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Risk and emotions:

An analysis of the effect of risk perception, emotions, and emotional intelligence on protective and investment decisions.

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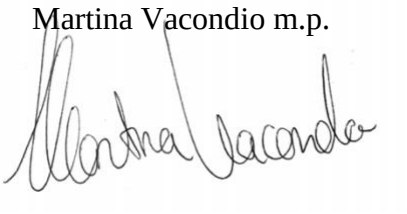

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Preface

We all go about our daily business assessing risks and making decisions about their potential negative consequences. Some of them are simpler, and we face them quickly and intuitively; others are more difficult, and their assessment requires more of our cognitive resources. For example, we might not even notice assessing the risk of crossing the street or deciding when to take a sip from our excruciatingly hot coffee in the morning. Instead, understanding the risk of financial assets for our first investments or how to best protect ourselves during a worldwide pandemic might result in a more troublesome risk assessment and decision-making process.

Understanding how people assess risks is not easy, especially considering the complexity of the concept of risk itself. For the longest time, when attempting to define risk, researchers tried to determine its objective components, i.e., probabilities and consequences associated with an event with a negative outcome and have expected people to perform rational calculations when assessing it (Loewenstein, 1996; Loewenstein et al., 2001; Weber & Johnson, 2009). However, more recent studies showed that when we subjectively perceive risks, we rarely have complete information; thus, we rely primarily on our previous experiences with similar hazards and our emotional and affective reactions.

Research showed that people store information, images, and stimuli about risky events tagging them with different positive and negative affective reactions. When assessing risks and making decisions, people automatically consult the affective tags associated with the stored mental images and use those emotions to guide their understanding of risks and actions ("affect heuristics"; Slovic, 2010). Our risk perception can be influenced by different emotional reactions, such as emotions related (i.e., integral) or unrelated (i.e., incidental) to the risky event and emotions that we anticipate we might feel if exposed to the risk (i.e., anticipated) or emotions that arise at the moment of exposure to the risk (i.e., anticipatory; Lerner & Keltner, 2000; Loewenstein & Lerner, 2003; Dickert et al., 2014; Västfjäll & Slovic, 2013).

However, when we deal with most familiar everyday risks, relying on experiences and emotions often leads to satisfactory risk assessments. When we face dreadful, new, or risky situations outside our control, we might incur biases and misinterpretations. For example, people tend to underestimate risks perceived as common or risky situations which they decide to expose themselves to voluntarily (Slovic et al., 1985). On the other hand, risks that are readily available in people's memory because they are covered extensively by the media can

be overestimated (i.e., dying in a plane crash). In contrast, risks that are not frequently covered can be underestimated (i.e., dying of diabetes; Tversky & Kahneman 1973). The media represents a powerful tool to shape the way people perceive risks, not only because of the relevance and coverage they give to some risky events but also by the way they frame messages and present information.

Research showed that people's risk perception and emotional reactions could also be influenced by how the information regarding the risk is communicated (Balog-Way et al., 2020). People's understanding of a risky situation and their behavior towards hazards can be influenced by the type of framing or the numerical format used by messengers (e.g., media). For example, presenting the negative consequences (i.e., loss frame) instead of the possible positive outcomes (i.e., gain frame) of a risky situation can elicit higher negative emotions toward the risk and make people more risk averse (Tversky & Kahneman, 1981; Nabi et al., 2020; Peters et al., 2006). However, media outlets continue to present information about risks underestimating the power of the attributes of messages on emotional reactions, risk perception, and behavioral intentions. A recent notable example is the media communication of the COVID-19 pandemic. At the beginning of the pandemic, every media outlet showed growing numbers of people who died of the disease and presented them through numerical formats difficult to evaluate for a general population (Hameleers, 2021); however, risk communicators did not consider that the communication of those numbers would influence people's choices to protect or not protect themselves and others.

In the first two studies presented in this dissertation, I investigate how different ways of reporting information in the media can influence citizens' protective behaviors during the COVID-19 pandemic by interfering with their emotional reactions and risk perception. It is paramount to understand how people emotionally react to new and unfamiliar risks, how media communication can influence their perception, and how their risk perception leads them to actions, especially during a worldwide health emergency (COVID-19).

In Study 1, I test how presenting positive or negative information (i.e., the number of people who recovered versus the number of people who died) about the COVID-19 pandemic and the comparison with seasonal flu can lead citizens to different emotional and risk appraisals. This different emotional and cognitive interpretation would, in turn, affect their decision to act preventive measures to reduce their risk of contagion. Moreover, I provide a multi-national perspective offering a comparison between an Italian, Austrian, and English sample. This study is the result of an international collaboration with Prof. Nicolao Bonini and Dr. Giulia Priolo from the University of Trento and Assoc. Prof. Stephan Dickert affiliated

with the University of Klagenfurt and the Queen Mary University of London during the time of the data collection. It has been published in the special issue "Coronavirus Disease (COVID-19): Psychological Reactions to the Pandemic" of Frontiers in Psychology. In Study 2, I look into more specific details of the risk communication of the pandemic, investigating whether different numerical formats used to report mortality rates of COVID-19 can affect citizens' emotional reactions, risk perception, and health-related risky behaviors. This study is part of a research project financed by the University of Trento, and it has been submitted to the special issue "Risk Science Foundations in Light of COVID-19" of Risk Analysis.

Finally, since emotions have such a central role in our perception of risks, it is important to note that we all experience emotions differently. If we want to have a complete understanding of the way our affective and emotional reactions influence risk perception, we have to consider the subjectivity of our emotional experiences. Research investigated how personality dispositions that inform us on how subjectively we manage and understand our and others' emotions, such as the trait of emotional intelligence, can influence our perception of risks (e.g., Mikolajczak et al., 2008; Robinson & Clore, 2002; Rubaltelli et al., 2016). However, while more literature investigated the role of emotions in assessing risks, there is still a limited understanding of the importance of these personality traits on risk perception, especially in risk domains characterized by high uncertainty. For example, the financial market represents one of the fields with the highest uncertainty. Decision makers, both professional advisors and investors, often have to assess risks and make decisions with little information to rely upon. However, bad decisions in this field can cause severe consequences on people's finances and, therefore, their wellbeing, especially if the people who incur biases are professionals who should advise others on the best decisions to make. In this dissertation, I investigate the role of emotions in risk perception and judgments, also testing the influence of trait emotional intelligence on our understanding of risks. In Study 3, I investigate the effect of trait emotional intelligence and experience on the misperception of the correlation between risk and returns in professional financial advisors. This study has been published in the journal "Personality and Individual Differences".

In the following paragraphs, I will introduce the theoretical framework under which the abovementioned studies have been developed. Specifically, I will first discuss literature concerning the definition of the concept of risk and the way research operationalizes and measures it. Then, I will address the role of emotions and affect on risk perception, presenting the early literature that first established the paramount role of emotions in the understanding of risk. Then I will then analyze the ways in which emotions can influence risk perception. I

conclude this section by discussing the role of personality traits such as trait emotional intelligence on risk perception and the heuristics and biases that can challenge our understanding of risks. Finally, I will end the introduction with an overview of the role of risk communication in shaping society's risk perception and actions toward risks.

Chapter 1

Theoretical Background[1]

1.1 Risk

1.1.1 Definition

[T]here is no such thing as "real" risk, or "objective" risk. (Slovic, 1999, pp. 63)

The definition of risk is complex and far from univocal. In fact, different definitions of risk exist both in the scientific world and in the layperson's understanding of the concept. A careful analysis of risk as a concept uncovers different layers regarding its meaning, created by the different contexts in which it has been studied and the ways in which it has been characterized, conceptualized, and operationalized over the years.

Laypeople usually associate the word "risk" with the possibility that an unpleasant or unwelcome event can happen. From a scientific perspective, risk is defined by taking into consideration all the elements that compose the idea behind the word "risk", providing a complete explanation of the concept. The Stanford Encyclopedia of Philosophy offers an example of technical definitions widely used across scientific disciplines. Accordingly, the first element can be conceptualized as risk being a *consequence;* it is described as "an unwanted event which may or may not occur". For example, a fatal car accident is a risk that can occur when driving a car under the influence of alcohol. Another definition frames risk as a *probability*, describing it as "the probability of an unwanted event which may or may not occur". An example of this conceptualization of risk would be to state that the probability of being involved in a fatal car accident when drinking and driving is 45%. Those two definitions are part of a bigger categorization of risk, specifically *risk as analysis*, which "brings logic, reason, and scientific deliberation to bear on hazard management", and *risk as feeling*, which "refers to our fast, instinctive, and intuitive reactions to danger" (Slovic et al., 2004, p. 311). These two macro-categories belong to the idea that we perceive reality in at least two different ways (Epstein, 1994; Evans, 2008; Kahneman, 2003; Stanovich & West, 2000). One way is

[1] Parts of this introduction are taken and adapted from a book chapter I published in "The Palgrave Encyclopedia of the Possible", and should be cited as Vacondio M., Dickert S. (2020) Risk. In: Glăveanu V. (eds) The Palgrave Encyclopedia of the Possible. Palgrave Macmillan, Cham. https://doi.org/10.1007/978-3-319-98390-5_81-1. Specifically, parts of the sections "Risk", "Research on Risk" and "*Heuristics and biases in risk perception*". The paper is not open access; however, I have been granted an exclusive license by Springer Nature Switzerland AG 2020 to publish the chapter in my dissertation (License number: 5265790203900). The chapter has been written in collaboration with Assoc. Prof. Dr. Stephan Dickert (Department of Marketing, Queen Mary University of London, London, UK).

intuitive and fast, more primitive, and belief-based. The other is rational, more recent, and slower. The perception of risk and its interpretation depend on how information is processed. The conceptualization of *risk as a feeling* will be further analyzed in this dissertation under the section "Risk perception: the central role of emotions".

Another characterization of risk, referring back to this section's opening quote, differentiates between objective and subjective risk. Objective risk is described as an actual probability of an unwanted or unpleasant event, and this probability is usually quantifiable. For example, the actual statistics regarding refugees drowning while trying to cross the Mediterranean Sea in order to come to Europe provide an objective measure of risk. The survival of these refugees depends on the type of boat, the winds, how rough the sea is, and the probability of finding a safe place to land, among other factors. Although the probabilities and the specific consequences of these aspects are calculable, we, as humans, almost always give a subjective value to them. Indeed, the perception of risk depends on how the risk is framed and how subjectively it is perceived. An example of the subjectivity of "objective risks" is given below. The United Nations High Commissioner for Refugees report that the absolute number of refugees that died trying to reach Europe by crossing the Mediterranean Sea diminished from 2016 to 2017 (UNHCR n.d.). This statement could lead to the conclusion that trying to cross the sea became less risky. However, data also show that the number of drowned refugees per number of people that tried to migrate increased in the same year. This statement, on the other hand, leads to the conclusion that crossing the sea became riskier. The two statements are both factually true, but they elicit a different perception of the same risk.

The approach of investors to the financial market is another instance of the distinction between objective and subjective risk assessment. According to financial theories, risk and returns are typically positively connected over long time horizons and through effective diversification, meaning that rational investors should be willing to face large risks if they expect high returns from their investments (Sharpe, 1964; Shefrin, 2001). This happens because objective risk is an indicator of the distribution of potential outcomes; consequently, a riskier investment offers a wider distribution of potential outcomes, which should include both larger gains and losses, especially in contrast to a safer investment (Ganzach, 2000). Nevertheless, laypeople (MacGregor et al., 2000; Rubaltelli et al., 2010; Statman et al., 2008) do not perceive risk objectively, but instead focus too much on the potential negative consequences, leading many investors to subjectively perceive a negative correlation between risk and the expected returns of investments (Alhakami & Slovic, 1994; Ganzach, 2000; Oehler & Wedlich, 2018; Statman et al., 2008).

It is clear, then, that there is no such thing as objective risk (Slovic, 1999), and it is more correct to use the word "risk" in its subjective connotation. Specifically, the subjective risk concerns personal thoughts, beliefs, and values that determine how we perceive risk and how we subjectively judge risky situations. Subjective judgments of risks occur frequently. Individuals must often assess the threats with which they come into contact. However, when making these assessments, most people do not have the appropriate knowledge, skills, or time to objectively deal with those risks. Instead, they adopt subjective assessments based on information cues that allow people to draw conclusions. These cues refer to the characteristic of the risk itself, exemplified by several dichotomies when judging a risky situation (Slovic et al., 1985). For example, the perception of risk varies if people *voluntarily* expose themselves to the risk or if the exposure is instead involuntary, and if the risk is *chronic* or *catastrophic*. Moreover, subjective risk assessments depend on whether the risk is seen as *common*, such that people are used to it and react calmly to it, or *dreadful*, causing people to respond in a visceral and impulsive way. Other factors influencing subject risk assessments include whether the risk is seen as *certainly fatal* or *certainly not fatal*, if it is *known* or *not known* to the exposed, if it is *immediate* or *delayed*, *known to science*, or *not known to science*, *controllable* or *uncontrollable*, and *new* or *old*. These characteristics make it possible to create profiles of the perceived risk and compare them on different dimensions.

1.1.2 Theoretical Approaches to the Study of Risk

The different definitions of risk are accompanied by different schools of thought on risk perception. Two relatively prominent approaches focus on how individuals perceive risk (i.e., the psychological approach) and how risk is influenced by culture (i.e., cultural theory). In this dissertation, I will predominantly focus on the psychological approach. However, I will first briefly describe and discuss the central tenets of the cultural theory of risk.

The main goal of cultural theory is to illustrate that the study of the perception of risk must necessarily take into consideration the social and cultural context. In the frame of this theory, risk perception and risk acceptance are strictly related to cultural adherence and social learning. Thus, people's value system and judgments belong to social groups and do not happen in a social vacuum. In this frame, risk is defined as "a joint product of knowledge of future and consent about the most desired prospect" (Douglas & Wildavsky, 1983, p. 5). The framework of cultural theory is based on the group-grid theory. It posits two dimensions (grid and group) to create typical social positions to represent most of the cultural diversity (Mamadouh, 1999).

The underlying hypothesis is that these two dimensions have a significant impact on people's worldviews. *Group* is defined as "the outside boundary that people have erected between themselves and the outside world" (Douglas & Wildavsky 1983, p. 138). This signifies the belongingness of an individual to social groups and his or her degree of involvement in them. *Grid*, on the other hand, refers to "all the other social distinctions and delegations of authority that they use to limit how people behave to one another" (Douglas & Wildavsky, 1983, p. 138). This indicates how restrictive and regulated a social context is. The two dimensions then generate four types of social environment or worldwide views that represent the four possible filters to a various number of judgments, values, and beliefs: collectivism, egalitarianism, individualism, and fatalism. The attitudes of people toward risk are filtered by these views and, similarly, their social trust in the institutions that regulate risks. Individuals tend to trust people or institutions more when they share the same worldwide view.

The psychological approach to the study of risk, on the other hand, focuses more on the cognitive and emotional aspect of risk perception. One of the main ideas behind the psychological approach is the *psychometric paradigm* (Slovic et al., 1985). It is explained as a "theoretical framework that assumes risk is subjectively defined by individuals who may be influenced by a wide array of psychological, social, institutional, and cultural factors" (Slovic, 2000, p. xxiii). The goal of this idea was to use behavioral measures to quantify and model psychological factors in order to provide a better understanding of how people perceive and respond to risks (e.g., natural, technological, behavioral hazards) and judge the annual fatalities related to specific dangers and the level of acceptability of risks.

Early results showed that the concept of risk "meant different things for different people" (Slovic, 2000, p. xxiii) and that laypeople and experts estimate risks differently. The two groups were similar in assessing statistical frequencies of deaths. However, while experts' risk perception corresponded relatively well to the actual statistics, laypeople's perception differed significantly (Slovic et al., 1981).

Moreover, the relationship between the acceptability of a risk and its perceived risk and benefit is influenced by various characteristics, such as knowledge of the risk, the dread it causes, and how much control one has. A factor analysis of the dichotomies mentioned above (e.g., familiar vs. unfamiliar, chronic vs. catastrophic, controllable vs. uncontrollable) led to a model of risk perception that utilizes a two-factor space (Slovic, 2000). One factor represents how new, uncontrollable, unknown, delayed, and involuntary risks are perceived to be. The other factor indicates how fatal, dreadful, and catastrophic the risk is perceived to be (Fischhoff et al., 1978). In this space, for example, cycling was judged to be relatively controllable, known,

and at the same time having a low probability of being associated with death. Nuclear power, on the other hand, was perceived as an involuntary, uncontrollable, and potentially fatal hazard.

More recent research associated with this approach aimed to show which characteristics of people's traits, beliefs, and ideologies influence risk perceptions. Results show that worldwide visions, gender, ethnicity, and trust have an impact on the perception of risk. Specifically, people with an egalitarian preference for power have a higher perceived risk of several hazards than people preferring a hierarchical social order (Slovic, 1999), and white males perceive risks to be smaller than women and nonwhite people do (Finucane et al., 2000b). Lastly, trust in scientific risk assessments and in the government seems to be essential in explaining the relationship between risk communication, risk management, and risk perception (Slovic, 1999; Slovic et al., 1991).

1.2 Research on Risk

The concept of risk is multifaceted, which is mirrored by the scientific research conducted on the topic. In this section, different methodologies and findings related to research on risk will be presented and discussed. It is important to note that this research evolved and changed over time. The first attempts of systematically measuring attitudes related to risk were done about a century ago in the 1920s (Thurstone, 1928) and subsequently went through methodological changes. In the initial approaches, risk perception was mainly studied using qualitative methods, such as semi-structured interviews with open questions conducted in person or by phone. However, the limitations of these methodologies have turned the research on risk perception toward quantitative measurements (Sjöberg, 2000). These approaches still represent the predominant methods of the psychological approach in the study of risk nowadays. The elements that characterize the quantitative research on risk perception can be listed as the type of risk (i.e., the hazard), the dimensions of risk, and the sample used.

1.2.1 Type of risk

The hazards considered in the research on risk perception are various and diversified. They can be categorized according to the kind of source, which can be personal (i.e., depending on people's own decisions and actions), societal (e.g., risky choices made by politicians and the society), and environmental (related to natural and uncontrollable events). Additionally, hazards can be classified according to their type, which can be behavioral, technological (e.g.,

industrial and high-tech products), and natural (e.g., biological and physical consequences of climate changes). Finally, hazards can also be distinguished depending on who bears the consequences of the risk (e.g., whether hazards impact individuals or groups). Examples of the combination of these elements are the risks of unprotected sex or skydiving that both represent a personal and behavioral risk that can have dire consequences on the self. Nuclear power and pollutions are, instead, risks considered societal and technological, and with consequences that involve many people (Wilson et al., 2019). In this dissertation I will also investigate the effect of emotions on risks associated with investment decisions which can be categorized as behavioral type of risks that can have consequences on a personal and societal level. Some of the most common risks studied are large-scale new technologies (such as nuclear power), natural disasters (e.g., floods), and diseases (e.g., AIDS; Rohrmann & Renn, 2000).

A notable example of this last category, which gathered significant attention in the recent years, is represented by risks related to the COVID-19 pandemic. A new highly infective corona virus (SARS-CoV-2) spread form Wuhan, China to the entire world between December 2019 and April 2020. COVID-19 then became a global pandemic, putting governments and individuals in front of a new unprecedented global crisis (Dryhurst, 2020). In the classification described above, the risks related to the COVID-19 pandemic can be considered personal, societal and natural, with consequences on the individual and the society. Both the individual actions and measures propagated by the governments (e.g., social isolation, protective behaviors, and vaccination) had a paramount role in limiting the spread of this natural hazard, but also shaping people's risk perception on the pandemic (Caserotti et al., 2021).

1.2.2 Dimensions of risk

Compared to the types of risks, the dimensions of risk perception examined in research are more difficult to be categorized due to a large number of studies on the topic. Firstly, it is important to note that most of the studies testing risk perceptions used primarily surveys and questionnaires. Consequently, the dimensions of the risk analyzed depend on the type of questions used in the various studies. A recent paper proposes an overview of the most used dimensions in the study of risk perception (Wilson et al., 2019). The first dimension deals with general risk perception, which is usually measured by items such as "How risky is X?" or "Indicate the level of risk that X presents to Y". A second dimension pertains to affective reactions by measuring the feelings (e.g., worry) related to risk perception. Examples of the items used by this approach are "How concerned are you (if at all) about X?" or "When you

think about X for a moment, to what extent do you feel fearful?". Next to the general risk perception and the affective reactions, two more dimensions proposed by Wilson and colleagues are relative to probability and consequences. Perceptions of probability are measured using words such as chances, likelihood, and probability of realizing a risk. For measuring consequences, people are typically asked about the severity or seriousness of an event. Two examples of items are "How likely is it that X (e.g., an earthquake) will occur this year where you live?" for the probability and "If I did experience X (e.g., an earthquake), it is likely that it would negatively impact me" for the consequences. In order to measure this characteristic of risk, scales like the Domain-Specific Risk-Taking (DOSPERT; Blais and Weber, 2006) can be used. In health-related settings, and particularly in research on previous (i.e., SARS, swine flu, MERS) and recent (i.e., COVID-19) pandemics, the assessment of risk through a combination of perceived likelihood of infection (i.e., probability) and perceived severity of the disease (i.e., consequence) has been widely utilized, and it has been shown to be a significant predictor of protective behavioral intentions (de Zwart et al., 2009; Leppin & Aro, 2009; Chang & Song, 2016; Prentice-Dunn & Rogers, 1986; Rogers & Prentice-Dunn, 1997; Rogers, 1975).

Often, research investigates more than one dimension in order to address the multidimensionality of risk perception. Moreover, the complete way of testing risk perception includes using separate items for affect, consequence, and probability (Slovic, et al., 2004; Wilson et al., 2019). A notable example of a scale that encapsulates the multifaceted nature of risk perception is a tripartite model of risk perception (TRIRISK; Ferrer et al., 2016), which distinguishes among deliberative (i.e., reason-based perceived likelihood of incurring a negative event), affective (i.e., affective reactions driven by the possibility of incurring a negative event), and experiential (i.e., heuristic-based, "gut" feeling of vulnerability toward a negative event) components of risk. The three risk dimensions of the TRIRISK have been used in risk perception assessments of several diseases (e.g., cancer, heart disease, and diabetes), and proven to explain health related protective intentions (Ferrer et al., 2016).

1.2.3 Sample used

The last element that characterizes the research on risk perception is the type of sample used. A large number of studies were conducted with ad hoc samples, especially university students. However, research on risk used also cross-cultural samples to test hypotheses related to cultural differences in risk perception. Other research used samples of experts compared to

samples of laypeople, in order to understand how expertise impacts risk assessments. The specific characteristics of each sample are important to answer different research questions and allow different degrees of generalization of the findings.

1.3 Risk perception: the central role of emotions

The modern conceptualization of risk perception defines it through two main components, *risk as analysis* and *risk as a feeling*. This categorization derives from an essential theory in the field of judgement and decision making that identified the distinction between two types of processes that people use to infer and extract information (Dual-process theories, see Epstein, 1994; Evans & Stanovich, 2013; Kahneman & Frederick, 2002). Much research investigated how people use the two theorized processes and, over the years, labeled them in different ways (e.g., experiential and rational; Epstein, 1994; intuitive and analytic; Hammond, 1996; heuristics and analytic; Evans, 1989, 2006; associative and rule based; Sloman, 1999; Evans & Stanovich, 2013), the most used being *System 1* and *System 2* (Evans, 2008; Stanovich, 1999). Information processing in line with the postulates of *System 1* refers to the unconscious, automatic, and rapid system which is evolutionary the oldest and allows us to infer information without a big expenditure of cognitive resources. This type of information processing is emotionally charged and employs a parallel information processing to form impressions. Information processing in line with the postulates of *System 2* instead refers to the conscious, analytic, and slow system, which is evolutionary the most recent system, and requires the employment of much cognitive energy. This type of information processing *System 2* allows us to direct complex cognitive functions, such as working memory, self-control, and attention towards complex tasks which can be performed only sequentially, using rule-based elaborations (Evans & Stanovich, 2013). Inferring information through System 1 allows people to create fast impressions, and the processes associated with System 2 evaluates their plausibility. If accepted, they become beliefs. However, because of our cognitive limitations evaluations by processes in line with the postulates of System 2 are lax, and people often believe their intuitive judgements. Information processing performed using System 1 is characterized by the use of heuristics, which are an experience-based strategy that allow people to perform quick effort-accuracy tradeoffs, and while they often lead to acceptable conclusions, they can also lead to systematic biases, i.e., normatively not logical or plausible conclusions. The categorization of risk in *risk as a feeling* and *risk as analysis* mirrors the need, inspired by the dual-process theory, to take the intuitive and emotionally charged component of decisions

into consideration. While most humans share the way, they can analytically calculate the risk of a specific hazard through algorithmic reasoning (*System 2*), the way emotions and heuristics influence risk perception is more complex. Therefore, in this dissertation I will discuss the System 1 components of risk perception, thus the role of affect and emotion (risk as feeling), and heuristics and biases on intuitive judgements of risks (risk as analysis).

1.3.1 The role of affect and emotions on decision making under risk

Affect is an essential component of judgement and decision making under risk, which has often been overlooked (Västfjäll & Slovic, 2013). Traditional judgement and decision-making research focused on understanding how people reach "correct" rational conclusions through cognitive evaluations of alternatives and outcomes (Loewenstein, 1996; Weber & Johnson, 2009). During those years research put, cognition and analytical thinking on a pedestal, framing it as the essential component of rationality. They assumed that, when making choices, people would assess the likelihood and severity of each alternative, and they would combine that information and perform an operation based on expectations to decide (Loewenstein et al., 2001). From an evolutionary perspective, before formal risk assessment and decision analysis, humans were guided by their intuitions and gut feelings to discriminate what was safe to eat, drink, or approach. When life became more complex and humans started to manipulate and gain control over the environment around them, their brain developed and the role of analytical thinking became more and more pervasive of the human experience. The role of affective reactions and emotions was often neglected and considered interfering with reason (Slovic, 2010).

However, at the end of the 80's and in the 90's, many researchers recognized and tested the importance of affect on decision making and risk assessment in many fields of psychology. During that time, research argued that affective reactions precede cognition in decisions, by being automatic, faster than analytical elaborations, and therefore serving as guiding mechanism to navigate a complex and dangerous world (Bargh, 1984; Loewenstein et al., 2001; Slovic, 2010; Zajonc, 1980, 1984). For example, studies in the field of cognitive psychology showed that the quality of decision making is reduced if affective inputs are suppressed (Wilson et al., 1991, 1993). Moreover, the Dual-process theory (Epstein, 1994) solidified the importance of affect on decisions by postulating that people process information using two separate systems, one of which is predominantly affective based (*System 1*). Neurologically, research found a direct connection between the thalamus (one of the first sites of raw

information processing) and the amygdala (important processor of affective stimuli; LeDoux, 1998), which illustrates a direct link between emotions and areas of crude signal processing, without the cortical mediation, associated instead with analytical reasoning. Further research by neurologists provided a more comprehensive theoretical explanation of the role of affect and emotion on decision making. The Somatic Marker Hypothesis (SMH; Bechara & Damasio, 2005; Damasio, 1996) postulated that people's thoughts are composed by images of stimuli and related outcomes. Through experience people "mark" mental images and outcomes with positive or negative affects ("somatic markers"), which will be used as inputs for future avoidance or approaching decisions. In social psychology, the "affect-as-information hypothesis" was postulated (Clore et al., 1994; Schwarz & Clore, 1983). This research demonstrated that positive and negative feelings of liking or disliking have an effect on the judgements of others. Specifically, affective states that are experienced as reactions to the imminent judgement, influence people's judgements and choices in social settings.

The role of affect has been especially studied in its function on decisions under risk in the theoretical framework of the "affect heuristic" (see Figure 1; Finucane et al., 2000, Slovic et al., 1991; Slovic et al., 2007). This theory postulates that people store information, images and stimuli tagging them with different affective reactions. All the positive and negative tags associated consciously, or not, to their mental images constitute their "affective pool". When making decisions, people automatically and rapidly consult their affective tags of mental images instead of performing slow and complex cognitive calculus of utility maximization (Slovic, 2004, 2007). One of the greatest contributions of the affect heuristic came from its application to decisions under risk. Early studies showed that, even if risk and benefits are usually positively correlated (high risks correspond to high benefits), they are negatively correlated in people's mind (Fischhoff et al., 1978). Further studies explained that this misperception is linked to a positive or negative affect that people automatically associate to hazardous activities. Specifically, when people have positive feelings toward a risky activity, they tend to associate low risks and high benefits to it, while if the feelings are negative, people tend to associate high risks and low benefits to the activity (Alhakami & Slovic, 1994). Two important studies provided empirical support for the affect heuristics, and confirmed that affect influences our judgments and decisions directly and not as a reaction to previous analytical evaluations (Finucane et al., 2000). In the first study, participants were asked to assess the risk and benefit of technologies, and the researchers manipulated the amount of favorable or unfavorable information provided to participants about the risks and benefits of those technologies. Results show that people were influenced by their affective evaluation, elicited

by the negative or positive pieces of information received, when making risk and benefit judgements. In the second study, the authors manipulated whether participants needed to make risk and benefit judgements under time pressure or without time limitations. Findings showed that under time pressure, thus with a reduced possibility to rely on analytical reasoning, the negative correlation between risk and benefits was greater (Finucane et al., 2000).

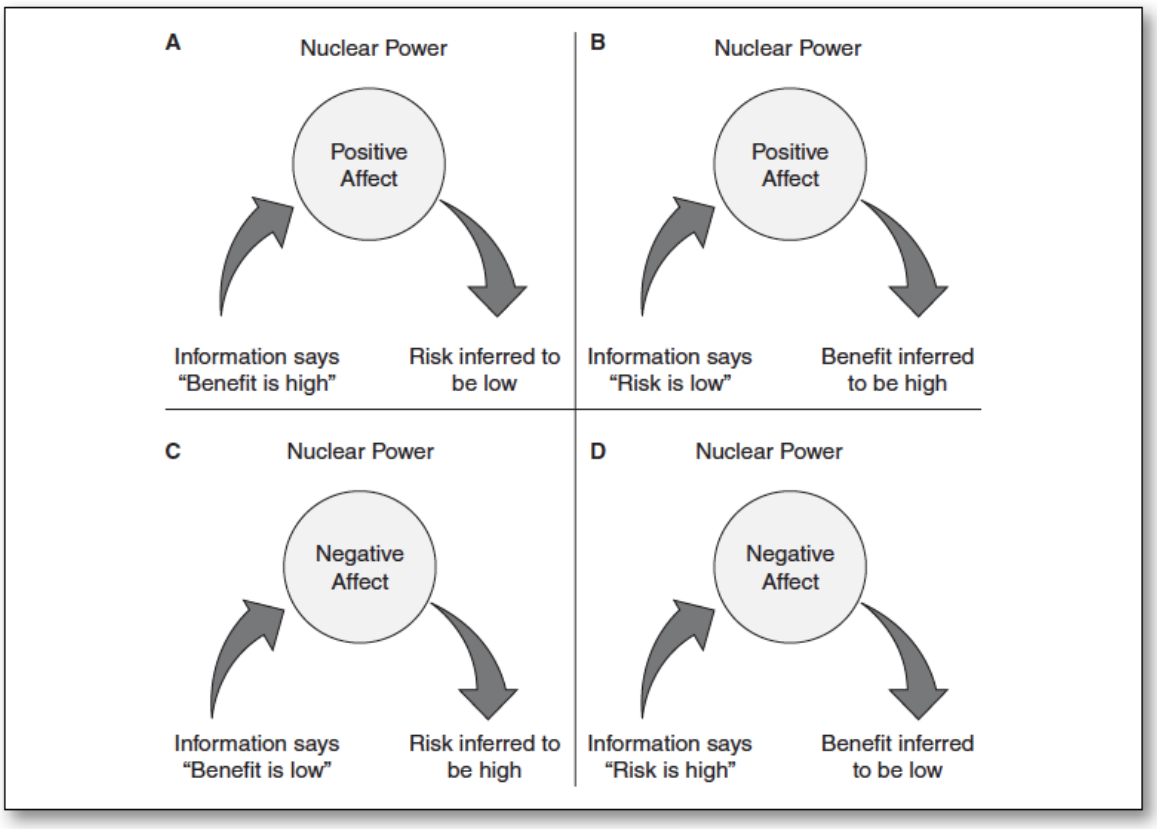


Figure 1. ***Sources:*** Adapted from Slovic et al. (2007)

Note. Model showing how information about benefit (A/C) or risk (B/D) could increase (A/B) or decrease (C/D) the affective evaluation of nuclear power and lead to inferences about risk and benefit that are affectively congruent with the information input.

Since the pivotal role of affect on decisions making has been widely studied, researchers categorized how more specific and discreate type of affect and emotions can influence our cognitive processes. Affect and emotions have been categorized as *anticipated* vs *anticipatory,* and *integral* vs *incidental* (e.g., Dickert et al., 2015; Lerner & Keltner, 2000; Loewenstein & Lerner, 2003; Västfjäll & Slovic, 2013). Decisions can be influenced by both *anticipated,* i.e., cognitive representations of how people predict they will feel in a future situation, and *anticipatory,* emotions i.e., affective reactions people feel in the moment they make the

decisions. When it comes to *affective forecasting*, i.e., the act of predicting the valence, the duration and the intensity of our future feelings, research demonstrated that people are not always accurate in their estimations (Wilson & Gilbert, 2003). Therefore, decision makers that rely too much on their affective prediction in a risky situation can incur systematic biases and can be blind towards other information that could increase the accuracy of their decisions (Gilbert et al., 1998; Schkade & Kahneman, 1998). Affect and emotions can also be *integral, i.e.,* related to an object, stimuli or situation and *incidental, i.e*., unrelated to an object, stimuli or situation, and both have an impact on decisions under risk. Integral emotions have been shown to be beneficial in rational decisions, so that the negative affect elicited by risky outcomes can direct people to avoid the source of that outcome, and move towards more beneficial options (Damasio, 1996). Research also demonstrated that incidental emotions, which represent mood states without a clear source, can have both a congruent as well as incongruent effect on risk perception. A congruent effect happens when people associate lower risks to hazardous activities when in a good mood (Schwarz & Clore, 1983). An incongruent association between risk perception and mood appears when people in a good mood, to stay in a positive mindset tend to overestimate risks and become more risk adverse (Andrade, 2005).

In the attempt of capturing the complexity of the role of affect on judgment and decision-making research defined four distinct functions of affect in constructing decisions: *affect as information, affect as a spotlight, affect as a motivator of behaviors, affect as a common currency* (Peters, 2006; Peters et al., 2006). *Affect as information* refers to the knowledge that affect develops via experiences and its link to mental representations, which can provide guidance on what to avoid and what to select (Damasio, 1996). If people are presented with affective labels connected with numerical information, they can access it more quickly and are more influenced by it when making decisions than analytical interpretation (Peters et al., 2004). *Affect* also serves as a *spotlight* in two phases of the decision-making process; first, based on the nature of the affective sensation (e.g., good or bad), the decision maker concentrates their attention on certain information, and second, they use that information to drive their choices (Peters et al., 2003). *Affect* has been connected to avoidance or approach *behaviors* (Chen & Bargh, 1999), as well as the execution of behaviors driven by gaining or maintaining positive mood states, according to research (Isen, 2000). Lastly, *affect as a common currency* is an extension of the affect as information function applied to situations in which individuals must interpret more sophisticated information. People utilize affect to transform complex thoughts into simpler evaluations and to compare and integrate simple

emotive response rather than complex analytical reasoning when making decisions (Peters, 2006).

1.3.2 Trait emotional intelligence

Research has largely focused on the effect of affect and emotion on judgement and decision making under risk, however, there is a wide variability in the way people perceive, experience and manage emotions (Robinson & Clore, 2002). An individual difference that captures the subjective nature of humans' emotional experience is trait emotional intelligence (Trait EI). Trait EI has been defined as a "constellation of emotional self-perceptions located at the lower levels of the personality hierarchies" (Petrides et al., 2007). People with higher trait emotional intelligence have greater abilities of understanding, regulating, and managing their own and others' emotions. Trait EI has been shown to occupy a unique position in the personality space, explaining a distinctive amount of variance when factored with other personality traits for example the Big Five (Costa & McCrae, 1992). Research showed that trait EI moderates the effect of emotions in people's behaviors and risk perception. For example, people with high trait EI are more resilient to failure (Agnoli et al., 2015), better at managing stress (Petrides et al., 2006), more accurate when anticipating emotions elicited by decision outcomes (Sevdalis et al., 2007), and are less likely to perceive events as threatening (Mikolajczak et al., 2008). However, as every other personality trait, trait EI also portrays specific behavioral tendencies that can be adaptive or maladaptive depending on the context. Research showed that, in a high uncertainty situation, where relying on other information is difficult, people with high trait EI, who use emotions to guide their decision or forecast future events, tend to be less accurate and make more mistakes (Pe˜na-Sarrionandia et al., 2015). A notable example of high uncertainty environments, where people are asked to make decisions every day, is the financial market. In this context, research found that people with high trait EI are more willing to independently invest in the expected values of the investments, thus gaining when the expected value is positive, but losing when it is negative (Rubaltelli et al., 2016).

1.3.3 Heuristics and biases in risk perception

A substantial body of research has shown that individuals, when making choices or estimating the possible occurrence of hazardous events, are often suboptimal in dealing with probabilities. The possibility of an event (or its consequences) is related to calculations that require an in-depth knowledge of a specific risk domain, which is not always present.

Additionally, calculations of probabilities, like many other reasoning strategies, are constrained by cognitive limitations. It is virtually impossible to process all possibilities and their corresponding consequences. Therefore, when dealing with uncertainty, people usually rely on heuristics, instinctive assumptions, beliefs, and feelings. While this saves cognitive resources, it can also lead to systematic errors with severe consequences. Many studies have analyzed specifically how these shortcuts affect risk perception and estimations of the probabilities related to risks.

One of the most common mistakes in the estimation of the probability of occurrence of a risky event is due to the *availability bias* (Tversky & Kahneman, 1973). This bias refers to a judgment and decision-making strategy that can lead to errors because people tend to judge the frequency of an event depending on how easily that specific event comes to their mind. It can lead to overestimating the frequency of events that were personally experienced more often or are more emotionally charged. Moreover, the estimation of probability of occurrence of an event can be greatly influenced by the media coverage of specific events. For example, people overestimate the probability of dying in an airplane crash and underestimate the probability of dying in a car accident because the media tends to report more about the former than the latter. Research showed that individuals tend to judge the probability of dying due to a terrorist attack as higher than dying due to climate change (Sunstein, 2007). However, official reports show that, for example, in 2012, annual deaths due to climate changes were 400,000 (Climate Vulnerability Monitor), compared to 12,000 deaths due to terroristic attacks (this estimation is reduced to 2000 dead people when the deaths in Syria, Iraq, Nigeria, Afghanistan, and Pakistan are not considered: Global Terrorism Index). A more recent possible application of the availability bias and the effect of media coverage on risk perception is represented by the COVID-19 pandemic; it can be assumed that the extensive media coverage of this specific hazard seen between Spring of 2020 and the Winter of 2021 had the potential to lead people to overestimate the likelihood of dying and enhance the perception of risk associated with this particular hazard (Cowling, et al., 2020; Lichtenstein et al., 1978). However, since the COVID-19 pandemic represented a new threat and an unprecedented emergency, it is important to test the effect of cognitive biases in people's understanding of the risks related to the pandemic.

When assessing the probability of risky events people are also limited by our cognitive limitations in *inferring information from small samples* (Tversky & Kahneman, 1971) and *predicting future risky events* (Tversky & Kahneman, 1973). Research has found that humans fail systematically in taking the laws of big numbers into consideration when making categorical judgments or assessing probabilities. When presented with data from non-

representative or small samples, people interpret that information as belonging to a general population and make decisions accordingly (Tversky & Kahneman, 1971). A famous example of this cognitive limitation is the Gambler's fallacy. When playing roulette, people tend to bet more often on the outcome (i.e., red or black) that was the least drawn in the previous four or five rounds. However, they neglect that such a small number of rounds does not represent a sample big enough to follow the rules of a general population, which would present a 50/50 distributions of outcomes (Croson & Sundali, 2005). Research also showed that people's intuitive probabilistic predictions do not align with normative statistical predictions in several ways. First, people tend to neglect base rates, i.e., the information on prior probabilities people have before receiving new evidence on a specific event. When assessing risks, people tend to rely almost exclusively on new information and ignore prior information they had on the hazard (Lyon &Slovic, 1976; Tversky & Kahneman, 1973). Second, research has found that humans do not consider the validity of the source of information when making predictions. If the validity of the source is not perfect, people should correct their estimations by regressing them towards the mean. However, people tend not to perform this calculation even when they themselves consider the validity of information as low (Tversky & Kahneman, 1971). Finally, people tend to have (erroneously) great confidence on predictions with highly redundant variables even though normative principles state that the accuracy of a prediction decreases when the redundancy increases (Tversky & Kahneman, 1971; Slovic, 2000).

Other cognitive mistakes that influences how we perceive risks are the *optimism bias* (Weinstein & Klein, 1996), *illusion of control* (Langer, 1975), and the *hindsight bias* (Fischhoff, 1974). Research showed that people tend to be more of an optimist about themselves and believe to be less at risk than other people for several adverse events such as getting divorced, having cancer, or becoming addicted to drugs (Weinstein, 1980). Research also demonstrated that people evaluate risks as lower when they are considered under personal control and over evaluate the risk of events that are not personally controllable. For example, individuals generally judge taking a plane as riskier than driving a car, possibly due to an overestimation of control when driving (Langer, 1975). Finally, when people become aware of an event that happened in the past they tend to believe it was inevitable and it was apparent in foresight. People tend to erroneously believe, in retrospect, that they had a much better understanding of what was going on than they actually had. This bias can limit our perception of risks, especially the possibility of learning from them (Fischhoff, 1974).

