts et al. 2018). The word count is 320 for the story and 319 for the statistical communication. The words are also counted for each part of the argument. This means that the specific information about relevance, causes, and consequences for both the story and statistics have approximately the same number of words.
4. Finally, the textual elements should provide the same information across communication forms; this should apply at the beginning and at the end of the message (Baesler and Burgoon 1994; Cox and Cox 2001; de Wit et al. 2008). In the present

[3] Information for the two textual elements are taken from brochures of Allianz SE, Deloitte GmbH WPG, KPMG WPG AG, and PwC WPG AG (Hubmann et al. 2017; KPMG 2017; PwC 2015).

study, the treatment groups receive the same beginning and end message. The control group receives the same beginning and end message as the treatment groups.

3.3.2 Time Gap

The manipulation of the time gap variable is done within-subjects by having two different rounds (immediate and after one week) of the experiment.[4] The dependent variable was collected in both experimental rounds. Thus the dependent variable is first collected immediately after the manipulation of the communication form. Then, one week after the first round, the dependent variable is collected again. However, in the second round, there was no repeated communication of a risk factor (Note: The second round serves only for the observation of the time-effect).

The influence of a time gap can be captured by comparing the behavior of individuals at the different moments of time. Behavioral differences can be traced back to the fact that time gap has an influence.[5]

3.3.3 Risk Preference

Risk preference is operationalized with the widely used experimental approach developed by Holt and Laury (2002; Schildberg-Hörisch 2018). Their scale measures individuals' degree of risk aversion. The measurement model contains 10 lottery decisions. For the complete model, see Appendix B.

3.3.4 Preference for Numbers

Researchers have measured the preference for numbers through both objective math tests and self-reported perceptions of math ability (Peters et al. 2007). In the present study, the construct preference for numbers is measured on a seven-point Likert scale. The scale is taken from Fagerlin et al. (2007). The scale includes eight items that ask the participants for their self-evaluation regarding their quantitative skills. The first four questions measure an individual's belief about her or his skill in performing mathematical tasks. Thus they measure cognitive ability. The second four questions

[4] One week is taken as the time horizon for two reasons. First, earlier studies in a comparable context use this time horizon (Baesler and Burgoon 1994; Kazoleas 1993). Second, the idea of the Ebbinghaus forgetting curve is used to define the period. The Ebbinghaus curve indicates the amount of stored information (as a percentage) that an individual can remember from newly absorbed information (Ebbinghaus 1885). Following this curve, a huge part of newly absorbed information is forgotten after 24 h: only 34% of the newly absorbed information is remembered after one day. After six days, 25% is remembered, and, after 31 days, 21% is remembered. The difference between six and 31 days is not particularly high, and it could be concluded that one week is a sufficient time lag. Therefore a difference of one week is a good proxy for longer periods.

[5] To ensure that the behavioral changes can be traced to time and not to the fact that the participants had experience with a cyber incident in the week between the two data collections, a question was inserted in the second round. Participants were asked whether they had had experiences with cyber incidents. If they had, they were asked to state the time when this happened. One participant stated that a cyber incident occurred in the week between the two data collection times. This data was excluded from the analysis.

measure an individual's preference for the display of numerical information.[6] This scale not only indicates the skills of an individual but also that person's preference for a display of information. Using a math test to analyze the numeracy skills might not help in understanding an individual's preferences: even though a person has high numeracy skills, he or she may prefer a different form of communication.

The reliability of the construct was assessed using Cronbach's Alpha (alpha = 0.834), which confirms that the underlying questions capture the preference for numbers. See Appendix C for the full scale.

3.4 Experimental Setting and Procedure

Participants were randomly assigned to one of the treatment groups (story or statistics) or to the control group. In the beginning of the study, they had to answer questions on their risk preferences and their preference for numbers. Afterward they were told they were the manager of the research and development for *Future Corp* and were responsible for guiding and training a team of 25 employees. After reading some information about the company, the participants read an e-mail from the company's risk manager in which they were informed about the increasing risk of cyber incidents (either in story form, in statistical form, or without detailed information).

After receiving information about the risk of a cyber incident, the participants could choose to book a certain number of training hours for their team. The choice of training hours affects the probability of the occurrence of cyber incidents: The more hours booked, the lower the likelihood.