Emotions and cognitive biases have a central role in how we perceive risks and how we make judgements and decisions. We use affect and heuristics as a fast, easier information,

compared to analytical thinking, to guide our understanding of a complex world. We all have a unique experience of emotions and we differently use them as guidance. The challenge of this dissertation is to apply the knowledge we have on the effect of emotions and cognitive biases on decisions in regards of new and unexpected phenomena (e.g., COVID-19), and to test how the unique way in which we perceive emotions can interact with other personal predispositions (e.g., experience) in explaining how we decided under risk.

1.4 Risk communication

The conceptualization of risk communication is intertwined with the way risk is defined, and the changes in its characterization, at a scientific and societal level, over the years. Early efforts defined the "deficit model" as standard for the research on risk communication. Risk was considered as objective, and an outcome of "experts" assessments, while the perception of "lay" people, audience of the risk communication, was considered subjective and irrational. The goal of risk communication in the frame of the "deficit model" was to close as much as possible the gap between experts' assessments and lay people's imperfect risk perception (Balog-Way et al., 2020). Further research reviewed this limited perspective and redefined risk as composed by both objective and subjective components, and recognized it as a social construct (Leiss, 1996; Slovic, 1999). Risk is indeed a product of societal and cultural influences and people's risk perception should not be investigated as happening in a social vacuum. This new understanding of risk allowed a shift in the field of risk communication from the "deficit model" to the "multi-way" approaches (Slovic, 1999). The "multi-way" approaches include the audience and the engagement of all the actors involved in the risk communication process (e.g., individuals, groups, organizations; Pidgeon, 2020). In this modern framework research attempted to identify when risk communication is considered "effective", thus when it achieves its desired results.

This debate has been organized around normative, instrumental, and substantive arguments (Balog-Way et al., 2020). *Normative* arguments consider risk communication as a practice that has intrinsic value and the goal to represent the right thing to do. Scientists, governments, and companies have the obligation of communicating their findings and their level of uncertainty; the audience is the best judge of the normative effectiveness of risk communication (Wardman, 2008). *Instrumental* arguments refer to the aim of risk communication to achieve its desired result of eliciting belief and behavioral changes in the audience (Brewer, 2011). A notable example is the instrumental use of risk communication during the COVID-19 pandemic, designed to make people implement protective behaviors

aimed to limit the spread of the virus (Balog-Way & McComas, 2020). Finally, *substantive* arguments reflect on the importance of risk communication to go further than communicating existing knowledge and aim, through the engagement of the audience, to generate original ideas and improve the quality of the existing knowledge (Balog-Way et al., 2020; Pidgeon,2020; Wardman, 2008).

Recent research grouped the above-mentioned arguments and reorganized it in the two main functions of risk communication: *risk communication as constitutive* and *risk communication as pragmatic* (Cox & Pezzullo, 2016; Rickard, 2021). The constitutive function of risk communication has its roots in the conviction that risk is a social construct and risk communication cannot be disentangled from its societal and cultural context. This function shed light on the need to consider that people perceive risks and judge their acceptability in their interaction with their community and institutions. Specifically *risk communication as constitutive* aimed to create and recreate the meaning behind the perception of hazards by prioritizing the lived experience of individuals over official and normative indications. This line of research has been shaped mainly by cultural anthropologists and sociologists (Beck, 1992; Douglas, 1990, 1992). The pragmatic function refers to the practical role of risk communication to be a means to a specific goal. Through an appropriate, persuasive and, well-designed set of messages, risk communication should aim to modify beliefs, attitudes, and promote behaviors to contain the hazard and people's exposure to it. In *risk communication as pragmatic,* it is easy to delineate successes, i.e., effective communication that led to a reduction or containment of the risk and failures, i.e., communication that did not manage to create attitude or behavioral changes in the population. Research fields that mainly investigated the pragmatic function of risk communication are social psychology and decision research (Leiss, 2014; Rickard, 2021; Slovic et al., 2004). The research on risk communication as pragmatic focused on three main domains: the *messenger*, i.e., the effect of who communicates the risk, especially the role of trust on people's compliance with the communicators' indications, the *audience,* i.e., the characteristics of the people receiving the communication such has age, gender, and ethnicity, and the importance of tailoring messages on the target audience in effective risk communication, and the *message attributes, i.e.*, the way the message is presented or framed and its effect of people's information processing and perception of risk (Balog-Way et al., 2020). In this dissertation I focus mainly on the pragmatic function of risk communication, and specifically, I test the effect of *message attributes* on people's risk perception, emotional reaction, and behavioral intentions.

1.4.1 Message attributes

The line of research that studies the *message attributes* in risk communication investigates how different presentations of information can shape the understanding, interpretation of the message, and elicit people's attitude and behavioral changes toward the risk. Research has found that the way the content of messages is presented can affect people's approach to the hazard (Balog-Way et al., 2020). For example, creating a lower psychological distance between the audience and the risk leads to higher concerns and higher willingness to implement behavior aimed to reduce the risk especially in climate-change risk communication (Broomell et al., 2015; Jones et al., 2017; Spence et al., 2012). Moreover, the use of humor in risk communication has been widely studied and both positive and negative effects have been shown. Humor can lead to an underestimation of the problem and lower intentions to engage in the behaviors encouraged by the message (Hansmann et al., 2009; Skurka et al., 2018); however, other studies showed that it can also be a tool to increase awareness, involvement, and can work as a learning vehicle about a hazard (Anderson & Becker, 2018; Boykoff & Osnes, 2019; Kaltenbacher & Drews, 2020). Finally, one of the biggest challenges of risk communication is represented by communication of uncertainty. The literature presents mixed findings on the effect of communicating uncertainty on public trust. Some studies show that the communication of uncertainty has a limited negative effect on the trust for the messengers (van Der Bles et al., 2020). Other studies, on the other hand, show that it can lead not only to lower confidence in the messengers but also to a perception of lower transparency and offers opportunities to misuse the information (Osman et al., 2018). Some risk domains are particularly interested by uncertainty communication and therefore they have been of a higher interest for researchers. These domains have been categorized in risks that concern physical well-being (e.g., medical, climate change, personal safety), financial wellbeing (e.g., stick market and gambling), and social well-being (e.g., the use of social network and moral dilemmas). In these risk domains, often the messengers have incomplete knowledge of the hazards and need to communicate using probabilities and statistical terms, which research showed can be difficult to evaluate by a not knowledgeable audience (Dickert et al., 2015). In this dissertation, I specifically focus on the effect of types of presentation of numerical information (i.e., frames and numerical formats) on the audience's understanding of risks and behavioral intentions in the domain of physical well-being.

1.4.2 Framing

Framing and types of numerical formats can have a great impact on how people perceive risks, react emotionally, and finally behave around the hazards. Framing refers to the process of shaping a message, for example highlighting some information and undermining others, to induce in the audience specific emotions and understanding of the message. Many frames can effectively influence people's perception of an issue (e.g., human vs. the environment, closeness vs. distance, threats vs. benefit; Balog-Way et al., 2020). In this dissertation I will focus on one of the most used frames in risk communication: gains vs. losses. A gain or positive frame presents information on the possible advantages of a risky situation, for example, how much money people can win in a bet, or how many people can be saved by a medical treatment. A loss or negative frame, on the other hand, focuses on the possible damaging consequences of a risk, such as the money that needs to be paid or could be lost in a gamble, or the number of people that can die because of a medical treatment. Presenting information as a gain or loss frame can influence peoples' attitude towards risks, emotional reactions and behavioral intentions toward a hazard. A famous study showed that, when presented with positive frames, people tend to have a more risk adverse attitude, while, when presented with negative frames, they tend to be more risk seeking (Tversky & Kahneman, 1981). In this experiment, participants were asked to read one of two numerically equivalent scenarios involving potential programs to battle an Asian disease, providing either the number of people who may die or the number of people who would be saved. Both scenarios included a probabilistic outcome (e.g., three-quarters of the population will be saved) and a certain outcome (e.g., 400 people will die). The results demonstrated that the different framing produced a preference reversal and a different risk perception. Participants who read the gain frame scenario were more likely to choose the certain alternative, demonstrating a greater aversion to risk. However, participants who read the loss frame scenario instead showed to be more risk seeking choosing more often the probabilistic option. Judgment and decision-making evidence showed that gain and loss frames can also be affected by and affect people's emotional reactions. Research showed that negative emotions, such as anxiety and distress, can enhance the effect of framing because they are associated to higher alert to external stimuli, and therefore, higher susceptibility to the way information is framed. On the other hand, both negative emotions that elicit aversive responses (e.g., anger), and positive emotions (e.g., enthusiasm) can temper the effect of framing since they activate a "disposition system", which induces people to be less attentive to external stimuli (Druckman & McDermott, 2008; Marcus

et al., 2000). Metanalytic evidence also showed that gain and loss frames can elicit specific integral emotion; gain frames generally elicit more positive emotional reactions, while loss frames elicit negative ones (Nabi et al., 2020; Peters et al., 2006).

Finally, gain and loss frames can influence behavioral intentions toward dangers. According to research in the health domain, gain frames are more effective in promoting preventive behaviors, whereas loss frames are more effective in health-related promoting behaviors (Rothman & Salovey, 1997). Inconsistently, reviews on a variety of health behaviors reveal little or contradicting effects of the two framing strategies (Akl et al., 2011; Gallagher & Updegraff, 2012; O'Keefe & Jensen, 2007, 2009; O'Keefe & Nan, 2012). A recent example of the media's use of benefit and loss framing to influence public perception on risky occurrences is the coverage of the COVID-19 pandemic. During the initial stages of the coronavirus outbreak, the media focused more on number of fatalities (negative or loss frame) than on the number of people who recovered (positive or gain frame; Hameleers, 2021). However, while some studies found that negative framing was more effective in promoting action (Van Bavel et al., 2020), others found that positive framing was associated with greater support for stringent preventive measures for example the lockdown (Hameleers, 2021). It is of the utmost importance to explore the impact of media framing tactics on people's emotional response, risk perception, and behavior, particularly when the public is asked to make sense of a new global pandemic such as COVID-19. One of the goals of this dissertation is to contribute to this body of research and examine the effect of gain and loss framing on risk communication during the initial stages of the COVID-19 pandemic.

1.4.3 Numerical formats

Research has shown that the formats used to present numerical information in risk communication can also lead to different interpretations, emotional reaction, and behavioral responses (Fagerlin et al., 2007; Timmermans & Oudhoff, 2011; Visschers et al., 2009). Research has shown that information presented as probabilities leads to lower risk perception and higher risky behavior compared to frequency formats. Indeed, studies showed that risk presented as probability entails lower imaginability (i.e., lower ability to evoke mental images of the event), making this format harder to comprehend compared to when the same risk is expressed in frequency formats (Peters et al., 2006; Slovic et al., 2000; Timmermans et al., 2008; Timmermans & Oudhoff, 2011; Visschers et al., 2009; Newell et al., 2008; Purchase & Slovic, 1999; Koehler & Macchi, 2004).

For example, in a set of studies, researchers showed that experts' judgements could be affected by the numerical format used to present information to them. In the experiments, forensic psychologists and psychiatrists were asked to assess the likelihood that a patient with mental health disorders could commit an act of violence six months after release. The experts read the opinion of another collogue presented either through a frequency format ("20 out of 100 patients similar to Mr. Jones are estimated to commit an act of violence") or a probability format ("20% of patients similar to Mr. Jones are estimated to commit an act of violence"). Results showed that, when presented with the frequency format, 41% of the expert clinicians refused to discharge the patient while, when presented with the probability format, only 21% refused to discharge him (Slovic et al., 2000).

Literature on risk also showed that different types of frequencies and ratio formats can lead to different risk perception. In a study, participants were given the possibility to win $1 by drawing a red jellybean from one of two urns. In the first urn there were 7 red out of 100 jellybeans, while in the second there was 1 red out of 10 jellybeans. Results showed that people tended to prefer the first urn because, even though they knew it gave them a lower possibility of winning, it represented the option with the highest absolute number of red jellybeans (Denes-Raj & Epstein, 1994).

Finally, information about a risk can also be presented in terms of absolute risk or relative risk information. Information presented as absolute (vs relative) risk reduction is usually perceived as more intuitive and easier to comprehend, but it was also shown to lead to lower compliance with health related recommendations (e.g., Covey, 2007; Visschers et al., 2009; Zipkin et al., 2014 for a review).

There is a lot of evidence indicating some formats as more effective in increasing people's risk perception, and compliance to protective behaviors than others. However, risk communicators used many different numerical formats in trying to inform the population on the new COVID-19 pandemic without being aware of the great effect that the choice of the numerical format can have on people's understanding of the pandemic. Thus, a deeper understanding of this issue is pivotal, also in light of future health crises and pandemics. In such a context, risk scholars need to provide authorities with adequate strategies to increase citizens' compliance with recommended policies. In this dissertation I contribute to this important matter by systematically testing the effect of six of the most common numerical formats used by the Italian media and public policy outlets to report COVID-19 mortality rates during the second wave of the pandemic on people's risk perception and understanding of the pandemic.

1.5 Studies' overview[2]

The following chapters will present three studies conducted during my doctoral course. These studies aim at investigating the role of emotional reactions and trait emotional intelligence in shaping people's risk-taking behaviors in conditions of uncertainty and the influencing role of risk communication.

This research specifically examined the effect of emotional reactions and risk perception on lay people's health-related risk-taking behaviors during the COVID-19 pandemic, and professional financial advisors' judgments of financial assets' risks and expected returns. This thesis also tests the role of different media communication strategies implemented during the COVID-19 pandemic, in shaping people's understating and behaviors towards the pandemic. Finally, it investigates the effect of a personality trait that can inform us on how we subjectively manage and understand our and others' emotions (i.e., trait emotional intelligence) on people's emotional reactions and risk perception under uncertainty.

Study 1 (Chapter 2) explores the effect of two types of media communication strategies used during the early stages of the COVID-19 pandemic, framing (positive frame: number of recovered vs. negative frame: number of dead) and the comparison between COVID-19 and t seasonal flu, on citizens' compliance with self-protective behaviors. It also tests, the mediating role of emotional reaction, i.e., worry, and risk perception. Moreover, it compares results from three different European samples to offer a multicounty perspective (Italian vs. Austrian vs. English). Study 2 (Chapter 3) tests the influence of six information formats used frequently in the Italian media to report COVID-19 mortality rates on people's emotional reactions, risk perception, and the intention to comply with recommended self-protective behaviors against the virus. Study 3 (Chapter 4) investigates the role of trait emotional intelligence and experience on the misperception of the relationship between risk and return in professional financial advisors.

This dissertation shows that emotions represent an essential component of people's risk perception, who use these internal cues to make judgments and decisions on health-related and economic contexts. The three studies show that emotions and risk perception can be influenced by the way information communicated by the media is presented and that this can lead people

[2] The three studies I present in this dissertation have been conducted in collaboration with several colleagues whose names are reported in footnotes in every chapter. I am the co-first author in all of them, and for transparency, I will report my contribution to the articles. In Study 1 and Study 2, I had a leading role in the project's ideation, the creation of the materials, and the data collection, I ran all the statistical analyses, and I collaborated in the writing and editing of the manuscript. For Study 3, I collaborated on the project's ideation, the materials' creation, and the data collection, and I collaborated on the writing and editing of the manuscript.

to decide whether or not to protect themselves and others. Finally, this thesis shows that both lay people and professionals primarily use emotions to guide their perception of risks in uncertain situations and that the subjective way of managing one's emotions can interfere with effective risk assessment and decision-making.

References

Agnoli, S., Pittarello, A., Hysenbelli, D., & Rubaltelli, E. (2015). Give, but give until it hurts: The modulatory role of trait emotional intelligence on the motivation to help. *PLoS One*, 10(6). https://doi.org/10.1371/journal.pone.0130704

Akl, E. A., Oxman, A. D., Herrin, J., Vist, G. E., Terrenato, I., Sperati, F., Costiniuk, C., Blank, D., Schünemann, H. (2011). Framing of health information messages. *Cochrane Database Sys. Rev.*, 12. https://doi.org/10.1002/14651858.CD006777.pub2

Alhakami, A. S., & Slovic, P. (1994). A psychological study of the inverse relationship between perceived risk and perceived benefit. *Risk analysis*, *14*(6), 1085-1096. https://doi.org/10.1111/j.1539-6924.1994.tb00080.x

Anderson, A. A., & Becker, A. B. (2018). Not just funny after all: Sarcasm as a catalyst for public engagement with climate change. *Science Communication*, 40(4), 524–540. https://doi.org/10.1177/1075547018786560

Andrade, E. B. (2005). Behavioral consequences of affect: Combining evaluative and regulatory mechanisms. *Journal of Consumer Research*, 32, 355–362. https://doi.org/10.1086/497546

Balog-Way, D. H. P., & McComas, K. A. (2020). COVID-19: Reflections on trust, tradeoffs, and preparedness. *Journal of Risk Research*, 23, 838-848. https://doi.org/10.1080/13669877.2020.1758192

Balog-Way, D., McComas, K., & Besley, J. (2020). The evolving field of risk communication. *Risk Analysis*, 40(S1), 2240-2262. https://doi.org/10.1111/risa.13615

Bargh, J. A. (1984). Automatic and conscious processing of social information. In *American Psychological Association convention.* Washington, DC, USA: Lawrence Erlbaum Associates Publishers.

Bechara, A., & Damasio, A. R. (2005). The somatic marker hypothesis: A neural theory of economic decision. *Games and economic behavior*, 52(2), 336-372. https://doi.org/10.1016/j.geb.2004.06.010

Beck, U. (1992). *Risk society*. London: Sage.

Blais, A. R., & Weber, E. U. (2006). A domain-specific risk-taking (DOSPERT) scale for adult populations. *Judgment and Decision making*, 1(1), 33. https://doi.org/10.1037/t13084-000

Boykoff, M., & Osnes, B. (2019). A laughing matter? Confronting climate change through humor. *Political Geography*, 68, 154–163. https://doi.org/10.1016/j.polgeo.2018.09.006

Brewer, N. T. (2011). Goals. In B. Fischoff, N. T. Brewer, & J. Downs (Eds.). *Communicating risks and benefits: An evidence-based users guide* (pp. 3–10). Silver Spring, MD, USA: Food and Drug Administration (FDA), US Department of Health and Human Services.

Broomell, S. B., Budescu, D. V., & Por, H. H. (2015). Personal experience with climate change predicts intentions to act. *Global Environmental Change*, 32, 67–73. https://doi.org/10.1016/j.gloenvcha.2015.03.001

Caserotti, M., Girardi, P., Rubaltelli, E., Tasso, A., Lotto, L., & Gavaruzzi, T. (2021). Associations of COVID-19 risk perception with vaccine hesitancy over time for Italian residents. *Social science & medicine*, *272*, 113688. https://doi.org/10.1016/j.socscimed.2021.113688

Chang, C.-H., Xu, J., & Song, D.-P. (2016). Impact of different factors on the risk perceptions of employees in container shipping companies: A case study of Taiwan. *International Journal of Shipping and Transport Logistics*, *8*(4), 361–388. https://doi.org/10.1504/IJSTL.2016.077306

Chen, M., & Bargh, J. A. (1999). Consequences of automatic evaluation: Immediate behavioral predispositions to approach or avoid the stimulus. *Personality and social psychology bulletin*, *25*(2), 215-224. https://doi.org/10.1177/0146167299025002000

Clore, G. L., Schwarz, N., & Conway, M. (1994). Affective causes and consequences of social information processing. In Wyer Jr., R. S., Srull, T. K. (Eds.), *Handbook of social cognition* (2). New York, USA; London, UK: Psychology Press.

Costa Jr, P. T., & McCrae, R. R. (1992). Four ways five factors are basic. *Personality and individual differences*, 13(6), 653-665. https://doi.org/10.1016/0191-8869(92)90236-I

Covey, J. (2007). A Meta-analysis of the Effects of Presenting Treatment Benefits in Different Formats. *Medical Decision Making*, *27*(5), 638–654. https://doi.org/10.1177/0272989X07306783

Cowling, B. J., Ali, S. T., Ng, T. W. Y., Tsang, T. K., Li, J. C. M., Fong, M. W., Liao, Q., Kwan, M. Y., Lee, S. L., Chiu, S. S., Wu, J. T. W., Wu, P., Leung, G., M. (2020). Impact assessment of non-pharmaceutical interventions against coronavirus disease 2019 and influenza in Hong Kong: an observational study. *Lancet Public Health*, 5, 279–288. https://doi.org/10.1016/S2468-2667(20)30090-6

Cox, R., & Pezzullo, P. C. (2016). Environmental communication and the public sphere (4th ed.). Thousand Oaks, CA: Sage.

Croson, R., & Sundali, J. (2005). The gambler's fallacy and the hot hand: Empirical data from casinos. *Journal of risk and uncertainty*, 30(3), 195-209. https://doi.org/10.1007/s11166-005-1153-2

Damasio, A. R. (1996). The somatic marker hypothesis and the possible functions of the prefrontal cortex. *Philosophical Transactions of the Royal Society of London. Series B: Biological Sciences*, 351(1346), 1413-1420. https://doi.org/10.1098/rstb.1996.0125

de Zwart, O., Veldhuijzen, I. K., Elam, G., Aro, A. R., Abraham, T., Bishop, G. D., Voeten, H. A. C. M., Richardus, J. H., & Brug, J. (2009). Perceived Threat, Risk Perception, and Efficacy Beliefs Related to SARS and Other (Emerging) Infectious Diseases: Results of an International Survey. *International Journal of Behavioral Medicine*, *16*(1), 30–40. https://doi.org/10.1007/s12529-008-9008-2

Denes-Raj, V., & Epstein, S. (1994). Conflict between intuitive and rational processing: when people behave against their better judgment. *Journal of personality and social psychology*, 66(5), 819. https://doi.org/10.1037/0022-3514.66.5.819

van Der Bles, A. M., van der Linden, S., Freeman, A. L.,& Spiegelhalter, D. J. (2020). The effects of communicating uncertainty on public trust in facts and numbers. *Proceedings of the National Academy of Sciences*, 117(14), 7672–7683. https://doi.org/10.1073/pnas.191367811

Dickert, S., Västfjäll, D., Mauro, R., & Slovic, P. (2015). The feeling of risk: Implications for risk perception and communication. In Cho. H., Reimer, T., & McComas, K. A: T. (Eds.), *The Sage handbook of risk communication* (pp. 41-54). Thousand Oaks: Sage Publications. https://doi.org/10.4135/9781483387918.n7

Douglas, M. (1990). Risk as forensic resource. *Daedalus*, 119(4), 1–16.

Douglas, M. (1992). *Risk and blame: Essays in cultural theory*. London: Routledge.

Douglas, M., & Wildavsky, A. (1983). *Risk and culture: An essay on the selection of technological and environmental dangers.* Berkeley: University of California Press.

Druckman, J. N., & McDermott, R. (2008). Emotion and the framing of risky choice. *Political behavior*, 30(3), 297-321. https://doi.org/10.1007/s11109-008-9056-y

Dryhurst, S., Schneider, C. R., Kerr, J., Freeman, A. L., Recchia, G., Van Der Bles, A. M., Spiegelhalter, D., & Van Der Linden, S. (2020). Risk perceptions of COVID-19

around the world. *Journal of Risk Research*, 23(7-8), 994-1006. https://doi.org/10.1080/13669877.2020.1758193

Epstein, S. (1994). Integration of the cognitive and the psychodynamic unconscious. *American Psychologist*, 49, 709–724. https://doi.org/10.1037/0003-066X.49.8.709

Evans, J. S. B. (1989). *Bias in Human Reasoning: Causes and Consequences*. Brighton, UK: Erlbaum.

Evans, J. S. B.. (2006). The heuristic-analytic theory of reasoning: extension and evaluation. *Psychon. Bull. Rev.*, 13(3), 378–95. https://doi.org/10.3758/BF03193858

Evans, J. S. B. (2008). Dual-processing accounts of reasoning, judgment, and social cognition. *Annual Review of Psychology*, 59, 255–278.

Evans, J. S. B., & Stanovich, K. E. (2013). Dual-process theories of higher cognition: Advancing the debate. *Perspectives on psychological science*, 8(3), 223-241.

Fagerlin, A., Ubel, P. A., Smith, D. M., & Zikmund-Fisher, B. J. (2007). Making Numbers Matter: Present and Future Research in Risk Communication. *American Journal of Health Behavior*, 31(1), S47–S56.

Ferrer, R. A., Klein, W. M. P., Persoskie, A., Avishai-Yitshak, A., & Sheeran, P. (2016). The Tripartite Model of Risk Perception (TRIRISK): Distinguishing Deliberative, Affective, and Experiential Components of Perceived Risk. *Annals of Behavioral Medicine*, *50*(5), 653–663. https://doi.org/10.1007/s12160-016-9790-z

Finucane, M. L., Alhakami, A., Slovic, P., & Johnson, S. M. (2000a). The affect heuristic in judgments of risks and benefits. *Journal of Behavioral Decision Making*, 13(1), 1–17. https://doi.org/10.1002/(SICI)1099-0771(200001/03)13:1<1::AID-BDM333>3.0.CO;2-S

Fischhoff, B. (1974). *Hindsight: thinking backward*. Eugene, Oregon: Oregon Research Institute.

Fischhoff, B., Slovic, P., Lichtenstein, S., Read, S., & Combs, B. (1978). How safe is safe enough? A psychometric study of attitudes towards technological risks and benefits. *Policy Sciences*, 9(2), 127–152. https://doi.org/10.1007/BF00143739

Gallagher, K. M., and Updegraff, J. A. (2012). Health message framing effects on attitudes, intentions, and behavior: a meta-analytic review. *Ann. Behav. Med.* 43(1), 101–116. https://doi.org/10.1007/s12160-011-9308-7

Ganzach, Y. (2000). Judging Risk and Return of Financial Assets. Organizational Behavior and Human Decision Processes, 83(2), 353–370. https://doi.org/10.1006/obhd.2000.2914

Gilbert, D. T., Pinel, E. C., Wilson, T. D., Blumberg, S. J., & Wheatley, T. P. (1998). Immune neglect: A source of durability bias in affective forecasting. *Journal of Personality and Social Psychology*, 75, 617–638. https://doi.org/10.1037/0022-3514.75.3.617

Hameleers, M. (2021). Prospect theory in times of a pandemic: The effects of gain versus loss framing on risky choices and emotional responses during the 2020 coronavirus outbreak–Evidence from the US and the Netherlands. *Mass Communication and Society*, *24*(4), 479-499. https://doi.org/10.31235/osf.io/7pykj

Hammond KR. 1996. *Human Judgment and Social Policy*. New York: Oxford Univ. Press.

Hansmann, R., Loukopoulos, P., & Scholz, R. W. (2009). Characteristics of effective battery recycling slogans: A Swiss field study. *Resources, Conservation and Recycling*, 53(4), 218– 230. https://doi.org/10.1016/j.resconrec.2008.12.003

Isen, A. M. (2000). Some perspectives on positive affect and self-regulation. *Psychological inquiry*, 11(3), 184-187.

Jones, C., Hine, D. W., & Marks, A. D. (2017). The future is now: Reducing psychological distance to increase public engagement with climate change. *Risk Analysis*, 37(2), 331–341. https://doi.org/10.1111/risa.12601

Kahneman, D. (2003). A perspective on judgment and choice: Mapping bounded rationality. *American Psychologist*, 58(9), 697. https://doi.org/10.1037/0003-066X.58.9.697

Kahneman, D., & Frederick, S. (2002). Representativeness Revisited: Attribute Substitution in Intuitive Judgment. In T. Gilovich, D. Griffin, & D. Kahneman (Eds.), *Heuristics and Biases: The psychology of intuitive judgement* (pp. 103-119). Cambridge: Cambridge University Press.

Kaltenbacher, M., & Drews, S. (2020). An inconvenient joke? A review of humor in climate change communication. *Environmental Communication*, 14(6), 717-729. https://doi.org/10.1080/17524032.2020.1756888

Koehler, J. J., & Macchi, L. (2004). Thinking About Low-Probability Events: An Exemplar-Cuing Theory. *Psychological Science*, 15(8), 540–546. https://doi.org/10.1111/j.0956-7976.2004.00716.x

Langer, E. J. (1975). The illusion of control. *Journal of Personality and Social Psychology*, 32(2), 311. https://doi.org/10.1037/0022-3514.32.2.311

LeDoux, J. (1998). The emotional brain: The mysterious underpinnings of emotional life. New York, USA: Simon and Schuster.

Leiss, W. (1996). Three phases in the evolution of risk communication practice. *The Annals of the American Academy of Political and Social Science*, 545(1), 85-94. https://doi.org/10.1177/0002716296545001010

Leiss, W. (2014). Learning from failures. In J. Arvai & L. Rivers, III (Eds.), *Effective risk communication* (pp. 277–291). New York, USA: Routledge.

Leppin, A., & Aro, A. R. (2009). Risk Perceptions Related to SARS and Avian Influenza: Theoretical Foundations of Current Empirical Research. *International Journal of Behavioral Medicine*, *16*(1), 7–29. https://doi.org/10.1007/s12529-008-9002-8

Lerner, J. S., & Keltner, D. (2000). Beyond valence: Toward a model of emotion-specific influences on judgement and choice. *Cognition & emotion*, 14(4), 473-493. https://doi.org/10.1080/026999300402763

Lichtenstein, S., Slovic, P., Fischhoff, B., Layman, M., and Combs, B. (1978). Judged frequency of lethal events. *Journal of Experimental Psychology: Human Learning and Memory*, 4, 551–578. https://doi.org/10.1037/0278-7393.4.6.551

Loewenstein, G. (1996). Out of control: Visceral influences on behavior. *Organizational behavior and human decision processes*, 65(3), 272-292. https://doi.org/10.1006/obhd.1996.0028

Loewenstein, G., & Lerner, J. (2003). The role of emotion in decision making. In R. J. Davidson , H. H. Goldsmith , & K. R. Scherer (Eds.), *The handbook of affective science*. Oxford, England: Oxford University Press.

Loewenstein, G. F., Weber, E. U., Hsee, C. K., & Welch, N. (2001). Risk as feelings. *Psychological bulletin*, 127(2), 267. https://doi.org/10.1037/0033-2909.127.2.267

Lyon, D., & Slovic, P. (1976). Dominance of accuracy information and neglect of base rates in probability estimation. *Acta Psychologica*, *40*(4), 287-298. https://doi.org/10.1016/0001-6918(76)90032-9

Mamadouh, V. (1999). Grid-group cultural theory: An introduction. *GeoJournal*, 47(3), 395–409. https://doi.org/10.1023/A:1007024008646

Marcus, G. E., Neuman, W. R., & MacKuen, M. (2000). Affective intelligence and political judgment. Chicago, USA: University of Chicago Press.

MacGregor, D. G., Slovic, P., Dreman, D., & Berry, M. (2000). Imagery, Affect, and Financial Judgment. Journal of Psychology and Financial Markets, 1(2), 104–110. https://doi.org/10.1207/S15327760JPFM0102_2

Mikolajczak, M., Nelis, D., Hansenne, M., & Quoidbach, J. (2008). If you can regulate sadness, you can probably regulate shame: Associations between trait emotional intelligence, emotion regulation and coping efficiency across discrete emotions. *Personality and Individual Differences*, 44, 1356–1368. https://doi.org/10.1016/j.paid.2007.12.004

Nabi, R. L., Walter, N., Oshidary, N., Endacott, C. G., Love-Nichols, J., Lew, Z. J., & Aune, A. (2020). Can emotions capture the elusive gain-loss framing effect? A meta-analysis. *Communication Research*, 47(8), 1107-1130. https://doi.org/10.1177/0093650219861256

Newell, B. R., Mitchell, C. J., & Hayes, B. K. (2008). Getting scarred and winning lotteries: Effects of exemplar cuing and statistical format on imagining low-probability events. *Journal of Behavioral Decision Making*, 21(3), 317–335. https://doi.org/10.1002/bdm.584

O'Keefe, D. J., and Jensen, J. D. (2007). The relative persuasiveness of gain-framed loss-framed messages for encouraging disease prevention behaviors: A meta-analytic review. *J. Health Communication*, 12(7), 623–644. https://doi.org/10.1080/10810730701615198

O'Keefe, D. J., and Jensen, J. D. (2009). The relative persuasiveness of gain-framed and loss-framed messages for encouraging disease detection behaviors: A meta-analytic review. *Journal of. Communication*, 59(2), 296–316. . https://doi.org/10.1111/j.1460-2466.2009.01417.x

O'Keefe, D. J., and Nan, X. (2012). The relative persuasiveness of gain- and loss-framed messages for promoting vaccination: A meta-analytic review. *Health Communication*, 27(8), 776–783. https://doi.org/10.1080/10410236.2011.640974

Oehler, A., & Wedlich, F. (2018). The Relationship of Extraversion and Neuroticism With Risk Attitude, Risk Perception and Return Expectations (SSRN Scholarly Paper ID 3308503). Social Science Research Network. https://papers.ssrn.com/abstract=3308503

Osman, M., Heath, A. J., & Löfstedt, R. (2018). The problems of increasing transparency on uncertainty. *Public Understanding of Science*, 27(2), 131–138. https://doi.org/10.1177/0963662517711058

Peña-Sarrionandia, A., Mikolajack, M., & Gross, J. J. (2015). Integrating emotion regulation and emotional intelligence traditions: A meta-analysis. *Frontiers in Psychology*, 6, 1–22. https://doi.org/10.3389/fpsyg.2015.00160

Peters, E. (2006). The functions of affect in the construction of preferences. In Lichtenstein, S., Slovic, P. (Eds.), *The construction of preference* (pp. 454-463). New York: Cambridge University Press.

Peters, E., Slovic, P., & Gregory, R. (2003). The role of affect in the WTA/WTP disparity. *Journal of Behavioral Decision Making*, 16(4), 309-330. https://doi.org/10.1002/bdm.448

Peters, E., Slovic, P., & Hibbard, J. (2004). Evaluability manipulations influence the construction of choices among health plans. *Decision Research*, (24).

Peters, E., Västfjäll, D., Gärling, T., & Slovic, P. (2006a). Affect and decision making: A "hot" topic. *Journal of behavioral decision making*, 19(2), 79-85. https://doi.org/10.1002/bdm.528

Petrides, K. V., Pita, R., & Kokkinaki, F. (2007). The location of trait emotional intelligence

in personality factor space. *British Journal of Psychology*, 98, 273–289. https://doi.org/10.1348/000712606X120618

Petrides, K. V., Sangareau, Y., Furnham, A., & Frederickson, N. (2006). Trait emotional intelligence and children's peer relations at school. *Social Development*, 15(3), 537–547. https://doi.org/10.1111/j.1467-9507.2006.00355.x

Pidgeon, N. (2020). Engaging publics about environmental and technology risks: Frames, values and deliberation. *Journal of Risk Research*, 24(1), 28-46. https://doi.org/10.1080/13669877.2020.1749118

Prentice-Dunn, S., & Rogers, R. W. (1986). Protection motivation theory and preventive health: Beyond the health belief model. *Health education research*, *1*(3), 153-161. https://doi.org/10.1093/her/1.3.153

Rogers, R. W. (1975). A protection motivation theory of fear appeals and attitude change1. The journal of psychology, 91(1), 93-114. https://doi.org/10.1177/109019817400200405

Purchase, I. F. H., & Slovic, P. (1999). Quantitative risk assessment breeds fear. *Human and Ecological Risk Assessment: An International Journal*, 5(3), 445–453. https://doi.org/10.1080/10807039.1999.10518869

Rickard, L. N. (2021). Pragmatic and (or) constitutive? On the foundations of contemporary risk communication research. *Risk analysis*, 41(3), 466-479. https://doi.org/10.1111/risa.13415

Robinson, M. D., & Clore, G. L. (2002). Belief and feeling: evidence for an accessibility model of emotional self-report. *Psychological bulletin*, 128(6), 934. https://doi.org/10.1037/0033-2909.128.6.934

Rohrmann, B., & Renn, O. (2000). Risk perception research. In *Cross-cultural risk perception: State and challenges* (pp. 11– 53). Boston: Springer.

Rothman, A. J., and Salovey, P. (1997). Shaping perceptions to motivate healthy behavior: The role of message framing. *Psychol. Bull.,* 121(1), 3–19.

Rubaltelli, E., Agnoli, S., & Franchin, L. (2016). Sensitivity to affective information and investors' evaluation of past performance: An eye-tracking study. *Journal of Behavioral Decision Making*, 29(2–3), 295–306. https://doi.org/10.1002/bdm.1885

Rubaltelli, E., Pasini, G., Rumiati, R., Olsen, R. A., & Slovic, P. (2010). The Influence of Affective Reactions on Investment Decisions. Journal of Behavioral Finance, 11(3), 168–176. https://doi.org/10.1080/15427560.2010.507409

Schkade, D. A., & Kahneman, D. (1998). Does living in California make people happy? A focusing illusion in judgments of life satisfaction. *Psychological science*, 9(5), 340-346. https://doi.org/10.1111/1467-9280.00066

Schwarz, N., & Clore, G. L. (1983). Mood, misattribution, and judgments of well-being: informative and directive functions of affective states. *Journal of personality and social psychology*, 45(3), 513. https://doi.org/10.1037/0022-3514.45.3.513

Sevdalis, N., Petrides, K. V., & Harvey, N. (2007). Trait emotional intelligence and decision-related emotions. *Personality and Individual Differences*, 42(7), 1347–1358. https://doi.org/10.1016/j.paid.2006.10.012

Sharpe, W. F. (1964). Capital Asset Prices: A Theory of Market Equilibrium Under Conditions of Risk. *The Journal of Finance*, *19*(3), 425–442. https://doi.org/10.1111/j.1540-6261.1964.tb02865.x

Shefrin, H. (2001). Do Investors Expect Higher Returns From Safer Stocks Than From Riskier Stocks? Journal of Psychology and Financial Markets, 2(4), 176–181. https://doi.org/10.1207/S15327760JPFM0204_1

Sjöberg, L. (2000). The methodology of risk perception research. *Quality and Quantity*, 34(4), 407–418. https://doi.org/10.1057/palgrave.rm.8250038

Skurka, C., Niederdeppe, J., Romero-Canyas, R., & Acup, D. (2018). Pathways of influence in emotional appeals: Benefits and tradeoffs of using fear or humor to promote climate change-related intentions and risk perceptions. *Journal of Communication*, 68(1), 169–193. https://doi.org/10.1093/joc/jqx008

Sloman, S. A. (1996). The empirical case for two systems of reasoning. *Psychol. Bull.*, 119(1), 3–22. https://doi.org/10.1037/0033-2909.119.1.3

Slovic, P. (1999). Trust, emotion, sex, politics, and science: Surveying the risk-assessment battlefield. *Risk Analysis*, 19(4), 689–701. https://doi.org/10.1023/A:1007041821623

Slovic, P. E. (2000). *The perception of risk.* London: Earthscan Publications.

Slovic, P. (2010). *The feeling of risk: New perspectives on risk perception*. Earthscan.

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: An International Journal*, 24(2), 311– 322. https://doi.org/10.1111/j.0272-4332.2004.00433.x

Slovic, P., Finucane, M. L., Peters, E., & MacGregor, D. G. (2007). The affect heuristic. *European journal of operational research*, 177(3), 1333-1352. https://doi.org/10.1016/j.ejor.2005.04.006

Slovic, P., Fischhoff, B., & Lichtenstein, S. (1981). Rating the risks. In *Risk/benefit analysis in water resources planning and management* (pp. 193–217). Boston: Springer.

Slovic, P., Fischhoff, B., & Lichtenstein, S. (1985). Characterizing perceived risk. In *Perilous progress: Managing the hazards of technology* (pp. 91–125). Boulder: Westview.

Slovic, P., Flynn, J. H., & Layman, M. (1991). Perceived risk, trust, and the politics of nuclear waste. *Science*, 254(5038), 1603–1607. https://doi.org/10.1126/science.254.5038.160

Slovic, P., Monahan, J., & MacGregor, D. G. (2000). Violence Risk Assessment and Risk Communication: The Effects of Using Actual Cases, Providing Instruction, and Employing Probability Versus Frequency Formats. *Law and Human Behavior*, 24(3), 271–296. https://doi.org/10.1023/A:1005595519944

Spence, A., Poortinga, W., & Pidgeon, N. (2012). The psychological distance of climate change. *Risk Analysis: An International Journal*, 32(6), 957–972. https://doi.org/10.1111/j.1539-6924.2011.01695.x

Statman, M., Fisher, K. L., & Anginer, D. (2008). Affect in a Behavioral Asset-Pricing Model. Financial Analysts Journal, 64(2), 20–29. https://doi.org/10.2469/faj.v64.n2.8

Stanovich K. E., (1999). *Who is Rational? Studies of Individual Differences in Reasoning*. Mahwah: Psychology Press. https://doi.org/10.4324/9781410603432

Stanovich, K. E., & West, R. F. (2000). Individual differences in reasoning: Implications for the rationality debate? *Behavioral and Brain Sciences*, 23, 645–726. https://doi.org/10.1017/S0140525X00003435

Sunstein, C. R. (2007). On the divergent American reactions to terrorism and climate change. *Columbia Law Review*, 107, 503.

Thurstone, L. L. (1928). Attitudes can be measured. *American Journal of Sociology*, 33(4), 529–554.

Timmermans, D., Ockhuysen-Vermey, C. W., & Henneman, L. (2008). Presenting health risk information in different formats: The effect on participants' cognitive and emotional evaluation and decisions. *Patient Education and Counseling*, 73(3), 443–447. https://doi.org/10.1016/j.pec.2008.07.013

Timmermans, D., & Oudhoff, J. (2011). Different Formats for the Communication of Risks: Verbal, Numerical, and Graphical Formats. In *Wiley Encyclopedia of Operations Research and Management Science*. American Cancer Society: https://doi.org/10.1002/9780470400531.eorms0954

Tversky, A., & Kahneman, D. (1971). Belief in the law of small numbers. *Psychological bulletin*, 76(2), 105. https://doi.org/10.1037/h0031322

Tversky, A., & Kahneman, D. (1973). Availability: A heuristic for judging frequency and probability. *Cognitive Psychology*, 5(2), 207–232. https://doi.org/10.1016/0010-0285(73)90033-9

UNHCR. (n.d.). Operational portal: Refugee situations. Retrieved from https://data2.unhcr.org/en/situations/mediterranean

Van Bavel, J. J., Baicker, K., Boggio, P. S., Capraro, V., Cichocka, A., Cikara, M., Crockett, M. J., Crum, A. J., Douglas, K. M., Druckman, J. N., Drury, J., Dube, O., Ellemers, N., FInkel, E: J., Fowler, J. H., Gelfand, M., Han, S., Haslam, S. A., Jetten, J., Kitayama, S., Mobbs, D., Napper, L. E., Packer, D: J., Pennycook, G., Peters, E., Petty, R. E., Rand, D. G., Reicher, S. D., Schnall, S., Shariff, A., Skitka, L. J., Smith, S. S., Sunstein, C. R., Tabri, N., Tucker, J. A., van der Linden, S., van Lange, P., Weeden, K. A., Wohl, M. J. A., Zaki, J., Zion, S. R., & Willer, R. (2020). Using Social and behavioural science to support COVID-19 pandemic response. *Nature human behaviour*, 4, 460-471. https://doi.org/10.1038/s41562-020-0884-z

Västfjäll, D., & Slovic, P. (2013). Cognition and emotion in judgment and decision making. In Robinson, M. D., Watkins, E. R., Harmon-Jones, E. (Eds.). *Handbook of Cognition and Emotion* (pp. 252-271). New York: Guilford Press.

Visschers, V. H. M., Meertens, R. M., Passchier, W. W. F., & De Vries, N. N. K. (2009). Probability Information in Risk Communication: A Review of the Research Literature. *Risk Analysis*, 29(2), 267–287. https://doi.org/10.1111/j.1539-6924.2008.01137.x

Wardman, J. K. (2008). The constitution of risk communication in advanced liberal societies. *Risk Analysis: An International Journal*, 28(6), 1619–1637. https://doi.org/10.1111/j.1539-6924.2008.01108.x

Weber, E. U., & Johnson, E. J. (2009). Mindful judgment and decision making. *Annual review of psychology*, 60, 53-85.

Weinstein, N. D. (1980). Unrealistic optimism about future life events. *Journal of personality and social psychology*, 39(5), 806. https://doi.org/10.1037/0022-3514.39.5.806

Weinstein, N. D., & Klein, W. M. (1996). Unrealistic optimism: Present and future. *Journal of Social and Clinical Psychology*, 15(1), 1–8.

Wilson, T. D., & Gilbert, D. T. (2003). Affective forecasting. *Advances in experimental social psychology*, 35, 345-411. https://doi.org/10.1016/S0065-2601(03)01006-2

Wilson, T. D., Lisle, D. J., Schooler, J. W., Hodges, S. D., Klaaren, K. J., & LaFleur, S. J. (1993). Introspecting about reasons can reduce post-choice satisfaction. *Personality and Social Psychology Bulletin*, 19(3), 331-339. https://doi.org/10.1177/0146167293193010

Wilson, T. D., & Schooler, J. W. (1991). Thinking too much: introspection can reduce the quality of preferences and decisions. *Journal of personality and social psychology*, 60(2), 181. https://doi.org/10.1037/0022-3514.60.2.181

Wilson, R. S., Zwickle, A., & Walpole, H. (2019). Developing a broadly applicable measure of risk perception. *Risk Analysis*, 39(4), 777–791. https://doi.org/10.1111/risa.13207

Zajonc, R. B. (1980). Feeling and thinking: Preferences need no inferences. *American psychologist*, 35(2), 151. https://doi.org/10.1037/0003-066X.35.2.151

Zajonc, R. B. (1984). The interaction of affect and cognition. *Approaches to emotion*, 239, 246.

Zipkin, D. A., Umscheid, C. A., Keating, N. L., Allen, E., Aung, K., Beyth, R., Kaatz, S., Mann, D. M., Sussman, J. B., Korenstein, D., Schardt, C., Nagi, A., Sloane, R., & Feldstein, D. A. (2014). Evidence-Based Risk Communication. *Annals of Internal Medicine*, 161(4), 270–280. https://doi.org/10.7326/M14-0295

Chapter 2[3]

Worry, Perceived Threat and Media Communication as Predictors of Self-Protective Behaviors During the COVID-19 Outbreak in Europe.

Abstract: Efforts to contain the spread of the coronavirus emphasize the central role of citizens' compliance with self-protective behaviors. Understanding the processes underlying the decision to self-protect is, therefore, essential for effective risk communication during the COVID-19 pandemic. In the present study, we investigate the determinants of perceived threat and engagement in self-protective measures in the United Kingdom, Italy, and Austria during the first wave of the pandemic. The type of disease (coronavirus versus seasonal flu) and the type of numerical information regarding the disease (number of recovered versus number of dead) were manipulated. Participants' cognitive and emotional risk assessment as well as self-reported engagement in protective behaviors were measured. Results show that worry was the best predictor of perceived threat in all countries. Moreover, a path analysis revealed that worry and perceived threat serially mediated the effect of type of disease on engagement in self-protective behaviors. The framing manipulation did not significantly impact behavior but had a direct effect on worry and an indirect effect on perceived threat. These results are in line with theoretical accounts that identify emotions as a central determinant for risk perception. Moreover, our findings also suggest that effective risk communication during the COVID-19 pandemic should not stress comparisons to other viral diseases, as this can ultimately reduce self-protective behaviors.

Keywords: risk perceptions, precautionary behaviors, coronavirus outbreak, pandemic, COVID-19, framing, emotions

[3] A version of this chapter has been published in the Frontiers in Psychology Research Topic "Coronavirus Disease (COVID-19): Psychological Reactions to the Pandemic", and should be cited as Vacondio, M., Priolo, G., Dickert, S., & Bonini, N. (2021). Worry, Perceived Threat and Media Communication as Predictors of Self-Protective Behaviors During the COVID-19 Outbreak in Europe. Frontiers in psychology, 12, 231. https://doi.org/10.3389/fpsyg.2021.577992. The paper is distributed as an open access article under the Creative Commons Attribution License. This study is also reported in Giulia Priolo's dissertation thesis titled "(Don't) follow your gut: How affective reactions (mis)guide decision-making under uncertainty. Insights from the Iowa Gambling Task and the COVID-19 pandemic", discussed on the 23rd of February 2022 at the University of Trento. The study has been conducted in collaboration with Prof. Nicolao Bonini (Department of Economics and Management, University of Trento), Dott. Giulia Priolo (Department of Psychology and Cognitive Sciences, University of Trento, Rovereto, Italy) and Assoc. Prof. Stephan Dickert (Department of Marketing, School of Business and Management, Queen Mary University of London). Dott. Vacondio and Dott. Priolo have contributed equally to this work and share the first authorship.

2.1 Introduction

At the end of 2019, a new coronavirus, known as SARS-CoV-2, rapidly spread from Wuhan, China to the rest of the world, causing the most significant health emergency in recent history. In the absence of a vaccine and effective cures, governments had to rely on non-pharmaceutical (i.e., behavioral) interventions to "flatten the curve" of infections.

Unprecedented public policies (e.g., nationwide lockdowns, travel restriction, social distancing) and preventive behaviors (e.g., wearing a face mask, frequent handwashing with soap) have been stressed by the World Health Organization, (2020) and were implemented to varying degrees by governments to combat the pandemic. However, the effectiveness of these measures is higher when policies and behaviors are adopted in combination, are implemented promptly, and when citizens' adherence is nearly universal (Eikenberry et al., 2020; Hsiang et al., 2020; Stutt et al., 2020).

Understanding the drivers of preventive behaviors is, therefore, paramount to boost compliance and increase the effectiveness of containment measures through adequate health campaigns. The general aim of our study is to investigate how emotional reactions and perceived threat influence engagement in self-protective behaviors during the COVID-19 pandemic and if these factors can be affected by media communication content (e.g., information about the type of the disease and the number of affected people). Our study was inspired by the media communication during the early stages of the pandemic, which often highlighted the comparison of the coronavirus to the seasonal flu and was selective in which numbers were presented to describe the pandemic (e.g., initially only the number of affected as well as the number of dead were presented, but not the number of recovered).

2.1.1 Perceived threat and preventive behaviors

The literature in the health-risk domain considers the subjective perception of a threat as a major driver of people's preventive actions. Models such as the Health Beliefs Model (HBM; Hochbaum 1952; Rosenstock, 1960, 1974) and Protection Motivation Theory (PMT; Prentice-Dunn & Rogers, 1986; Rogers & Prentice-Dunn, 1997; Rogers 1975) include threat perception as a key factor in motivating people towards preventive behaviors. Specifically, the perception of a threat is positively related to people's intention to undertake protective actions (Brewer et al., 2007; Sheeran et al., 2014). Studies on previous infectious disease outbreaks such as SARS, swine flu, and MERS show a direct association between perceived threat and adherence to mitigating measures (de Zwart et al., 2009; Leppin & Aro, 2009; Kim & Song, 2017; Rubin et al., 2009). Following these theoretical approaches and previous studies, in our

research, we define "perceived threat" as the multiplication of two dimensions: the perceived likelihood of contracting a disease (i.e., vulnerability to a hazard) and the perceived severity of it (i.e., perceived negative consequences of a hazard). Consistent with the literature, we expect to find that higher perceived threat will be associated with higher engagement in self-protective behaviors (H1).

2.1.2 Emotional reactions

A possible limitation of the HBM and PMT models is that they do not adequately account for the role of emotions in perceptions of threat and risk judgments (Leppin & Aro, 2009). This underestimation of affective reactions can explain the modest associations found between perceived threat and behaviors (Leppin & Aro, 2009; Sheeran et. al., 2014). According to frameworks such as the dual-process models (Evans, 2008; Kahneman and Frederick, 2002) and the "risk as feelings" approach (Slovic et al., 2004), feelings and emotions can have a predominant role in guiding information processing underlying the perception of risk and benefits (Finucane et al., 2000; Lerner et al., 2003; Lerner & Keltner, 2000; Loewenstein et al., 2001; Peters et al., 2006; Sjöberg, 2007; Slovic et al., 2002, 2004; Slovic & Peters, 2006; Vacondio & Dickert, 2020). According to this view, emotional reactions come prior to and can direct risk judgments and behavioral reactions.

The role of emotions could be even more prevalent in a highly threatening situation, such as the coronavirus pandemic, due to the lack of clear and precise information (Leppin & Aro, 2009). Indeed, studies on previous pandemics have shown that negative emotions (e.g., worry, anxiety) are correlated with preventive behaviors (Brug et al., 2004; Goodwin et al., 2011; Rubin et al., 2009; Setbon & Raude, 2010). Based on these findings and in line with the role of emotions in the risk as feelings framework we expect that higher negative emotional reactions (i.e., worry) will be associated with higher perceived threat (H2). We also hypothesize that higher negative emotional reactions will be associated with higher engagement in self-protective behaviors (H3).

2.1.3 Type of threat

Emotional reactions and threat perception can be amplified or attenuated by specific characteristics of the hazard itself and how it is communicated. Characteristics such as perceived dreadfulness, controllability, and familiarity are among the most relevant ones

(Fischhoff, et al., 1978). Moreover, the coverage and the framing of the hazard in the media can influence these characteristics, by making the threat and specific facets of it more salient and available in people's minds (Tversky & Kahneman, 1973). For example, during the initial stage of the pandemic, the media often compared the coronavirus to the seasonal flu virus. However, while the two viruses share a similar symptomatology and behavioral interventions to reduce their spread (e.g., isolation, washing hands, distancing), they differ in other regards both from the medical and the psychological perception of the disease (Haas, 2020; Cowling, et al., 2020). Medically, the lack of immunity and higher death rates in some subpopulations makes the coronavirus potentially more dangerous than the seasonal flu. Psychologically, at least at the beginning of the pandemic, the seasonal flu represented a more familiar and less dreadful hazard than the coronavirus.

Research showed that higher familiarity may produce an undervaluation of the risk because of the normalization of its presence in people's life. Similarly, higher dread might cause an overvaluation of a threat by eliciting instinctive and negative emotional reactions (Slovic, 2000). Research on the availability heuristic suggests that heavy media coverage of a particular threat, such as the one related to the coronavirus, can make people overestimate the probability of death and increase the perception of risk of that specific hazard (Cowling, et al., 2020; Lichtenstein et al., 1978; Tversky & Kahneman, 1973).

In sum, we expect to find that participants in our study will perceive higher worry (H4), higher perceived threat (H5), and will report higher engagement in self-protective behaviors (H6) when faced with information about the coronavirus (vs. seasonal flu). Moreover, we expect that the effect of the type of viral disease on engagement in self-protective behaviors will be serially mediated by both worry and perceived threat in line with the risk as feelings framework (H7).

2.1.4 Type of numerical frame

By selecting and promoting (i.e., framing) some information rather than all information, the media can make some aspects of a story more or less salient and, in turn, bias people's assessment of the threat (Entman, 1993). During the first stages of the coronavirus outbreak, for example, the media focused more on the information regarding the number of deaths (negative or loss frame) than the numbers of those who recovered (positive or gain frame; Hameleers, 2020).

Research in the health domain suggested that gain and loss framing can differently influence people's decisions and behaviors, with gain frames being more effective in the context of preventive behaviors and loss frames being more effective in the context of health-promoting (e.g., screening) actions (Rothman & Salovey, 1997). However, reviews on different types of health behaviors are inconsistent in their findings and report little or contradictory effects of the two types of framing (Akl et al., 2011; Gallagher & Updegraff, 2012; O'Keefe & Jensen, 2007, 2009; O'Keefe & Nan, 2012). These inconsistencies extend also to research on the actual pandemic in which negative framing was found to be more effective in promoting action (Van Bavel et al., 2020), while other studies reported the opposite effect finding positive framing to be associated with higher support for strict preventive measures such as the lockdown (Hameleers, 2020).

However, in judgment and decision-making literature, evidence has been found regarding the ability of gain and loss frames to affect people's emotional reactions. Gain frames generally elicit more positive emotional reactions, while loss frames elicit negative ones (Druckman & McDermott, 2008; Nabi et al., 2020; Peters et al., 2006). A recent meta-analysis (Nabi et al., 2020) highlighted also that emotional reactions mediate the relationship between the framing of a message and behavioral effects. This interpretation is in line with studies on the coronavirus pandemic investigating emotional reactions to positive and negative frames, including specific emotions such as frustration, fear, and powerlessness (Hameleers, 2020).

In the present study, we expect that providing negative information (i.e., dead) versus positive numerical information (i.e., recovered) will lead participants to report higher levels of worry (H8), perceived threat (H9), and engagement in self-protective behaviors (H10). We also hypothesize, in line with the risk as feelings framework, that worry, and perceived threat will mediate the effect of the frame used to report information on the engagement in self-protective behaviors (H11).

However, it is important to note that previous research on the coronavirus pandemic tested mainly equivalency frames (Hameleers, 2020). An equivalency frame consists of offering the same information with different presentation and organization formats following the example of the first studies on framing from Tversky and Kahneman (1981). In their study, participants read one of two numerically identical scenarios regarding possible programs aiming to combat an Asian disease, presenting either the number of people who could die or the number of who could be saved. The different framing elicited a preference reversal and a different attitude towards risk. In our paper instead, we choose to test a different type of framing by reporting the real numbers of deaths and recovered from two types of viral disease, therefore

using a frame that is best identified in the group of "emphasis frames" (Entman, 1993). Emphasis frames do not present equivalent numerical information but focus on a different facet of events making some information more salient than others.

We believe that this type of framing will allow us to better mimic how the media report the actual numbers of dead and recovered in the early stage of the pandemic, thus providing a more realistic approach.

Lastly, we also assessed several trait individual differences (subjective knowledge, trait emotional intelligence, conspiracy beliefs, trust in politics, media, and science) that have previously been linked to preventive actions in health-related decisions and studies on previous pandemics. Those individual differences were included with an exploratory purpose and are presented in the Appendix 1 (see Section 1 and Section 3).

2.2 Methods

2.2.1 Participants

A total of 731 undergraduate students from Italy, Austria, and the United Kingdom participated in the study. Participants were excluded from the analysis if they (1) took either more or less than three standard deviations from the average time to complete the survey (N=12), (2) did not fully complete the study (N=110), or (3) failed the manipulation check (N=62). Hence, the total sample comprised of 547 participants (Table 1). Participants were recruited from a subject pool at the University of Trento (Italy) and the Behavioral Lab at Queen Mary University of London (United Kingdom), while the Austrian sample was recruited as part of a large undergraduate lecture at the University of Klagenfurt (Austria). They all received credits for their participation in the study. Ethical principles were respected following the Declaration of Helsinki and all participants provided their informed consent.

Table 1. Sample composition by country.

	Italy	Austria	UK
Female	58.4%	81.5%	68.8%
Mean age	M_{age}=25.9 yrs, *SD*=8.47	M_{age}=25.5 yrs, *SD*=8.40	M_{age}=23.4 yrs, *SD*=5.20
Condition A	44 (26.5%)	56 (32.4%)	53 (25.5%)
Condition B	46 (27.7%)	48 (27.7%)	68 (32.7%)
Condition C	39 (23.5%)	38 (22%)	41 (19.7%)
Condition D	37 (22.3%)	31 (17.9%)	46 (22.1%)

Note. Italy *N*=166, Austria *N*=173, UK *N*=208. Condition A; coronavirus-positive frame; Condition B: coronavirus-negative frame; Condition C: seasonal flu-positive frame; Condition D: seasonal flu-negative frame.

2.2.2 Design & Procedure

Data collection took place online from 11th to 18th of April, 2020. At that time, the three countries were all in a nationwide lockdown, even though it was implemented at different times and the rate of infections and mortality varied across the countries.

Participants in the three countries received an invitation via email to partake in a study about risk perception of diseases and public policies and were randomly assigned to one of the experimental conditions, resulting in a 2 (Viral Disease: coronavirus vs seasonal flu) x 2 (Frame: positive vs negative) x 3 (Country) between-subject design.

After reading the informed consent form and agreeing to take part, participants read a short text created to simulate the information provided by the media regarding one of the two viral diseases (coronavirus or seasonal flu). The term "coronavirus" was used instead of "COVID-19", as it was prevalently used in the media at that time. In the positive frame condition, the number of people recovered from the viral disease was presented alongside the total number of people infected between October and March. The number of dead was used in the negative frame condition.

Participants' emotional reactions and perceived threat of the viral disease, the public policies implemented by their national government, and the way the national media

communicates about the disease were assessed. Perceived usefulness and dangerousness of the public policies and media communication were also assessed. Moreover, participants were asked about how often they engage in self-protective behaviors (e.g., washing hands, coughing and sneezing in a tissue or flexed elbow, etc.). Participants in the coronavirus condition received information and answered questions referring only to COVID-19, while in the seasonal flu condition they received information and answered questions referring only to the seasonal flu. A manipulation check was also introduced before the demographic questions to confirm that participants had paid attention during the survey. The survey took around 20 minutes to complete.

The study design, manipulations, sample size, emotional reactions, and threat perception as main dependent variables were pre-registered on AsPredicted (https://aspredicted.org/blind.php?x=zp4j2c). The texts for each condition and the items in English, German, and Italian are in the Appendix 1 (see Section 2, Table A1 and Table A2). The datasets for the three countries are available on the OSF platform and are accessible through the following link: https://osf.io/uwv6r/?view_only=855c79250de8442b964f1bbd2f41626b

2.2.3 Materials

Emotional reactions. Participants' emotional reactions were assessed by asking how much they felt worried about the (1) viral disease, (2) public policies, and (3) media communication on a scale from 0 (Not worried) to 10 (Very worried). A new variable called "Worry" was created by combining the three items (Cronbach's $\alpha_{UK,\ AT,IT} > .765$).

Perceived threat. To investigate participants' perceived threat of the viral disease, the subjectively perceived likelihood of infection and perceived severity of the disease were assessed on a scale from 1 (Extremely low/Not dangerous at all) to 7 (Extremely high/Very dangerous). In line with studies on previous pandemics and the Protection Motivation Theory, we created a variable called "Perceived Threat" by multiplying the perceived severity of the disease by the subjectively perceived likelihood of infection (Chang, Xu, & Song, 2016; Leppin, & Aro, 2009; de Zwart et al., 2009). To normalize the distribution of the new variable we performed a square root transformation. Thus, the new variable "Perceived Threat" resulted in a scale from 1 (Low) to 7 (High). Perceived dangerousness and perceived usefulness of the public policies and the media communication was also assessed (1) in general, (2) for the national economy, (3) for the national social-emotional climate, and (4)

for individuals' physical health using a scale from 1 (Not dangerous/useful at all) to 7 (Very dangerous/useful). For each variable, one scale that included the four relevant items was created (Danger public policies: Cronbach's $\alpha_{UK,AT,IT}$ >.791; Danger media communication: Cronbach's $\alpha_{UK,AT,IT}$ > .886; Usefulness public policies: Cronbach's $\alpha_{UK,AT,IT}$ > .697; Usefulness media communication: Cronbach's $\alpha_{UK,AT,IT}$ > .840).

Behavior. Participants were asked to state how often they engage in protective behaviors from 1 (Never) to 7 (Always). Furthermore, participants' perceived capability and control over the self-protective behaviors was assessed adapting two items from the Theory of Planned Behavior-TPB Questionnaire from Ajzen (2006).

Manipulation check. To ensure participants paid attention while completing the survey, they were asked to indicate between four options ("Coronavirus"; "Seasonal flu"; "Measles"; "None of the options") which viral disease they were asked to give their opinion about.

2.3 Results

To test the effect of the manipulations (i.e., Viral Disease, Frame, and Country) on the three main variables (i.e., Behavior, Worry, and Perceived Threat) we conducted a MANOVA. Subsequently, we ran a linear regression to test the predictors of perceived threat for each country. Finally, to investigate our hypotheses concerning the relationship between our main dependent variables and the effect of the manipulations, we conducted a path analysis both for the total sample and for each country individually. Post-hoc power analyses indicated that we reach a power of at least .992 for all our tests.

2.3.1 Effect of Frame, Viral disease, and Country

A 2 (Viral Disease: coronavirus vs seasonal flu) x 2 (Frame: positive vs negative) x 3 (Country) MANOVA (Table 2) showed that Behavior, Worry, and Perceived Threat varied significantly depending on Viral Disease, Frame, and Country.

Viral disease. Participants in the coronavirus (vs seasonal flu) condition indicated higher Perceived Threat, Worry, and Behavior. These findings confirm part of our initial hypotheses (H8, H4, H5, H6) while others were rejected (H9, H10; see Table 6 for a summary of the hypotheses).

Framing. Results illustrate that participants were significantly more worried in the negative (versus positive) frame condition. However, the type of frame did not affect participants' Perceived Threat or Behavior.

Country. Participants reported significantly higher Worry and Perceived Threat in the United Kingdom sample compared to the Italian and Austrian sample (see Table A4 for the main effect of "Country" on the complete list of our dependent variables). Lastly, the MANOVA revealed a two-way interaction effect (Country x Viral Disease) on Worry (see Appendix 1 Table A5 for means and standard deviations). We performed a follow-up ANOVA to test the significance of the single comparisons. A Scheffè post-hoc test (De Mendiburu, 2020) showed that Italy reported significantly higher Worry that Austria in the coronavirus condition, but the two countries did not differ in the seasonal flu condition. The United Kingdom consistently reported the highest Worry in both Viral Disease conditions (see Table 3 and Appendix 1 Table A6 for significance and mean differences).

Table 2. MANOVA of the effect of the manipulations on the three main dependent variables.

Source	Dependent variables	*df*	F	*p*	η_p^2
Viral Disease	Behavior	1	18.74	<.001	.034
	Worry	1	387.32	<.001	.421
	Perceived threat	1	115.54	<.001	.178
	Wilks' Lambda = .57, F(3,532) = 132.45, p < .001				
Frame	Behavior	1	.41	.521	.001
	Worry	1	8.48	.004	.016
	Perceived threat	1	2.01	.157	.004
	Wilks' Lambda = .98, F(3,532) = 2.89, p = .035				
Country	Behavior	2	1.40	.247	.008
	Worry	2	23.93	<.001	.117
	Perceived threat	2	11.64	<.001	.042
	Wilks' Lambda = .87, F(6,1064) = 12.81, p <.001				
Viral Disease x Country	Behavior	2	1.55	.213	.006
	Worry	2	5.36	.005	.020
	Perceived threat	2	1.92	.147	.007
	Wilks' Lambda = .97, F(6,1064) = 2.68, p = .014				
Viral Disease x Frame	Behavior	1	2.24	.140	.004
	Worry	1	.25	.616	.001
	Perceived threat	1	.08	.783	<.001
	Wilks' Lambda = .99, F(3,532) = .80, p = .512				
Frame x Country	Behavior	2	.02	.977	<.001
	Worry	2	1.00	.368	.004
	Perceived threat	2	1.52	.220	.006
	Wilks' Lambda = .99, F(6,1064) = .85, p = .533				
Viral Disease x Frame Country	Behavior	2	1.73	.178	.006
	Worry	2	.54	.582	.002
	Perceived threat	2	.38	.686	.001
	Wilks' Lambda = .99, F(6,1064) = 1.00, p = .422				

Note. Viral Disease Frame were coded orthogonally (Viral Disease: .5 = coronavirus, -.5 = seasonal flu; Frame: .5 = positive frame, -.5 = negative frame)

Table 3. Analysis of the interaction of Country and Viral Disease on Worry

UK		Austria		Italy		F	*p*
Coronavirus	Seasonal flu	Coronavirus	Seasonal flu	Coronavirus	Seasonal flu		
5.27_a	2.82_c	3.87_b	2.11_{cd}	4.39_b	1.68_d	5.36	.005

Note. Means with different subscript differ at the p=.05 level by Scheffè test.

2.3.2 Predictors of Perceived Threat for each Country

We performed a linear regression (Table 4) to assess, for each Country, the role of Worry, Perceived Dangerousness and Usefulness of public policies and media communication as predictors of Perceived Threat. Consistent with the literature that demonstrates a strong link between perceived risk and emotions, our results illustrated that Worry was the strongest predictor of participants' Perceived Threat in all countries. However, although the samples in the United Kingdom and Austria show similar results, in the Italian sample higher Perceived Usefulness of the public policies and the media communication, and higher Perceived Dangerousness of the media communication also predicted higher Perceived Threat.

Table 4. Regression analysis for perceived threat.

Country		B	SE	t	*p*
UK	Worry	.40	.05	8.22	.000
	Danger public policies	.12	.06	1.97	.050
	Danger media communication	.01	.05	.22	.825
	Usefulness public policies	.05	.07	.81	.417
	Usefulness media communication	-.04	.05	-.69	.491
Austria	Worry	.19	.05	3.47	.001
	Danger public policies	.10	.09	1.20	.233
	Danger media communication	.09	.07	1.37	.174
	Usefulness public policies	.04	.07	.59	.554
	Usefulness media communication	.10	.07	1.53	.128
Italy	Worry	.31	.06	5.50	.000
	Danger public policies	-.04	.08	-.52	.605
	Danger media communication	.15	.07	2.20	.029
	Usefulness public policies	.18	.07	2.44	.016
	Usefulness media communication	.13	.05	2.41	.017

2.3.3 Engagement in self-protective behaviors: direct and indirect effects

To test our hypotheses on the effect of the manipulations (i.e., Viral Disease and Frame) on self-protective behaviors, with Worry and Perceived Threat as serial mediators, we used the entire sample for the analysis. Also, fitting our main model (Path model 2) separately for each country revealed a similar pattern of results (see Appendix 1 for details and other exploratory tested Path models).

Although mean level differences exist between countries for some of the included variables, the regression analyses presented above have shown that Worry is a central predictor for Perceived Threat for all countries.

Bivariate correlations between the variables of interest are presented in Table 5. The results showed that Perceived Threat was associated with higher engagement in self-protective behaviors (H1) and that higher Worry was associated with higher Perceived Threat (H2). Moreover, higher emotional reactions were associated with higher engagement in self-protective behaviors (H3).

Table 5. Correlations among perceived threat, Worry and Behavior.

	Perceived threat	Worry	Behavior
Perceived threat	-		
Worry	.586**	-	
Behavior	.162**	.198**	-

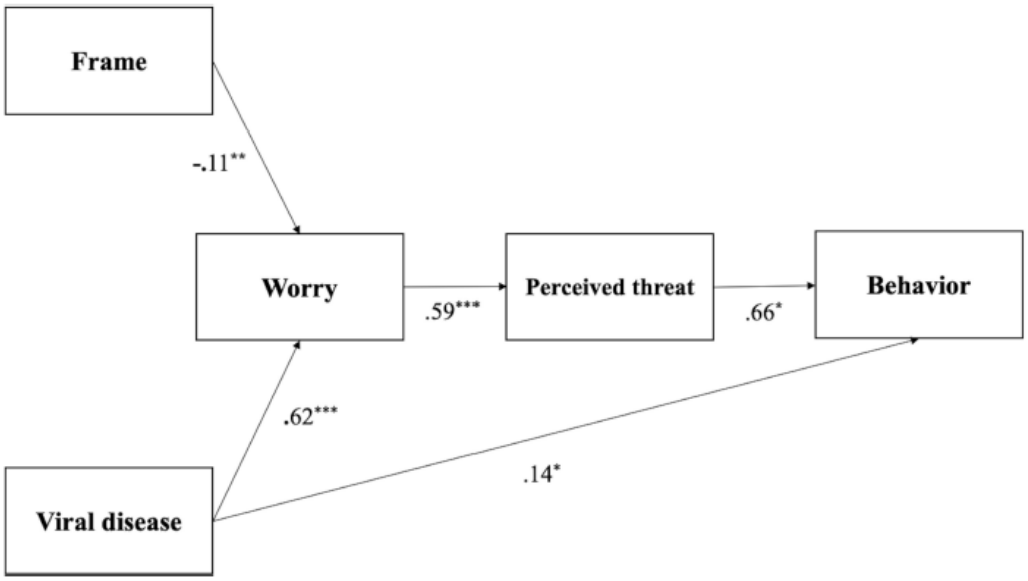
Note. *** p-value < 0.001

To investigate our hypotheses on direct and indirect effects of the manipulations we used Stata 14 (StataCorp, 2015) to conduct a path analysis using structure equation modeling (SEM). We first examined Path Model 1 to test H7 and H11. Specifically, we investigated the two indirect effects of our exogenous variables (i.e., Viral Disease and Frame) on the outcome variable (i.e., Behavior), serially mediated by Worry and Perceived Threat, alongside with the direct effects of the exogenous variables on the outcome variable and the mediators. The resulting model was not significantly worse than the fully specified model, $\chi 2$ (1, N = 547) = 2.96, p = .085, and showed moderately good fit indices (RMSEA = .060, p = .292, CFI = .996, BIC = 6634.0) according to Kline (2011). The results of the first model indicated that Viral Disease had a significant direct effect on Worry, z = 18.64, p < .001, 95% CI [2.07, 2.56], and Behavior, z = 3.03, p = .002, 95% CI [.10, .45], but only marginally on Perceived Threat, z = 1.95, p = .051, 95% CI [-.01, .43]. Frame had a significant effect only

on Worry, z = -3.29, p = .001, 95% CI [-.64, -.16]. These results are consistent with the correlation matrix and support H8 but not H9 and H10.

We then removed the paths that did not show a significant effect to create a second, more parsimonious model (Figure 2). The second model tested the indirect effect of Frame and Viral Disease on the outcome variable (i.e., Behavior) and the direct effect of Viral Disease on Behavior (i.e., Path Model 2[4]). The model showed a good fit, $\chi 2$ (4, N = 547) = 6.87, p = .143, RMSEA = .036, p = .632, the CFI = .995, BIC= 6619.0, and was not significantly worse than Path Model 1, $\Delta \chi 2$ (3) = 3.91, p = 0.271.

Figure 2. Path model testing the indirect effect of Frame and Viral Disease on Behavior and the direct effect of Viral Disease on Behavior.



Note. Coefficients presented are standardized. p-value < 0.05, ** p-value < 0.01, *** p-value < 0.001.

Consistent with the hypothesis (H7), a positive and significant indirect effect emerged for Viral Disease on the engagement in self-protective behaviors serially mediated by Worry and Perceived Threat, z = 2.22, p = .026, 95% CI [.01, .14]. Being in the coronavirus (vs seasonal flu) condition made participants more worried, which was related to a higher Perceived Threat. Higher Perceived Threat significantly and directly predicted higher self-report engagement in self-protective behaviors. Our results also showed a significant direct effect of Viral Disease

[4] A model testing the inverted order of the main variables (i.e., Perceived Threat preceding Worry) have been tested but found not significantly better compared to the original, hypothesized model. The result of the comparison between the inverted model and the original one is displayed in Appendix 1.

on the engagement in self-protective behaviors. The indirect effect of the Frame on self-protective behavior with Worry and Perceived Threat as serial mediators was only marginally significant, not supporting H11, z = - 1.85, p = .064, 95% CI [-.03, .001]. However, being in the negative frame condition made participants experience more Worry and this was positively associated with higher Perceived Threat, z = -3.19, p = .001, 95% CI [-1.83, -.44].

2.4 Discussion

In this study, we investigated different determinants of engagement in self-protective behaviors during the early stages of the COVID-19 pandemic in three European countries (Italy, Austria, and the United Kingdom). An overview of the hypotheses and results can be found in Table 6.

Table 6. Summary of research hypotheses and results.

	Hypotheses	**Results**
H_1	Higher perceived threat will be associated to higher engagement in self-protective behaviors.	Supported
H_2	Higher worry will be associated with higher perceived threat.	Supported
H_3	Higher worry will be associated with higher engagement in self-protective behaviors.	Supported
H_4	In the Coronavirus condition (vs Seasonal Flu) participants will perceive higher worry.	Supported
H_5	In the Coronavirus condition (vs Seasonal Flu) participants will perceive higher perceived threat.	Not fully supported
H_6	In the Coronavirus condition (vs Seasonal Flu) participants will report higher engagement in self-protective behaviors.	Supported
H_7	The effect of Viral Disease manipulation on engagement in self-protective behaviors will be serially mediated by worry and perceived threat.	Supported
H_8	In the negative frame condition (vs positive frame) participants will perceive higher worry.	Supported
H_9	In the negative frame condition (vs positive frame) participants will perceive higher perceived threat.	Not supported
H_{10}	In the negative frame condition (vs positive frame) participants will report higher engagement in self-protective behaviors.	Not supported
H_{11}	The effect of Frame manipulation on engagement in self-protective behaviors will be serially mediated by worry and perceived threat.	Not fully supported

Perceived threat and negative emotional reaction (i.e., worry) have been identified as central predictors of self-reported preventive behaviors. Higher levels of perceived threat and higher worry were found to be associated with higher engagement in self-protective behaviors in all the countries sampled, and higher worry was consistently associated with higher perceived threat. Our results are consistent with psychological literature and studies on

previous and the actual pandemic, indicating the perception of a threat as a prevailing factor in determining intention and effective implementation of protective behaviors (Brug et al., 2004; Goodwin et al., 2011; Niepel et al., 2020; Rubin et al., 2009; Setbon & Raude, 2010; Sheeran et al., 2014).

The role of negative emotional reaction is consistent with the "risk as feelings" framework in which affective reactions are considered to guide the judgment of risks and benefits (Slovic et al., 2002). Our results support also the argument that negative emotional reactions can have a positive effect on self-protective behaviors by their influence on risk perception. Communicators should be aware that conveying some level of worry in the population can be useful to enhance compliance with government interventions. We can speculate that a campaign aimed at underestimating the threat of the coronavirus, like the one implemented in the first stages of the pandemic by the British authorities (Conn, et al., 2020) or as currently done by the American (Barth, 2020) and Brazilian (Kemeny, 2020) authorities, may lead citizens to not worry enough about the threat and consequently not protect against it sufficiently. On the other hand, it is possible that other emotions, such as fear or anxiety, can cause panic, and lead to overreactions, such as exaggerated protective behaviors, discrimination towards groups associated with the threat and, mental illness symptoms (Depoux et al., 2020; Taylor, 2019; Yang & Cho, 2017). Thus, media communication and policies should be careful in tailoring messages for the population that induces a commensurate emotional reaction and risk perception.

Our experiment aimed also at understanding if the way the media addressed the pandemic might have affected threat perception, emotional reaction, and compliance with the behavioral indications propagated by the WHO. Information about the coronavirus or the seasonal flu (Viral Disease manipulation) reporting the number of those who died (Negative Frame) or those who recovered (Positive Frame) was presented to participants to mimic actual media communication at the time of the study.

Results showed a significant indirect effect of the Viral Disease manipulation on behavior serially mediated by worry and perceived threat. People in the coronavirus condition were more worried, which was related to a higher perceived threat and, subsequently, higher compliance with self-protective behaviors. These results are in line with the availability heuristic and the risk profile of the two diseases (Cowling et al, 2020; Fischhoff, et al., 1978; Tversky and Kahneman, 1973). Higher dreadfulness and heavy media coverage of a particular threat, such as the one related to the coronavirus, can make people overestimate the probability of death and increase the perception of risk. Conversely, higher familiarity with a threat (e.g., seasonal

flu), and lower media attention may produce an undervaluation of the risk (Cowling, et al., 2020; Fischhoff, et al., 1978; Lichtenstein et al., 1978; Slovic, 2000; Tversky & Kahneman, 1973). It is therefore advisable to stay away from a comparison that can trigger people's use of heuristics judgment and lead to an underestimation of the risk.

Our results also showed that people in the Negative Frame condition (vs Positive Frame) reported higher levels of worry, consistent with previous research (Druckman & McDermott, 2008; Hameleers, 2020; Peters et al., 2006). Higher worry, in turn, was associated with a higher perceived threat, which is in line with previous studies showing the effect of the frame on other kinds of emotional reactions in health-related behaviors (Peters et al., 2006). Finally, although previous literature shows an effect of framing on preventive actions in the COVID-19 pandemic (Hameleers, 2020; Van Bavel et al., 2020), our results did not show a significant impact of framing on self-protective behaviors. The different results found in our study, can be partially accounted by the conceptual differences between the framing used in the present article and the one used in previous ones. Earlier literature on the coronavirus pandemic indeed, tested mainly equivalency frames (Hameleers, 2020), while we used a type of framing that better resemble the "emphasis frame" family (Entman, 1998) to better mimic media communication. However, although using actual numbers can provide a more realistic approach, it is also subject to interference by previous knowledge of the number of infections, deaths, and recovered by the participants.

2.4.1 Limitation and future directions

In our study, we considered a comprehensive affective reaction to the pandemic including not only the reactions to the disease but also to the public policies and the media communication. Focusing on such a general emotional reaction may allow inclusive inferences but also lacks specificity. Future studies should thus assess emotional reactions in both a general and more specific way. Moreover, we also focused solely on worry as a negative emotional reaction as it was identified as main driver of threat perception in prior studies (Peters et al., 2006). However, focusing only on such (in some way mild) emotional reaction, might have not adequately grasped the "dreadful" characteristics usually associated with uncontrollable and potentially fatal hazards as the COVID-19 might be (Fischhoff, et al., 1978). Future studies should thus assess other, more intense, emotional reactions (e.g., fear, frustration, powerlessness) to better tackle this central component of the emotional appraisal of threat perception.

We calculated the perceived threat multiplying the perceived likelihood of contagion and the perceived disease severity following works on previous pandemic and the PTM model. However, different approaches to assess risk perception, as the Tripartite Model of Risk Perception (TRIRISK; Ferrer et al., 2016), can be tested in future studies. Furthermore, we assessed the perceived severity of the disease in a generic manner (i.e., "how dangerous is the coronavirus") while the likelihood of contagion was directly addressed to the participant (i.e., "What is the probability that you will get infected by the coronavirus in the next month?"). The generic format of the severity question gave participants greater freedom of interpretation but makes it impossible to know whether participants were referring to themselves or to others. However, perceived severity correlated positively with the engagement in self-protective behavior, which was addressed directly to the participant. This gives us reasons to think that, overall, participants interpreted the severity question to include personal danger to themselves.

The framing manipulation was presented only at the beginning of the survey. In future studies, the manipulation should be presented more than once, or recalled in crucial questions, to better recall the frame. The number shared by the primary actual national media were used in our manipulation. Although, these numbers might be slightly different than the factual number of deaths or recovered because of the difficulties in assessing them, we decided to report those numbers to have a more ecological representation of reality.

An interesting relation was also found between perceived usefulness of the public policies and media communication and perceived dangerousness of the media communication with increase perceived threat in the Italian sample. A possible explanation for the fact that those who perceived the mitigating measures and the mediatic debate as useful also perceived the virus as more threating, might be that those subjects used the entity of the recommended behaviors and the debate around the topic as a proxy of the severity of the virus (e.g., "if the measures are strict and the media talks about it a lot, then it must be serious"). On the contrary, it is possible that those who perceived the media communication as dangerous, also perceived the threat as high because they were afraid that the mediatic debate was causing people to underestimate the threat thus making the virus more dangerous. This explanation is in line with the concerns raised on the comparison between the seasonal flu and the coronavirus often proposed in the news in the period. However, these proposed interpretations are only speculative since in the present study we did not check for participants' reasons behind their perception of the public policies and media communication. Moreover, the variables used were composed of four items, including perceptions associated not only to personal health, but also to more general aspects like economic and socio-emotional climate. It is thus possible that the

effects detected might have been driven more by some items rather than others. Nevertheless, these findings shed a light on the pivotal role played especially by the media in shaping citizens perceptions, both from a positive and negative perspective. Future studies should thus consider checking for the effect of the four items separately and including questions to directly assess the reasons behind their perception, in order to better tackle the mechanism behind the influence of media communication on citizen risk perception.