After this decision, the participants answered a post-experimental questionnaire, which included questions on demographics. The first round of the experiment then concluded.

One week later, the second part of the experiment was conducted. The participants were informed that they had changed from the rocket booster division to the helicopter division of *Future Corp*. They were now the department manager of research and development in this division and were responsible for guiding and training a team of 25 employees. Once again, they had to decide on the hours of training they wanted to book for their new team.

The experiment was conducted in paper and pencil. Participation took approximately 30 min in the first round and approximately 15 in the second. Participants got a payment for the participation (see below). Their decision in the experiment influenced their final payout.

3.5 Compensation System

Participants were informed about the payment procedures before they started the experiment but after answering questions on their risk preferences and preference for numbers. The currency in the experiment was communicated in monetary units (MU) (1000 MU equal 1 €); this was done with the aim to have higher sums of

[6] Only four items mark the final construct as a factorial analysis leads to the conclusion that the first four items are the ones that measure the construct.

Table 1 Decision to book training hours

Training Hours	Investment in Training Hours in (MU)	Probability of *No* Occurrence of a Cyber Incident	Your Decision
0 h	0 MU	10%	☐
0.5 h	1000 MU	20%	☐
1 h	2000 MU	30%	☐
...	...	...	☐
4 h	8000 MU	90%	☐

money in the experiment to make the scenario more realistic. The compensation system reflected that a risk would occur in the study. The payment consisted of four parts, which are shown in the following formula.

$$\text{Payment} = \underbrace{\text{Show-up}}_{5000\,\text{MU}} + \underbrace{\text{Budget}}_{10{,}000\,\text{MU}} + \underbrace{\text{Bonus}_{\text{Risk does not occur}}}_{10{,}000\,\text{MU}} - \underbrace{\text{Investment in Training Hours}}_{\text{xMU}}$$

Participants received a fixed and a variable component. The fixed component ensured payment for each participant, independent of the decisions in the experiment. Participants got a 5€ (5000 MU) show-up payment. They also received a variable component calculated in three parts. As part of the variable component, they received a budget and a bonus when no cyber incident occurred. The third part of the variable component was the amount of MU that the participant invested in training hours. This part was subtracted from the payment.

A part of the variable component is the budget. In their role, participants had to decide on the number of training hours they wanted to book. Participants had to choose the number of training hours based on a table they received. (Table 1 is an excerpt of the decision to book training hours as posed in the experimental study.) Participants could choose from zero up to four hours of training.

The bonus was paid to the participants when no cyber incident occurred. In the table, there is a column that shows the probability of no occurrence of a cyber incident. Following the table, an increase in training hours booked led to a reduction of the probability with which a cyber incident occurred. Thus the more training hours booked, the lower the probability of an incident. When no incident occurred, the participants got 10,000 MU as a bonus.

The third part of the variable component is the investment in training hours. The booking of training hours came with a cost for the participants. In the table, an overview of the different investments in training hours is shown. The increase in training hours booked corresponded to an increase in investment. (An increase of 0.5 h corresponded to costs of 1000 MU). Moreover, the probability of occurrence of a cyber incident decreased with the increasing number of training hours booked. Thus, when participants spent more budget on training hours, a smaller budget remained. At the same time, the probability of receiving a bonus increased. Whether a cyber incident occurred was determined with a lottery, which was conducted during the payment session.

Considering these points, the overall compensation of the participants depended on their decisions in the experiment as well as on the lottery. However, the expected payment value of all participants, regardless of the number of chosen training hours, was 16,000 MU.[7]

The cyber incident lottery was conducted to determine the participant's final payout. It worked as follows. Nine bags, enumerated from one to nine with different amounts of blue and white marbles, were prepared. The blue marbles indicated a cyber incident. The white marbles represented no incident. For those participants who chose zero hours of training, there was one white marble and nine blue ones in the bag. For those who chose four hours of training, there were nine white marbles and one blue one in the bag. During the payment session, each of the participants had to pull a marble out of the bag that corresponded to her or his number of training hours booked in the experiment.

The average participants' profit in the study amounted to 15 €, which is slightly below the expected value of 16 €. The highest payment was 25 € and the lowest 7 €.