Finally, future research should replicate these results with larger and more representative samples from the general population.

References

Ajzen, I. (2006). *Constructing a TpB Questionnaire: Conceptual and Methodological Considerations*. 14.

Akl, E. A., Oxman, A. D., Herrin, J., Vist, G. E., Terrenato, I., Sperati, F., ... & Schünemann, H. (2011). Framing of health information messages. *Cochrane Database of Systematic Reviews*, (12). https://doi.org/10.1002/14651858.CD006777.pub2

Barth F. D., (2020, March 30) Denying the reality of the coronavirus has made it more dangerous for everyone. Think. Retrieved 2020, from https://www.nbcnews.com/think

Brewer, N. T., Chapman, G. B., Gibbons, F. X., Gerrard, M., McCaul, K. D., & Weinstein, N. D. (2007). Meta-analysis of the relationship between risk perception and health behavior: The example of vaccination. *Health Psychology*, *26*(2), 136–145. https://doi.org/10.1037/0278-6133.26.2.136

Brug, J., Aro, A. R., Oenema, A., de Zwart, O., Richardus, J. H., & Bishop, G. D. (2004). SARS Risk Perception, Knowledge, Precautions, and Information Sources, the Netherlands. Emerging Infectious Diseases, 10(8), 1486–1489. https://doi.org/10.3201/eid1008.040283

Chang, C.-H., Xu, J., & Song, D.-P. (2016). Impact of different factors on the risk perceptions of employees in container shipping companies: A case study of Taiwan. *International Journal of Shipping and Transport Logistics*, *8*(4), 361–388. https://doi.org/10.1504/IJSTL.2016.077306

Conn, D., Lawrence, F., Lewis, P., Carrell, S., Pegg, D., Davies, H., & Evans, R., (2020, April 29). Revealed: the inside story of the UK's Covid-19 crisis. The Guardian. Retrieved 2020, from https://www.theguardian.com/international

Cowling, B. J., Ali, S. T., Ng, T. W. Y., Tsang, T. K., Li, J. C. M., Fong, M. W., Liao, Q., Kwan, M. Y., Lee, S. L., Chiu, S. S., Wu, J. T., Wu, P., & Leung, G. M. (2020). Impact assessment of non-pharmaceutical interventions against coronavirus disease

2019 and influenza in Hong Kong: An observational study. *The Lancet Public Health*, *5*(5), e279–e288. https://doi.org/10.1016/S2468-2667(20)30090-6

de Zwart, O., Veldhuijzen, I. K., Elam, G., Aro, A. R., Abraham, T., Bishop, G. D., Voeten, H. A. C. M., Richardus, J. H., & Brug, J. (2009). Perceived Threat, Risk Perception, and Efficacy Beliefs Related to SARS and Other (Emerging) Infectious Diseases: Results of an International Survey. *International Journal of Behavioral Medicine*, *16*(1), 30–40. https://doi.org/10.1007/s12529-008-9008-2

Depoux, A., Martin, S., Karafillakis, E., Preet, R., Wilder-Smith, A., & Larson, H. (2020). The pandemic of social media panic travels faster than the COVID-19 outbreak. *Journal of Travel Medicine*, *27*(3). https://doi.org/10.1093/jtm/taaa031

Druckman, J. N., & McDermott, R. (2008). Emotion and the Framing of Risky Choice. *Political Behavior*, *30*(3), 297–321. https://doi.org/10.1007/s11109-008-9056-y

Eikenberry, S. E., Mancuso, M., Iboi, E., Phan, T., Eikenberry, K., Kuang, Y., Kostelich, E., & Gumel, A. B. (2020). To mask or not to mask: Modeling the potential for face mask use by the general public to curtail the COVID-19 pandemic. *Infectious Disease Modelling*, *5*, 293–308. https://doi.org/10.1016/j.idm.2020.04.001

Entman, R. M. (1993). Framing: Toward Clarification of a Fractured Paradigm. *Journal of Communication*, *43*(4), 51–58. https://doi.org/10.1111/j.1460-2466.1993.tb01304.x

Evans, J. S. B. (2008). Dual-processing accounts of reasoning, judgment, and social cognition. *Annu. Rev. Psychol.*, *59*, 255-278. https://doi.org/10.1146/annurev.psych.59.103006.093629

Felipe de Mendiburu (2020). agricolae: Statistical Procedures for Agricultural Research. R package version 1.3-3. https://CRAN.R-project.org/package=agricolae

Ferrer, R. A., Klein, W. M. P., Persoskie, A., Avishai-Yitshak, A., & Sheeran, P. (2016). The Tripartite Model of Risk Perception (TRIRISK): Distinguishing Deliberative,

Affective, and Experiential Components of Perceived Risk. *Annals of Behavioral Medicine*, *50*(5), 653–663. https://doi.org/10.1007/s12160-016-9790-z

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. https://doi.org/10.1002/(SICI)1099-0771(200001/03)13:1<1::AID-BDM333>3.0.CO;2-S

Fischhoff, B., Slovic, P., Lichtenstein, S., Read, S., & Combs, B. (1978). How safe is safe enough? A psychometric study of attitudes towards technological risks and benefits. *Policy Sciences*, *9*(2), 127–152. https://doi.org/10.1007/BF00143739

Gallagher, K. M., & Updegraff, J. A. (2012). Health message framing effects on attitudes, intentions, and behavior: a meta-analytic review. *Annals of behavioral medicine*, *43*(1), 101-116. https://doi.org/10.1007/s12160-011-9308-7

Goodwin, R., Gaines, S. O., Myers, L., & Neto, F. (2011). Initial Psychological Responses to Swine Flu. *International Journal of Behavioral Medicine*, *18*(2), 88–92. https://doi.org/10.1007/s12529-010-9083-z

Haas, C. (2020). Coronavirus and Risk Analysis. *Risk Analysis*, *40*(4), 660–661. https://doi.org/10.1111/risa.13481

Hameleers, M. (2020). *Prospect Theory in Times of a Pandemic: The Effects of Gain versus Loss Framing on Policy Preferences and Emotional Responses During the 2020 Coronavirus Outbreak* [Preprint]. SocArXiv. https://doi.org/10.31235/osf.io/7pykj

Hochbaum, G., Rosenstock, I., & Kegels, S. (1952). Health belief model. *United states public health service*, 1.

Hsiang, S., Allen, D., Annan-Phan, S., Bell, K., Bolliger, I., Chong, T., Druckenmiller, H., Huang, L. Y., Hultgren, A., Krasovich, E., Lau, P., Lee, J., Rolf, E., Tseng, J., & Wu,

T. (2020). The effect of large-scale anti-contagion policies on the COVID-19 pandemic. *Nature*, 1–9. https://doi.org/10.1038/s41586-020-2404-8

Kahneman, D., & Frederick, S. (2002). Representativeness revisited: Attribute substitution in intuitive judgment. *Heuristics and biases: The psychology of intuitive judgment*, *49*, 81.

Kemeny, R., (2020, April 14) Bolsonaro's denial of coronavirus puts the country at risk. The World. Retrieved 2020, from https://www.pri.org/

Kim, C. W., & Song, H. R. (2017). Structural Relationships among Public's Risk Characteristics, Trust, Risk Perception and Preventive Behavioral Intention—The Case of MERS in Korea -. *Crisis and Emergency Management*, *13*(6), 85–95. https://doi.org/10.14251/crisisonomy.2017.13.6.85

Kline, R. B. (2011). Convergence of structural equation modeling and multilevel modeling (pp. 562-589). na.

Leppin, A., & Aro, A. R. (2009). Risk Perceptions Related to SARS and Avian Influenza: Theoretical Foundations of Current Empirical Research. *International Journal of Behavioral Medicine*, *16*(1), 7–29. https://doi.org/10.1007/s12529-008-9002-8

Lerner, J. S., & Keltner, D. (2000). Beyond valence: Toward a model of emotion-specific influences on judgement and choice. *Cognition and Emotion*, *14*(4), 473–493. https://doi.org/10.1080/026999300402763

Lerner, J. S., Gonzalez, R. M., Small, D. A., & Fischhoff, B. (2003). Effects of Fear and Anger on Perceived Risks of Terrorism: A National Field Experiment. *Psychological Science*, *14*(2), 144–150. https://doi.org/10.1111/1467-9280.01433

Lichtenstein, S., Slovic, P., Fischhoff, B., Layman, M., & Combs, B. (1978). Judged frequency of lethal events. *Journal of Experimental Psychology: Human Learning and Memory*, *4*(6), 551–578. https://doi.org/10.1037/0278-7393.4.6.551

Loewenstein, G., Weber, E., Hsee, C., & Welch, N. (2001). Risk as Feelings. *Psychological Bulletin*, *127*(2), 267–286.

Nabi, R. L., Walter, N., Oshidary, N., Endacott, C. G., Love-Nichols, J., Lew, Z. J., & Aune, A. (2020). Can emotions capture the elusive gain-loss framing effect? A meta-analysis. *Communication Research*, *47*(8), 1107-1130. https://doi.org/10.1177/0093650219861256"

Niepel, C., Kranz, D., Borgonovi, F., Emslander, V., & Greiff, S. (2020). The coronavirus (COVID-19) fatality risk perception of US adult residents in March and April 2020. *British Journal of Health Psychology*, https://doi.org/10.1111/bjhp.12438

O'Keefe, D. J., & Jensen, J. D. (2009). The relative persuasiveness of gain-framed and loss-framed messages for encouraging disease detection behaviors: A meta-analytic review. *Journal of Communication*, *59*, 296-316. https://doi.org/10.1111/j.1460-2466.2009.01417.x

O'Keefe, D. J., & Jensen, J. D. (2007). The relative persuasiveness of gain-framed loss-framed messages for encouraging disease prevention behaviors: A meta-analytic review. *Journal of health communication*, *12*(7), 623-644. https://doi.org/10.1080/10810730701615198

O'Keefe, D. J., & Nan, X. (2012). The relative persuasiveness of gain-and loss-framed messages for promoting vaccination: A meta-analytic review. *Health communication*, *27*(8), 776-783. https://doi.org/10.1080/10410236.2011.640974

Peters, E., Slovic, P., Hibbard, J. H., & Tusler, M. (2006). Why worry? Worry, risk perceptions, and willingness to act to reduce medical errors. *Health Psychology: Official Journal of the Division of Health Psychology, American Psychological Association*, *25*(2), 144–152. https://doi.org/10.1037/0278-6133.25.2.144

Peters, E., Västfjäll, D., Gärling, T., & Slovic, P. (2006). Affect and decision making: A "hot" topic. *Journal of Behavioral Decision Making*, *19*(2), 79–85. https://doi.org/10.1002/bdm.528

Prentice-Dunn, S., & Rogers, R. W. (1986). Protection motivation theory and preventive health: Beyond the health belief model. *Health education research*, *1*(3), 153-161. https://doi.org/10.1093/her/1.3.153

Rogers, R. W. (1975). A protection motivation theory of fear appeals and attitude change1. The journal of psychology, 91(1), 93-114. https://doi.org/10.1177/109019817400200405

Rogers, R. W., & Prentice-Dunn, S. (1997). Protection motivation theory. In D. S. Gochman (Ed.), Handbook of health behavior research 1: Personal and social determinants (p. 113–132). Plenum Press.

Rosenstock, I. M. (1960). What research in motivation suggests for public health. *American Journal of Public Health and the Nations Health*, *50*(3_Pt_1), 295-302. 10.2105/ajph.50.3_pt_1.295

Rosenstock, I. M. (1974). The health belief model and preventive health behavior. *Health education monographs*, *2*(4), 354-386.

Rothman, A. J., & Salovey, P. (1997). Shaping perceptions to motivate healthy behavior: the role of message framing. *Psychological bulletin*, *121*(1), 3. DOI: 10.1037/0033-2909.121.1.3

Rubin, G. J., Amlôt, R., Page, L., & Wessely, S. (2009). Public perceptions, anxiety, and behaviour change in relation to the swine flu outbreak: Cross sectional telephone survey. *BMJ*, *339*. https://doi.org/10.1136/bmj.b2651

Setbon, M., & Raude, J. (2010). Factors in vaccination intention against the pandemic influenza A/H1N1. *European Journal of Public Health*, *20*(5), 490–494. https://doi.org/10.1093/eurpub/ckq054

Sheeran, P., Harris, P. R., & Epton, T. (2014). Does heightening risk appraisals change people's intentions and behavior? A meta-analysis of experimental studies. *Psychological Bulletin*, *140*(2), 511–543. https://doi.org/10.1037/a0033065

Sjöberg, L. (2007). Emotions and Risk Perception. *Risk Management*, *9*(4), 223–237. https://doi.org/10.1057/palgrave.rm.8250038

Slovic, P. E. (2000). *The perception of risk*. Earthscan publications.

Slovic, P., & Peters, E. (2006). Risk Perception and Affect. *Current Directions in Psychological Science*, *15*(6), 322–325. https://doi.org/10.1111/j.1467-8721.2006.00461.x

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. https://doi.org/10.1111/j.0272-4332.2004.00433.x

Slovic, P., Finucane, M., Peters, E., & MacGregor, D. G. (2002). Rational actors or rational fools: Implications of the affect heuristic for behavioral economics. *The Journal of Socio-Economics*, *31*(4), 329–342. https://doi.org/10.1016/S1053-5357(02)00174-9

StataCorp. 2015. *Stata Statistical Software: Release 14*. College Station, TX: StataCorp LP.

Stutt, R. O. J. H., Retkute, R., Bradley, M., Gilligan, C. A., & Colvin, J. (2020). A modelling framework to assess the likely effectiveness of facemasks in combination with 'lock-down' in managing the COVID-19 pandemic. *Proceedings of the Royal Society A: Mathematical, Physical and Engineering Sciences*, *476*(2238), 20200376. https://doi.org/10.1098/rspa.2020.0376

Taylor, S. (2019). *The Psychology of Pandemics: Preparing for the Next Global Outbreak of Infectious Disease*. Cambridge Scholars Publishing.

Tversky, A., & Kahneman, D. (1973). Availability: A heuristic for judging frequency and probability. *Cognitive Psychology*, *5*(2), 207–232. https://doi.org/10.1016/0010-0285(73)90033-9

Tversky, A., & Kahneman, D. (1979). The framing of decisions and the psychology of choice. science, 211(4481), 453-458. https://doi.org/10.1126/science.7455683

Vacondio M., Dickert S. (2020) *Risk*. In: Glăveanu V. (eds) The Palgrave Encyclopedia of the Possible. Palgrave Macmillan, Cham

van Bavel, J. J., Baicker, K., Boggio, P. S., Capraro, V., Cichocka, A., Cikara, M., Crockett, M. J., Crum, A. J., Douglas, K. M., Druckman, J. N., Drury, J., Dube, O., Ellemers, N., Finkel, E. J., Fowler, J. H., Gelfand, M., Han, S., Haslam, S. A., Jetten, J., … Willer, R. (2020). Using social and behavioural science to support COVID-19 pandemic response. *Nature Human Behaviour*, *4*(5), 460–471. https://doi.org/10.1038/s41562-020-0884-z

World Health Organization. (2020). *Coronavirus Disease (COVID-19) disease*. https://covid19.who.int/

Yang, S., & Cho, S.-I. (2017). Middle East respiratory syndrome risk perception among students at a university in South Korea, 2015. *American Journal of Infection Control*, *45*(6), e53–e60. https://doi.org/10.1016/j.ajic.2017.02.013

Chapter 3[5]

The influence of COVID-19 mortality rate formats on emotional reactions, risk perception, and self-protective behavioral intentions.

Abstract: We investigated whether different mortality rate formats used to express the same objective probability affected people's emotional reactions, risk perception, and protective behavioral intentions. A sample from the Italian population (N=604) was exposed to six different formats (i.e., Absolute value; Raw ratio; 1 in X; Verbal; Percentage; Probability) to report the mortality rate of COVID-19 in a between-subject design. In line with expectations, the Probability format led to lower emotional reactions compared to all the other formats. Results from a path analysis showed that each of the tested mortality rate formats led to higher negative emotional reactions and risk perception compared to the Probability format. The mortality rate formats also had an indirect effect on behavioral intentions to protect oneself, which was mediated by emotional reactions and risk perception. The direct effect of risk on intentions was found to differ among the two dimensions of risk. Affective Risk led to higher behavioral intentions, while Deliberative Risk had the opposite effect. We discuss these results considering the multidimensional nature of risk perception and offer practical implications for risk management during health crises like COVID-19.

Keywords: risk perception, emotions, behavior, communication, COVID-19

[5] A version of this chapter has been submitted to Risk Analysis the Special Issue on "Risk Science Foundations in Light of COVID-19". Preliminary results of this study are also reported in Dott. Giulia Priolo's dissertation thesis titled "(Don't) follow your gut: How affective reactions (mis)guide decision-making under uncertainty. Insights from the Iowa Gambling Task and the COVID-19 pandemic", discussed the 23rd of February 2022 at the University of Trento. The study is part of a grant project: UNIVERSITA' DI TRENTO, 2020, "Bando di Ateneo "Covid-19", "Fattori psicologici della percezione del rischio e comportamenti di protezione: uno studio applicativo relativo alla pandemia di Sars-CoV-2". Scientific coordinator: Bonini. Research Unit: Priolo, Vacondio, Savadori, Tokarchuk, Dickert e Bonini. This Study is in collaboration with Prof. Nicolao Bonini (Department of Economics and Management, University of Trento), Dott. Giulia Priolo (Department of Psychology and Cognitive Sciences, University of Trento, Rovereto, Italy) and Assoc. Prof. Stephan Dickert (Department of Marketing, School of Business and Management, Queen Mary University of London). Dott. Vacondio and Dott. Priolo have contributed equally to this work and share the first authorship.

3.1 Introduction

The outbreak of the COVID-19 pandemic at the beginning of 2020 has posed challenges to societies on different levels. Next to the development of medical solutions (e.g., vaccines, PCR and antigen tests, and medication to fight the infection with SARS-CoV-2), the necessity to better understand the psychological drivers behind health behaviors during the pandemic became clear. People's acceptance of medical solutions as well as their compliance with self-protective behaviors (e.g., wearing a facemask, sanitizing hands with alcoholic solutions, and social distancing) were fundamental factors in combating the worldwide health crisis. Risk scholars had to face the challenge of applying risk analysis and communication knowledge to a real, unprecedented emergency and to help authorities better understand the drivers of citizens' behavior in order to find efficient ways to boost their compliance.

In the present article, we show how different formats used to communicate COVID-19 mortality rates to the public can influence citizens' emotional reactions, risk perception, and intention to engage in protective behaviors. Specifically, we show how the effect of the formats on behavior is mediated primarily by citizens' emotional reactions and the affective dimension of risk perception (Ferrer et al., 2016). Thus, our results shed light on the pivotal role played by affective components in shaping people's risk appraisal and behavior, and also stress the necessity for policy makers and communicators to adequately take this dimension into account.

3.1.1 Communication of health risks

Risk perceptions and health behaviors often depend on how information is communicated. Literature on the pragmatic function of risk communication shows that message attributes are an essential component of effective communication strategies, capable of changing attitudes and behaviors towards a risk (Balog-Way et al., 2020; Brewer, 2011; Pezzullo & Cox, 2017; Rickard, 2021). Previous research demonstrated that different ways to frame COVID-19-related information affects people's intentions to engage in self-protective behaviors by influencing their emotional reactions and risk perception. Presenting negative information (i.e., number of people who died) compared to positive information (i.e., number of people who recovered) increases negative emotional reactions towards the pandemic, which in turn are related to higher risk perception and higher intentions of people to protect themselves and others (Vacondio et al., 2021). Emphasizing emotions as a reaction to different risk communication formats is in line with the "*risk as feelings*" framework, which postulates that we mostly perceive risks in a fast and intuitive way, using our emotions and experience to

guide us rather than logical calculations (Finucane et al., 2000; Loewenstein et al., 2001; Slovic et al., 2002, 2004). Studies on the actual and previous pandemics showed that negative emotions and threat perception play a paramount role in shaping people's preventive behaviors (Brug et al., 2004; Goodwin et al., 2011; Rubin et al., 2009; Savadori & Lauriola, 2021; Setbon & Raude, 2010).

Different numerical formats have been used to present risk information, all of which can lead to different interpretations, likelihood estimations, and behavioral responses (Fagerlin et al., 2007; Freeman et al., 2021; Jie, 2022; Shoots-Reinhard et al., 2022; Sinayev et al., 2015; Timmermans & Oudhoff, 2011; Visschers et al., 2009). These include percentages (e.g., "0.17% of the Italian population died"), probability (e.g., "a person has a 0.0017 probability of dying") and several frequency or ratio formats (e.g., "98.974 people on a population of 59.641.488 inhabitants died"; "1 person of every 603 inhabitants died"). Research on the effects of risk communication formats has found that expert clinicians are more inclined to consider patients with psychiatric history as less dangerous when a percentage probability format (e.g., 20%) rather than a frequency format (e.g., 20 out of 100 people) was used to report their risk of committing harmful acts, although the two formats were mathematically equivalent (Slovic et al., 2000). Similarly, a disease able to kill 24.4% of the population was perceived as less dangerous than a disease that could kill 1,286 people out of 10,000 in a famous study by Yamagishi (1997). Additionally, providing (vs. not providing) numeric information increased vaccine intentions in Shoots-Reinhard and colleagues (2022) and using percentages with labels to communicate the risk of adverse side effects increased people's willingness to use a specific medication compared to using a frequency format (Sinayev et al., 2015).

Several subsequent studies showed that expressing risk information with a probability format leads to lower risk perception and higher risky behavior compared to frequency formats (i.e., "frequency format effect"). The reasons behind this effect have been attributed to the fact that risk expressed as probability entails lower imaginability (i.e., lower ability to evoke mental images of the event), making this format harder to comprehend and use compared to when the same risk is expressed using frequency-ratio formats (Koehler & Macchi, 2004; Newell et al., 2008; Peters et al., 2006; Purchase & Slovic, 1999; Slovic et al., 2000; Timmermans et al., 2008; Timmermans & Oudhoff, 2011; Visschers et al., 2009).

Other studies found that different types of frequencies and ratio formats can lead to different risk appraisals. For instance, when an integer (e.g., 50 out of 5000) is used to express an absolute frequency to communicate risk, that risk is perceived as higher compared to when a fractional value is used (e.g., 0.5 out of 50; Newell et al., 2008). Moreover, medical risks

expressed by the ratio 1 in X (e.g., 1 out of 200) are usually perceived as more worrying and probable than an equivalent ratio of N in X*N (e.g., 5 out of 1000) or percentages (Pighin et al., 2011). The "1 in X" format was also found to drive subsequent health decisions and preventive behaviors (Sirota et al., 2018; Sirota & Juanchich, 2019).

Information about a risk can also be presented in terms of absolute risk or relative risk information. Information presented as absolute risk reduction is usually perceived as more intuitive and easier to comprehend compared to relative risk reduction formats, but less effective in influencing consequent health-related decision-making (e.g., lower compliance with medical recommendations or willingness to initiate therapy; see Covey, 2007; Visschers et al., 2009; Zipkin et al., 2014 for a review).

Despite the evidence indicating some formats as more effective in increasing people's risk perception rather than others, the debate about the effect of the different formats available to report risk on actual behavior is still open. As the human factor is crucial to navigate through the current pandemic, a deeper understanding of this issue is vital, also in light of future health crises and pandemics. In such a context, risk scholars need to provide authorities with adequate strategies to increase citizens' compliance with recommended policies.

3.1.2 Current Study: Risk formats & The multidimensionality of risk

To achieve this goal, the present work compares six of the most common formats used by the Italian media and public policy outlets to report COVID-19 mortality rates during the second wave of the pandemic (March 2021). Specifically, we examine the effect of these mortality rate formats on emotional reactions, risk perception, and intention to comply with preventive behaviors. We expect that expressing the mortality rate using a probability format will lead to lower negative emotional reactions (H1a), perceived risk (H1b), and intention to engage in self-protective behaviors (H1c) compared to when frequency-ratio formats are used. Previous studies also showed that higher levels of negative emotions towards COVID-19 and previous pandemics can heighten the perception of risk and, in turn, increase adherence to mitigating measures (Kim & Song, 2017; Leppin & Aro, 2009; Rubin et al., 2009; Savadori & Lauriola, 2021; Vacondio et al., 2021). We thus expect that the mortality rate formats will influence people's negative emotional reactions and risk perception which should ultimately affect behavioral responses (H2). Nevertheless, the association between risk perception and health behaviors is still unclear and the reported effect sizes were modest in Brewer et al., (2007) and Leppin & Aro (2009) reviews. Other research found that risk perception predicted

further information seeking rather than having a direct impact on preventative health behaviors (Manika et al., 2021). A possible explanation for these mixed results could be that most of those studies investigated risk perception as a mono-dimensional construct equating it to the perceived likelihood of harm (Brewer et al., 2007; Leppin & Aro, 2009).

However, risk perception is a more complex construct that involves not only reason-based processes, but also other dimensions (Siegrist & Árvai, 2020; Slovic et al., 2004). According to Wilson et al., (2019), for instance, perceived risk is a multifaceted construct that is better captured as a combination of personal exposure and/or perceived *probability* of exposure to a target hazard, perceived severity of the potential negative *consequences* of the hazard, and *affective* reactions (e.g., concern) related to that hazard. The authors found this three-dimensional structure to be consistent among different types of hazards but found the three dimensions to differently impact the subjective assessment of risk and the consequent decision on how to respond to it. While the affective and perceived severity of the consequences dimensions were found to be the main factors in determining both subjective judgment of the risk and behavior, the probability dimension was instead predictive (to a lesser degree) of behavioral intentions. In the health domain specifically, a tripartite model has been proposed by Ferrer and colleagues (2016). In their TRIRISK model, the authors distinguish among *deliberative* (i.e., reason-based perceived probability of being exposed to a negative event), *affective* (i.e., anticipated affective reactions: cognitive representations of how people predict they will feel in a future situation; Dickert et al., 2014; Loewenstein et al., 2001), and *experiential* (i.e., heuristic-based, "gut" feeling of vulnerability toward the negative consequences of the event) components of risk. Although the items and the labels used are somewhat different, both papers suggest that it is advisable to assess risk by including multiple components. These dimensions have been shown to uniquely predict intentions to engage in preventive behavior in studies on cancer, diabetes and heart disease, with affective and experiential dimensions being stronger positive predictors, similarly to the findings by Wilson and colleagues (2019). The deliberative dimension instead showed an opposite effect, such that higher deliberative risk perception seems to be associated with lower protective intentions. This result may reflect the fact that people can adequately understand that their actual protective behaviors can lower their risk of getting sick in the future, but they fail to properly regulate their affective and experiential reaction to this possibility. Although a consensus on how to assess the dimensions and how to label them is still missing among risk scholars, both models agree on the fact that assessing risk as a multidimensional construct represent the best option to capture the influence of perceived risk on protective actions. Thus, in the present study we

measured perceived risk of COVID-19 as a multidimensional construct. Specifically, we assessed it in line with the TRIRISK model as being specifically created for the health domain. We thus expect that participants who report higher levels of affective (H3a) and experiential (H3b) dimensions of risk will also report higher intentions to engage in protective behaviors, while we expect to find the opposite effect for the deliberative dimension of risk (H3c).

3.2 Methods

3.2.1 Participants

A total of 604 participants (50.3% female; Mage=43.83; SD=12.54) were recruited through Demetra opinion.net Srl, an Italian company specialized in market research and opinion surveys, using a Computer Assisted Web Interviewing (CAWI) method; we paid every participant 2.50 euros. The sample was representative of age and gender distribution of the Italian population and balanced for age, gender, and geographical provenance. Participants were randomly but evenly assigned to one of six between-subjects conditions (explained below). All participants provided their written informed consent to partake in the study and ethical principles were respected following the Declaration of Helsinki. The study was exempt from ethical approval according to the Ethical Committee standards at the University of Trento.

3.2.2 Design and procedure

Data collection took place online from the 5th to the 18th of March 2021. In that period Italy was undergoing a second wave of COVID-19 infections with increasing incidence and hospital burden in most regions (National Rt[6], 03-16 March=1.08). Vaccines were available only to the elderly, health care workers, and vulnerable people. The survey took approximately twenty minutes to complete. After providing their informed consent, participants were asked to read a short text reporting information about mortality rates related to COVID-19 in Italy from the start of the pandemic to the day before the beginning of the data collection. Data were retrieved from the official national Health Department's website (Ministero della Salute, 2021). Based on the mortality rate format used to present the mortality rate, six between-subjects conditions were created: 1) "Absolute Value" (i.e., "98.974 people died"); 2) "Raw ratio format" (i.e., "98.974 people on a population of 59.641.488 inhabitants died"); 3) "1 in X

[6] The R_t is a measure of the spread of an infectious disease in a population, which includes information on the progress of a pandemic over time and considers that part of the population develop immunity by contracting the disease. R_t is a common way to present information about the COVID-19 pandemic in media. Source: https://www.nature.com/articles/d41586-020-02009-w

format" ("1 person of every 603 inhabitants died"); 4) "Verbal format" (i.e. "several people died"); 5) "Percentage format" (i.e., "0.17% of the Italian population died"); 6) "Probability format" (i.e., "a person has a 0.0017 probability of dying"). Then, participants' emotional reactions to the short text, their COVID-19 risk perceptions, and behavioral intentions were assessed. Before each section, the mortality rate was presented again according to the participants' condition to ensure that the information was still considered. An attention check was included to make sure participants were paying attention and a manipulation check was also included to ensure they correctly understood and remembered the information format they were presented with during the survey (see Appendix 2). Those who failed the manipulation, or the attention check, or those who took less than a third of the median value of the Length Of the Interview (LOI < median LOI * 0.33) were deleted and automatically replaced with new subjects. The survey ended with demographics and other questions which were part of a separate research investigation. The study was pre-registered on AsPredicted[7] (https://aspredicted.org/DQ3_SH5). The dataset is available on the OSF platform and accessible through the following link: https://osf.io/x49uy/?view_only=0c0b6a05e9994b4ea7278b6a5af347c2

3.2.3 Materials

*Emotional reaction***:** We assessed participants' anticipatory emotions (i.e., affective reactions people feel in the moment they make the decisions; Dickert et al., 2014; Loewenstein et al., 2001) to the displayed mortality rate statistics by means of the PANAS (1 = "Not at all", 5 = "Extremely"; Watson et al., 1988). We primarily focused on negative emotional reactions in our analysis ("Negative Emotions" α=.865).

Risk perception: Participants' risk perception of COVID-19 was assessed with the TRIRISK scale (Ferrer et al., 2016). The scale comprises eighteen items divided into three subscales representing the Affective (six items), Deliberative (six items), and Experiential (six items) dimensions of risk perception according to the TRIRISK model (see Table 7). Items were adapted to COVID-19. Since one item of the Deliberative Risk scale was not assessed on the same rating scale as the others, all items were standardized (z-scored) to allow comparability, following Ferrer et al. (2016). We then performed an Exploratory Factor Analysis using a Principal Component (PC) model and found that the items were best

[7] Assessment of individual differences (i.e., trait emotional intelligence, numeracy, general and specific trust, knowledge about COVID-19) were included in the pre-registration for reasons beyond the scope of the present work.

represented by two, rather than three, principal components (see section "Methodology" of the Appendix 2 for details of PC analysis). We called the two new factors "Affective Risk", composed by all the items of the original Affective Risk scale plus three items of the original Experiential Risk scale, and "Deliberative Risk", composed by all the items of the original Deliberative Risk scale plus two items of the original Experiential Risk scale.

Behavioral Intentions: Participants' intention to engage in self-protective measures propagated by the Italian government was assessed using sixteen items adapted from Keinan and colleagues (2021). Specifically, participants were asked to rate from 1 ("Extremely unlikely") to 7 ("Extremely likely") the likelihood that they would exhibit a list of active and passive risk-taking behaviors in the following month that included the Easter holiday. Active risk-taking behaviors (eight items) comprise those behaviors that involve taking actions that may cause harm (e.g., "Visit friends at their home"), while passive risk-taking behaviors (eight items) involve the acceptance of potential harm caused by inaction (e.g., "(not) Using a facemask"). In addition to the original items from Keinan and colleagues (2021), we used ad hoc items created to include protective measures not addressed in their original study (e.g., "getting vaccinated"). The complete list of items is displayed in Appendix 2. We performed an exploratory factor analysis and grouped the items into three new variables, in line with previous work (e.g., Siegrist, 2021; Wismans et al., 2020): "WHO Guidelines" (eight items regarding participants' intention to engage in protective behaviors suggested by the WHO such as washing hands and wearing a facemask, α=.844); "Social Engagement" (four items regarding participants' intention to engage socially like visiting people or going to a restaurant, α=.713); "Insurance" (two items regarding participants' intention to take out life insurance as well as COVID-19 insurance, α=.841). Higher scores for the WHO guidelines and Insurance variables indicate higher intention to exhibit the behaviors, i.e., higher intention to protect themselves. On the contrary, higher scores for the Social Engagement variables indicate higher intention to engage socially, thus lower intention to protect themselves. The item "Vaccine" (one item asking about participants' intention to get a COVID-19 vaccine when available) was included as a single item. We use a single item to measure vaccine intention because it represents a common practice in health research (Bowling, 2005; DeSalvo et al., 2005). Extant literature considers single-item measures increasingly accepted in academic research, especially if aimed to test behavioral outcomes (Fuchs & Diamantopoulos, 2009). One item assessing participants' intention to use the Italian contagion tracking system ("Immuni App") was excluded from the analyses since it disappeared from the public debate due to lack of effectiveness (Biagio, 2021).

Table 7. Items of the TRIRISK scale

Subscale	Items
Affective Risk	1.How worried are you about developing COVID-19 in the future?
	2.How fearful are you about developing COVID-19 in the future?
	3.How nervous are you about developing COVID-19 in your lifetime?
	4.When you think about COVID-19 for a moment, to what extent do you feel fearful?
	5.When you think about COVID-19 for a moment, to what extent do you feel worried?
	6.When you think about COVID-19 for a moment, to what extent do you feel anxious?
Deliberative Risk	1.How likely is it that you will get COVID-19 at some point in the future?
	2.On a scale from 0 to 100 %, how would you rate the probability that you will develop COVID-19 in the future?
	3.The way I look after my health means that my odds of getting COVID-19 in the future are:…
	4.When I think carefully about my lifestyle, it does seem possible that I could get COVID-19.
	5.If I look at myself as if I was a doctor, I realize that my behavior puts me at risk of getting COVID-19,
	6.How do you think your chance of developing COVID-19 in the future compares to the average person of your gender and age?
Experiential Risk	1.How concerned are you about developing COVID-19 in your lifetime?
	2.How easy is it for you to imagine yourself developing COVID-19 in the future?
	3. I feel very vulnerable to COVID-19
	4.I am confident that I will not get COVID-19. [reverse scored]
	5.I would be lying if I said “There is no chance of me getting COVID-19.”
	6.My first reaction when I hear of someone getting COVID-19 is “that could be me someday”

3.3 Results

Descriptive statistics for the main variables (i.e., Negative Emotions, Risk, and Behavioral Intentions) by condition are provided in Table 8.

Table 8. Means and standard deviations (in brackets) of the main variables by condition.

	Emotions	Risk		Behavioral Intentions			
	Negative Emotions	Affective Risk	Deliberative Risk	WHO Guidelines	Social Engagement	Insurance	Vaccine
Absolute	30.82	.14	-.007	6.05	3.45	2.66	5.80
	(7.52)	*(.81)*	*(.71)*	*(1.02)*	*(1.09)*	*(1.63)*	*(1.84)*
Raw	30.20	.10	.05	6.14	3.22	2.36	5.66
	(7.44)	*(.89)*	*(.65)*	*(.95)*	*(.87)*	*(1.61)*	*(1.86)*
1 in X	29.03	-.02	.04	6.07	3.41	2.36	5.70
	(7.89)	*(.83)*	*(.65)*	*(.84)*	*(1.08)*	*(1.53)*	*(1.95)*
Verbal	29.66	-.004	-.06	6.16	3.35	2.28	5.68
	(6.94)	*(.80)*	*(.70)*	*(.86)*	*(.90)*	*(1.57)*	*(2.03)*
Percentage	27.64	-.05	.02	6.04	3.30	2.44	5.74
	(8.23)	*(.93)*	*(.81)*	*(.96)*	*(.97)*	*(1.51)*	*(1.98)*
Probability	25.30	-.16	-.03	5.88	3.31	2.26	5.46
	(8.47)	*(.93)*	*(.68)*	*(1.13)*	*(.91)*	*(1.56)*	*(2.11)*

Note. Affective Risk and Deliberative Risk factors are standardized (z-scores; 1= highest risk perception, -1= lowest risk perception). Negative Emotions were assessed on a scale ranging from 1= "Not at all" to 5= "Extremely", and the scores of 10 items for the Negative Emotions scale were summed (50= highest score, 10= lowest score). Behavioral Intentions were assessed on a scale ranging from 1= "Extremely unlikely" and 7= "Extremely likely".

Bivariate correlations between the main variables are presented in Table 9. Results showed that stronger Negative Emotions are associated with higher risk perception (for both risk components). Additionally, respondents who reported higher Negative Emotions also reported higher intentions to comply with WHO guidelines, getting vaccinated against COVID-19, as well as higher intentions to take out insurance. Participants who reported higher Affective Risk were more willing to protect themselves (i.e., higher intentions to comply with the WHO guidelines, get vaccinated, take-out insurance and lower intention to engage socially). Higher Deliberative Risk was associated with higher intentions to get vaccinated, take out insurance and comply with the WHO guidelines. Finally, our findings showed that participants who reported higher intentions to comply with the WHO guidelines also reported

higher intentions to get vaccinated and take out insurance, while they also reported lower intentions to engage socially. Insurance and Vaccine were positively associated, however those who reported higher intentions to engage socially also reported higher intentions to take out insurance.

Table 9. Correlations among Negative Emotions, Risk, and Behavioral Intentions

	Negative Emotions	Affective Risk	Deliberative Risk	WHO Guidelines	Social Engagement	Insurance	Vaccine
Negative Emotions	-						
Affective Risk	.74***	-					
Deliberative Risk	.39***	.54***	-				
WHO Guidelines	.35***	.49***	.10*	-			
Social Engagement	-.07	-.10*	.01	-0.9*	-		
Insurance	.25***	.28***	.20***	.21***	.24***	-	
Vaccine	.18***	.27***	.12**	.28***	-.11**	.09*	-

Note *p-value <.05, **p-value <.01, ***p-value <.001

3.1.1 Effect of Mortality Rate Formats on Negative Emotions, Risk, and Behavioral Intentions

Separate regression models with planned contrasts (i.e., Dummy coding) were used to test our hypotheses (H1a, H1b, H1c) on the effect of the six different Mortality Rate Formats on participants' Negative Emotions, Risk, and intention to engage in protective behaviors. The Probability format was used as the comparison group since prior literature indicated this format to elicit the lowest risk perception and behavioral intentions (Peters et al., 2006; Slovic et al., 2000; Timmermans et al., 2008; Timmermans & Oudhoff, 2011; Visschers et al., 2009) and our descriptive analysis aligned with these previous findings (see Table 8).

Results showed that the format mainly affected participants' emotional appraisal. Indeed, confirming H1a and partially H1b, significant effects of the format were found only for Negative Emotions (i.e., anticipatory emotions) and the Affective component of risk (i.e., anticipated emotions; Table 10). For these variables, all the formats (compared to Probability) made participants experience higher negative emotional reactions, while the effect was limited to Raw (p=.033) and Absolute value (p = .013) formats for Affective Risk. No direct effect of the Mortality Rate Format could be detected for the other component of risk and for Behavioral Intentions, which led us to reject H1c and partially H1b (See Appendix 2 section "Results" for the regressions on Deliberative Risk and Behavioral Intentions).

Table 10. Regression model of the effect of Mortality Rate Formats on Negative Emotions and Affective Risk.

Variable	B	SE	t	*p*	95%Cl LL	UL
			Negative Emotions			
Absolute	5.52	1.09	5.06	**<.001**	3.38	7.67
Raw	4.90	1.10	4.48	**<.001**	2.75	7.05
1 in X	3.73	1.09	3.42	**.001**	1.59	5.88
Verbal	4.37	1.09	3.40	**<.001**	2.22	6.51
Percentage	2.34	1.10	2.14	**.033**	.19	4.49
R^2	.054					
			Affective Risk			
Absolute	.30	.12	2.48	**.013**	.06	.54
Raw	.26	.12	2.14	**.033**	.02	.50
1 in X	.13	.12	1.14	.257	-.10	.38
Verbal	.16	.12	1.29	.199	-.08	.40
Percentage	.11	.12	.89	.373	-.13	.35
R^2	.013					

Note. Bold: Significant results, (reference group= Probability). Affective Risk and Deliberative Risk factors are standardized (z-scores; 1= highest risk perception, -1= lowest risk perception). Negative Emotions were assessed on a scale ranging from 1= "Not at all" to 5= "Extremely", and the scores of 10 items for the "Negative Emotions" scale were summed (50= highest score, 10= lowest score).

3.3.2 Path analysis for the effect of Mortality Rate Format on Behavioral Intentions

To test our hypotheses on the direct and indirect effect of risk format (i.e., planned contrasts; reference group: Probability) on COVID-19-related Behavioral Intentions (i.e., WHO guidelines, Social engagement, Insurance and Vaccine), with Negative Emotions and Risk (i.e., Affective and Deliberative Risk) as mediators (H2, H3a, and H3c)[8], we used the *sem* R function (package *lavaan*; Rosseel, 2012) to conduct a path analysis using structural equation modeling (SEM).