3.6 Participants

One hundred and sixty-five participants participated in the first round. In the second round, there were no-shows and participants who did not complete the study. Overall, 136 business students participated in both rounds. The average age was 21.94 years, and 46 of participants were female. Ten percent of the participants were pursuing a master's or a doctoral degree, 90% were pursuing a bachelor's degree; the bachelor's students were in the second or fourth semester of their studies. The participants had approximately one year of work experience (including internships), and all of them had taken at least one finance and accounting class.

4 Findings

Hypothesis 1 predicts that, when the form of communication is a story, individuals will invest more in a resilience-promoting activity, compared to when the form of communication is a statistic. The level of investment is reflected by the number of training hours booked. Table 2 shows descriptive statistics, reporting cell sizes, means, and standard deviations for the chosen number of training hours for the two communication forms.

To test Hypothesis 1, a one-way analysis of variance (ANOVA) with investment in a resilience-promoting activity as the dependent variable is conducted (Table 3). The result reveals that, consistent with our expectations, the mean values of the

[7] The expected payment value is 16,000 MU. For instance, in case a participant chose to book zero training hours, the expected payment value constituted of 5000 (show-up fee) + 10,000 (budget) + 10,000 (bonus) * 0.1 (likelihood of receiving the bonus) – 0 (investment in training hours). Thus the expected payment value was 16,000. For the case that a participant booked four training hours, the expected payment value had also been 16,000 as the payment constituted 5000 (show-up fee) + 10,000 (budget) + 10,000 (bonus) * 0.9 (likelihood of receiving the bonus) – 8000 (investment in training hours).

Table 2 Descriptive statistics on the influence of communication form and time gap on investment in a resilience-promoting activity

Descriptive statistics Dependent variable: Investment in a resilience-promoting activity			
		Time 1 Immediate	Time 2 After one week
Story	Mean	**2.53**	**2.30**
	(Std Dev)	(0.9075)	(1.1096)
	N	48	48
Statistic	Mean	**2.13**	**1.92**
	(Std Dev)	(1.0299)	(1.1543)
	N	43	43
Column Mean	Mean	2.34	2.12
	(Std Dev)	(0.9829)	(1.1410)
	N	91	91
Control Group	Mean	2.42	2.13
	(Std Dev)	(0.9412)	(1.0412)
	N	45	45

Table 3 Test of H1 on the influence of communication form on investment in a resilience-promoting activity

One-way ANOVA Model Dependent variable: Investment in a resilience-promoting activity					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	3.690	1	3.690	3.945	**0.050***
Within Groups	82.250	89	0.935	–	–
Total	86.940	90	–	–	–

The table presents the test of H1. We used a between-subjects design and manipulated the form of communication (story or statistics). As a dependent variable, we asked for training hours to be booked. The more training hours, the less likely the cyber incident
*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$

two groups differ significantly ($p = 0.050$*, one-tailed). The mean value of the story group is significantly higher than the mean value of the statistical group. Even the control group shows a higher level of investment than the statistical group.

Hypothesis 2 predicts that the investment in a resilience-promoting activity will decrease over time for both communication forms and that the decrease will be lower when the communication form is a story compared to a statistic. The mean values show that the investment in a resilience-promoting activity does decrease over time for both groups (Table 4). There is a significant influence of time gap on investment in a resilience-promoting activity ($p = 0.040$**). The cell means show that, for the story form of communication, the mean is lower by 0.23. The difference for the statistical group is 0.21. Thus the decrease does not differ substantially between the story and statistics group. Inconsistent with our expectations, there is no interaction effect of the communication form and the time gap on investment in a resilience-promoting

Table 4 Test of H2 on the influence of the interaction of communication form and time gap on investment in a resilience-promoting activity

Two-way repeated-measures ANOVA Model Dependent variable: Investment in a resilience-promoting activity					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups					
Group	7.021	1	7.021	4.096	0.046**
Error	152.537	89	1.714	–	–
Within Groups					
Time Gap	2.180	1	2.180	4.356	0.040**
Time Gap × Group	0.004	1	0.004	0.009	**0.925**
Error	44.548	89	0.501	–	–

The table presents tests of H2. We use a mixed factorial design and manipulate the form of communication (story or statistics) between subjects and a time gap (immediate and after one week) within subjects. Time gap is analyzed by measuring the dependent variable at two points in time. As a dependent variable, we asked for training hours to be booked. The more training hours, the less likely the cyber incident
*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$

Table 5 Descriptive statistics on the influence of communication form and risk preference on investment in a resilience-promoting activity

Descriptive statistics Dependent variable: Investment in a resilience-promoting activity				
		Risk Preference		Row Mean
		Low	High	
Story	Mean	**2.52**	**2.54**	2.53
	(Std Dev)	(0.8905)	(0.9431)	(0.9075)
	N	24	24	48
Statistic	Mean	**2.63**	**1.50**	2.13
	(Std Dev)	(0.9808)	(0.7071)	(1.0299)
	N	24	19	43
Column Mean	Mean	2.57	2.08	–
	(Std Dev)	(0.9282)	(0.9876)	
	N	48	43	
Control Group	Mean	2.72	2.05	–
	(Std Dev)	(0.9904)	(0.7416)	
	N	25	20	

activity ($p = 0.925$; one-tailed). That said, the storytelling group on average still invests more in resilience (2.30) after one week than the statistical group (1.92).

H3 predicts that, when the form of communication is statistics, the level of investment in a resilience-promoting activity is influenced by the risk preference of an individual; that is, individuals will invest more (less) when their risk preference is low (high). H3 also predicts that, when the form of communication is a story, the risk preference of an individual will have no effect on the level of investment. The descriptive statistics support this hypothesis (Table 5): Individuals in the statistical group with a high risk preference book on average 1.5 h of training, whereas those with a low risk preference book on average more training hours (2.63). Thus

Table 6 Test of H3 on the influence of communication form and risk preference on investment in a resilience-promoting activity

Two-way ANOVA Model Dependent variable: Investment in a resilience-promoting activity					
	Sum of Squares	Df	Mean Square	F	Sig.
Group	4.948	1	4.948	6.165	0.015**
Risk Preference	6.864	1	6.864	8.552	0.004***
Risk Preference × Group	7.391	1	7.391	9.210	0.003***
Error	69.823	87	0.803	–	–

The table presents tests of H3. We use a between-subject design and manipulate the form of communication (story or statistics) as well as measure the risk preference (high and low). Risk preference was measured using a scale by Holt and Laury (2002). A high risk preference classifies an individual as less risk-averse, whereas a low risk preference characterizes an individual as more risk-averse. As a dependent variable, we asked for training hours to be booked. The more training hours, the less likely a cyber incident
*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$

risk preferences influence the level of investment in the statistics group.[8] In the story group, the descriptive statistics for level of investment in a resilience-promoting activity for individuals with a low risk preference (2.52) and with a high risk preference (2.54) are almost identical. Consistent with our expectations, there is an interaction effect of communication form and risk preference on level of investment in a resilience-promoting activity (Table 6; $p = 0.003$***; one-tailed).

H4 states that, when individuals have a high preference for numbers, the level of investment in a resilience-promoting activity will be higher when the form of communication is statistics, compared to a story. When individuals have a low preference for numbers, the level of investment is higher when the form of communication is a story, compared to when it is statistics.[9] Regarding the descriptive statistics in Table 7, individuals with a low preference for numbers book more training hours when they receive information in a story (2.46) rather than in statistical form (2.33). This is consistent with our expectations. However, the story also leads to more training hours booked by individuals with high preference for numbers (2.60). Individuals with high preferences for numbers who receive the statistical form of communication book on average 1.93 h of training. Thus the difference between the statistical and story groups is even higher for individuals with a higher preference for numbers. This is inconsistent with our expectation. Overall, inconsistent with Hypothesis 4,

[8] A median split is used to identify individuals with high and low risk preferences. The median of the results of the measurement of risk preference is five. A measure of five or higher indicates a low risk preference, and a measure below five indicates a high risk preference.

[9] Preference for numbers is measured using the scale of Fagerlin et al. (2007). The scale includes eight different items with the possibility of choices on a seven-point Likert scale. To be able to classify individuals as having a high or low preference for numbers, a median split is used. The median is 5.75 for the preference for numbers. A higher number classifies an individual as preferring mathematical tasks and numerical displays of information, whereas a lower number characterizes an individual as not preferring mathematical tasks and numerical displays of information. Participants with a score of 5.75 or higher were attributed a high preference for numbers, and those with a score below 5.75 were attributed a low preference for numbers.