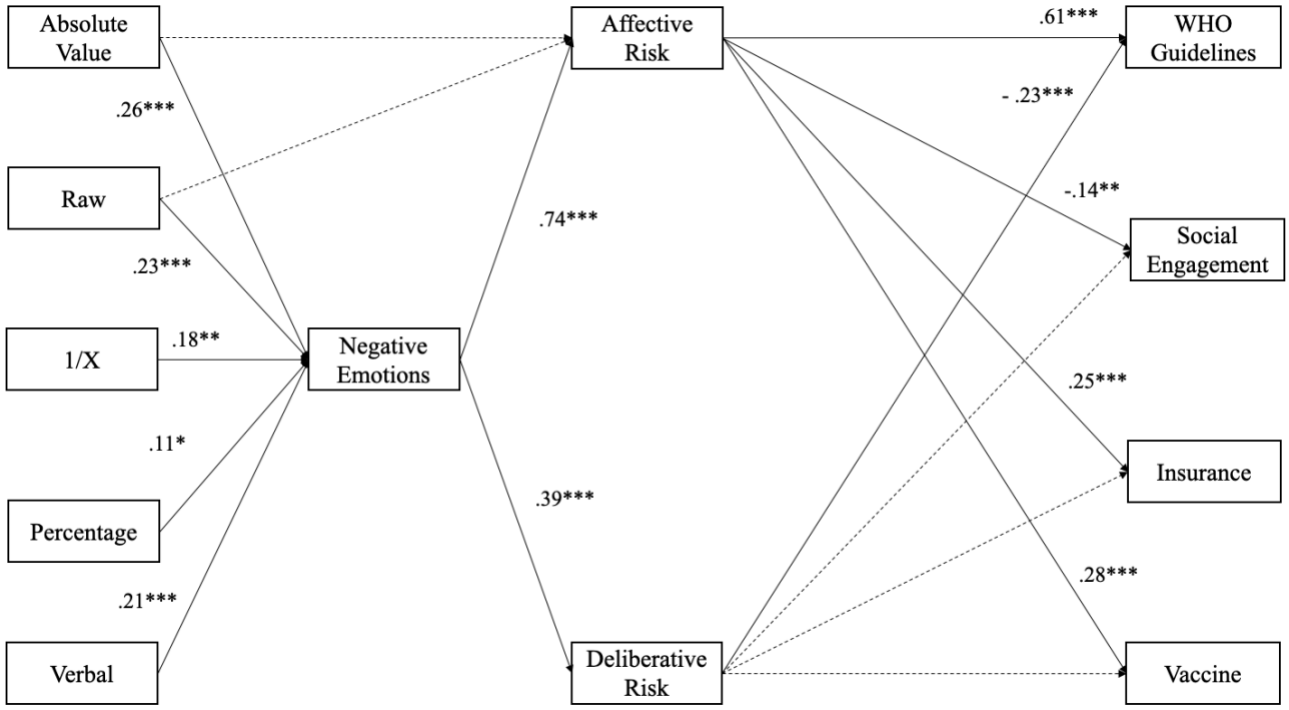
Specifically, we investigated the indirect effect of format on Behavioral Intentions mediated by Negative Emotions and Risk alongside the direct effect of Mortality Rate Format on Negative Emotions and the direct effect of the Absolute value and Raw format on Affective

[8] H3b was not tested because of the absence of the Experiential component of risk due to the PC analysis. We replicated all the analyses we ran with the new two components of Risk also for a three factors structure (i.e., Affective Risk, Deliberative Risk and Experiential Risk) and we reported them in the Appendix 3 in the section "Analyses 3 factors Risk".

Risk as a result of the regression analyses (Figure 3). In the model we controlled for the shared variance of the two components of Risk, by including correlation paths between the variables.

Our Path Model was not significantly worse than the fully specified model, (χ^2 (32, N = 604) = 28.34, p = .652), and showed good fit indices (RMSEA < .0001, p = 1.00, CFI = 1.000, BIC = 14262.2) according to Kline (2011).

Figure 3. Path model testing the direct and indirect effects of Mortality Rate Format and on Behavioral Intentions mediated by Negative Emotions and Risk. Coefficients presented are standardized. The dotted lines show non-significant direct paths. *p-value <.05, **p-value <.01, ***p-value <.001



3.3.3 The effect of Mortality Rate Format on Negative Emotions and Risk

Participants in each of the format conditions (i.e., Absolute value, Raw, 1/X, Percentage, Verbal) reported higher Negative Emotions than those in the Probability condition, replicating the results of the regressions. However, the direct association between the format and Affective Risk was not significant. Each of the formats (vs. Probability) of the COVID-19 mortality rate lead to higher risk perception (see Table 11). These findings partially confirm H1b showing

that the expected effect of mortality rate formats on Risk was not direct but mediated by Negative Emotions.

Table 11. Indirect effects of Mortality Rate Formats on Risk through Negative Emotions.

	Affective Risk	Deliberative Risk
Absolute Value	z = 5.00, p <.001, 95% CI [.27, .63]	z = 4.57, p <.001, 95% CI [.11, .27]
Raw	z = 4.43, p <.001, 95% CI [.22, .57]	z = 4.13, p <.001, 95% CI [.09, .25]
1/X	z = 3.41, p =.001, 95% CI [.13, .48]	z = 3.26, p =.001, 95% CI [.05, .21]
Percentage	z = 2.14, p =.032, 95% CI [.02, .36]	z = 2.11, p =.035, 95% CI [.006,.16]
Verbal	z = 3.97, p <.001, 95% CI [.18, .53]	z = 3.75, p <.001, 95% CI [.07, .23]

3.3.4 The indirect effect of Mortality Rate Format on Behavior

Participants in all format conditions (vs. Probability) perceived higher Negative Emotions, which was associated with higher Affective Risk perception, which in turn correlated with a higher willingness to comply with WHO-encouraged protective behaviors, lower willingness to engage socially, higher intentions to take out insurance and get vaccinated (see Table 12). However, the indirect path of format on Behavioral Intentions through Negative emotions and Deliberative Risk was significant only for WHO-encouraged behaviors. In line with H3c, when controlling for the affective components of Risk, higher Deliberative Risk was associated with lower intentions to follow the WHO-encouraged behaviors. Finally, compared to the other formats Percentage resulted in less significant indirect effects (i.e., no significant indirect effect on Social engagement) and presented the weakest indirect effects on Behavioral Intentions (e.g., p_s = .49, .47,.43; see Table 12).

Table 12. Indirect effects of Mortality Rate Formats on Behavioral Intentions through Negative Emotions and Risk

Mortality Rate Format	Negative Emotions	Risk	Behavioral Intentions	Indirect effect
Absolute Value	Negative Emotions	Affective Risk	WHO Guidelines	$z = 4.73$, $p < .001$, 95% CI [.18, .43]
			Social engagement	$z = -2.58$, $p = .010$, 95% CI [-.13, -.02]
			Insurance	$z = 3.64$, $p < .001$, 95% CI [.31, .20]
			Vaccine	$z = 3.87$, $p < .001$, 95% CI [.43, .29]
		Deliberative Risk	WHO Guidelines	$z = 3.54$, $p < .001$, 95% CI [.09, .06]
Raw	Negative Emotions	Affective Risk	WHO Guidelines	$z = 4.25$, $p < .001$, 95% CI [.15, .40]
			Social engagement	$z = -2.49$, $p = .013$, 95% CI [-.15, -.01]
			Insurance	$z = 3.41$, $p = .001$, 95% CI [.08, .28]
			Vaccine	$z = 3.59$, $p < .001$, 95% CI [.12, .40]
		Deliberative Risk	WHO Guidelines	$z = 3.32$, $p = .001$, 95% CI [.02, .09]
1/X	Negative Emotions	Affective Risk	WHO Guidelines	$z = 3.32$, $p = .001$, 95% CI [.08, .33]
			Social engagement	$z = -2.26$, $p = .024$, 95% CI [-.09, -.006]
			Insurance	$z = 2.87$, $p = .004$, 95% CI [.04, .23]
			Vaccine	$z = 2.98$, $p = .003$, 95% CI [.07, .32]
		Deliberative Risk	WHO Guidelines	$z = 2.82$, $p = .005$, 95% CI [.01, .07]
Percentage	Negative Emotions	Affective Risk	WHO Guidelines	$z = 2.12$, $p = .034$, 95% CI [.01, .25]
			Insurance	$z = 1.99$, $p = .047$, 95% CI [.001, .17]
			Vaccine	$z = 2.02$, $p = .043$, 95% CI [.004, .24]
		Deliberative Risk	WHO Guidelines	$z = 1.97$, $p = .049$, 95% CI [.000, .05]
Verbal	Negative Emotions	Affective Risk	WHO Guidelines	$z = 3.84$, $p < .001$, 95% CI [.12, .36]
			Social engagement	$z = -2.40$, $p = .016$, 95% CI [-.10, -.01]
			Insurance	$z = 3.18$, $p = .001$, 95% CI [.06, .26]
			Vaccine	$z = 3.33$, $p = .001$, 95% CI [.09, .36]
		Deliberative Risk	WHO Guidelines	$z = 3.11$, $p = .002$, 95% CI [.02, .08]

Note. Only significant effects are presented in the table.

3.3.5 The effect of Risk on Behavior

We found that people who reported higher Negative Emotions also reported higher Risk perception. However, the direct effect of the two components of Risk on our behavioral measures varied. People who perceived a higher Affective Risk (H3a) reported to be more willing to engage in protective behaviors encouraged by the WHO, to engage less socially, more likely take out insurance and to be more willing to get vaccinated. However, as predicted, once controlled for the affective components of risk, those who perceived a higher Deliberative risk (H3c) also reported to be less willing to engage in WHO-encouraged protective behaviors. Deliberative Risk did not have a direct significant effect on any other outcome variable.

3.4 Discussion

The present study investigated whether different formats used to report COVID-19 mortality rates can influence people's negative anticipatory emotional reactions, risk perception, and, in turn, their willingness to engage in protective behaviors to reduce the spread of the virus. As the COVID-19 pandemic represents an unprecedented challenge for risk analysts at a societal and public policy level, it is vital to understand how and why people's risk perception differs. Several ways can be used to communicate risk, and each of them can have a different effect on people's appraisal of the situation and behavioral response (Fagerlin et al., 2007; Timmermans & Oudhoff, 2011; Visschers et al., 2009). In our systematic approach, we tested the effect of six different formats used by the Italian media to report mortality rates and different risk dimensions (i.e., affective and deliberative risk) on several behavioral intentions.

Our results showed that mortality rates expressed as probability (e.g., a risk of 0.0017 of dying) led to lower negative emotions towards the COVID-19 mortality rate compared to all other tested risk communication formats. Additionally, the SEM analysis showed that people in the probability format condition reported lower risk perception compared to all other formats. These findings are in line with our hypotheses (H1a, H1b) and with extant literature that showed that risk information expressed in probability formats elicits the least emotional reactions and risk perception, possibly due to a lower ability of this kind of mortality rate format to elicit mental images of the event (Koehler & Macchi, 2004; Newell et al., 2008; Peters et al., 2006; Purchase & Slovic, 1999; Slovic et al., 2000; Timmermans et al., 2008; Timmermans & Oudhoff, 2011; Visschers et al., 2009). Moreover, path analyses showed that anticipatory emotional reactions mediated the effect of the Mortality Rate Formats on risk perception. Perhaps unsurprisingly, these negative emotional reactions more strongly predicted Affective Risk than Deliberative Risk. It should be noted, however, that our measure of emotional reaction towards the mortality rate is conceptually different from the Affective Risk component. Whereas the emotional reaction to the mortality rate represents anticipatory negative emotions (i.e., how people feel when presented with the risk), the Affective Risk component captures how people feel when anticipating the negative consequences of the risk (i.e., contracting COVID-19). Overall, our results align with prior research that posits affect and emotions as primary drivers for risk perceptions (Finucane et al., 2000; Loewenstein et al., 2001; Slovic et al., 2002, 2004).

As hypothesized (H2), our findings also showed that Mortality Rate Formats indirectly affected participants' intention to protect themselves and others through the

mediation of both emotional reactions and perceived risk. Specifically, we found that those who were presented with the mortality rates expressed as probability (compared to all other formats) reported lower negative emotions and perceived risk which in turn led to lower intention to comply with WHO-encouraged protective behaviors, getting vaccinated, and taking out an insurance. This indirect effect of Mortality Rate Formats on behavioral intention is in line with previous studies that showed how different frames (e.g., positive vs negative framing; equivalence vs emphasis framing) used to report information about the COVID-19 outbreak influence citizens' compliance with mitigation measures through the effect of negative emotional reaction and risk perception (Hameleers, 2021; Hameleers & Boukes, 2021; Reinholtz et al., 2021; Vacondio et al., 2021; van Bavel et al., 2020).

Our results also confirm our hypotheses (H3a and H3c), showing that the link between the two risk dimensions and behavioral intentions varied. Whereas higher affective risk perception was associated with higher intentions to engage in self-protective behaviors, higher deliberative risk perception was related to lower willingness to protect oneself. This result is in line with those from Ferrer and colleagues (2016) in which deliberative risk perception and intention to protect against cancer were negatively associated. The authors explained this apparently counterintuitive finding by speculating that, contrary to an affective (or experiential) risk perception, a deliberative assessment of risk might be related to an accurate estimation of one's own future risk of getting sick. Our results lead us to speculate about another possible reason why Deliberative Risk is negatively correlated with protective behavior. Although Deliberative Risk was originally designed to capture the reason-based perceived probability of being exposed to a negative event (Ferrer et al., 2016), it seems likely that this perception is influenced by anticipatory affect related to the communication of the risk and also that the likelihood estimations of the consequences are difficult to perform without using anticipated affective inputs. This interpretation is in line with prior work showing that probability weights are different for affect rich and affect poor outcomes (Rottenstreich & Hsee, 2001). In line with this interpretation is the fact that in our study the bivariate correlations between Deliberative Risk and the Behavioral Intentions were initially positive and only reversed when the affective component of risk was controlled for in the path analysis. Finally, although our Deliberative Risk dimension included items from the Experiential Risk dimension, which could have inadvertently caused this reversal, we find the same results when using the original three-factor solution proposed by Ferrer and colleagues (see Appendix 2 section "Analyses 3 factors Risk"). Results from the present study highlight the importance of conceptualizing risk as a multifaceted phenomenon (Wilson et al., 2019) and provide evidence of the fact that numerical

information primarily influences the emotional and affective components of risk perception and consequent behavior in line with the "*risk as feeling*" framework (Slovic et al., 2004). This finding is particularly noteworthy considering the fact that in the present study we explicitly manipulated the likelihood of dying which is one of the main components of deliberative assessment of risk.

Our results also have important practical and ethical implications. For instance, policy makers should avoid communicating risk information using probability formats if they want to increase the chances that citizens comply with protective measures by enhancing their emotional reactions and risk perception. When their goal is the opposite, they should prefer probability formats instead. This showcases that there is often not one "correct" way to communicate risks in times of crises. As perceived risk always has a strong subjective component, "objective" risks are usually subjectively interpreted and can lead to different emotional and behavioral reactions. The COVID-19 pandemic has challenged public policy and risk management to find effective, but responsible, ways to increase protective behavior on a large scale. Results from the present study thus offer valuable insights to help risk analysts and policy makers facing the challenge posed by the actual pandemic and potential future ones.

Finally, in contrast with previous research, in our study we did not find the "1 in X effect" (Pighin et al., 2011). Reading the mortality rate expressed as 1 in X did not elicit higher negative emotions, risk perception, or intention to engage in self-protective behaviors in our participants compared to those who read the information expressed as probability. Our results corroborate findings from a metanalysis by Sirota and colleagues (2014) according to which the 1 in X effect might be smaller and not always significant as originally suggested. The authors attributed this to potential publication bias of negative results.

3.4.1 Limitations and future direction

In our study, we showed that mortality rate formats can have different indirect effects on different types of behavioral intentions to protect oneself and others from COVID-19. Although our results extended the literature by disentangling the effect of Mortality Rate Formats on a more diversified set of behaviors, it is important to note that we tested behavioral intentions only, not actual behavior. Previous literature has shown that, in health-related contexts, the willingness to behave can be an effective indicator of real-life behaviors, especially when people perceive little control over a situation, such as the COVID-19 pandemic (Austin et al., 2021; Gibbons, 2008; Webb & Sheeran, 2006). However, meta-analytic evidence shows that

medium to large changes in behavioral intentions correspond to small to medium changes in actual behaviors (Webb & Sheeran, 2006). It is therefore advisable that future studies will replicate our results assessing actual behaviors.

Although in the present study we tested the effect of several formats presenting mortality rate data, risk information can also be reported in form of graphs, using positive (vs. negative) information, or presenting different groupings of data or changes over time. Previous research demonstrated that graphical information can be a powerful tool, if correctly designed, for teaching and communicating in several domains (Franconeri et al., 2021; Visschers et al., 2009). Research in the health field also showed that compared to only textual information the addition of graphical representation can help increasing accuracy of understanding health-related risks (Waters et al., 2006). Moreover, previous literature showed that positive numerical information (i.e., number of recovered; vs. negative i.e., number of deaths related to COVID-19) can lead to lower negative emotions and lower risk perception towards COVID- 19 pandemic (Vacondio et al., 2021). Finally, a recent study from Reinholtz and colleagues (2021) showed how presenting COVID-19 data as *stock* (i.e., the cumulative number of total cases) leads to higher risk appraisal and protective behavioral intentions compared to when the same data is reported as *flow* (i.e., the number of new infections per day), especially when the former is still increasing but the latter is decreasing. Future studies should thus test the effect of graphical methods, positive information and different grouping to report data of the outbreak on risk perception and behavioral intentions, as well as on emotional reactions.

Finally, in the present study we focused on the COVID-19 outbreak and people's response to it. However, it is important to test whether our findings can be replicated and applied to other risky contexts (e.g., other medical causes, natural disasters, wars and terrorism).

Taken together, our findings contribute to the literature related to how different ways of reporting health-related information can shape people's emotional reactions and risk appraisals and consequently their behaviors. Moreover, they also give important suggestions to practitioners, media outlets, and politicians on how to increase the chances that citizens will accept and adopt specific protective behaviors.

References

Austin, E. W., Austin, B. W., Willoughby, J. F., Amram, O., & Domgaard, S. (2021). How Media Literacy and Science Media Literacy Predicted the Adoption of Protective Behaviors Amidst the COVID-19 Pandemic. *Journal of Health Communication*, *26*(4), 239–252. https://doi.org/10.1080/10810730.2021.1899345

Balog-Way, D., McComas, K., & Besley, J. (2020). The Evolving Field of Risk Communication. *Risk Analysis*, *40*(S1), 2240–2262. https://doi.org/10.1111/risa.13615

Biagio, S. (2021). *Tracciamento, che fine ha fatto la app Immuni?* Il Sole 24 Ore. https://24plus.ilsole24ore.com/art/tracciamento-che-fine-ha-fatto-app-immuni-AEOuIcG

Bowling, A. (2005). Just one question: If one question works, why ask several? *Journal of Epidemiology & Community Health*, *59*(5), 342–345. https://doi.org/10.1136/jech.2004.021204

Brewer, N. T. (2011). Goals. In B. Fischoff, N. T. Brewer, & J. Downs (Eds.), *Communicating risks and benefits: An evidence-based users guide,* (pp. 3–10). Rockville, MD: Food and Drug Administration (FDA), US Department of Health and Human Services.

Brewer, N. T., Chapman, G. B., Gibbons, F. X., Gerrard, M., McCaul, K. D., & Weinstein, N. D. (2007). Meta-analysis of the relationship between risk perception and health behavior: The example of vaccination. *Health Psychology*, *26*(2), 136–145. https://doi.org/10.1037/0278-6133.26.2.136

Brug, J., Aro, A. R., Oenema, A., de Zwart, O., Richardus, J. H., & Bishop, G. D. (2004). SARS Risk Perception, Knowledge, Precautions, and Information Sources, the Netherlands. *Emerging Infectious Diseases*, *10*(8), 1486–1489. https://doi.org/10.3201/eid1008.040283

Covey, J. (2007). A Meta-analysis of the Effects of Presenting Treatment Benefits in Different Formats. *Medical Decision Making*, *27*(5), 638–654. https://doi.org/10.1177/0272989X07306783

Dickert, S., Västfjäll, D., Mauro, R., & Slovic, P. (2014). The feeling of risk. *The SAGE handbook of risk communication*, 41-54.

DeSalvo, K. B., Fan, V. S., McDonell, M. B., & Fihn, S. D. (2005). Predicting Mortality and Healthcare Utilization with a Single Question. *Health Services Research*, *40*(4), 1234–1246. https://doi.org/10.1111/j.1475-6773.2005.00404.x

Fagerlin, A., Ubel, P. A., Smith, D. M., & Zikmund-Fisher, B. J. (2007). Making Numbers Matter: Present and Future Research in Risk Communication. *American Journal of Health Behavior*, *31*(1), S47–S56.

Ferrer, R. A., Klein, W. M. P., Persoskie, A., Avishai-Yitshak, A., & Sheeran, P. (2016). The Tripartite Model of Risk Perception (TRIRISK): Distinguishing Deliberative, Affective, and Experiential Components of Perceived Risk. *Annals of Behavioral Medicine*, *50*(5), 653–663. https://doi.org/10.1007/s12160-016-9790-z

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. https://doi.org/10.1002/(SICI)1099-0771(200001/03)13:1<1::AID-BDM333>3.0.CO;2-S

Franconeri, S. L., Padilla, L. M., Shah, P., Zacks, J. M., & Hullman, J. (2021). The Science of Visual Data Communication: What Works. *Psychological Science in the Public Interest*, *22*(3), 110–161. https://doi.org/10.1177/15291006211051956

Freeman, A. L. J., Kerr, J., Recchia, G., Schneider, C. R., Lawrence, A. C. E., Finikarides, L., Luoni, G., Dryhurst, S., & Spiegelhalter, D. (2021). Communicating personalized risks

from COVID-19: Guidelines from an empirical study. *Royal Society Open Science*, *8*(4), 201721. https://doi.org/10.1098/rsos.201721

Fuchs, C., & Diamantopoulos, A. (2009). Using single-item measures for construct measurement in management research. *Die Betriebswirtschaft*, *96*(2), 16.

Gibbons, F. X. (2008, April 28). Intention, expectation, and willingness. National Cancer Institute. Retrieved from: June 10, 2020 https://cancercontrol.cancer.gov/brp/research/constructs/intent-expect-willingness.htm

Goodwin, R., Gaines, S. O., Myers, L., & Neto, F. (2011). Initial Psychological Responses to Swine Flu. *International Journal of Behavioral Medicine*, *18*(2), 88–92. https://doi.org/10.1007/s12529-010-9083-z

Hameleers, M. (2021). Prospect Theory in Times of a Pandemic: The Effects of Gain versus Loss Framing on Risky Choices and Emotional Responses during the 2020 Coronavirus Outbreak – Evidence from the US and the Netherlands. *Mass Communication and Society*, *24*(4), 479–499. https://doi.org/10.1080/15205436.2020.1870144

Hameleers, M., & Boukes, M. (2021). The Effect of Gain-versus-Loss Framing of Economic and Health Prospects of Different COVID-19 Interventions: An Experiment Integrating Equivalence and Emphasis Framing. *International Journal of Public Opinion Research*, *33*(4), 927–945. https://doi.org/10.1093/ijpor/edab027

Jie, Y. (2022). Frequency or total number? A comparison of different presentation formats on risk perception during COVID-19. *Judgment and Decision Making*, *17*(1), 215–237. https://go.gale.com/ps/i.do?p=AONE&sw=w&issn=19302975&v=2.1&it=r&id=GALE%7CA693956270&sid=googleScholar&linkaccess=abs

Keinan, R., Idan, T., & Bereby-Meyer, Y. (2021). Compliance with COVID-19 prevention guidelines: Active vs. Passive risk takers. *Judgment and Decision Making*, *16*(1), 16.

Kim, C. W., & Song, H. R. (2017). Structural Relationships among Public's Risk Characteristics, Trust, Risk Perception and Preventive Behavioral Intention—The Case of MERS in Korea -. *Crisis and Emergency Management*, *13*(6), 85–95. https://doi.org/10.14251/crisisonomy.2017.13.6.85

Kline, R. B. (2011). "Convergence of structural equation modeling and multilevel modeling," in *The SAGE Handbook of Innovation in Social Research Methods,* eds M.Williams and W. P. Vogt (Ann Arbor, MI: Sage), 562–589. doi: 10.4135/ 9781446268261.n31

Koehler, J. J., & Macchi, L. (2004). Thinking About Low-Probability Events: An Exemplar-Cuing Theory. *Psychological Science*, *15*(8), 540–546. https://doi.org/10.1111/j.0956-7976.2004.00716.x

Leppin, A., & Aro, A. R. (2009). Risk Perceptions Related to SARS and Avian Influenza: Theoretical Foundations of Current Empirical Research. *International Journal of Behavioral Medicine*, *16*(1), 7–29. https://doi.org/10.1007/s12529-008-9002-8

Loewenstein, G., Weber, E., Hsee, C., & Welch, N. (2001). Risk as Feelings. *Psychological Bulletin*, *127*(2), 267–286. insights.ovid.com

Manika, D., Dickert, S., & Golden, L. L. (2021). Check (it) yourself before you wreck yourself: The benefits of online health information exposure on risk perception and intentions to protect oneself. *Technological Forecasting and Social Change*, *173*, 121098. https://doi.org/10.1016/j.techfore.2021.121098

Ministero della salute. (2021). *COVID-19 Report monitoraggio.* https://www.salute.gov.it/portale/nuovocoronavirus/homeNuovoCoronavirus.jsp

Newell, B. R., Mitchell, C. J., & Hayes, B. K. (2008). Getting scarred and winning lotteries: Effects of exemplar cuing and statistical format on imagining low-probability events. *Journal of Behavioral Decision Making*, *21*(3), 317–335. https://doi.org/10.1002/bdm.584

Peters, E., Västfjäll, D., Slovic, P., Mertz, C. K., Mazzocco, K., & Dickert, S. (2006). Numeracy and Decision Making. *Psychological Science*, *17*(5), 407–413. https://doi.org/10.1111/j.1467-9280.2006.01720.x

Pezzullo, P. C., & Cox, R. (2017). *Environmental Communication and the Public Sphere*. SAGE Publications.

Pighin, S., Savadori, L., Barilli, E., Cremonesi, L., Ferrari, M., & Bonnefon, J.-F. (2011). The 1-in-X Effect on the Subjective Assessment of Medical Probabilities. *Medical Decision Making*, *31*(5), 721–729. https://doi.org/10.1177/0272989X11403490

Purchase, I. F. H., & Slovic, P. (1999). Quantitative Risk Assessment Breeds Fear. *Human and Ecological Risk Assessment: An International Journal*, *5*(3), 445–453. https://doi.org/10.1080/10807039.1999.10518869

Reinholtz, N., Maglio, S. J., & Spiller, S. A. (2021). Stocks, flows, and risk response to pandemic data. *Journal of Experimental Psychology: Applied*, *27*(4), 657–668. https://doi.org/10.1037/xap0000395

Rickard, L. N. (2021). Pragmatic and (or) Constitutive? On the Foundations of Contemporary Risk Communication Research. *Risk Analysis*, *41*(3), 466–479. https://doi.org/10.1111/risa.13415

Rosseel, Y. (2012). lavaan: An R Package for Structural Equation Modeling. *Journal of Statistical Software*, *48*, 1–36. https://doi.org/10.18637/jss.v048.i02

Rottenstreich, Y., & Hsee, C. K. (2001). Money, Kisses, and Electric Shocks: On the Affective Psychology of Risk. *Psychological Science*, *12*(3), 185–190. https://doi.org/10.1111/1467-9280.00334

Rubin, G. J., Amlôt, R., Page, L., & Wessely, S. (2009). Public perceptions, anxiety, and behaviour change in relation to the swine flu outbreak: Cross sectional telephone survey. *BMJ*, *339*. https://doi.org/10.1136/bmj.b2651

Savadori, L., & Lauriola, M. (2021). Risk Perception and Protective Behaviors During the Rise of the COVID-19 Outbreak in Italy. *Frontiers in Psychology*, *11*, 3822. https://doi.org/10.3389/fpsyg.2020.577331

Setbon, M., & Raude, J. (2010). Factors in vaccination intention against the pandemic influenza A/H1N1. *European Journal of Public Health*, *20*(5), 490–494. https://doi.org/10.1093/eurpub/ckq054

Shoots-Reinhard, B., Lawrence, E. R., Schulkin, J., & Peters, E. (2022). Excluding numeric side-effect information produces lower vaccine intentions. *Vaccine*, *40*(31), 4262–4269. https://doi.org/10.1016/j.vaccine.2022.06.001

Siegrist, M. (2021). Trust and Risk Perception: A Critical Review of the Literature. *Risk Analysis*, *41*(3), 480–490. https://doi.org/10.1111/risa.13325

Siegrist, M., & Árvai, J. (2020). Risk Perception: Reflections on 40 Years of Research. *Risk Analysis*, *40*(S1), 2191–2206. https://doi.org/10.1111/risa.13599

Sinayev, A., Peters, E., Tusler, M., & Fraenkel, L. (2015). Presenting Numeric Information with Percentages and Descriptive Risk Labels: A Randomized Trial. *Medical Decision Making*, *35*(8), 937–947. https://doi.org/10.1177/0272989X15584922

Sirota, M., & Juanchich, M. (2019). Ratio Format Shapes Health Decisions: The Practical Significance of the "1-in-X" Effect. *Medical Decision Making*, *39*(1), 32–40. https://doi.org/10.1177/0272989X18814256

Sirota, M., Juanchich, M., & Bonnefon, J.-F. (2018). «1-in-X» bias: «1-in-X» format causes overestimation of health-related risks. *Journal of Experimental Psychology. Applied*, *24*(4), 431–439. https://doi.org/10.1037/xap0000190

Sirota, M., Juanchich, M., Kostopoulou, O., & Hanak, R. (2014). Decisive Evidence on a Smaller-Than-You-Think Phenomenon: Revisiting the "1-in-X" Effect on Subjective

Medical Probabilities. *Medical Decision Making*, *34*(4), 419–429. https://doi.org/10.1177/0272989X13514776

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. https://doi.org/10.1111/j.0272-4332.2004.00433.x

Slovic, P., Finucane, M., Peters, E., & MacGregor, D. G. (2002). Rational actors or rational fools: Implications of the affect heuristic for behavioral economics. *The Journal of Socio-Economics*, *31*(4), 329–342. https://doi.org/10.1016/S1053-5357(02)00174-9

Slovic, P., Monahan, J., & MacGregor, D. G. (2000). Violence Risk Assessment and Risk Communication: The Effects of Using Actual Cases, Providing Instruction, and Employing Probability Versus Frequency Formats. *Law and Human Behavior*, *24*(3), 271–296. https://doi.org/10.1023/A:1005595519944

Timmermans, D., Ockhuysen-Vermey, C. W., & Henneman, L. (2008). Presenting health risk information in different formats: The effect on participants' cognitive and emotional evaluation and decisions. *Patient Education and Counseling*, *73*(3), 443–447. https://doi.org/10.1016/j.pec.2008.07.013

Timmermans, D., & Oudhoff, J. (2011). Different Formats for the Communication of Risks: Verbal, Numerical, and Graphical Formats. In *Wiley Encyclopedia of Operations Research and Management Science*. American Cancer Society. https://doi.org/10.1002/9780470400531.eorms0954

Vacondio, M., Priolo, G., Dickert, S., & Bonini, N. (2021). Worry, Perceived Threat and Media Communication as Predictors of Self-Protective Behaviors During the COVID-19 Outbreak in Europe. *Frontiers in Psychology*, *12*, 231. https://doi.org/10.3389/fpsyg.2021.577992

van Bavel, J. J., Baicker, K., Boggio, P. S., Capraro, V., Cichocka, A., Cikara, M., Crockett, M. J., Crum, A. J., Douglas, K. M., Druckman, J. N., Drury, J., Dube, O., Ellemers, N., Finkel, E. J., Fowler, J. H., Gelfand, M., Han, S., Haslam, S. A., Jetten, J., … Willer, R. (2020). Using social and behavioural science to support COVID-19 pandemic response. *Nature Human Behaviour*, *4*(5), 460–471. https://doi.org/10.1038/s41562-020-0884-z

Visschers, V. H. M., Meertens, R. M., Passchier, W. W. F., & De Vries, N. N. K. (2009). Probability Information in Risk Communication: A Review of the Research Literature. *Risk Analysis*, *29*(2), 267–287. https://doi.org/10.1111/j.1539-6924.2008.01137.x

Waters, E. A., Weinstein, N. D., Colditz, G. A., & Emmons, K. (2006). Formats for Improving Risk Communication in Medical Tradeoff Decisions. *Journal of Health Communication*, *11*(2), 167–182. https://doi.org/10.1080/10810730500526695

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology*, *54*(6), 1063–1070. https://doi.org/10.1037//0022-3514.54.6.1063

Webb, T. L., & Sheeran, P. (2006). Does changing behavioral intentions engender behavior change? A meta-analysis of the experimental evidence. *Psychological Bulletin*, *132*(2), 249–268. https://doi.org/10.1037/0033-2909.132.2.249

Wilson, R. S., Zwickle, A., & Walpole, H. (2019). Developing a Broadly Applicable Measure of Risk Perception. *Risk Analysis*, *39*(4), 777–791. https://doi.org/10.1111/risa.13207

Wismans, A. B., Letina, S., Thurik, R., Wennberg, K., Baptista, R., Barrientos Marín, J., Block, J., Burke, A., Dejardin, M., Janssen, F., Mukerjee, J., Santarelli, E., Millán, J. M., & Torrès, O. (2020). Hygiene and Social Distancing as Distinct Public Health Related Behaviours Among University Students During the COVID-19 Pandemic. *Social Psychological Bulletin*, *15*(4). https://doi.org/10.32872/spb.4383

Yamagishi, K. (1997). When a 12.86% mortality is more dangerous than 24.14%: Implications for risk communication. *Applied Cognitive Psychology*, *11*(6), 495–506. https://doi.org/10.1002/(SICI)1099-0720(199712)11:6<495::AID-ACP481>3.0.CO;2-J

Zipkin, D. A., Umscheid, C. A., Keating, N. L., Allen, E., Aung, K., Beyth, R., Kaatz, S., Mann, D. M., Sussman, J. B., Korenstein, D., Schardt, C., Nagi, A., Sloane, R., & Feldstein, D. A. (2014). Evidence-Based Risk Communication. *Annals of Internal Medicine*, *161*(4), 270–280. https://doi.org/10.7326/M14-0295

Chapter 4[9]

Beware the inexperienced financial advisor with a high trait emotional intelligence: Psychological determinants of the misperception of the risk-return relationship

Abstract: According to financial theories, on the long run, taking risk should reward investors with higher returns. However, most investors perceive this relationship as negative. In this study, we showed that even professional financial advisors misperceived the risk-returns relationship, and we investigated the psychological determinants of this misperception in professionals. Specifically, we assessed the role of feelings towards the financial market, trait emotional intelligence (EI), and trading experience. Our results showed that financial advisors with high (vs. low) trait EI were more impacted by their feelings when estimating expected returns. Specifically, inexperienced advisors with high (vs. low) trait EI are more likely to expect a negative relationship between risks and returns. Our findings shed light on the need to educate professionals on their reliance on emotions in financial judgments.

Keywords: Risk, Expected returns, Trait emotional intelligence, Experience, Affect heuristic Financial advisor

[9] A version of this chapter has been published in Personality and Individual Differences, and should be cited as Priolo, G., Vacondio, M., Bernasconi, S. M., & Rubaltelli, E. (2022). Beware the inexperienced financial advisor with a high trait emotional intelligence: Psychological determinants of the misperception of the risk-return relationship. *Personality and Individual Differences*, *188*, 111458, https://doi.org/10.1016/j.paid.2021.111458. The paper is distributed as an open access article under the Creative Commons Attribution License. The study has been conducted in collaboration with Prof. Enrico Rubaltelli (Department of Developmental Psychology and Socialization, University of Padova, Italy), Dott. Giulia Priolo (Department of Psychology and Cognitive Sciences, University of Trento, Rovereto, Italy) and Sara Bernasconi (Department of Developmental Psychology and Socialization, University of Padova, Italy). Dott. Vacondio and Dott. Priolo have contributed equally to this work and share the first authorship.

4.1 Introduction

One of the main principles of financial theories is that, over long-time horizons and through efficient diversification, risk and returns are usually positively correlated, thus implying that rational investors are willing to trade off a stock's risk and expected returns (Sharpe, 1964; Shefrin, 2001). This is because objective risk is a measure of the distribution of possible outcomes of an alternative; as a result, a riskier investment offers a larger distribution of possible results that should include larger gains as well as larger losses compared to a safer investment whose expected returns will not vary too much (Ganzach, 2000). However, laypeople (MacGregor et al., 2000; Rubaltelli et al., 2010), as well as high-net-worth investors (Statman et al., 2008), do not perceive risk in terms of the distribution of possible outcomes but focus excessively on the likelihood of incurring in a negative outcome or an outcome that is below some reference point (downside risk; Fishburn, 1977; Miller & Reuer, 1996). This leads many investors to perceive a negative correlation between the risk and the expected returns of investments (Alhakami & Slovic, 1994; Ganzach, 2000; Oehler & Wedlich, 2018; Statman et al., 2008). For instance, imagine Mr. Gray, who is looking to invest in a stock fund and is conflicted on what to do. He has a feeling that stocks are quite risky, and he does not expect them to have particularly good performance, although he seems to remember that financial theories state that risk and returns are positively correlated. Ultimately, he is reluctant to invest in high-risk assets, thus potentially missing good investment opportunities.

An explanation for this misperception is based on the affect heuristic. The affect heuristic (Slovic et al., 2004) states that people tend to base their judgments about risk and returns on affective cues. People tend to associate highly risky events or behaviors (e.g., an investment in stocks) with negative feelings and use these affective reactions to judge their returns which, consequently, are perceived as low. In finance, this misperception leads many investors to biased judgments (Kempf et al., 2014; Statman et al., 2008) and potentially unfavorable or too conservative investments behaviors, such as buying when the market is high and selling when it is low (thus, failing to take advantage of a contrarian investment strategy; Friesen & Sapp, 2007) or underinvest in stocks (Siegel & Thaler, 1997). However, individual investors such as Mr. Gray can rely on professional financial advisors whose job is to manage their clients' money and should therefore be more expert about investments and the financial market's dynamics.

Nevertheless, to the best of our knowledge, no previous studies investigated whether professional financial advisors are actually less susceptible to these affective biases. Previous research on the misperception of the risk and returns correlation indeed focused on students

(Kempf et al., 2014; Oehler & Wedlich, 2018) and high net-worth investors (Statman et al., 2008). Thus, the aim of this study is to investigate if professional financial advisors misperceive the risk-return relationship too and investigate the psychological determinants of this misperception in professionals. Specifically, we will assess the role played by a series of variables that pertain to how professionals perceive and manage their emotions and their experience.

Since the misperception of the risk-return relationship in financial investments is an affect-driven bias, we can expect that people's management and regulation of their emotions play a relevant role in their judgments. Past work has linked people's trait emotional intelligence (EI) to investment decision-making (Rubaltelli et al., 2016). Trait EI is defined as a set of emotion-related self-perceptions and dispositions located at the lowest level of personality hierarchies (Petrides et al., 2007). Higher trait EI has been linked to higher sensitivity to environmental emotional cues (Petrides & Furnham, 2003), better stress management (Petrides et al., 2006), and more accurate anticipation of emotions elicited by decisions' outcomes (Sevdalis et al., 2007). However, since it is a personality dimension, higher levels of trait EI correspond to a specific behavioral tendency that, depending on the context, can be either adaptive or maladaptive (Pena-Sarrionandia, et al., 2015). Better regulation of emotional reactions can indeed protect people from impulsive behaviors. However, when decisions are made under uncertainty and the reliability of other information is difficult to assess, emotions might be the only useful cue to make a forecast about future events (Duxbury et al., 2020; Griffith et al., 2020; Rubaltelli et al., 2010). As a result, people with high trait EI might be willing to let their emotions emerge and to rely on them, especially when they are unable to base their judgments on other, more diagnostic information (Pena-Sar-rionandia et al., 2015). However, in an uncertain environment like financial markets, relying too much on one's emotions can conflict with the tenets of financial theories and effective investment strategy. For instance, a study from Rubaltelli et al. (2016) showed how people with high (vs. low) trait EI were more willing to invest regardless of the expected value. As a result, when the expected value was positive, they gained money whereas when the expected value was negative, they lost money. Finally, investigating trait EI extends the literature on the role of individual differences in investment behavior (see, Oehler & Wedlich, 2018 for an assessment of the role played by personality traits).

This potential negative effect of trait EI might also be enhanced in conditions when individuals are unable to rely on other types of information, such as when experience is low. Indeed, experience is an important factor in investors' behavior. According to previous literature, more

(vs. less) experienced investors should be better able to understand the market and to judge the future returns independently from their feelings of the moment (Dvorak & Hanley, 2010; Frijns et al., 2014; Martin, 2019). Experienced investors have likely gone through different economic cycles, and they should have learned not to trust their gut feelings too much. Consistent, Barber and Odean (2000) showed that among financial professionals, experience leads to an increased proficiency to assess their trading ability. Further, when it comes to the risk and expected returns relationship, Ganzach (2000) showed a negative correlation but only for unfamiliar assets. This may hint that increasing experience (and familiarity with the market) should reduce the negative correlation between risk and expected returns.

Summarizing the literature reviewed so far, we know that based on the affect heuristic, investors are likely to perceive a negative correlation between risk and returns. In addition, when they have high (vs. low) trait EI, they should be more likely to attend to emotional cues to predict the future performance of the market. However, experience should reduce this tendency by making investors more aware of their past reliance on non-diagnostic information. Therefore, we make the following hypotheses:

Hypothesis 1. Increasing perception of risk associated with investing in a series of companies should lead to decreasing expected returns in professional financial advisors.