Table 7 Descriptive statistics on the influence of communication form and preference for numbers on investment in a resilience-promoting activity

Descriptive statistics Dependent variable: Investment in a resilience-promoting activity				
		Preference for Numbers		Row Mean
		Low	High	
Story	Mean	**2.46**	**2.60**	2.53
	(Std Dev)	(0.8106)	(1.000)	(0.9075)
	n	*n* = 23	*n* = 25	*n* = 48
Statistic	Mean	**2.33**	**1.93**	2.13
	(Std Dev)	(0.8266)	(1.1781)	(1.0299)
	n	*n* = 21	*n* = 22	*n* = 43
Column Mean	Mean	2.40	2.29	–
	(Std Dev)	(0.8111)	(1.1265)	
	n	*n* = 44	*n* = 47	
Control Group	Mean	2.35	2.50	–
	(Std Dev)	(0.9704)	(0.9258)	
	n	*n* = 23	*n* = 22	

Table 8 Test of H4 on the influence of communication form and preference for numbers on investment in a resilience-promoting activity

Two-way ANOVA Model Dependent variable: Investment in a resilience-promoting activity					
	Sum of Squares	Df	Mean Square	F	Sig.
Group	3.547	1	3.547	3.797	0.055*
Preference for numbers	0.377	1	0.377	0.404	0.527
Preference for numbers × Group	1.682	1	1.682	1.801	**0.183**
Error	81.271	87	0.934	–	–

The table presents tests of H4. We use a between-subject design and manipulate the form of communication (story or statistics). Furthermore, we measure the preference for numbers (high and low). Preference for numbers was measured using a scale by Fagerlin et al. (2007). A high preference for numbers classifies individuals as preferring mathematical tasks and numerical displays of information, whereas a low preference for numbers characterizes an individual as not preferring quantitative mathematical tasks or numerical displays of information. An individual's preference for numbers was measured before the experiment started. As a dependent variable, we asked for training hours to be booked. The more training hours, the less likely a cyber incident

*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$

there is no interaction effect of communication form and preference for numbers on investment in a resilience-promoting activity (Table 8; $p = 0.183$; one-tailed).

5 Discussion and Conclusion

The results of the experiment indicate that individuals will invest more in a resilience-promoting activity when they receive information about a risk factor in story rather

than in statistical form. This implies that, in general, the form of communication of risks influences investment in resilience. This experimental finding provides novel empirical support for the literature that argues for storytelling over other forms of communication (Adaval and Wyer 1998; Baesler and Burgoon 1994; Cox and Cox 2001; van Laer 2014), in particular for preference-inconsistent information (Slater and Rouner 1996). It also comports with findings on personal health risk prevention (Costantino and Malgady 1994; de Wit et al. 2008; Hinyard and Kreuter 2007; Larkey and Gonzalez 2007) and extends empirical support for storytelling to the communication of risks in an organizational setting.

The results also indicate that storytelling may increase awareness (Chen et al. 2021; Hillmann and Guenther 2021; Lee et al. 2013) and preparedness for risks (Conz and Magnani 2020; Evenseth et al. 2022; Hillmann and Guenther 2021; Zebrowski 2019) in an organization, thereby supporting anticipation, coping, and adaptation as cornerstones of organizational resilience (Duchek 2020; Wieland and Durach 2021). What's more, the results also provide support for the broader supposition that risk communication can help promote organizational resilience by creating greater risk awareness (Brown et al. 2017; Chen et al. 2021; Duchek 2020; Ishak and Williams 2018; Kaplan and Mikes 2016; Lee et al. 2013; Lengnick-Hall et al. 2011; Mikes and Kaplan 2015; Power et al. 2013; Sinha and Arena 2020; Zebrowski 2019).