Hypothesis 2. Trait EI should moderate the effect of feelings on the perception of risk and expected returns. Specifically, the effect of the feelings towards the market should be stronger for professional financial advisors with high (vs. low) trait EI.

Hypothesis 3. The interaction between risk perception and trait EI should be moderated by professional trading experience. Specifically, the moderating effect of trait EI on the relationship between risk perception and expected returns should decrease as experience Increases.

4.2 Materials and methods

4.2.1 Participants

A total of 273 Italian participants (27% female, mean age = 49.72 yrs., SD = 9.43) took part in the study. Participants were recruited through TESEO Srl, an Italian consulting firm, and were primarily financial advisors. They received the link from TESEO Srl and answered

the questionnaire online. Participants who did not fully complete the survey were excluded from the sample. Thus, the final sample included 191 participants.

4.2.2 Materials and procedure

Data collection took place online between April 2 and May 23, 2019. After giving their informed consent participants completed a mental imagery task (Gavaruzzi et al., 2021; Rubaltelli et al., 2010) to measure their feelings towards the financial markets. They were presented with three words: stocks, bonds, and financial market. For each word, they were asked to rate the feelings these words evoked on a 9-point scale ranging from - 4 (extremely negative) to +4 (extremely positive). Then, participants were asked to rate their expectations about the future of the Italian economy three years from the day they completed the survey, on a 7-point scale ranging from 1 (absolutely gloomy) to 7 (absolutely optimistic). This measure was added to determine whether the participants' expectations about the future of their country's economy could influence the perception of risk and expected returns of an investment. Results can be found in Appendix 3. Afterwards, participants were also asked to evaluate, for the current year, the potential risk and expected returns (i.e., subjective estimate of an investment's returns) of investing in five large Italian companies listed in the Milan
Stock Exchange and familiar to the participants (Assicurazioni Generali, GEOX, Piaggio, Poste Italiane, Enel). Participants provided their ratings on a 10-point scale ranging from 1 (no risk/no return) to 10 (extreme risk/very high return). In the following section of the questionnaire, participants were presented with the short form of the Trait Emotional Intelligence questionnaire (TEIQue-SF, Petrides, 2009). This is a 30-item questionnaire using a 7-point response scale ranging from 1 (completely disagree) to 7 (completely agree). The items ask participants to selfreport their ability in regulating, expressing, and perceiving emotions (α = 0.89). The survey ended with the assessment of experience in active trading (number of years) and demographic questions (e.g., political orientation). Completion of the questionnaire took about 10 min.

4.3 Results

4.3.1 Preliminary analyses

Since the feelings evoked by the three items from the mental imagery task were correlated to each other, we averaged the answers to create a single score of feelings ($\alpha = 0.71$). Similarly, we computed a single score of expected returns by averaging participants' estimates

for the five companies they were asked to evaluate ($\alpha = 0.73$) and a score of risk of investing in each of the companies ($\alpha = 0.85$).

Consistent with Hypothesis 1, correlations showed that expected returns and risk were significantly and negatively correlated. Trait EI was significantly and positively related to both feelings towards the financial markets and expectations about the Italian economy. However, it was not correlated with either estimates of risk or expected returns. The years of experience did not correlate significantly with any of the variables in the matrix (Table 13).

Table 13. Correlations and descriptive statistics for the main variables.

	1.	2.	3.	4.	5.	Mean	SD
1. Trait EI	---					5.14	.74
2. Feelings	.18*	---				1.58	1.41
3. Economy	.20**	.29***	---			3.22	1.37
4.Expected return	-.14	.12	.20**	---		4.73	1.05
5. Risk	.05	.04	-.03	-.23**	---	5.64	1.57
6. Experience	.04	-.05	.00	-.02	.01	23.18	10.09

Note. *p< .05, **p< .01, ***p< .001

4.3.2 Expected returns and risk estimates

We first investigated whether the interaction between trait EI and feelings predicted expected returns estimates for the aggregated index of the five companies listed in the Italian stock market. Consistent with Hypothesis 2, results showed a significant effect of trait EI, as well as a significant effect of feelings (a second regression model, in which a series of covariates were introduced, is reported in Appendix 3). In addition, the interaction between trait EI and feelings was significant (Table 14).

Table 14. Predictors of expected returns estimates.

	B	*SE*	*t*	*p*	*β*	*95% C.I.*	
						LL	*UL*
Intercept	6.62	0.66	9.90	<0.001		5.30	7.95
Trait EI	-0.41	0.13	-3.08	0.002	-0.29	-0.68	-0.15
Feelings	-0.55	0.32	-1.72	0.088	-0.74	-1.17	0.08
Trait EI x Feelings	0.13	0.06	2.10	0.037	0.09	0.01	0.26
Adj. R^2	0.05						

A slope analysis showed that the effect of feelings on expected returns was significant for participants with high trait EI (B = 0.23, SE = 0.08, t = 2.96, p < .001) but not for those with low trait EI (B = 0.03, SE = 0.07, t = 0.51, p = .61). Increasingly negative feelings led people with high (vs. low) trait EI to estimate lower expected returns (Fig. 4).

We repeated the same analyses as above to assess whether the interaction between trait EI and feelings predicted participants' risk estimates for the aggregate index of the five companies listed in the Italian stock market. Results showed that none of the effects were significant in contrast with Hypothesis 2 (results can be found in Appendix 3).

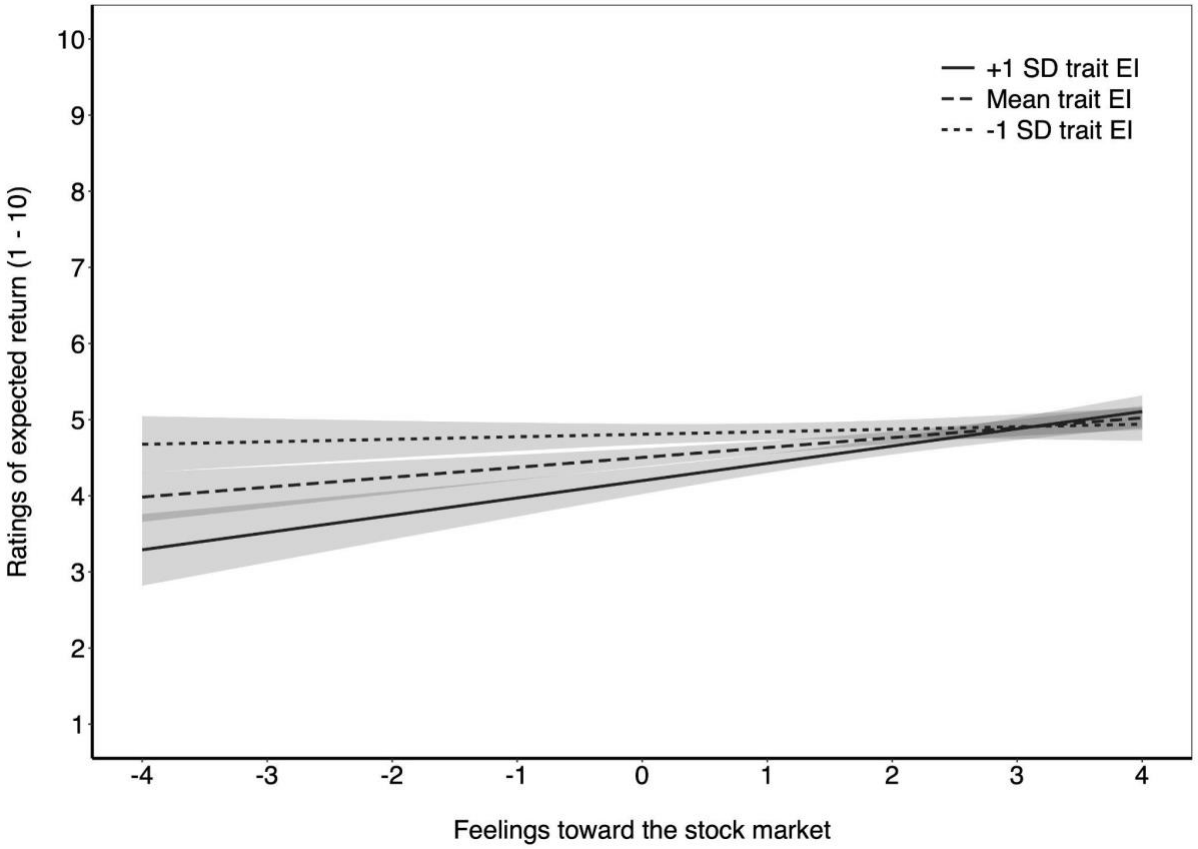


Figure 4. Interaction between trait EI and feelings towards the stock market predicting participants' estimates of the average expected return of five companies listed in the Italian stock market.

4.3.3 Risk-return correlation

Finally, we ran a linear regression with trait EI, risk estimates aggregated for the five companies, experience, all two-way interactions, and the three-way interaction between trait EI, risk, and experience with expected returns estimates as the dependent variable (Table 15; results for the five companies separately can be found in Appendix 3). Results showed main effects of trait EI, risk estimates, and experience. Significant effects emerged also for the interactions between trait EI and risk, trait EI and experience, and risk and experience. Finally, the three-way interaction was also significant.

Table 15. Predictors of expected returns.

	B	*SE*	*t*	*p*	*β*	*95% C.I.*	
						LL	*UL*
Intercept	-11.64	5.60	-2.08	0.039		-22.70	-0.58
Trait EI	3.28	1.05	3.12	0.002	2.25	1.20	5.36
Risk	3.16	0.91	3.47	<0.001	4.65	1.36	4.96
Experience	0.63	0.25	2.51	0.013	5.95	1.14	1.13
Trait EI x Risk	-0.63	0.17	-3.64	<0.001	-0.43	-0.97	-0.29
Trait EI x Experience	-0.12	0.05	-2.51	0.013	-0.18	-0.21	-0.03
Risk x Experience	-0.12	0.04	-2.88	0.004	-1.11	-0.20	-0.04
Trait EI x Risk x Experience	0.02	0.01	2.84	0.005	0.02	0.01	0.04
Adj. R^2	0.14						

We then ran a slope analysis to probe the three-way interaction between trait EI, risk estimates, and experience. Consistent with Hypothesis 3, results revealed that as experience increased the effect of the interaction between trait EI and risk on expected returns estimates decreased. For advisors who have low experience and judged the risk as high, we found a significant slope indicating that, those who have high (vs. low) trait EI are more likely to expect a negative correlation between risk and expected returns ($B = -0.80$, $SE = 0.20$, $t = -4.02$, $p < .001$; Fig. 5). Among low experience advisors, the effect of trait EI on expected returns estimates was not significant when participants judged the risk to be average ($p = .08$) or low ($p = .18$). For participants with high experience, instead, the effect of trait EI on expected returns estimates was never significant regardless of the estimates of the risk of the investment (ps = .44 or higher). In all these cases, an estimate of high risk led to the expectation of lower returns compared to when risk was estimated to be low (a second regression model, in which a series of covariates were introduced, is reported in the Appendix 3). The same analysis has been conducted with risk as the dependent variable and can be found in Appendix 3.

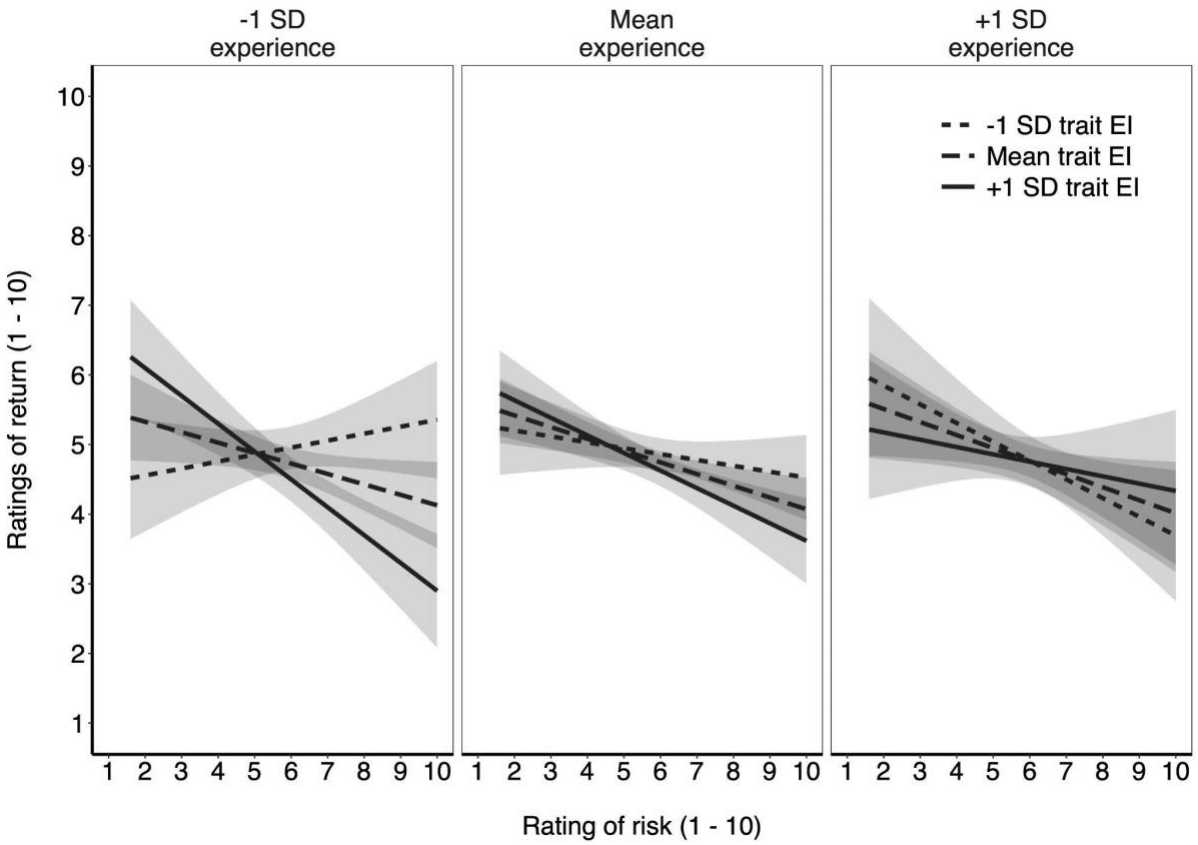


Figure 5. Three-way interaction between risk estimates, trait EI, and experience predicting expected return estimates.

4.4 Discussion

The aim of our study was to investigate the misperception of the relationship between risk and returns in professional financial advisors. Our results showed that they perceive a negative correlation, much like individual investors. Moreover, we found that this misperception is moderated by trait EI and years of experience. As experience increases, the impact of trait EI on the negative relationship between risk and returns decreases. This is a novel set of results which contributes to the literature on investment behavior and the role of individual differences in multiple ways.

First, we reported that professional financial advisors also show a biased perception of the risk-return relationship. This misperception is in line with the affect heuristic that shows how people often rely on their feelings to judge risk and benefits, which are often perceived as negatively correlated (Slovic et al., 2004). Consistently, the same has been found in the financial market, where investors perceive a negative relationship between risk and expected returns, despite the fact that historical data show a positive correlation between these two dimensions (Ganzach, 2000; Kempf et al., 2014; Statman et al., 2008). Nevertheless, previous

studies have been conducted with students or high-net worth investors. On the contrary, we used a sample of professional financial advisors who should be experts in in the actual dynamics of the financial market and are expected to base their judgments mostly on their economic knowledge.

Second, we showed that trait EI and feelings towards the financial market moderate the misperception for the risk-return relationship. When deciding on how to invest their clients' money, financial advisors are required to make predictions about the future outcomes of the assets. In a highly uncertain and complex environment such as the financial market, they are likely to experience a large set of emotional reactions. Research shows that, in the financial market, reliance on feelings can have a significant impact on financial decision making and potentially lead to mistakes (Duxbury et al., 2020; Griffith et al., 2020; MacGregor et al., 2000). Consistently we showed how financial advisors with high (vs. low) trait EI were more prone to use their feelings to estimate expected returns.

Third, we showed how the level of experience in trading plays an important role in the risk-return misperception, too. Specifically, our results showed a difference between advisors with high and low experience that, in turn, was moderated by their trait EI. Among all financial advisors, those with lower experience and high trait EI reported a more negative correlation between risk and expected returns. A possible interpretation of this finding is that, in a context characterized by high uncertainty, highly emotional intelligent but inexperienced advisors let their feelings emerge and guide their assessment of the market because they are not yet able to use other, more diagnostic cues. As a result, and consistent with the explanation based on the affect heuristic (Kempf et al., 2014; Statman et al., 2008), this leads to an exacerbation of their perception of the negative correlation between risk and expected returns. This interpretation is consistent with the fact that the effect of trait EI did not emerge for the more experienced financial advisors, likely because they have learned not to trust their emotional reaction but to rely more on other types of information (Martin, 2019). This result adds up to a line of research that highlights the potential maladaptive side of trait EI (Petrides, 2011), since higher sensitivity to one's own emotions leads less experienced advisors to rely more on affect, thus enhancing their misperception of the risk-return relationship.

Despite the contributions we made, this paper is not without limitations. For instance, we measured experience in terms of years of activity in the financial market. However, we did not control for participants' financial literacy. Future studies should measure this dimension since it has been shown to predict financial decision making (Lusardi & Mitchell, 2014). Nevertheless, previous studies showed a correlation between years of experience and financial

literacy (Dvorak & Hanley, 2010; Frijns et al., 2014) thus our conclusion regarding the role of job experience seems to be backed by the literature.

We are aware that three-way interactions can be problematic in terms of replicability. However, all the elements involved in the interaction have been tested separately in the literature. For instance, previous work has found that investors perceive a negative correlation between risk and returns (Ganzach, 2000; Kempf et al., 2014; Statman et al., 2008). Similarly, it has been shown that experience influences investors' perceptions of the market (Martin, 2019), and previous work found that people's trait EI and their emotions can influence the way they invest (Rubaltelli et al., 2016). Nevertheless, these different streams of literature have not been studied together before and have seldom been studied with samples of professional advisors. Thus, we believe this work makes a relevant contribution to the extant literature. Yet, we encourage future replications of our results and extensions of this work to support and strengthen our conclusions.

In our study, we asked professional advisors to judge the risk and future returns of a series of financial assets, but we did not assess whether they would invest in those assets. Future studies should include a behavioral measure that investigates how financial advisors' judgments of the risk-return relationship translate into decisions for themselves and for their clients. This future research would be valuable because professional advisors may invest differently their own and their clients' money. Indeed, a large body of literature showed that people tend to be more risk-seeking when deciding for themselves than for others (Batteux et al., 2019; Batteux et al., 2021; Li et al., 2021; Polman, 2012). However, in finance specifically, the results are not conclusive. Some studies show that people's risk attitude does not change if they have to decide for themselves or others (Batteux et al., 2019) while other studies show that people tend to be more risk-seeking when deciding for others (vs. themselves) but only in the gain frame and not in the loss frame (Batteux et al., 2021).

Further, more experienced financial advisors showed to rely less on emotional cues but we can only speculate about what other information they use to make their predictions. Future studies could manipulate the presentation of different types of information (e.g., charts, news, company fundamentals) to better understand how these cues impact the perception of the risk and returns relationship depending on the experience level of the advisors.

Moreover, other types of individual differences could play a role in shaping advisors' judgments of risk and expected returns. For example, numeracy has been found to influence decision making in several domains (Peters et al., 2006), and it is likely to be related with

financial estimates especially when they are expressed in numerical formats (Almenberg & Widmark, 2011).

Finally, financial advisors are not the only people whose work can be informed by the way they perceive risk and returns in the financial domain; others are traders and venture capitalists. Each of these professionals has a different way to look at risk and expected returns and operate according to different time horizons (Antonczyk & Salzmann, 2012; Barber & Odean, 2000; Dorn et al., 2015; Grinblatt & Keloharju, 2009; Wustenhagen & Teppo, 2006). Thus, it will be interesting to compare how they perceive the risk-return relationship depending on their trait EI and level of experience.

To sum up, Mr. Gray should beware of talking to his financial advisor on matters related to the relationship between risk and returns. In fact, he could receive very different answers depending on the level of experience and trait EI. Our study showed that these variables have a role in how financial advisors misperceive the correlation between risk and returns. This is an important finding that sheds light on the need to educate professionals on their reliance on emotions in financial judgments.

References

Alhakami, A. S., & Slovic, P. (1994). A Psychological Study of the Inverse Relationship Between Perceived Risk and Perceived Benefit. Risk Analysis, 14(6), 1085–1096. https://doi.org/10.1111/j.1539-6924.1994.tb00080.x

Almenberg, J., & Widmark, O. (2011). Numeracy, Financial Literacy and Participation in Asset Markets. Social Science Research Network. https://doi.org/10.2139/ssrn.1756674

Antonczyk, R. C., & Salzmann, A. J. (2012). Venture capital and risk perception. Zeitschrift Für Betriebswirtschaft, 82(4), 389–416. https://doi.org/10.1007/s11573-012-0556-1

Barber, B. M., & Odean, T. (2000). Trading Is Hazardous to Your Wealth: The Common Stock Investment Performance of Individual Investors. The Journal of Finance, 55(2), 773–806. https://doi.org/10.1111/0022-1082.00226

Batteux, E., Ferguson, E., & Tunney, R. J. (2019). Do our risk preferences change when we make decisions for others? A meta-analysis of self-other differences in decisions involving risk. PLOS ONE, 14(5), e0216566. https://doi.org/10.1371/journal.pone.0216566

Batteux, E., Ferguson, E., & Tunney, R. J. (2021). Do We Become More Cautious for Others When Large Amounts of Money Are at Stake? Experimental Psychology, 68(1), 32–40. https://doi.org/10.1027/1618-3169/a000508

Dorn, A. J., Dorn, D., & Sengmueller, P. (2015). Trading as Gambling. Management Science, 61(10), 2376–2393. https://doi.org/10.1287/mnsc.2014.1979

Duxbury, D., Gärling, T., Gamble, A., & Klass, V. (2020). How emotions influence behavior in financial markets: A conceptual analysis and emotion-based account of buy-sell preferences. The European Journal of Finance, 26(14), 1417–1438. https://doi.org/10.1080/1351847X.2020.1742758

Dvorak, T., & Hanley, H. (2010). Financial literacy and the design of retirement plans. The Journal of Socio-Economics, 39(6), 645–652. https://doi.org/10.1016/j.socec.2010.06.013

Fishburn, P. C. (1977). Mean-Risk Analysis with Risk Associated with Below-Target Returns. *The American Economic Review*, *67*(2), 116–126. https://www.jstor.org/stable/1807225

Friesen, G. C., & Sapp, T. R. A. (2007). Mutual fund flows and investor returns: An empirical examination of fund investor timing ability. Journal of Banking & Finance, 31(9), 2796–2816. https://doi.org/10.1016/j.jbankfin.2007.01.024

Frijns, B., Gilbert, A., & Tourani-Rad, A. (2014). Learning by doing: The role of financial experience in financial literacy. Journal of Public Policy, 34(1), 123–154. https://doi.org/10.1017/S0143814X13000275

Ganzach, Y. (2000). Judging Risk and Return of Financial Assets. Organizational Behavior and Human Decision Processes, 83(2), 353–370. https://doi.org/10.1006/obhd.2000.2914

Gavaruzzi, T., Caserotti, M., Leo, I., Tasso, A., Speri, L., Ferro, A., Fretti, E., Sannino, A., Rubaltelli, E., & Lotto, L. (2021). The Role of Emotional Competences in Parents' Vaccine Hesitancy. Vaccines, 9(3), 298. https://doi.org/10.3390/vaccines9030298

Griffith, J., Najand, M., & Shen, J. (2020). Emotions in the Stock Market. Journal of Behavioral Finance, 21(1), 42–56. https://doi.org/10.1080/15427560.2019.1588275

Grinblatt, M., & Keloharju, M. (2009). Sensation Seeking, Overconfidence, and Trading Activity. The Journal of Finance, 64(2), 549–578. https://doi.org/10.1111/j.1540-6261.2009.01443.x

Kempf, A., Merkle, C., & Niessen-Ruenzi, A. (2014). Low Risk and High Return – Affective Attitudes and Stock Market Expectations. European Financial Management, 20(5), 995–1030. https://doi.org/10.1111/eufm.12001

Li, H., Yang, Y., Liu, D., & Xie, X. (2021). Risk preferences in self–other decisions: The effect of payoff allocation framing. Journal of Behavioral Decision Making, 34(2), 247–260. https://doi.org/10.1002/bdm.2207

Lusardi, A., & Mitchell, O. S. (2014). The Economic Importance of Financial Literacy: Theory and Evidence. Journal of Economic Literature, 52(1), 5–44. https://doi.org/10.1257/jel.52.1.5

MacGregor, D. G., Slovic, P., Dreman, D., & Berry, M. (2000). Imagery, Affect, and Financial Judgment. Journal of Psychology and Financial Markets, 1(2), 104–110. https://doi.org/10.1207/S15327760JPFM0102_2

Martin, R. (2019). Examination and implications of experimental research on investor perceptions. Journal of Accounting Literature, 43, 145–169. https://doi.org/10.1016/j.acclit.2019.11.001

Miller, K. D., & Reuer, J. J. (1996). Measuring Organizational Downside Risk. *Strategic Management Journal*, *17*(9), 671–691. https://doi.org/10.1002/(SICI)1097-0266(199611)17:9<671::AID-SMJ838>3.0.CO;2-1

Oehler, A., & Wedlich, F. (2018). The Relationship of Extraversion and Neuroticism With Risk Attitude, Risk Perception and Return Expectations (SSRN Scholarly Paper ID 3308503). Social Science Research Network. https://papers.ssrn.com/abstract=3308503

Peña-Sarrionandia, A., Mikolajczak, M., & Gross, J. J. (2015). Integrating emotion regulation and emotional intelligence traditions: A meta-analysis. Frontiers in Psychology, 6. https://doi.org/10.3389/fpsyg.2015.00160

Peters, E., Västfjäll, D., Slovic, P., Mertz, C. K., Mazzocco, K., & Dickert, S. (2006). Numeracy and Decision Making. Psychological Science, 17(5), 407–413. https://doi.org/10.1111/j.1467-9280.2006.01720.x

Petrides, K. V. (2009). Psychometric Properties of the Trait Emotional Intelligence Questionnaire (TEIQue). In J. D. A. Parker, D. H. Saklofske, & C. Stough (A c. Di), Assessing Emotional Intelligence: Theory, Research, and Applications (pp. 85–101). Springer US. https://doi.org/10.1007/978-0-387-88370-0_5

Petrides, K. V. (2011). Ability and trait emotional intelligence. In The Wiley-Blackwell handbook of individual differences (pp. 656–678). Wiley Blackwell.

Petrides, K. V., & Furnham, A. (2003). Trait emotional intelligence: Behavioural validation in two studies of emotion recognition and reactivity to mood induction. European Journal of Personality, 17(1), 39–57. https://doi.org/10.1002/per.466

Petrides, K. V., Pita, R., & Kokkinaki, F. (2007). The location of trait emotional intelligence in personality factor space. British Journal of Psychology, 98(2), 273–289. https://doi.org/10.1348/000712606X120618

Petrides, K. V., Sangareau, Y., Furnham, A., & Frederickson, N. (2006). Trait Emotional Intelligence and Children's Peer Relations at School. Social Development, 15(3), 537–547. https://doi.org/10.1111/j.1467-9507.2006.00355.x

Polman, E. (2012). Self–other decision making and loss aversion. Organizational Behavior and Human Decision Processes, 119(2), 141–150. https://doi.org/10.1016/j.obhdp.2012.06.005

Rubaltelli, E., Agnoli, S., & Franchin, L. (2016). Sensitivity to Affective Information and Investors' Evaluation of Past Performance: An Eye-tracking Study. Journal of Behavioral Decision Making, 29(2–3), 295–306. https://doi.org/10.1002/bdm.1885

Rubaltelli, E., Pasini, G., Rumiati, R., Olsen, R. A., & Slovic, P. (2010). The Influence of Affective Reactions on Investment Decisions. Journal of Behavioral Finance, 11(3), 168–176. https://doi.org/10.1080/15427560.2010.507409

Sevdalis, N., Petrides, K. V., & Harvey, N. (2007). Trait emotional intelligence and decision-related emotions. Personality and Individual Differences, 42(7), 1347–1358. https://doi.org/10.1016/j.paid.2006.10.012

Sharpe, W. F. (1964). Capital Asset Prices: A Theory of Market Equilibrium Under Conditions of Risk. *The Journal of Finance*, *19*(3), 425–442. https://doi.org/10.1111/j.1540-6261.1964.tb02865.x

Shefrin, H. (2001). Do Investors Expect Higher Returns From Safer Stocks Than From Riskier Stocks? Journal of Psychology and Financial Markets, 2(4), 176–181. https://doi.org/10.1207/S15327760JPFM0204_1

Siegel, J. J., & Thaler, R. H. (1997). Anomalies: The Equity Premium Puzzle. Journal of Economic Perspectives, 11(1), 191–200. https://doi.org/10.1257/jep.11.1.191

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. https://doi.org/10.1111/j.0272-4332.2004.00433.x

Statman, M., Fisher, K. L., & Anginer, D. (2008). Affect in a Behavioral Asset-Pricing Model. Financial Analysts Journal, 64(2), 20–29. https://doi.org/10.2469/faj.v64.n2.8

Wustenhagen, R., & Teppo, T. (2006). Do venture capitalists really invest in good industries? Risk-return perceptions and path dependence in the emerging European energy VC

market. International Journal of Technology Management, 34(1–2), 63–87. https://doi.org/10.1504/IJTM.2006.009448

Chapter 5

General Discussion

5.1 Research questions and methodology

This thesis investigated the role of emotions in shaping people's risk perceptions and risk-taking behaviors in health-related (COVID-19) and financial decisions making. It also offered new insights related to the influence of risk communication, and the role of trait emotional intelligence (EI).

Specifically, in the health domain, Study 1 and Study 2 tested how the risk communication during a worldwide emergency (i.e., COVID-19) could influence the way people feel about the pandemic, their perceived risk of COVID-19, and how they use this information to decide whether or not to comply with government measures designed to protect themselves and others.

Both Study 1 and 2 hypothesized that stronger negative feelings toward the pandemic would elicit a higher perceived risk that would in turn lead people to protect themselves and others more. The dual-process and the "risk as feelings" frameworks state that affect guide and precede information processing in risk perception (Evans, 2008; Finucane et al., 2000; Kahneman & Frederick, 2002; Lerner et al., 2003; Lerner & Keltner, 2000; Loewenstein et al., 2001; Peters et al., 2006; Sjöberg, 2007; Slovic et al., 2002, 2004; Slovic & Peters, 2006). Previous studies on infective diseases, and specifically on previous pandemics (i.e., SRAS and MERS), showed that the perception of a threat is an essential factor in determining people's intentions to adhere with mitigating measures (Brewer et al., 2007, de Zwart et al., 2009; Leppin & Aro, 2009; Kim & Song, 2017; Rubin et al., 2009, Sheeran et al., 2014).

In Study 1 risk perception was assessed by asking participants to report their subjectively perceived likelihood of infection and perceived severity of the disease (Chang Xu & Song, 2016; Leppin, & Aro, 2009; de Zwart et al., 2009). In Study 2, on the other hand, a multidimensional model was used (TRIRISK, Ferrer et al., 2016). The TRIRISK distinguishes among a *deliberative*, an *affective*, and an *experiential* component of risk[10]. Emotional reactions toward the pandemic were assessed in Study 1 by asking how much participants worried about the viral disease, public policies, and media communication. While in Study 2,

[10] A principal component analysis on the TRIRISK scale was performed and results showed that Study 2's data were best represented by a 2 components structure (i.e., "Affective Risk" and "Deliberative Risk").

participants' anticipatory emotions (i.e., affective reactions people feel in the moment they make the decisions; Dickert et al., 2015; Loewenstein et al., 2001) were assessed by means of the PANAS-SF, a scale that measures 20 different emotions (Watson et al., 1988). Finally, in Study 1, behaviors were assessed by asking participants how often they engage in protective behaviors, while in Study 2, intention to engage in self-protective measures propagated by the Italian government was assessed using sixteen items adapted from Keinan and colleagues (2021).

In this dissertation it was hypothesized that the media's risk communication would play a central role in shaping people's risk perception, emotional reactions, and behavioral intentions, especially in unfamiliar and dreadful emergencies, such as the COVID-19 pandemic. Literature on the pragmatic function of risk communication shows that message attributes are an essential component of effective communication strategies, capable of changing attitudes and behaviors towards a risk (Balog-Way et al., 2020; Brewer, 2011; Cox & Pezzullo, 2016; Rickard, 2021).

For example, during the initial stage of the pandemic, the media often compared the coronavirus to the seasonal flu virus, which in Study 1 was hypothesized could lead to an underestimation of the risks of COVID-19. While the two viruses share common characteristics, at the start of the pandemic, seasonal flu constituted a more familiar, less threatening danger that received less media coverage than the coronavirus. Literature showed that risks that are perceived as familiar (vs. new and unfamiliar), common (vs. dreadful), and less covered by the media (i.e., availability heuristic), can lead lower negative emotional reactions and to an underestimation of the risk (Cowling, et al., 2020; Lichtenstein et al., 1978; Slovic, 2000; Tversky & Kahneman, 1973). Another common phenomenon by the media regarding the initial stages of the pandemic was presenting asymmetrically more than the numbers of people who died (i.e., loss or negative frame) compared to the people who recovered (i.e., gain or positive frame). However, research showed that loss frames evoke more negative emotions, while gain frames elicit more positive emotional reactions (Druckman & McDermott, 2008; Nabi et al., 2020; Peters et al., 2006). There is still an open debate on how gain and loss frames influence heath related protective behaviors (Akl et al., 2011; Gallagher & Updegraff, 2012; O'keefe & Jensen, 2007, 2009; O'keefe & Nan, 2012). To test those hypotheses, in Study 1 a 2 (Viral Disease: coronavirus vs seasonal flu) x 2 (Frame: positive vs negative) x 3 (Country) between-subject design was implemented. Participants from three countries (i.e., Italy, Austria and the UK, N_{total}=703) could either be exposed to a message on

the seasonal flu or the COVID- 19, and either presented with the numbers of people who died or who recovered from the disease.

Finally, over the years, information on the COVID-19 pandemic has been reported through many different numerical formats, overlooking the research which showed that different numerical formats used to present risk information can lead to different interpretations, likelihood estimations, and behavioral responses (Fagerlin et al., 2007; Freeman et al., 2021; Jie, 2022; Shoots-Reinhard et al., 2022; Sinayev et al., 2015; Timmermans & Oudhoff, 2011; Visschers et al., 2009). In Study 2, to test the hypotheses, an Italian sample (N=603) read a short text reporting information about mortality rates related to COVID-19 presented in a six between-subjects conditions: 1) "Absolute Value"; 2) "Raw ratio format"; 3) "1 in X format"; 4) "Verbal format"; 5) "Percentage format"; 6) "Probability format".

Study 3 extended the research question of this thesis on the effect of emotions on risk perception and decision-making to a field that is even more uncertain than the health domain, i.e., financial decision-making, and included the investigation of personality traits that can reveal the subjectivity of humans' emotional experience (i.e., trait EI).

Research has identified many biases that can occur when people judge the risks, potential returns, and make decisions about financial assets. For example, one of the main principles of financial theories is that risk and returns of financial assets are usually positively correlated (Sharpe, 1964; Shefrin, 2001). Nevertheless, laypeople, but also high-net-worth investors, perceive a negative correlation between the risk and the expected returns of investments (Alhakami & Slovic, 1994; Ganzach, 2000; MacGregor et al., 2000; Oehler & Wedlich, 2018; Rubaltelli et al., 2010; Statman et al., 2008). However, to the best of my knowledge no research has tested this bias on professional advisors. Thus, in Study 3 the risk and return misperception was tested on a group of Italian financial advisors (N=191), asking them to separately assess the potential risk and expected returns (i.e., subjective estimate of an investment's returns) of investing in five large Italian companies listed in the Milan Stock Exchange.

An explanation for this misperception is based on the affect heuristic (Slovic et al., 2004). People have a tendency to equate highly risky behaviors, such as investing in stocks, with negative emotions and utilize these emotional responses to evaluate their returns, which are consequently viewed as low. In finance, this misperception leads to biased judgments and unfavorable investments decisions (Friesen & Sapp, 2007; Kempf et al., 2014; Siegel & Thaler, 1997; Statman et al., 2008). In Study 3, to assess the effect of emotions on the risk and return

misperception, participants completed a mental imagery task (Gavaruzzi et al., 2021; Rubaltelli et al., 2010).

Since the misjudgment of the correlations between risk and return in the context of financial investments is a bias influenced by emotions, in Study 3 it was expected that people's subjective management and regulation of their emotions would play a relevant role in their judgments. Higher levels of trait EI correspond to specific behavioral tendencies that, depending on the context, can be either adaptive but also maladaptive (Pena-Sarrionandia, et al., 2015). For example, people with high trait EI might over rely a on emotions when decisions are made under uncertainty and the reliability of other information is difficult to assess (e.g., financial decision-making; Duxbury et al., 2020; Griffith et al., 2020; Pena-Sar-rionandia et al., 2015; Rubaltelli et al., 2010). Research showed that, in the financial markets, relying too much on one's emotions can conflict with effective investment strategy (Rubaltelli et al., 2016). Therefore, in Study 3 it was expected that high trait EI, assessed using the trait EI questionnaire (TEIQue-SF, Petrides, 2009), might lead professionals to a stronger misperception of the risk-return relationship.

Finally, in Study 3 also tested the mitigating role of experience on the effect of trait EI on the misperception of the risk and return relationship, which was assessed by asking the sample of financial advisors to report the number of years of work experience in the field.

5.2 Summary of General findings and theoretical implications

5.2.1 Effect of emotions on risk perception and behaviors

The results of both Study 1 and Study 2 confirmed the studies' hypotheses and showed that, during a worldwide health emergency, such as the COVID-19 pandemic, people who perceive higher negative emotions also perceive the situation to be riskier.

Study 2 additionally demonstrated that negative anticipatory emotional reactions more strongly predict the Affective component of risk rather than the Deliberative component, showing that emotions can have a different influence on different dimensions of risk. It is important to note that Study 2's measure of emotional reaction towards the mortality rate was conceptually different from the Affective Risk component. While the emotional response to mortality rate represents anticipatory negative emotions (i.e., how people feel when confronted with the risk), the Affective Risk component captures how people feel when anticipating the negative consequences of risk (i.e., catching COVID-19). These findings are consistent with the "risk as feelings" approach and with earlier studies that contend that affect and emotions

are the main factors influencing risk perception (Finucane et al., 2000; Loewenstein et al., 2001; Slovic et al., 2002, 2004).

The findings of this thesis identified perceived risk and negative emotional reaction as central predictors of self-reported preventive behaviors and behavioral intentions. Higher levels of perceived risk and higher negative emotional reactions were found to be associated with higher engagement in self-protective behaviors in both Study 1 and Study 2. Consistent with literature on previous and actual pandemics, the results indicate risk perception as a crucial determinant of intention and effective compliance with protective behaviors (Brug et al., 2004; Goodwin et al., 2011; Niepel et al., 2020; Rubin et al., 2009; Setbon & Raude, 2010; Sheeran et al., 2014).

Study 2 also showed that the link between the Affective and Deliberative risk dimensions and behavioral intentions varied. Whereas higher affective risk perception was associated with higher intentions to engage in self-protective behaviors, higher deliberative risk perception was related to lower willingness to protect oneself. This outcome is consistent with research by Ferrer and colleagues (2016), who found a negative correlation between deliberate risk perception and people's intentions to protect themselves against diabetes, heart disease, and cancer. The authors speculated that, in contrast to an affective (or experiential) risk perception, a cognitive risk assessment would be associated to an accurate evaluation of one's future risk of becoming ill in order to explain this seemingly counterintuitive conclusion. In this thesis, it was conjectured about a further reason why Deliberative Risk negatively correlates with protective behavior in light of Study 2's findings. Despite the fact that Deliberative Risk was initially intended to capture the reason-based perceived likelihood of being exposed to a negative event (Ferrer et al., 2016), it appears to be likely that this perception is influenced by anticipatory affect related to the communication of the risk. Additionally, it appears that it is challenging to perform likelihood estimations of threats' consequences without using anticipated affective inputs. This explanation is consistent with other research that demonstrates that probability weights differ for affect rich and affect poor outcomes (Rottenstreich & Hsee, 2001). The bivariate correlations between Deliberative Risk and Behavioral Intentions in Study 2 were originally positive and only changed after the affective component of risk was considered in the analysis, which is consistent with this interpretation. Study 2 finds the same results when applying the original three-factor solution suggested by Ferrer and colleagues (see Appendix 2 section "Analyses 3 factors Risk"), despite the fact that Study 2's Deliberative Risk dimension contained items from the Experiential Risk dimension, which may have unintentionally contributed to the reversal.

The findings this thesis contribute to the recent open discussion on the significance of conceptualizing risk as a multifaceted phenomenon and disentangling the influence of its dimensions on other factors, such as behavioral intentions and emotional reactions (Wilson et al., 2019). Risk perception is a complex phenomenon, and this dissertation shows that affective and deliberative components of risk have different, if not opposite, effects on behavioral intentions. Finally, it shows that, in line with the "*risk as feeling*" framework, numerical information reporting mortality rates of a worldwide pandemic primarily affects the emotional and affective components of risk perception rather than the deliberative one (Slovic et al., 2004).

5.2.2 Effect of risk communication on emotions, risk perception and behaviors

Both Study 1 and 2 showed that media communication of the risk of COVID-19 affected peoples' emotional reactions, risk perception and intentions to protect themselves and others.