The experiment suggests that individuals with either a high or low risk preference who receive risk information in statistical form differ in their willingness to invest according to their risk preference: Those with a low risk preference will invest more in a resilience-promoting activity than do those with a high risk preference. This implies that risk preferences influence an individual's behavior when information is communicated via statistics. When communication occurs in story form, we observe no influence of an individual's risk preferences on the level of investment. With stories, those with a high risk preference exhibit the same (high) investment level as individuals with a low risk preference. This indicates that stories create a commitment to resilience (Weick and Sutcliffe 2007) also from employees with a high risk preference and provides novel support for our suggestion that storytelling as a form of risk communication invites less interpretation (Baesler and Burgoon 1994; Xiao et al. 2012) and prompts sense-making and problem solving (Lengnick-Hall et al. 2011). An organization, after having defined its risk appetite, can use this finding to guide its employees with storytelling without assessing and considering individual risk preferences.

Overall our results indicate that storytelling could help improve risk communication. Adding storytelling to the risk communication toolbox could help enhance the impact of risk management throughout the organization, awareness and preparedness for risks, sense-making and commitment, and thus organizational resilience.

Note that, in this study, storytelling and statistics are analyzed as alternative forms of communication. However, we acknowledge that they have distinctive potentials. Superiority of one over another may depend on circumstances, and their combined use may be beneficial. Moreover, drawing on the studies of Mikes (2009, 2011), there are different calculative cultures "quantitative enthusiasm" and "quantitative skepticism" (Mikes 2009, p. 226). In these cultures, different tools are effective.

Thus the effectiveness of storytelling may also depend upon the culture; it may work better in cultures where quantitative skepticism prevails and a more holistic risk management approach is followed.

The results of the experiment did not support the expectation that communication in story form leads to a more enduring effect than communication in statistical form, as the decrease in investment after a time gap does not differ substantially between the story and statistics groups. Thus theories and empirical findings that argue for a more enduring effect of stories (Moll and Miikkulainen 1997; Norman and Brooks 1997; Tulving 1972) are not supported by our experiment. However, the storytelling group still invests more in resilience after the time gap than the statistical group. Storytelling does not prevent the decrease in investment after a time gap, but there is an enduring advantage over statistics. This is particularly relevant for resilience management because it is important to maintain preparedness, even if no adverse events have occurred for some time.

An explanation for the similar decrease in investment could be the design and execution of the experiment. The participants knew that there would be first and second rounds, and they knew the rounds were interrelated. Therefore they might have tried to remember the information from the first round, a possibility that could have been avoided if the participants had not known about the second round. However, this might have caused participants to skip the second round. In addition, it is conceivable that the time span of one week might have been too short for valid results. Experiments with longer time spans may show different results.

Furthermore, the expected influence of preference for numbers could not be supported. Individuals with a high preference for numbers booked the lowest number of training hours when they received the information in a statistical form and the highest number of training hours when they received the information in story form. Based on the elaboration likelihood model of communication by Petty and Cacioppo (1986), we expected that individuals would prefer to receive and process information in ways that suit their personalities, as this increases the elaboration likelihood. Our experimental findings do not confirm this expectation. The reason for this result could be that individuals with a high preference for numbers might have been surprised when they received information in story form. They might have been accustomed to receiving it in statistical form, which might give them a feeling of safety. Communication in story form, which elicits mental imagery, might have created a feeling of insecurity regarding the risks conveyed. This could have led to an increase in training hours booked.

There are methodology-related limitations that relate to the degree of abstraction and simplicity of experimental studies. One is the design of the risk situation. The risk was operationalized by constructing a scenario in which a risk would either occur or not. Moreover, in the experimental setting, there was a linear relationship between the booking of training hours and the likelihood of a cyber incident. What's more, in the experiment, the occurrence of the risk affected the bonus directly. However, for an employee in an organization, other factors could be associated with receiving a bonus.

Regarding the degree of simplicity in the experiment, it is a limitation that the analysis has been conducted for one specific risk. In the specific case of a cyber

incident, storytelling proved to be useful. However, organizations face a variety of risks. It might be interesting for further research to analyze for which types of risks storytelling best communicates. It might also be of interest to analyze whether storytelling could be useful in communicating risk interdependencies.

Finally, as this is the first experiment to analyze effects of risk communication form on organizational resilience, we chose a simple operationalization of organizational resilience, namely the willingness to invest in a resilience-promoting activity. This comports with measuring organizational resilience based on features of the organization that are captured by indicators (Ruiz-Martin et al. 2018). Different indicators, such as indicators of awareness, preparedness, and adaptability of the organization, could be used. Alternatively, organizational resilience can be measured by organizational outcomes or organizational recovery (Ruiz-Martin et al. 2018).

Another limitation of the study is that only one situation could be considered in the experiment. The study focused on communication prior to the occurrence of a risk. However, the suitability of a specific communication form could depend on the situation (i.e., ex ante versus ex post communication). For instance, when a risk (e.g., business interruption) materializes, there might be a need for direct communication. In this case, clear instructions of what to do might be required (Kreuter et al. 2007). For future research, it might be of interest to understand whether and how different situations require different forms of communication.

Overall, in the present study, the control group continuously showed high levels of investment in a resilience-promoting activity. The values even exceeded those of the statistics group. This result is surprising, as the persuasive power of a message is usually improved when the message includes some other form of information (Reinard 1988). Therefore it may be of interest for future research to analyze in greater detail the resilience management activities of individuals who do not receive specific information about a certain risk.

It could also be fruitful to analyze different storytelling forms (Eshraghi and Taffler 2015; Kreuter et al. 2007; van Laer et al. 2014). Different genres (e.g., comic, epic, tragic, and romantic) or different types of stories (e.g., official stories, invented stories, firsthand stories, secondhand stories, and culturally familiar stories) could be analyzed. Further dimensions of stories could also influence storytelling's effectiveness, for instance, the length of a story, its quality, compelling characters, and captivating plot.

The medium of communication might also influence the usefulness of storytelling (van Laer et al. 2014). In the present study, a print medium is used. However, modern technologies allow individuals to participate in the plot of a story. Virtual reality, for instance, offers a potentially immediate and powerful presentation of environments and emotions, giving stories a potentially greater impact on decision-makers. Further research might analyze the interaction of modern technologies and storytelling.

6 Appendix

6.1 Appendix A

Table A.1 Manipulation of Independent Variables

	Story	Statistic
Introduction	Cyber-criminality is the criminality that is associated with computers and the internet. Cyber-criminality can appear in a wide variety of versions and can occur everywhere and anytime	Cyber-criminality is the criminality that is associated with computers and the internet. Cyber-criminality can appear in a wide variety of versions and can occur everywhere and anytime
Relevance	In the last few weeks our direct competitor, the Air Group, has experienced an incident of cyber-criminality. Within the Jets division, the research and development department has been working on an innovative technology for a year now. The new jet was supposed to be launched in six months. However, the department has been victim of a cyber incident, in which internal, strictly confidential documents were copied and published	The Institute of Data Security reports that the likelihood of occurrence of cyber incidents increased for companies from 25 to 33% in the last year. A further increase is expected in the next year. The average amount of damage caused by a cyber incident is 6.1 Mio. MU. Cyber incidents can affect companies of different industries and sizes, whereby large companies are more likely to be attacked
Cause	The incident occurred because Mr. Schmidt, Ph.D., manager at the Air Group, loaded a document on a USB-stick shortly before end of work. Mr. Schmidt is renowned expert in the field of aerospace and has been working for the Air Group for twelve years. Since he had no USB stick from the company at hand, he used a USB stick that he had previously received as a gift from outside the company. However, the stick was infected with a Trojan. Subsequently, the Trojan infected the computer system and made all data that was stored on the system accessible to the attacker	Recently, the Institute of Data Security published a study, which investigated the most common causes of cyber incidents. In this context, they found that 52% of cyber incidents are caused by employees or former employees. In this context, a distinction is made between incidents that are caused by unintended errors and those that are caused by intention. The second most common cause of cyber incidents are hacker attacks. Hacker attacks cause cyber incidents with 25%. The attacks are problematic, since the attacker enters the internal systems of a company. 23% of cyber incidents are caused by malware
Consequence	This incident of cyber-criminality has led to the publication of sensitive internal data of the jets division. The data contained information on the development of innovative technologies, which were not available on the market yet. The Air Group wanted to use this innovative technology in order to increase their market share in their jet division. Now that the information is also available to competitors, the Air Group must expect significant future sales losses	An incident of cyber-criminality contributes to an economic loss through different effects. The main cause is a sales loss, with a 45% probability. A sales loss can be caused by business interruptions and impacts on supply-chains resulting in decreasing market shares and losses of customers. With a 33% probability, negative effects on companies' reputation and with a 22% probability, liability claims after a data breach are stated as causes of economic losses after an incident of cyber-criminality