In Study 1, it was found that individuals in the condition "coronavirus", as opposed to the conditions "seasonal flu" reported higher levels of worry, which led people to also report higher risk perceptions and, subsequently, greater compliance with protective behaviors. These findings are consistent with both the risk profile of the two diseases in the psychometric paradigm framework, and the availability heuristic (Tversky and Kahneman, 1973). Greater familiarity with a danger (such as the seasonal flu) and less media attention to the risk may result in an underestimation of the risk. On the other hand, increased fear and extensive media coverage of a specific threat, like the coronavirus, might cause people to overestimate the likelihood of mortality and elevate their sense of risk (Cowling, et al., 2020; Fischhoff, et al., 1978; Lichtenstein et al., 1978; Slovic, 2000; Tversky & Kahneman, 1973). These findings contribute to literature on the effect of media communication on risk perception by investigating a new phenomenon. The comparison (i.e., COVID-19 and seasonal flu) that, at the beginning of the pandemic, the media might have used to reduce negative emotions and COVID-19's perception of the risk. As shown by the results of this thesis, this communication strategy could have led to an underestimation of the virus and consequent lower engagement in protective behaviors. These comparisons, aimed at enhancing or reducing the perceived risk of dangerous situations, are often used by risk communicators. More research is needed to investigate their effect on people's understanding of different types of risk (e.g., climate change) and their influence on protective behavioral intentions.

Consistent with extant literature, Study 1 also showed that individuals reported to feel more worried when presented with the Negative Frame compared to the Positive Frame condition (Druckman & McDermott, 2008; Peters et al., 2006; Hameleers, 2021). In line with previous studies on the effect of the frame on different types of emotions in health-related behaviors in Study 1 higher negative emotions (i.e., worry) led to a higher risk perception (Peters et al., 2006). The results of Study 1 also contribute to the mixed outcomes found in previous literature on the effect of framing on health-related behaviors. Studies on the COVID-19 pandemic showed that loss frames might lead people to protect themselves more (Van Bavel et al., 2020) but also that people exposed to gain frames also tend to report higher support for stringent preventive actions (e.g., lockdown; Hameleers, 2021). The results of Study 1 did not show a significant impact of framing on self-protective behaviors, demonstrating the need to investigate further how framing influences health-related behaviors, especially in the context of worldwide pandemics.

The results of Study 2 showed that mortality rates expressed as probability (e.g., a risk of 0.0017 of dying), compared to all other tested risk communication formats led to lower negative emotions towards COVID-19. Additionally, they showed that people in the probability format condition reported lower risk perception compared to all other formats. These findings are in line with extant literature that showed that risk information expressed in probability formats elicits the least emotional reactions and risk perception, possibly due to a lower ability of this kind of mortality rate format to elicit mental images of the event (Koehler & Macchi, 2004; Newell et al., 2008; Peters et al., 2006; Purchase & Slovic, 1999; Slovic et al., 2000; Timmermans et al., 2008; Timmermans & Oudhoff, 2011; Visschers et al., 2009).

Mortality Rate formats indirectly affected participants' intention to protect themselves and others through the mediation of both emotional reactions and perceived risk. Specifically, it was found that those who were presented with the mortality rates expressed as probability (compared to all other formats) reported lower negative emotions and perceived risk which in turn led to lower intention to comply with WHO-encouraged protective behaviors, getting vaccinated, and taking out an insurance. This indirect effect of Mortality Rate formats on behavioral intention is in line with previous studies, included Study 1, that showed how different frames (e.g., positive vs negative framing; equivalence vs emphasis framing) used to report information about the COVID-19 outbreak influence citizens' compliance with mitigation measures through the effect of negative emotional reaction and risk perception (Hameleers, 2021; Hameleers & Boukes, 2021; Reinholtz et al., 2021; van Bavel et al., 2020). The results of Study 2 shed light on the pivotal role of numerical formats in risk communication

in shaping people's decisions and behaviors towards risks in health-related contexts. The findings of this thesis show that, even in a historical time when the risk perception of COVID-19 was incredibly high, people still used the way the information about mortality rates was presented to them when deciding how to behave. Thus, showing the influencing power of a message attribute (i.e., numerical formats) often used lightly by the media.

5.2.3 Effect of trait emotional intelligence on risk perception

Study 3 showed, for the first time, that professional financial advisors can also have a biased perception of the risk-return relationship. This bias is consistent with the affect heuristic, which demonstrates how people frequently use their emotions to evaluate risk and benefits, which are frequently viewed as being negatively associated (Slovic et al., 2004). The same has repeatedly been observed in the financial market, where investors believe that risk and expected returns are negatively correlated, despite the fact that historical data indicates that these two factors are positively correlated (Ganzach, 2000; Kempf et al., 2014; Statman et al., 2008). This result shows the importance of not taking for granted that even professionals can be biased and the importance of testing samples of experts and their use of heuristics on professional judgments and decisions.

Study 3 also showed that trait EI and feelings towards the financial market moderate the misperception for the risk-return relationship. The financial market represents an extremely uncertain environment, thus financial advisors are inclined to feel a wide group of when they try to predict risk and returns on financial assets. However, studies found that, in this specific field, relaying on emotions might lead poor financial decisions (Duxbury et al., 2020; Griffith et al., 2020; MacGregor et al., 2000). Consistently Study 3 showed how financial advisors with high (vs. low) trait EI were more prone to use their feelings to estimate expected returns.

Study 3 showed that the level of experience in trading plays an important role in moderating the effect of trait EI on the risk-return misperception. Financial advisors with less experience and high trait EI reported a more negative correlation between risk and return. This conclusion could mean that highly emotional intelligent but inexperienced advisors allowed their emotions to take control of how they evaluate the market in high uncertainty situations, because they are unable to employ other, more diagnostic clues. Because of this, and in line with the affect heuristic (Kempf et al., 2014; Statman et al., 2008), they see the negative association between risk and expected returns as being more pronounced. This explanation is in line with the fact that the influence of trait EI did not manifest for the more experienced

financial advisors, possibly as a result of their increased reliance on non-emotional sources of information rather than their emotional responses (Martin, 2019). Study 3 contributes to the literature that discloses the potentially maladaptive aspects of trait EI (Pena-Sar-rionandia et al., 2015; Petrides, 2011; Rubaltelli et al., 2010). Early research on trait EI mainly investigated its adaptive and "positive" influences on judgments and decisions. However, as has been done in this thesis, also focusing on its maladaptive characteristics can lead to a more complete understating of this personality trait. Further research is needed to investigate interventions aimed at unbiasing situations where high trait EI can lead to misjudgments or poor decision-making strategies.

5.3 Practical implications

The results of this thesis on the central role of emotions on risk perception and behavioral intentions in the health domain can also have practical implications for media outlets and governments, while the results of this thesis on the effect of trait EI on biases in financial decision making can impact professional advisors.

Communicators should be aware that in the context of a global health emergency like the COVID-19 pandemic, instilling some amount of apprehension in the public can help to increase compliance with government measures. Additionally, a campaign to downplay the threat posed by the coronavirus, such as the one launched in the early stages of the pandemic by the British (Conn et al., 2020), American (Barth, 2020), and Brazilian (Kemeny, 2020) authorities, may make people feel too unconcerned about the danger and fail to take adequate precautions against it. It is crucial to remember that other emotions, like anxiety or fear may trigger panic and cause overreactions including exaggerated protective behaviors, prejudice against groups linked with the threat, and signs of mental illness (Depoux et al., 2020; Taylor, 2019; Yang & Cho, 2017). Therefore, policies and media communication should take care to craft messages for the people that cause a correlating emotional response and risk perception.

The results of this thesis also offer practical indications on the design of messages destined to the population during an international pandemic which aim to indirectly, through emotional reactions and risk, lead people to comply more with protective measures. For instance, policy makers should avoid communicating risk information using probability formats, and comparing the disease to another more familiar less dreadful disease, if they want to increase the chances that citizens comply with protective measures by enhancing their emotional reactions and risk perception. It is crucial to remember that there is usually more than one "right" way to communicate hazards during emergencies. "Objective" hazards are frequently

viewed subjectively and can result in a variety of emotional and behavioral responses since perceived risk always has a strong subjective component. The COVID-19 pandemic has made it difficult for risk management and public policy to come up with efficient yet acceptable means of boosting protective behavior on a big scale. As a result, the findings from this thesis provide vital information that risk analysts and decision-makers can use to address the challenge provided by the current pandemic and potential future pandemics.

Finally, the results of Study 3 show that it is important to take into consideration the subjective way people experience emotions and use them to make decisions. Specifically, since Study 3 shows that trait EI can affect how financial advisors judge financial assets for themselves and for others, it is important to educate professionals of the weigh their emotions can have on their judgements and, potentially, on their investment decisions.

5.4 Limitations and future directions

This thesis presents limitations that should be addressed in future research to generalize the results of this thesis' different contexts and domains, and to answer some open questions raised by this thesis's findings. In this section I reported and discussed the main areas of limitations: *methodological assessments, actual behaviors vs. behavioral intentions,* and *information formats presentation.*

5.4.1 Methodological assessments

The methodological choices of the three studies reported in this thesis present limitations, and therefore potentiality for future studies. Some of them were addressed within this thesis, for example, part of the methodological limitations of Study 1 were addressed in Study 2, while some of them should be addressed in future research.

In Study 1 only worry was assessed to investigate negative emotional reactions towards the COVID-19 pandemic, since it was identified in previous literature identified as the main determinant of risk perception (Peters et al., 2006). However, by concentrating solely on such an emotional response, it's possible that Study 1 hasn't fully captured the "dreadful" traits and the complexity of emotions that are typically linked to uncontrollable and potentially lethal threats, such as COVID-19. (Fischhoff et al., 1978). Therefore, in Study 2 the PANAS-SF scale was used, which measured 20 different emotions such as distress, fear, nervousness etc. (Watson et al., 1988). This thesis shows that it is essential to include people's emotional reactions in understanding how people perceive and decide in the context of a worldwide health

emergency. Future studies could investigate if different kinds of discrete emotions, such as fear vs anger (Lerner, & Keltner, 2000), can differently affect risk perception in this context, and longitudinal studies could track if changes in emotional reaction due to, for example, adaptation to the threat can lead to different risk perception or behavioral intentions.

In Study 1 risk perception was assessed by multiplying the perceived likelihood of contagion and the perceived disease severity following works on previous pandemic (Chang, Xu, & Song, 2016; Leppin, & Aro, 2009; de Zwart et al., 2009) and the Protection Motivation Theory (PMT; Prentice-Dunn & Rogers, 1986; Rogers & Prentice-Dunn, 1997; Rogers 1975). However, risk perception is a more complex construct that involves not only reason-based processes, but also other dimensions (Siegrist & Arvai, 2020; Slovic et al., 2004). According to a recent review, one item's risk assessment is not enough to capture its complexity, which is better represented by multifaceted construct (Wilson et al., 2019). In the review they propose a three-dimensional structure that combines personal exposure and/or perceived *probability* of exposure to a target hazard, perceived severity of the potential negative *consequences* of the hazard, and *affective* reactions (e.g., concern) related to that hazard. In the health domain specifically, a tripartite model has been proposed by Ferrer and colleagues (2016). In Study 2 it was therefore decided to use the latter, i.e., the TRIRISK model, to asses risk. While the labels of the dimensions of the two scales are different, both papers agree on the need to assess risk perception through measures that include multiple components. However, the debate is still open and it is important that future research investigates which dimensions of risk can better explain the cognitive evaluation of dangerous situations and better predict behavioral intentions in different contexts

Finally, in Study 1, which was ran at the beginning of the COVID-19 pandemic, behaviors were assessed by asking participants how often they engage in protective behaviors. It was decided for this type of assessment due to a lack of precise knowledge on the type of behaviors that would have been useful to limit the spread of the virus. However, when data collection of Study 2 started, the scientific community divulgated more information and therefore, in this study, intention to engage in self-protective measures propagated by the Italian government was assessed using sixteen items adapted from Keinan and colleagues (2021), which were then grouped in four factors "WHO Guidelines", "Social Engagement", "Insurance", and "Vaccination Intentions". While a wider group of behaviors was captured in Study 2, it is important that future research tests a larger variety of behavioral intentions and investigate how risk and emotions can differently influence diverse behaviors.

5.4.2 Actual behaviors vs behavioral intentions

In this thesis reported behaviors and behavioral intentions but not actual behaviors were measured. Previous literature has shown that willingness to act in health-related situations can effectively predict actual behavior, especially when people perceive having little control over a situation such as the COVID-19 pandemic (Austin et al., 2021; Gibbons, 2008; Webb & Sheeran, 2006). However, meta-analytic evidence suggests that moderate to large changes in behavioral intentions correspond to small to moderate changes in actual behavior (Webb & Sheeran, 2006). Future studies should provide more evidence of the correspondence between actual and behaviors and behavioral intentions and implement field studies that can investigate real life behaviors.

However, in Study 3, professional advisors were asked to judge the risk and future returns of a series of financial assets, but they were not asked to report if they would invest in them. Future studies should investigate whether the risk and return misperception found in professionals translate in biased decisions for themselves and for their clients. Because professional advisors might invest their own money and the money of their clients differently, this further research would be valuable. In fact, a substantial body of research shows that people frequently take more risks when making decisions for themselves as opposed to others (Batteux et al., 2019; Batteux et al., 2021; Li et al., 2021; Polman, 2012). The findings are not definitive, though, particularly in the field of finance. Other studies show that people tend to be more risk-seeking when making decisions for others (as opposed to themselves), but only in the gain frame and not in the loss frame. Some studies demonstrate that people's risk attitudes remain the same whether they must make decisions for themselves or others (Batteux et al., 2019).

5.4.3 Information formats presentation

Studies 1 and 2 tested the effect of media communication on people’s perception of the COVID-19 pandemic by testing positive (vs. negative) information, comparison with other diseases and several formats presenting mortality rate data. However, risk information, related to the COVID-19 pandemic but not only, are also reported in the media in form of graphs, or presenting different groupings of data or changes over time. Previous studies showed that, when properly developed, graphical information can be a potent tool for teaching and communicating in a variety of fields (Franconeri et al., 2021; Visschers et al., 2009). Research

in the healthcare field has revealed that adding graphical representations to text-only information can improve the accuracy of recognizing hazards to one's health (Waters et al., 2006). According to a recent study by Reinholtz and colleagues (2021), when COVID-19 data is reported as stock (i.e., the cumulative number of total cases), it results in a higher risk perception and protective behavioral intentions than when the same data is reported as flow (i.e., the number of new infections per day), particularly when the former is still increasing but the latter is decreasing. Future research should therefore examine the impact of different groupings and graphical ways for reporting outbreak data on risk perception, behavioral intentions, and emotional responses.

In Study 3, professionals were asked to report the perceived risk and returns of financial assets presenting them the names of known companies only. However, professional financial advisors often make decisions by consulting information on financial assets presented in the form of charts, news or company fundamentals. We know from this thesis, and other research presented here, that the way information is offered can affect the perception of risks. It is therefore important that future studies manipulate the presentation of different types of information to better understand how these cues impact the perception of the risk and returns relationship depending on the experience and the trait EI of professionals.

5.5. Conclusions

This thesis shows that emotions, of both lay people and professionals, play a central role in the way we perceive risks in highly uncertain and novel situations (e.g., the COVID-19 pandemic and financial decision-making), which in turn can lead to deciding differently on whether or not to protect ourselves or others, both in health-related and in financial domains. When people felt high negative emotions towards the COVID-19 pandemic, they reported perceiving the risk as higher, and in turn, they reported being more willing to protect themselves and others. These findings can be significant in guiding decisions if (when) new uncertain and dreadful worldwide events pose new challenges to our societies. Compliance with indications propagated by governments or the scientific community represents the best chances of containing or solving a situation that sometimes might mean many people's survival. It is therefore essential to continue testing how people react in those situations and the factors that contribute to higher compliance and, consequently, safety for the person and society.

This thesis also showed that media communication and information formats could heavily influence how people react emotionally, perceive risks, and behave towards hazards. This thesis illustrated that, in the context of worldwide health emergencies, if the goal is to lead

people to comply more with protective behaviors, it is advisable to not compare the new dreadful threat with a common and familiar, even if similar, hazard; that using probability to present the riskiness of the threat might be counterproductive, and that negative (vs. positive) information can lead to higher negative emotions and risk perception in the population. These findings can provide practical guidelines for media outlets and governments to select the most effective ways to increase compliance. However, more research needs to be done to better understand how information formats can serve to reach effective risk communication and behavioral changes.

Finally, this thesis showed that it is essential to consider lay people's and professionals' subjective emotional experiences when we investigate the effect of emotions on risk perception and decision-making. High trait EI can be a great asset in familiar situations but can be an obstacle when professionals face unfamiliar and highly uncertain decisional fields. The findings of this thesis illustrate the importance of not taking for granted that experts might also fall into well-known biases. Professionals who advise others on the best decisions to make must be informed and educated about how their emotions and how they subjectively deal with them can affect their judgments and decisions.

References

Akl, E. A., Oxman, A. D., Herrin, J., Vist, G. E., Terrenato, I., Sperati, F., ... & Schünemann, H. (2011). Framing of health information messages. *Cochrane Database of Systematic Reviews*, (12). https://doi.org/10.1002/14651858.CD006777.pub2

Alhakami, A. S., & Slovic, P. (1994). A Psychological Study of the Inverse Relationship Between Perceived Risk and Perceived Benefit. Risk Analysis, 14(6), 1085–1096. https://doi.org/10.1111/j.1539-6924.1994.tb00080.x

Austin, E. W., Austin, B. W., Willoughby, J. F., Amram, O., & Domgaard, S. (2021). How Media Literacy and Science Media Literacy Predicted the Adoption of Protective Behaviors Amidst the COVID-19 Pandemic. *Journal of Health Communication*, *26*(4), 239–252. https://doi.org/10.1080/10810730.2021.1899345

Balog-Way, D., McComas, K., & Besley, J. (2020). The Evolving Field of Risk Communication. *Risk Analysis*, *40*(S1), 2240–2262. https://doi.org/10.1111/risa.13615

Barth F. D., (2020, March 30) Denying the reality of the coronavirus has made it more dangerous for everyone. Think. Retrieved 2020, from https://www.nbcnews.com/think

Batteux, E., Ferguson, E., & Tunney, R. J. (2019). Do our risk preferences change when we make decisions for others? A meta-analysis of self-other differences in decisions involving risk. *PLOS ONE*, 14(5), e0216566. https://doi.org/10.1371/journal.pone.0216566

Batteux, E., Ferguson, E., & Tunney, R. J. (2021). Do We Become More Cautious for Others When Large Amounts of Money Are at Stake? *Experimental Psychology*, 68(1), 32–40. https://doi.org/10.1027/1618-3169/a000508

Brewer, N. T. (2011). Goals. In B. Fischoff, N. T. Brewer, & J. Downs (Eds.), *Communicating risks and benefits: An evidence-based users guide*, (pp. 3–10). Rockville, MD: Food and Drug Administration (FDA), US Department of Health and Human Services.

Brewer, N. T., Chapman, G. B., Gibbons, F. X., Gerrard, M., McCaul, K. D., & Weinstein, N. D. (2007). Meta-analysis of the relationship between risk perception and health behavior: The example of vaccination. *Health Psychology*, *26*(2), 136–145. https://doi.org/10.1037/0278-6133.26.2.136

Brug, J., Aro, A. R., Oenema, A., de Zwart, O., Richardus, J. H., & Bishop, G. D. (2004). SARS Risk Perception, Knowledge, Precautions, and Information Sources, the Netherlands. Emerging Infectious Diseases, 10(8), 1486–1489. https://doi.org/10.3201/eid1008.040283

Chang, C.-H., Xu, J., & Song, D.-P. (2016). Impact of different factors on the risk perceptions of employees in container shipping companies: A case study of Taiwan. *International Journal of Shipping and Transport Logistics*, *8*(4), 361–388. https://doi.org/10.1504/IJSTL.2016.077306

Conn, D., Lawrence, F., Lewis, P., Carrell, S., Pegg, D., Davies, H., & Evans, R., (2020, April 29). Revealed: the inside story of the UK's Covid-19 crisis. The Guardian. Retrieved 2020, from https://www.theguardian.com/international

Cowling, B. J., Ali, S. T., Ng, T. W. Y., Tsang, T. K., Li, J. C. M., Fong, M. W., Liao, Q., Kwan, M. Y., Lee, S. L., Chiu, S. S., Wu, J. T., Wu, P., & Leung, G. M. (2020). Impact assessment of non-pharmaceutical interventions against coronavirus disease 2019 and influenza in Hong Kong: An observational study. *The Lancet Public Health*, *5*(5), e279–e288. https://doi.org/10.1016/S2468-2667(20)30090-6

Cox, R., & Pezzullo, P. C. (2016). *Environmental communication and the public sphere* (4th ed.). Newbury Park, CA: Sage.

Depoux, A., Martin, S., Karafillakis, E., Preet, R., Wilder-Smith, A., & Larson, H. (2020). The pandemic of social media panic travels faster than the COVID-19 outbreak. *Journal of Travel Medicine*, *27*(3). https://doi.org/10.1093/jtm/taaa031

de Zwart, O., Veldhuijzen, I. K., Elam, G., Aro, A. R., Abraham, T., Bishop, G. D., Voeten, H. A. C. M., Richardus, J. H., & Brug, J. (2009). Perceived Threat, Risk Perception, and Efficacy Beliefs Related to SARS and Other (Emerging) Infectious Diseases: Results of an International Survey. *International Journal of Behavioral Medicine*, *16*(1), 30–40. https://doi.org/10.1007/s12529-008-9008-2

Dickert, S., Västfjäll, D., Mauro, R., & Slovic, P. (2014). The feeling of risk. *The SAGE handbook of risk communication*, 41-54. https://doi.org/10.4135/9781483387918.n7

Druckman, J. N., & McDermott, R. (2008). Emotion and the Framing of Risky Choice. *Political Behavior*, *30*(3), 297–321. https://doi.org/10.1007/s11109-008-9056-y

Duxbury, D., Gärling, T., Gamble, A., & Klass, V. (2020). How emotions influence behavior in financial markets: A conceptual analysis and emotion-based account of buy-sell preferences. The European Journal of Finance, 26(14), 1417–1438. https://doi.org/10.1080/1351847X.2020.1742758

Evans, J. S. B. (2008). Dual-processing accounts of reasoning, judgment, and social cognition. *Annu. Rev. Psychol.*, *59*, 255-278. https://doi.org/10.1146/annurev.psych.59.103006.093629

Fagerlin, A., Ubel, P. A., Smith, D. M., & Zikmund-Fisher, B. J. (2007). Making Numbers Matter: Present and Future Research in Risk Communication. *American Journal of Health Behavior*, *31*(1), S47–S56. https://doi.org/10.5555/ajhb.2007.31.supp.S47

Ferrer, R. A., Klein, W. M. P., Persoskie, A., Avishai-Yitshak, A., & Sheeran, P. (2016). The Tripartite Model of Risk Perception (TRIRISK): Distinguishing Deliberative, Affective, and Experiential Components of Perceived Risk. *Annals of Behavioral Medicine*, *50*(5), 653–663. https://doi.org/10.1007/s12160-016-9790-z

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.

https://doi.org/10.1002/(SICI)1099-0771(200001/03)13:1<1::AID-BDM333>3.0.CO;2-S

Fischhoff, B., Slovic, P., Lichtenstein, S., Read, S., & Combs, B. (1978). How safe is safe enough? A psychometric study of attitudes towards technological risks and benefits. *Policy Sciences*, *9*(2), 127–152. https://doi.org/10.1007/BF00143739

Franconeri, S. L., Padilla, L. M., Shah, P., Zacks, J. M., & Hullman, J. (2021). The Science of Visual Data Communication: What Works. *Psychological Science in the Public Interest*, *22*(3), 110–161. https://doi.org/10.1177/15291006211051956

Freeman, A. L. J., Kerr, J., Recchia, G., Schneider, C. R., Lawrence, A. C. E., Finikarides, L., Luoni, G., Dryhurst, S., & Spiegelhalter, D. (2021). Communicating personalized risks from COVID-19: Guidelines from an empirical study. *Royal Society Open Science*, *8*(4), 201721. https://doi.org/10.1098/rsos.201721

Friesen, G. C., & Sapp, T. R. A. (2007). Mutual fund flows and investor returns: An empirical examination of fund investor timing ability. Journal of Banking & Finance, 31(9), 2796–2816. https://doi.org/10.1016/j.jbankfin.2007.01.024

Gallagher, K. M., & Updegraff, J. A. (2012). Health message framing effects on attitudes, intentions, and behavior: a meta-analytic review. *Annals of behavioral medicine*, *43*(1), 101-116. https://doi.org/10.1007/s12160-011-9308-7

Ganzach, Y. (2000). Judging Risk and Return of Financial Assets. Organizational Behavior and Human Decision Processes, 83(2), 353–370. https://doi.org/10.1006/obhd.2000.2914

Gavaruzzi, T., Caserotti, M., Leo, I., Tasso, A., Speri, L., Ferro, A., Fretti, E., Sannino, A., Rubaltelli, E., & Lotto, L. (2021). The Role of Emotional Competences in Parents' Vaccine Hesitancy. Vaccines, 9(3), 298. https://doi.org/10.3390/vaccines9030298

Gibbons, F. X. (2008, April 28). Intention, expectation, and willingness. National Cancer Institute. Retrieved from: June 10, 2020 https://cancercontrol.cancer.gov/brp/research/constructs/intent-expect-willingness.htm

Goodwin, R., Gaines, S. O., Myers, L., & Neto, F. (2011). Initial Psychological Responses to Swine Flu. *International Journal of Behavioral Medicine*, *18*(2), 88–92. https://doi.org/10.1007/s12529-010-9083-z

Griffith, J., Najand, M., & Shen, J. (2020). Emotions in the Stock Market. Journal of Behavioral Finance, 21(1), 42–56. https://doi.org/10.1080/15427560.2019.1588275

Hameleers, M. (2021). Prospect Theory in Times of a Pandemic: The Effects of Gain versus Loss Framing on Risky Choices and Emotional Responses during the 2020 Coronavirus Outbreak – Evidence from the US and the Netherlands. *Mass Communication and Society*, *24*(4), 479–499. https://doi.org/10.1080/15205436.2020.1870144

Hameleers, M., & Boukes, M. (2021). The Effect of Gain-versus-Loss Framing of Economic and Health Prospects of Different COVID-19 Interventions: An Experiment Integrating Equivalence and Emphasis Framing. *International Journal of Public Opinion Research*, *33*(4), 927–945. https://doi.org/10.1093/ijpor/edab027

Jie, Y. (2022). Frequency or total number? A comparison of different presentation formats on risk perception during COVID-19. *Judgment and Decision Making*, *17*(1), 215–237.

Kahneman, D., & Frederick, S. (2002). Representativeness revisited: Attribute substitution in intuitive judgment. *Heuristics and biases: The psychology of intuitive judgment*, *49*, 81. https://doi.org/10.1017/CBO9780511808098.004

Keinan, R., Idan, T., & Bereby-Meyer, Y. (2021). Compliance with COVID-19 prevention guidelines: Active vs. Passive risk takers. *Judgment and Decision Making*, *16*(1), 16.

Kemeny, R., (2020, April 14) Bolsonaro's denial of coronavirus puts the country at risk. *The World.* Retrieved 2020, from https://www.pri.org/

Kempf, A., Merkle, C., & Niessen-Ruenzi, A. (2014). Low Risk and High Return – Affective Attitudes and Stock Market Expectations. *European Financial Management*, 20(5), 995–1030. https://doi.org/10.1111/eufm.12001

Kim, C. W., & Song, H. R. (2017). Structural Relationships among Public's Risk Characteristics, Trust, Risk Perception and Preventive Behavioral Intention—The Case of MERS in Korea -. *Crisis and Emergency Management*, *13*(6), 85–95. https://doi.org/10.14251/crisisonomy.2017.13.6.85

Koehler, J. J., & Macchi, L. (2004). Thinking About Low-Probability Events: An Exemplar-Cuing Theory. *Psychological Science*, *15*(8), 540–546. https://doi.org/10.1111/j.0956-7976.2004.00716.x

Leppin, A., & Aro, A. R. (2009). Risk Perceptions Related to SARS and Avian Influenza: Theoretical Foundations of Current Empirical Research. *International Journal of Behavioral Medicine*, *16*(1), 7–29. https://doi.org/10.1007/s12529-008-9002-8

Lerner, J. S., & Keltner, D. (2000). Beyond valence: Toward a model of emotion-specific influences on judgement and choice. *Cognition and Emotion*, *14*(4), 473–493. https://doi.org/10.1080/026999300402763

Lerner, J. S., Gonzalez, R. M., Small, D. A., & Fischhoff, B. (2003). Effects of Fear and Anger on Perceived Risks of Terrorism: A National Field Experiment. *Psychological Science*, *14*(2), 144–150. https://doi.org/10.1111/1467-9280.01433

Li, H., Yang, Y., Liu, D., & Xie, X. (2021). Risk preferences in self–other decisions: The effect of payoff allocation framing. *Journal of Behavioral Decision Making*, 34(2), 247–260. https://doi.org/10.1002/bdm.2207

Lichtenstein, S., Slovic, P., Fischhoff, B., Layman, M., & Combs, B. (1978). Judged frequency of lethal events. *Journal of Experimental Psychology: Human Learning and Memory*, *4*(6), 551–578. https://doi.org/10.1037/0278-7393.4.6.551

Loewenstein, G., Weber, E., Hsee, C., & Welch, N. (2001). Risk as Feelings. *Psychological Bulletin*, *127*(2), 267–286. https://doi.org/10.1037/0033-2909.127.2.267

MacGregor, D. G., Slovic, P., Dreman, D., & Berry, M. (2000). Imagery, Affect, and Financial Judgment. *Journal of Psychology and Financial Markets*, 1(2), 104–110. https://doi.org/10.1207/S15327760JPFM0102_2

Martin, R. (2019). Examination and implications of experimental research on investor perceptions. *Journal of Accounting Literature*, 43, 145–169. https://doi.org/10.1016/j.acclit.2019.11.001

Nabi, R. L., Walter, N., Oshidary, N., Endacott, C. G., Love-Nichols, J., Lew, Z. J., & Aune, A. (2020). Can emotions capture the elusive gain-loss framing effect? A meta-analysis. *Communication Research*, *47*(8), 1107-1130. https://doi.org/10.1177/0093650219861256

Newell, B. R., Mitchell, C. J., & Hayes, B. K. (2008). Getting scarred and winning lotteries: Effects of exemplar cuing and statistical format on imagining low-probability events. *Journal of Behavioral Decision Making*, *21*(3), 317–335. https://doi.org/10.1002/bdm.584

Niepel, C., Kranz, D., Borgonovi, F., Emslander, V., & Greiff, S. (2020). The coronavirus (COVID-19) fatality risk perception of US adult residents in March and April 2020. *British Journal of Health Psychology*, https://doi.org/10.1111/bjhp.12438

Oehler, A., & Wedlich, F. (2018). The Relationship of Extraversion and Neuroticism With Risk Attitude, Risk Perception and Return Expectations (SSRN Scholarly Paper ID 3308503). Social Science Research Network. https://papers.ssrn.com/abstract=3308503

O'Keefe, D. J., & Jensen, J. D. (2009). The relative persuasiveness of gain-framed and loss-framed messages for encouraging disease detection behaviors: A meta-analytic

review. *Journal of Communication*, *59*, 296-316. https://doi.org/10.1111/j.1460-2466.2009.01417.x

O'Keefe, D. J., & Jensen, J. D. (2007). The relative persuasiveness of gain-framed loss-framed messages for encouraging disease prevention behaviors: A meta-analytic review. *Journal of health communication*, *12*(7), 623-644. https://doi.org/10.1080/10810730701615198

O'Keefe, D. J., & Nan, X. (2012). The relative persuasiveness of gain-and loss-framed messages for promoting vaccination: A meta-analytic review. *Health communication*, *27*(8), 776-783. https://doi.org/10.1080/10410236.2011.640974

Peña-Sarrionandia, A., Mikolajczak, M., & Gross, J. J. (2015). Integrating emotion regulation and emotional intelligence traditions: A meta-analysis. *Frontiers in Psychology*, 6. https://doi.org/10.3389/fpsyg.2015.00160

Peters, E., Västfjäll, D., Gärling, T., & Slovic, P. (2006). Affect and decision making: A "hot" topic. *Journal of behavioral decision making*, 19(2), 79-85. https://doi.org/10.1002/bdm.528

Petrides, K. V. (2009). Psychometric Properties of the Trait Emotional Intelligence Questionnaire (TEIQue). In J. D. A. Parker, D. H. Saklofske, & C. Stough (A c. Di), *Assessing Emotional Intelligence: Theory, Research, and Applications* (pag. 85–101). Springer US. https://doi.org/10.1007/978-0-387-88370-0_5

Petrides, K. V. (2011). Ability and trait emotional intelligence. In The *Wiley-Blackwell handbook of individual differences* (pp. 656–678). Wiley Blackwell. https://doi.org/10.1002/9781444343120.ch25

Polman, E. (2012). Self–other decision making and loss aversion. *Organizational Behavior and Human Decision Processes*, 119(2), 141–150. https://doi.org/10.1016/j.obhdp.2012.06.005

Prentice-Dunn, S., & Rogers, R. W. (1986). Protection motivation theory and preventive health: Beyond the health belief model. *Health education research*, *1*(3), 153-161. https://doi.org/10.1093/her/1.3.153

Purchase, I. F. H., & Slovic, P. (1999). Quantitative Risk Assessment Breeds Fear. *Human and Ecological Risk Assessment: An International Journal*, *5*(3), 445–453. https://doi.org/10.1080/10807039.1999.10518869

Reinholtz, N., Maglio, S. J., & Spiller, S. A. (2021). Stocks, flows, and risk response to pandemic data. *Journal of Experimental Psychology: Applied*, *27*(4), 657–668. https://doi.org/10.1037/xap0000395

Rickard, L. N. (2021). Pragmatic and (or) Constitutive? On the Foundations of Contemporary Risk Communication Research. *Risk Analysis*, *41*(3), 466–479. https://doi.org/10.1111/risa.13415

Rogers, R. W. (1975). A protection motivation theory of fear appeals and attitude change1. *The journal of psychology*, 91(1), 93-114. https://doi.org/10.1177/109019817400200405

Rogers, R. W., & Prentice-Dunn, S. (1997). Protection motivation theory. In D. S. Gochman (Ed.), *Handbook of health behavior research 1: Personal and social determinants* (p. 113–132). Plenum Press.

Rottenstreich, Y., & Hsee, C. K. (2001). Money, Kisses, and Electric Shocks: On the Affective Psychology of Risk. *Psychological Science*, *12*(3), 185–190. https://doi.org/10.1111/1467-9280.00334

Rubaltelli, E., Agnoli, S., & Franchin, L. (2016). Sensitivity to Affective Information and Investors' Evaluation of Past Performance: An Eye-tracking Study. Journal of *Behavioral Decision Making*, 29(2–3), 295–306. https://doi.org/10.1002/bdm.1885

Rubaltelli, E., Pasini, G., Rumiati, R., Olsen, R. A., & Slovic, P. (2010). The Influence of Affective Reactions on Investment Decisions. *Journal of Behavioral Finance*, 11(3), 168–176. https://doi.org/10.1080/15427560.2010.507409

Rubin, G. J., Amlôt, R., Page, L., & Wessely, S. (2009). Public perceptions, anxiety, and behaviour change in relation to the swine flu outbreak: Cross sectional telephone survey. *BMJ*, *339*. https://doi.org/10.1136/bmj.b2651

Setbon, M., & Raude, J. (2010). Factors in vaccination intention against the pandemic influenza A/H1N1. *European Journal of Public Health*, *20*(5), 490–494. https://doi.org/10.1093/eurpub/ckq054

Sharpe, W. F. (1964). Capital Asset Prices: A Theory of Market Equilibrium Under Conditions of Risk. *The Journal of Finance*, *19*(3), 425–442. https://doi.org/10.1111/j.1540-6261.1964.tb02865.x

Sheeran, P., Harris, P. R., & Epton, T. (2014). Does heightening risk appraisals change people's intentions and behavior? A meta-analysis of experimental studies. *Psychological Bulletin*, *140*(2), 511–543. https://doi.org/10.1037/a0033065

Shefrin, H. (2001). Do Investors Expect Higher Returns From Safer Stocks Than From Riskier Stocks? *Journal of Psychology and Financial Markets*, 2(4), 176–181. https://doi.org/10.1207/S15327760JPFM0204_1

Shoots-Reinhard, B., Lawrence, E. R., Schulkin, J., & Peters, E. (2022). Excluding numeric side-effect information produces lower vaccine intentions. *Vaccine*, *40*(31), 4262–4269. https://doi.org/10.1016/j.vaccine.2022.06.001

Siegel, J. J., & Thaler, R. H. (1997). Anomalies: The Equity Premium Puzzle. *Journal of Economic Perspectives*, 11(1), 191–200. https://doi.org/10.1257/jep.11.1.191

Siegrist, M., & Árvai, J. (2020). Risk Perception: Reflections on 40 Years of Research. *Risk Analysis*, *40*(S1), 2191–2206. https://doi.org/10.1111/risa.13599

Sinayev, A., Peters, E., Tusler, M., & Fraenkel, L. (2015). Presenting Numeric Information with Percentages and Descriptive Risk Labels: A Randomized Trial. *Medical Decision Making*, *35*(8), 937–947. https://doi.org/10.1177/0272989X15584922

Sjöberg, L. (2007). Emotions and Risk Perception. *Risk Management*, *9*(4), 223–237. https://doi.org/10.1057/palgrave.rm.8250038

Slovic, P. E. (2000). *The perception of risk*. Earthscan publications.

Slovic, P., & Peters, E. (2006). Risk Perception and Affect. *Current Directions in Psychological Science*, *15*(6), 322–325. https://doi.org/10.1111/j.1467-8721.2006.00461.x

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. https://doi.org/10.1111/j.0272-4332.2004.00433.x

Slovic, P., Finucane, M., Peters, E., & MacGregor, D. G. (2002). Rational actors or rational fools: Implications of the affect heuristic for behavioral economics. *The Journal of Socio-Economics*, *31*(4), 329–342. https://doi.org/10.1016/S1053-5357(02)00174-9

Statman, M., Fisher, K. L., & Anginer, D. (2008). Affect in a Behavioral Asset-Pricing Model. *Financial Analysts Journal*, 64(2), 20–29. https://doi.org/10.2469/faj.v64.n2.8

Taylor, S. (2019). The Psychology of Pandemics: Preparing for the Next Global Outbreak of Infectious Disease. Newcastle upon Tyne, UK: Cambridge Scholars Publishing.

Timmermans, D., Ockhuysen-Vermey, C. W., & Henneman, L. (2008). Presenting health risk information in different formats: The effect on participants' cognitive and emotional evaluation and decisions. *Patient Education and Counseling*, *73*(3), 443–447. https://doi.org/10.1016/j.pec.2008.07.013

Timmermans, D., & Oudhoff, J. (2011). Different Formats for the Communication of Risks: Verbal, Numerical, and Graphical Formats. In *Wiley Encyclopedia of Operations Research and Management Science*. American Cancer Society. https://doi.org/10.1002/9780470400531.eorms0954

Tversky, A., & Kahneman, D. (1973). Availability: A heuristic for judging frequency and probability. *Cognitive Psychology*, *5*(2), 207–232. https://doi.org/10.1016/0010-0285(73)90033-9

Van Bavel, J. J., Baicker, K., Boggio, P. S., Capraro, V., Cichocka, A., Cikara, M., Crockett, M. J., Crum, A. J., Douglas, K. M., Druckman, J. N., Drury, J., Dube, O., Ellemers, N., Finkel, E. J., Fowler, J. H., Gelfand, M., Han, S., Haslam, S. A., Jetten, J., … Willer, R. (2020). Using social and behavioural science to support COVID-19 pandemic response. *Nature Human Behaviour*, *4*(5), 460–471. https://doi.org/10.1038/s41562-020-0884-z

Visschers, V. H. M., Meertens, R. M., Passchier, W. W. F., & De Vries, N. N. K. (2009). Probability Information in Risk Communication: A Review of the Research Literature. *Risk Analysis*, *29*(2), 267–287. https://doi.org/10.1111/j.1539-6924.2008.01137.x

Waters, E. A., Weinstein, N. D., Colditz, G. A., & Emmons, K. (2006). Formats for Improving Risk Communication in Medical Tradeoff Decisions. *Journal of Health Communication*, *11*(2), 167–182. https://doi.org/10.1080/10810730500526695

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social.* https://doi.org/10.1037/0022-3514.54.6.1063

Webb, T. L., & Sheeran, P. (2006). Does changing behavioral intentions engender behavior change? A meta-analysis of the experimental evidence. *Psychological Bulletin*, *132*(2), 249–268. https://doi.org/10.1037/0033-2909.132.2.249

Wilson, R. S., Zwickle, A., & Walpole, H. (2019). Developing a Broadly Applicable Measure of Risk Perception. *Risk Analysis*, *39*(4), 777–791. https://doi.org/10.1111/risa.13207

Yang, S., & Cho, S.-I. (2017). Middle East respiratory syndrome risk perception among students at a university in South Korea, 2015. *American Journal of Infection Control*, *45*(6), e53–e60. https://doi.org/10.1016/j.ajic.2017.02.013

Appendix 1

Section 1. Trait individual differences

1.1 Literature background.

Apart from investigating the effects of framing and the type of disease, our study was designed with specific trait individual differences in mind which have previously been linked to preventive actions in health-related decisions and studies on previous pandemics. The motivation for including these individual differences also stems from the observation that individuals differ in their acceptance of self-protective behavior.