Table A.1 (Continued)

	Story	Statistic
Future Action	To be able to prevent our organization from future cyber-criminality, training courses are offered organization-wide to learn about preventive actions and the handling with cyber threats. During the training hours, employees will be trained on issues such as how to identify fake emails and not to click through on suspicious links	To be able to prevent our organization from future cyber-criminality, training courses are offered organization-wide to learn about preventive actions and the handling with cyber threats. During the training hours, employees will be trained on issues such as how to identify fake emails and not to click through on suspicious links

6.2 Appendix B

Table B.1 Risk Aversion Measurement

Choice	Alternative A			Alternative B
1	10% likelihood of 20.00€ and 90% likelihood of 16.00€	○	○	10% likelihood of 38.50€ and 90% likelihood of 1.00€
2	20% likelihood of 20.00€ and 80% likelihood of 16.00€	○	○	20% likelihood of 38.50€ and 80% likelihood of 1.00€
3	30% likelihood of 20.00€ and 70% likelihood of 16.00€	○	○	30% likelihood of 38.50€ and 70% likelihood of 1.00€
4	40% likelihood of 20.00€ and 60% likelihood of 16.00€	○	○	40% likelihood of 38.50€ and 60% likelihood of 1.00€
5	50% likelihood of 20.00€ and 50% likelihood of 16.00€	○	○	50% likelihood of 38.50€ and 50% likelihood of 1.00€
6	60% likelihood of 20.00€ and 40% likelihood of 16.00€	○	○	60% likelihood of 38.50€ and 40% likelihood of 1.00€
7	70% likelihood of 20.00€ and 30% likelihood of 16.00€	○	○	70% likelihood of 38.50€ and 30% likelihood of 1.00€
8	80% likelihood of 20.00€ and 20% likelihood of 16.00€	○	○	80% likelihood of 38.50€ and 20% likelihood of 1.00€
9	90% likelihood of 20.00€ and 10% likelihood of 16.00€	○	○	90% likelihood of 38.50€ and 10% likelihood of 1.00€
10	100% likelihood of 20.00€ and 0% likelihood of 16.00€	○	○	100% likelihood of 38.50€ and 0% likelihood of 1.00€

6.3 Appendix C—Preference for Numbers Measurement

6.3.1 Cognitive Ability

1. How good are you at working with fractions? (*1 = not at all good, 7 = extremely good*)
2. How good are you at working with percentages? (*1 = not at all good, 7 = extremely good*)
3. How good are you at calculating a 15% tip? (*1 = not at all good, 7 = extremely good*)
4. How good are you at figuring out how much a shirt will cost if it is 25% off? (*1 = not at all good, 7 = extremely good*)

6.3.2 Preference for Display of Numeric Information

5. When reading the newspaper, how helpful do you find tables and graphs that are parts of a story? (*1 = not at all, 7 = extremely*)
6. When people tell you the chance of something happening, do you prefer that they use words ("it rarely happens") or numbers ("there's a 1% chance")? (*1 = always prefer words, 7 = always prefer numbers*)
7. When you hear a weather forecast, do you prefer predictions using percentages (e.g., "there will be a 20% chance of rain today") or predictions using only words (e.g., "there is a small chance of rain today")? (*1 = always prefer percentages, 7 = always prefer words*)
8. How often do you find numerical information to be useful? (*1 = never, 6 = very often*)

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Declarations

Conflict of interest A. Kampmann and B. Pedell declare that they have no competing interests.

Ethical standards Unfortunately, no ethics approval from an ethics commission was obtained before conducting the experiment. In the basic conception and design phase of the experiment, that meanwhile contains the request of approval by the ethics commission as a standard step at our department, the ethics commission of the University of Stuttgart had not yet started its work. Participation in the study was strictly voluntary and participants had the possibility to stop participation at any moment during the experiment. The data collected is completely anonymous; we are not able to connect datasets to individual participants. Participants were informed about anonymity. No medical research was conducted. We only collected data on preferences for risk and numbers, risk evaluation, and an investment decision in a resilience-promoting activity after having received information on cyber risk in storytelling versus statistics form.

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