Considering the central role of feelings and affect in risk perception and health-related behaviors, we wanted to investigate the role of the ability to self-regulate one's emotional reactions. Trait emotional intelligence (trait EI) is defined as the ability to identify, manage, and use emotions (Petrides et al., 2007). Individuals with high trait EI tend to regulate emotions more adaptively, are more able to deal with and downregulate negative affect under stress, are less influenced by irrelevant stimuli and perceive events as less threatening (Peña et al., 2015; Rubaltelli et al., 2020; Scrimin & Rubaltelli, 2019; Sevdalis et al., 2007). Based on that, we expect that participants with high trait EI will show a weaker emotional reaction and subsequently lower risk perception. Moreover, some dimensions of the construct have also been related to preventive (e.g., wellness maintenance) behaviors (Fernández-Abascal & Martín-Díaz, 2015; Mikolajczak et al., 2015), but to the best of our knowledge no study investigated the relationship with self-protective behaviors specifically. Nonetheless, we expect that higher trait EI will be associated with higher engagement in self-protective behaviors.

Moreover, perceived behavioral control over the action can also play a significant role in behavior engagement. According to Ajzen's Theory of Planned Behaviors (Ajzen, 1991), people need to feel able to control and have the resources to master the activity to carry out a behavior. We predict that those who feel to have high control over their engagement in self-protective behaviors will report higher effective compliance with those. Indeed, correlations between perceived behavioral control and health-related behaviors have been found, although those correlations were low (Ajzen, 2011; McEachan et al., 2011).

Additionally, we also examined the possible effects of personal values and worldviews such as conspiracy beliefs, trust in politics, media and science, and knowledge about the disease and the non-pharmaceutical measures taken by the authorities. Since the beginning of the pandemic, high levels of fake news and conspiracy-frame narratives around the origins of the

virus as well as remedies against it (e.g., the virus was created in a Chinese lab as a biological weapon; was caused by 5G electromagnetic waves; disinfectant injection can be used as a treatment) were disseminated among the media (Cuan-Baltazar et al., 2020; Depoux et al., 2020; Kouzy et al., 2020; Mian & Khan, 2020; Pennycook et al., 2020). The uncontrollable proliferation of misinformation and confusing news can make people adopt ineffective remedies and refrain from adhering to recommended self-protective behaviors (Brainard & Hunter, 2020; Pennycook et al., 2020; Taylor, 2019). Believing in conspiracy theories has been linked to negative health behavior such as a preference for alternative medicine and a lower likelihood to get influenza shots and vaccines against H1N1 (Lohiniva et al., 2014; Oliver & Wood, 2014; Setbon & Raude, 2010). In line with this, we expect to find lower engagement in self-protective behaviors in those more prone to endorse conspiracy theories.

This misinformation epidemic (Kouzy et al., 2020) and the different strategies implemented by governments can reduce public trust and bias citizens knowledge about the situation. However, both trust and knowledge play a key role in guiding citizens' risk perception (Siegrist & Cvetkovich, 2000). Trust in authorities, in media and science has been found relevant in enhancing compliance with recommended behaviors and vaccinations during previous pandemics (Kim & Song, 2017; Plohl & Musil, 2020; Prati et al., 2011; Siegrist & Zingg, 2014; Yang & Cho, 2017). Higher engagement in behaviors and lower risk perception were also found in individuals with higher disease-related knowledge (Brug et al., 2004; Rolison & Hanoch, 2015; Yang & Cho, 2017).

1.2 Materials

Participants' subjectively perceived knowledge about 1) the viral disease, 2) the public policies, and 3) the self-protective behaviors was measured by asking participants to rate from 1 (Nothing at all) to 7 (Very much) how much they think they know about the three topics. The three items were combined in a single variable (Knowledge). Trait emotional intelligence was assessed with the TEIQue-SF (Petrides, 2009) with 30 items using a 7-point scale ranging from 1 (Completely Disagree) to 7 (Completely Agree). The 15-item Generic Conspiracist Beliefs Scale (GCB - Brotherton et al., 2013) was used to measure participants' beliefs in conspiracies at a general level on a 5-point scale from 1 (Definitely not true) to 5 (Definitely true). Participants' trust in politics (Trust in politics) was assessed by asking how much they trusted national (legal system, police, politician, political parties, the Department of Health) and international institutions (WHO and European Parliament) on a scale from 0 (Not trust at all) to 10 (Complete trust) adapted from Ervasti & Ervasti (2008). To measure trust in media (Trust

in media), two sub-scales from the ADTRUST scale were adapted (Soh et al., 2009). The scales assessed participants' perceived reliability and usefulness of the information conveyed in national media with 13 adjectives (e.g., Honest, Credible, Valuable, etc.) on a scale from 1 (Completely Disagree) to 7 (Completely Agree). Finally, a scale from McCright, Dentzman, Charters & Dietz (2013) was adapted to understand participants' trust in science (Trust in science), measured by ratings from 1 (Completely distrust) to 5 (Completely trust) how much participants trusted scientists to create unbiased and useful knowledge with four items. Cronbach's alphas were acceptable for all of the scales and created variables (Cronbach's $_{UK,AT,IT} > .739$).

References

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, *50*(2), 179–211. https://doi.org/10.1016/0749-5978(91)90020-T

Ajzen, I. (2011). The theory of planned behaviour: Reactions and reflections. *Psychology & Health*, *26*(9), 1113–1127. https://doi.org/10.1080/08870446.2011.613995

Brainard, J., & Hunter, P. R. (2020). Misinformation making a disease outbreak worse: Outcomes compared for influenza, monkeypox, and norovirus. *SIMULATION*, *96*(4), 365–374. https://doi.org/10.1177/0037549719885021

Brotherton, R., French, C. C., & Pickering, A. D. (2013). Measuring Belief in Conspiracy Theories: The Generic Conspiracist Beliefs Scale. *Frontiers in Psychology*, *4*. https://doi.org/10.3389/fpsyg.2013.00279

Brug, J., Aro, A. R., Oenema, A., de Zwart, O., Richardus, J. H., & Bishop, G. D. (2004). SARS Risk Perception, Knowledge, Precautions, and Information Sources, the Netherlands. *Emerging Infectious Diseases*, *10*(8), 1486–1489. https://doi.org/10.3201/eid1008.040283

Cuan-Baltazar, J. Y., Muñoz-Perez, M. J., Robledo-Vega, C., Pérez-Zepeda, M. F., & Soto-Vega, E. (2020). Misinformation of COVID-19 on the Internet: Infodemiology Study. *JMIR Public Health and Surveillance*, *6*(2), e18444. https://doi.org/10.2196/18444

Depoux, A., Martin, S., Karafillakis, E., Preet, R., Wilder-Smith, A., & Larson, H. (2020). The pandemic of social media panic travels faster than the COVID-19 outbreak. *Journal of Travel Medicine*, *27*(3). https://doi.org/10.1093/jtm/taaa031

Ervasti, H., & Ervasti, H. (2008). *Nordic Social Attitudes in a European Perspective*. Edward Elgar Publishing.

Fernández-Abascal, E. G., & Martín-Díaz, M. D. (2015). Dimensions of emotional intelligence related to physical and mental health and to health behaviors. *Frontiers in Psychology*, *6*. https://doi.org/10.3389/fpsyg.2015.00317

Kim, C. W., & Song, H. R. (2017). Structural Relationships among Public's Risk Characteristics, Trust, Risk Perception and Preventive Behavioral Intention—The Case of MERS in Korea -. *Crisis and Emergency Management*, *13*(6), 85–95. https://doi.org/10.14251/crisisonomy.2017.13.6.85

Kouzy, R., Abi Jaoude, J., Kraitem, A., El Alam, M. B., Karam, B., Adib, E., Zarka, J., Traboulsi, C., Akl, E. W., & Baddour, K. (2020). Coronavirus Goes Viral: Quantifying the COVID-19 Misinformation Epidemic on Twitter. *Cureus*, *12*(3). https://doi.org/10.7759/cureus.7255

Lohiniva, A.-L., Barakat, A., Dueger, E., Restrepo, S., & Aouad, R. E. (2014). A Qualitative Study of Vaccine Acceptability and Decision Making among Pregnant Women in Morocco during the A (H1N1) pdm09 Pandemic. *PLOS ONE*, *9*(10), e96244. https://doi.org/10.1371/journal.pone.0096244

McCright, A. M., Dentzman, K., Charters, M., & Dietz, T. (2013). The influence of political ideology on trust in science. *Environmental Research Letters*, *8*(4), 044029. https://doi.org/10.1088/1748-9326/8/4/044029

McEachan, R. R. C., Conner, M., Taylor, N. J., & Lawton, R. J. (2011). Prospective prediction of health-related behaviours with the Theory of Planned Behaviour: A meta-analysis. *Health Psychology Review*, *5*(2), 97–144. https://doi.org/10.1080/17437199.2010.521684

Mian, A., & Khan, S. (2020). Coronavirus: The spread of misinformation. *BMC Medicine*, *18*(1), 89. https://doi.org/10.1186/s12916-020-01556-3

Mikolajczak, M., Avalosse, H., Vancorenland, S., Verniest, R., Callens, M., van Broeck, N., Fantini-Hauwel, C., & Mierop, A. (2015). A nationally representative study of emotional competence and health. *Emotion*, *15*(5), 653–667. https://doi.org/10.1037/emo0000034

Oliver, J. E., & Wood, T. (2014). Medical Conspiracy Theories and Health Behaviors in the United States. *JAMA Internal Medicine*, *174*(5), 817–818. https://doi.org/10.1001/jamainternmed.2014.190

Peña-Sarrionandia, A., Mikolajczak, M., & Gross, J. J. (2015). Integrating emotion regulation and emotional intelligence traditions: A meta-analysis. *Frontiers in Psychology*, *6*. https://doi.org/10.3389/fpsyg.2015.00160

Pennycook, G., McPhetres, J., Zhang, Y., Lu, J. G., & Rand, D. G. (2020). *Fighting COVID-19 misinformation on social media: Experimental evidence for a scalable accuracy nudge intervention* [Preprint]. PsyArXiv. https://doi.org/10.31234/osf.io/uhbk9

Petrides, K. V. (2009). Psychometric Properties of the Trait Emotional Intelligence Questionnaire (TEIQue). In J. D. A. Parker, D. H. Saklofske, & C. Stough (Eds.), *Assessing Emotional Intelligence: Theory, Research, and Applications* (pp. 85–101). Springer US. https://doi.org/10.1007/978-0-387-88370-0_5

Petrides, K. V., Pita, R., & Kokkinaki, F. (2007). The location of trait emotional intelligence in personality factor space. *British Journal of Psychology*, *98*(2), 273–289. https://doi.org/10.1348/000712606X120618

Plohl, N., & Musil, B. (2020). Modeling compliance with COVID-19 prevention guidelines: The critical role of trust in science. *Psychology, Health & Medicine*, *0*(0), 1–12. https://doi.org/10.1080/13548506.2020.1772988

Prati, G., Pietrantoni, L., & Zani, B. (2011). Compliance with recommendations for pandemic influenza H1N1 2009: The role of trust and personal beliefs. *Health Education Research*, *26*(5), 761–769. https://doi.org/10.1093/her/cyr035

Rolison, J. J., & Hanoch, Y. (2015). Knowledge and risk perceptions of the Ebola virus in the United States. *Preventive Medicine Reports*, *2*, 262–264. https://doi.org/10.1016/j.pmedr.2015.04.005

Rubaltelli, E., Priolo, G., Scrimin, S., & Moscardino, U. (2020). Media Exposure to Terrorism and Perception of Immigrants as a Threat: The Role of Emotional Intelligence and Psychophysiological Self-Regulation. *Risk Analysis*. https://doi.org/10.1111/risa.13498

Scrimin, S., & Rubaltelli, E. (2019). Dehumanization after terrorism: The role of psychophysiological emotion regulation and trait emotional intelligence. *Current Psychology*. https://doi.org/10.1007/s12144-019-00189-x

Setbon, M., & Raude, J. (2010). Factors in vaccination intention against the pandemic influenza A/H1N1. *European Journal of Public Health*, *20*(5), 490–494. https://doi.org/10.1093/eurpub/ckq054

Sevdalis, N., Petrides, K. V., & Harvey, N. (2007). Trait emotional intelligence and decision-related emotions. *Personality and Individual Differences*, *42*(7), 1347–1358. https://doi.org/10.1016/j.paid.2006.10.012

Siegrist, M., & Cvetkovich, G. (2000). Perception of Hazards: The Role of Social Trust and Knowledge. *Risk Analysis*, *20*(5), 713–720. https://doi.org/10.1111/0272-4332.205064

Siegrist, M., & Zingg, A. (2014). The Role of Public Trust During Pandemics: Implications for Crisis Communication. *European Psychologist*, *19*(1), 23–32. https://doi.org/10.1027/1016-9040/a000169

Soh, H., Reid, L. N., & King, K. W. (2009). Measuring Trust In Advertising. *Journal of Advertising*, *38*(2), 83–104. https://doi.org/10.2753/JOA0091-3367380206

Taylor, S. (2019). *The Psychology of Pandemics: Preparing for the Next Global Outbreak of Infectious Disease*. Cambridge Scholars Publishing.

Yang, S., & Cho, S.-I. (2017). Middle East respiratory syndrome risk perception among students at a university in South Korea, 2015. *American Journal of Infection Control*, *45*(6), e53–e60. https://doi.org/10.1016/j.ajic.2017.02.013

Section 2. Original materials of the manipulations and items translated in English, German and Italian.

Table A1. Original materials of the Frame and Viral Disease manipulations in the three countries.

Country	Viral disease	Frame	
UK	Coronavirus	Positive	"From October 2019 to March 2020, people around the world have been infected by the new coronavirus, and some of these people have recovered. In the UK, this year it has been estimated 11,658 cases and 135 people have recovered. "
		Negative	"From October 2019 to March 2020, several people around the world have been infected by the new coronavirus, and some of these people have died. In the UK, this year it has been estimated 11,658 cases and 578 people have died."
	Seasonal flu	Positive	"From October to March every year, as also in 2020, several people around the world are infected by the seasonal flu, and some of these people recovered. In the UK, this year it has been estimated that 6,775,000 people have been infected and 6,758,220 have recovered."
		Negative	"From October to March every year, as also in 2020, several people around the world are infected by the seasonal flu, and some people die. In the UK, this year it has been estimated that 6,775,000 people have been infected and 16,780 have died."
Austria	Coronavirus	Positive	"Im Zeitraum von Oktober 2019 bis März 2020 haben sich Menschen weltweit mit dem neuen Coronavirus infiziert und einige dieser Menschen sind bereits wieder gesund. In Österreich haben Schätzungen dieses Jahr ergeben, dass es bisher 7.196 Fälle gab und 225 Menschen wieder gesund wurden."

		Negative	"Im Zeitraum von Oktober 2019 bis März 2020 haben sich Menschen weltweit mit dem neuen Coronavirus infiziert und einige dieser Menschen sind bereits gestorben. In Österreich haben Schätzungen dieses Jahr ergeben, dass es bisher 7.196 Fälle gab und 58 Menschen gestorben sind."
	Seasonal flu	Positive	"Jedes Jahr von Oktober bis März, so auch 2020, infizieren sich Menschen weltweit mit dem saisonalen Grippevirus und einige dieser Menschen werden wieder gesund. In Österreich haben Schätzungen dieses Jahr ergeben, dass sich bisher 890.000 Menschen angesteckt haben und 887.888 Menschen wieder gesund worden sind."
		Negative	"Jedes Jahr von Oktober bis März, so auch 2020, infizieren sich Menschen weltweit mit dem saisonalen Grippevirus und einige dieser Menschen sterben. In Österreich haben Schätzungen dieses Jahr ergeben, dass sich bisher 890.000 Menschen angesteckt haben und 2.112 Menschen gestorben sind."
Italy	Coronavirus	Positive	"Da Ottobre 2019 a Marzo 2020, diverse persone nel mondo sono state contagiate dal nuovo coronavirus e alcune di queste persone sono guarite. In Italia, ci sono stati 86.498 casi di cui 10.950 guariti."
		Negative	"Da Ottobre 2019 a Marzo 2020, diverse persone nel mondo sono state contagiate dal nuovo coronavirus e alcune di queste persone sono decedute. In Italia, ci sono stati 86.498 casi di cui 9.134 deceduti."
	Seasonal flu	Positive	"Da Ottobre a Marzo ogni anno, come anche nel 2020, diverse persone nel mondo vengono contagiate dall'influenza stagionale e alcune di queste persone guariscono. In Italia, si stima che quest'anno 6.027.500 persone siano state contagiate e che 6.019.500 siano guarite."
		Negative	"Da Ottobre a Marzo ogni anno, come anche nel 2020, diverse persone nel mondo vengono contagiate dall'influenza stagionale e alcune di queste persone muoiono. In Italia, si stima che quest'anno 6.027.500 persone siano state contagiate e che 8.000 siano morte."

Table A2. Complete list of items and measuring scales for the three countries.

Country	Variable	Level	Item	Responses scale
UK	Emotional Reaction	disease	When I think about the coronavirus/seasonal flu I feel...	(0) Not Worried/(10) Very Worried
		public policies	When I think about the public policies implemented by the UK Government to limit the spread of coronavirus/seasonal flu I feel...	(0) Not Worried/(10) Very Worried
		media	When I think about what has been told about the coronavirus/seasonal flu in the UK media (journals, an online newspaper, television news) I feel...	(0) Not Worried/(10) Very Worried

Likelihood to get infected		What is the probability that you will get infected by coronavirus/seasonal flu in the next month?	(1) Extremely low/(7) Extremely high
Severity of the disease		How dangerous is the coronavirus/seasonal flu?	(1) Not dangerous at all/(7) Very dangerous
Behavior Capability		For me to follow the propagated behavior in the forthcoming month would be...	(1) Impossible/(7) Possible
Behavior Control		It is mostly up to me to follow the propagated behavior in the forthcoming month.	(1) Strongly disagree/(6) Strongly agree
Behavior		Please indicate how often you engage in the propagated behavior using a scale from 1 to 7 where 1 represents “Never” and 7 represents “Always”.	(1) Never/(7) Always
Danger Public Policies	in general	The UK Government has implemented public policies to limit the spread of the coronavirus/seasonal flu. In your opinion, how dangerous are these public policies...(1) in general?	(1) Not dangerous at all/(7) Extremely dangerous
	for national economy	The UK Government has implemented public policies to limit the spread of the coronavirus/seasonal flu. In your opinion, how dangerous are these public policies...(2) for the national economy?	(1) Not dangerous at all/(7) Extremely dangerous
	for national social-emotional climate	The UK Government has implemented public policies to limit the spread of the coronavirus/seasonal flu. In your opinion, how dangerous are these public policies...(3) for the national social-emotional climate?	(1) Not dangerous at all/(7) Extremely dangerous
	for individual physical health	The UK Government has implemented public policies to limit the spread of the coronavirus/seasonal flu. In your opinion, how dangerous are these public policies...(4) for individuals’ physical health?	(1) Not dangerous at all/(7) Extremely dangerous
Danger Media Communication	in general	How much do you perceive the way the UK media talk about the coronavirus/seasonal flu as dangerous...(1) in general?	(1) Not dangerous at all/(7) Extremely dangerous
	for national economy	How much do you perceive the way the UK media talk about the coronavirus/seasonal flu as dangerous...(2) for the national economy?	(1) Not dangerous at all/(7) Extremely dangerous

	for national social-emotional climate	How much do you perceive the way the UK media talk about the coronavirus/seasonal flu as dangerous...(3) for the national social-emotional climate?	(1) Not dangerous at all/(7) Extremely dangerous
	for individual physical health	How much do you perceive the way the UK media talk about the coronavirus/seasonal flu as dangerous...(4) for individuals' physical health?	(1) Not dangerous at all/(7) Extremely dangerous
Usefulness Public Policies	in general	The UK Government has implemented public policies to limit the spread of the coronavirus/seasonal flu. In your opinion, how useful are these public policies...(1) in general?	(1) Not useful at all/(7) Extremely useful
	for national economy	The UK Government has implemented public policies to limit the spread of the coronavirus/seasonal flu. In your opinion, how useful are these public policies...(2) for the national economy?	(1) Not useful at all/(7) Extremely useful
	for national social-emotional climate	The UK Government has implemented public policies to limit the spread of the coronavirus/seasonal flu. In your opinion, how useful are these public policies...(3) for the national social-emotional climate?	(1) Not useful at all/(7) Extremely useful
	for individual physical health	The UK Government has implemented public policies to limit the spread of the coronavirus/seasonal flu. In your opinion, how useful are these public policies...(4) for individuals' physical health?	(1) Not useful at all/(7) Extremely useful
Usefulness Media Communication	in general	How much do you perceive the way the UK media talk about the coronavirus/seasonal flu as useful...(1) in general?	(1) Not useful at all/(7) Extremely useful
	for national economy	How much do you perceive the way the UK media talk about the coronavirus/seasonal flu as useful...(2) for the national economy?	(1) Not useful at all/(7) Extremely useful
	for national social-emotional climate	How much do you perceive the way the UK media talk about the coronavirus/seasonal flu as useful...(3) for the national social-emotional climate?	(1) Not useful at all/(7) Extremely useful

		for individual physical health	How much do you perceive the way the UK media talk about the coronavirus/seasonal flu as useful...(4) for individuals' physical health?	(1) Not useful at all/(7) Extremely useful
	Knowledge	for public policies	How much do you think you know about the public policies implemented by the UK Government to limit the spread of the coronavirus/seasonal flu? (1)	(1) Nothing at all/(7) Very much
		for behavior	How much do you think you know about the propagated behaviors to limit the spread of the coronavirus/seasonal flu? (2)	(1) Nothing at all/(7) Very much
		in general	How much do you think you know about the coronavirus/seasonal flu? (3)	(1) Nothing at all/(7) Very much
	Manipulation Check		Please indicate, in the list below, which viral disease you were asked to give your opinion about:	(1) Coronavirus/(2) Seasonal flu/(3) Measles/(4) None of the options
Austria	Emotional Reaction	disease	Wenn ich über das Coronavirus/Saisonalen Grippevirus nachdenke fühle ich (mich)...	(0) Überhaupt nicht besorgt/(10) Sehr besorgt
		public policies	Wenn ich über die, von der österreichischen Regierung vorgenommenen, Maßnahmen gegen die weitere Ausbreitung des Coronavirus/Saisonalen Grippevirus nachdenke, dann fühle ich (mich)...	(0) Überhaupt nicht besorgt/(10) Sehr besorgt
		media	Wenn ich darüber nachdenke, was in den österreichischen Medien (Zeitschriften, online Zeitungen, Fernsehen) über das Coronavirus/Saisonalen Grippevirus berichtet wird, dann fühle ich (mich)...	(0) Überhaupt nicht besorgt/(10) Sehr besorgt
	Likelihood to get infected		Wie wahrscheinlich ist es, dass Sie sich im nächsten Monat mit dem Coronavirus/Saisonalen Grippevirus infizieren?	(1) Sehr niedrig/(7) Sehr hoch
	Severity of the disease		Wie gefährlich ist das Coronavirus/Saisonalen Grippevirus?	(1) Überhaupt nicht gefährlich /(7) Sehr gefährlich
	Behavior Capability		Die empfohlenen Verhaltensweisen im kommenden Monat einzuhalten, wäre für mich...	(1) Unmöglich/(7) Möglich
	Behavior Control		Ob ich im kommenden Monat die empfohlenen Verhaltensweisen einhalten werde, habe ich größtenteils selbst in der Hand.	(1) Stimme gar nicht zu /(6) Stimme sehr zu

Behavior		Bitte geben Sie auf einer Skala von 1 bis 7 an, wie häufig sie die zuvor genannten Verhaltensweisen anwenden, wobei 1 für "Nie" und 7 für "Immer" steht	(1) Nie/(7) Immer
Danger Public Policies	in general	Die österreichische Regierung hat Maßnahmen vorgenommen, um die weitere Ausbreitung des Coronavirus/Saisonalen Grippevirus einzugrenzen. Wie gefährlich sind diese staatlichen Maßnahmen Ihrer Meinung nach...(1) im Allgemeinen?	(1) Überhaupt nicht gefährlich/(7) Sehr gefährlich
	for national economy	Die österreichische Regierung hat Maßnahmen vorgenommen, um die weitere Ausbreitung des Coronavirus/Saisonalen Grippevirus einzugrenzen. Wie gefährlich sind diese staatlichen Maßnahmen Ihrer Meinung nach...(2) für die nationale Wirtschaft?	(1) Überhaupt nicht gefährlich/(7) Sehr gefährlich
	for national social-emotional climate	Die österreichische Regierung hat Maßnahmen vorgenommen, um die weitere Ausbreitung des Coronavirus/Saisonalen Grippevirus einzugrenzen. Wie gefährlich sind diese staatlichen Maßnahmen Ihrer Meinung nach…(3) für das nationale sozial-emotionale Klima?	(1) Überhaupt nicht gefährlich/(7) Sehr gefährlich
	for individual physical health	Die österreichische Regierung hat Maßnahmen vorgenommen, um die weitere Ausbreitung des Coronavirus/Saisonalen Grippevirus einzugrenzen. Wie gefährlich sind diese staatlichen Maßnahmen Ihrer Meinung nach...(4) für die physische Gesundheit des Einzelnen?	(1) Überhaupt nicht gefährlich/(7) Sehr gefährlich
Danger Media Communication	in general	Für wie gefährlich halten Sie die Art und Weise wie die österreichischen Medien über das Coronavirus/Saisonalen Grippevirus berichten...(1) im Allgemeinen?	(1) Überhaupt nicht gefährlich/(7) Sehr gefährlich
	for national economy	Für wie gefährlich halten Sie die Art und Weise wie die österreichischen Medien über das Coronavirus/Saisonalen Grippevirus berichten... (2) für die nationale Wirtschaft?	(1) Überhaupt nicht gefährlich/(7) Sehr gefährlich
	for national social-emotional climate	Für wie gefährlich halten Sie die Art und Weise wie die österreichischen Medien über das Coronavirus/Saisonalen Grippevirus berichten... (3) für das nationale sozial-emotionale Klima?	(1) Überhaupt nicht gefährlich/(7) Sehr gefährlich

	for individual physical health	Für wie gefährlich halten Sie die Art und Weise wie die österreichischen Medien über das Coronavirus/Saisonale Grippe berichten... (4) für die physische Gesundheit des Einzelnen?	(1) Überhaupt nicht gefährlich/(7) Sehr gefährlich
Usefulness Public Policies	in general	Die österreichischen Regierung hat Maßnahmen vorgenommen, um die weitere Ausbreitung des Coronavirus/Saisonalen Grippevirus einzugrenzen. Wie nützlich sind diese staatlichen Maßnahmen Ihrer Meinung nach...(1) im Allgemeinen?	(1) Überhaupt nicht nützlich/(7) Sehr nützlich
	for national economy	Die österreichischen Regierung hat Maßnahmen vorgenommen, um die weitere Ausbreitung des Coronavirus/Saisonalen Grippevirus einzugrenzen. Wie nützlich sind diese staatlichen Maßnahmen Ihrer Meinung nach...(2) für die nationale Wirtschaft?	(1) Überhaupt nicht nützlich/(7) Sehr nützlich
	for national social-emotional climate	Die österreichischen Regierung hat Maßnahmen vorgenommen, um die weitere Ausbreitung des Coronavirus/Saisonalen Grippevirus einzugrenzen. Wie nützlich sind diese staatlichen Maßnahmen Ihrer Meinung nach...(3) für das nationale sozial-emotionale Klima?	(1) Überhaupt nicht nützlich/(7) Sehr nützlich
	for individual physical health	Die österreichischen Regierung hat Maßnahmen vorgenommen, um die weitere Ausbreitung des Coronavirus/Saisonalen Grippevirus einzugrenzen. Wie nützlich sind diese staatlichen Maßnahmen Ihrer Meinung nach...(4) für die physische Gesundheit des Einzelnen?	(1) Überhaupt nicht nützlich/(7) Sehr nützlich
Usefulness Media Communication	in general	Für wie nützlich halten Sie die Art und Weise wie die österreichischen Medien über das Coronavirus/Saisonalen Grippevirus berichten... (1) im Allgemeinen?	(1) Überhaupt nicht nützlich/(7) Sehr nützlich
	for national economy	Für wie nützlich halten Sie die Art und Weise wie die österreichischen Medien über das Coronavirus/Saisonalen Grippevirus berichten... (2) für die nationale Wirtschaft?	(1) Überhaupt nicht nützlich/(7) Sehr nützlich
	for national social-emotional climate	Für wie nützlich halten Sie die Art und Weise wie die österreichischen Medien über das Coronavirus/Saisonalen Grippevirus berichten... (3) für das nationale sozial-emotionale Klima?	(1) Überhaupt nicht nützlich/(7) Sehr nützlich

		for individual physical health	Für wie nützlich halten Sie die Art und Weise wie die österreichischen Medien über das Coronavirus/Saisonalen Grippevirus berichten... (4) für die physische Gesundheit des Einzelnen?	(1) Überhaupt nicht nützlich/(7) Sehr nützlich
	Knowledge	for public policies	Wie viel wissen Sie Ihrer Meinung nach über die von der österreichischen Regierung vorgenommenen Maßnahmen zur Eingrenzung der Ausbreitung des Coronavirus/Saisonalen Grippevirus? (1)	(1) Überhaupt nichts/(7) Sehr viel
		for behavior	Wie viel wissen Sie Ihrer Meinung nach über Verhaltensweisen zur Eingrenzung der Ausbreitung des Coronavirus/Saisonalen Grippevirus? (2)	(1) Überhaupt nichts/(7) Sehr viel
		in general	Wie viel wissen Sie Ihrer Meinung nach über das Coronavirus/Saisonalen Grippevirus? (3)	(1) Überhaupt nichts/(7) Sehr viel
	Manipulation Check		Bitte geben Sie unten in der Liste an, zu welcher Viruserkrankung Sie Ihrer Meinung nach befragt wurden:	(1) Coronavirus/(2) Saisonale Grippe/(3) Masern /(4) Keine dieser Optionen
Italy	Emotional Reaction	disease	Quando penso al coronavirus/influenza stagionale mi sento….	(0) Per niente preoccupato/(10) Estremamente preoccupato
		public policies	Quando penso alle politiche pubbliche che il Governo italiano ha emanato per limitare la diffusione del coronavirus/influenza stagionale mi sento...	(0) Per niente preoccupato/(10) Estremamente preoccupato
		media	Quando penso al modo in cui i media italiani (giornali, siti giornalistici, TG) parlano del coronavirus/influenza stagionale mi sento...	(0) Per niente preoccupato/(10) Estremamente preoccupato
	Likelihood to get infected		Qual è la probabilità che tu venga contagiato dal coronavirus/influenza stagionale nel prossimo mese?	(1) Estremamente bassa/(7) Estremamente alta
	Severity of the disease		Quanto è pericoloso il coronavirus/l'influenza stagionale?	(1) Per niente pericoloso/(7) Estremamente pericoloso
	Behavior Capability		Per me rispettare le indicazioni comportamentali nel prossimo mese sarà impossibile/possibile	(1) Impossibile/(7) Possibile
	Behavior Control		Dipende più che altro da me rispettare le indicazioni comportamentali nel prossimo mese.	(1) Non sono per niente d'accordo/(6) Sono pienamente d'accordo

Behavior		Per piacere indica con quanta frequenza ti impegni a rispettare le indicazioni comportamentali usando una scala da 1 a 7, dove 1 indica "Mai" e 7 indica "Sempre".	(1) Mai/(7) Sempre
Danger Public Policies	in general	Il Governo italiano ha emanato delle politiche pubbliche per limitare la diffusione del coronavirus/influenza stagionale. Secondo te, quanto queste politiche pubbliche sono pericolose… (1) in generale?	(1) Per niente pericoloso/(7) Estremamente pericoloso
	for national economy	Il Governo italiano ha emanato delle politiche pubbliche per limitare la diffusione del coronavirus/influenza stagionale. Secondo te, quanto queste politiche pubbliche sono pericolose…(2) per l'economia nazionale?	(1) Per niente pericoloso/(7) Estremamente pericoloso
	for national social-emotional climate	Il Governo italiano ha emanato delle politiche pubbliche per limitare la diffusione del coronavirus/influenza stagionale. Secondo te, quanto queste politiche pubbliche sono pericolose…(3) per il clima socio-emotivo nazionale?	(1) Per niente pericoloso/(7) Estremamente pericoloso
	for individual physical health	Il Governo italiano ha emanato delle politiche pubbliche per limitare la diffusione del coronavirus/influenza stagionale. Secondo te, quanto queste politiche pubbliche sono pericolose…(4) per la salute fisica di ogni individuo?	(1) Per niente pericoloso/(7) Estremamente pericoloso
Danger Media Communication	in general	Quanto percepisci il modo in cui i media italiani parlano del coronavirus/influenza stagionale come pericoloso…(1) in generale	(1) Per niente pericoloso/(7) Estremamente pericoloso
	for national economy	Quanto percepisci il modo in cui i media italiani parlano del coronavirus/influenza stagionale come pericoloso…(2) per l'economia nazionale	(1) Per niente pericoloso/(7) Estremamente pericoloso
	for national social-emotional climate	Quanto percepisci il modo in cui i media italiani parlano del coronavirus/influenza stagionale come pericoloso…(3) per il clima socio-emotivo nazionale?	(1) Per niente pericoloso/(7) Estremamente pericoloso
	for individual physical health	Quanto percepisci il modo in cui i media italiani parlano del coronavirus/influenza stagionale come pericoloso…(4) per la salute fisica di ogni individuo?	(1) Per niente pericoloso/(7) Estremamente pericoloso
Usefulness Public Policies	in general	Il Governo italiano ha emanato delle politiche pubbliche per limitare la diffusione del coronavirus/influenza stagionale. Secondo te, quanto queste	(1) Per niente utili/(7) Estremamente utili

		politiche pubbliche sono utili…(1) in generale?	
	for national economy	Il Governo italiano ha emanato delle politiche pubbliche per limitare la diffusione del coronavirus/influenza stagionale. Secondo te, quanto queste politiche pubbliche sono utili…(2) per l'economia nazionale?	(1) Per niente utili/(7) Estremamente utili
	for national social-emotional climate	Il Governo italiano ha emanato delle politiche pubbliche per limitare la diffusione del coronavirus/influenza stagionale. Secondo te, quanto queste politiche pubbliche sono utili…(3) per il clima socio-emotivo nazionale?	(1) Per niente utili/(7) Estremamente utili
	for individual physical health	Il Governo italiano ha emanato delle politiche pubbliche per limitare la diffusione del coronavirus/influenza stagionale. Secondo te, quanto queste politiche pubbliche sono utili…(4) per la salute fisica di ogni individuo?	(1) Per niente utili/(7) Estremamente utili
Usefulness Media Communication	in general	Quanto percepisci il modo in cui i media italiani parlano del coronavirus/influenza stagionale come utile…(1) in generale?	(1) Per niente utili/(7) Estremamente utili
	for national economy	Quanto percepisci il modo in cui i media italiani parlano del coronavirus/influenza stagionale come utile…(2) per l'economia nazionale?	(1) Per niente utili/(7) Estremamente utili
	for national social-emotional climate	Quanto percepisci il modo in cui i media italiani parlano del coronavirus/influenza stagionale come utile…(3) per il clima socio-emotivo nazionale?	(1) Per niente utili/(7) Estremamente utili
	for individual physical health	Quanto percepisci il modo in cui i media italiani parlano del coronavirus/influenza stagionale come utile…(4) per la salute fisica di ogni individuo?	(1) Per niente utili/(7) Estremamente utili
Knowledge	for public policies	Quanto pensi di sapere sulle politiche pubbliche emanate dal Governo italiano per limitare la diffusione del coronavirus/influenza stagionale? (1)	(1) Non so assolutamente nulla a riguardo/(7) So tutto a riguardo
	for behavior	Quanto pensi di sapere sulle indicazioni comportamentali emanate dal Governo italiano per limitare la diffusione del coronavirus/influenza stagionale? (2)	(1) Non so assolutamente nulla a riguardo/(7) So tutto a riguardo

	in general	Quanto pensi di sapere sul coronavirus/influenza stagionale? (3)	(1) Non so assolutamente nulla a riguardo/(7) So tutto a riguardo
Manipulation Check		Per piacere, tra quelle proposte nella lista qui sotto, indica rispetto a quale malattia virale ti è stato chiesto di dare la tua opinione:	(1) Coronavirus/(2) Influenza stagionale/(3) Morbillo/(4) Nessuna di queste

Section 3. Additional analysis

3.1 Means and standard deviations of the main variables in the three countries

Table A4. Means and standard deviations of main variables by Country.

	UK	Austria	Italy
	M (SD)	M (SD)	M (SD)
Perceived threat***	3.96_{H} (1.28)	3.50_{L} (1.11)	3.42_{L} (1.18)
Worry***	4.25_{H} (1.80)	3.17_{L} (1.69)	3.15_{L} (1.83)
Capability**	6.53_{L} (0.86)	6.72_{H} (0.65)	6.75_{H} (0.57)
Control***	5.28_{L} (1.21)	5.60_{H} (0.75)	5.64_{H} (0.70)
Knowledge*	$4.88_{H\text{-}L}$ (1.30)	5.05_{H} (1.25)	4.68_{L} (1.27)
Danger public policies **	3.80_{H} (1.48)	3.90_{H} (1.39)	3.37_{L} (1.59)
Usefulness public policies***	4.05_{L} (1.31)	4.01_{L} (1.21)	4.55_{H} (1.11)
Danger media communication	4.31 (1.65)	4.26 (1.65)	4.03 (1.82)
Usefulness media communication***	3.80_{H} (1.53)	3.77_{H} (1.32)	3.27_{L} (1.42)
TEIque***	4.89_{L} (0.76)	5.25_{H} (0.68)	4.85_{L} (0.67)
Belief in conspiracy theories***	2.67_{H} (0.86)	2.30_{M} (0.85)	2.08_{L} (0.72)
Trust in science***	3.83_{M} (0.74)	3.60_{L} (0.63)	4.15_{H} (0.67)
Trust in politics*	5.54_{L} (1.44)	$5.78_{H\text{-}L}$ (1.51)	5.92_{H} (1.55)
Trust in media	3.71 (1.14)	3.72 (1.20)	3.61 (1.10)

Note: Results of the post-hoc (Scheffè) test are indicated by subscript (H= higher mean, L= lower mean, M= medium mean). If two countries present the same letter their means for that specific variable were not significantly different. ""H-L" is used to indicate that a mean was not significantly different than the higher (H) and the lower (L) mean. Significant contrasts were reported with asterisks as superscripts to the variables' labels *p-value < 0.05, ** p-value < 0.01, *** p-value < 0.001

3.2 Analysis of the interaction of Country and Viral Disease on Worry

Table A5. Mean and Standard Deviations of the Worry variable by Country and Viral Disease.

Viral Disease	Country	Mean	SD	N
Seasonal flu	UK	28.199	157.893	87
	Austria	21.159	151.553	69
	Italy	16.842	119.368	76
Coronavirus	UK	52.700	111.747	121
	Austria	38.750	142.196	104
	Italy	43.926	127.941	90

Table A6. Scheffe post hoc results of the interaction of Country and Viral Disease on Worry.

Comparisons	Mean difference	*p*	LCL	UCL
AU Seasonal flu - AU Coronavirus	-1.759	< .001	-2.457	-1-61
AU Seasonal flu - IT Seasonal flu	0.432	.591	-0.316	1.180
AU Seasonal flu - IT Coronavirus	-2.277	< .001	-2.996	-1.557
AU Seasonal flu - UK Seasonal flu	-0.704	.064	-1.430	0.021
AU Seasonal flu - UK Coronavirus	-3.154	< .001	-3.832	-2.475
AU Coronavirus - IT Seasonal flu	-2.191	< .001	1.151	2.870
AU Coronavirus - IT Coronavirus	-0.517	0.213	-1.165	0.130
AU Coronavirus - UK Seasonal flu	1.055	< .001	0.401	1.708
AU Coronavirus - UK Coronavirus	-1.395	< .001	-1.996	-0.793
IT Seasonal flu - IT Coronavirus	-2.708	< .001	-3.409	-2.008
IT Seasonal flu - UK Seasonal flu	-1.136	< .001	-1.842	-0.430
IT Seasonal flu - UK Coronavirus	-3.586	< .001	-4.244	-2.297
IT Coronavirus - UK Seasonal flu	1.573	< .001	0.896	2.249
IT Coronavirus - UK Coronavirus	-0.877	< .001	-1.503	-0.251
UK Seasonal flu - UK Coronavirus	-2.450	< .001	-3.082	-1.818

3.3 Additional path model tested.

We tested the effect of trait emotional intelligence, which has been found to be related to preventive actions, emotional reactions, and risk perception in health-related models (Fernández-Abascal & Martín-Díaz, 2015; Mikolajczak et al., 2015; Peña-Sarrionandia et al., 2015; Sevdalis et al., 2007). The results of a model investigating the effect of trait emotional intelligence on Worry, Perceived threat and Behavior are shown in Path Model 3.

The model had a moderately good model fit, χ^2 (4, N = 547) = 9.43, p = .051, RMSEA = .050, p= .434, the CFI = .990, BIC= 7800.0, and the addition of the TEIque did not modify the relationships between the variables shown in the previous model. Our findings illustrate that participants with higher trait emotional intelligence also reported lower Worry but higher engagement in self-protective behaviors. Moreover, higher emotional intelligence was associated, through its effects on Worry, with lower Perceived threat, z = -3.44, p = .001,

95% CI [-.18, -.05]. In addition to the direct positive effect on Behavior, results also revealed that higher emotional intelligence had a marginally significant negative indirect effect (by its relationship with lower Worry and Perceived threat, z = -1.77, p = .077, 95% CI [-.03, .002]. Thus, the direct and indirect effects of emotional intelligence on self-protective behaviors are in opposite directions.

Moreover, in line with the literature on the role of Knowledge in risk perception (Siegrist & Cvetkovich, 2000), we tested the effect of Knowledge on the model as a mediator on the effect of Viral Disease on Behavior (i.e., Path Model 4). The model is significantly worse than the fully specified model, χ^2 (8, N = 547) = 65.56, p < .001, RMSEA = .11, p < .001, the CFI = .924, BIC= 9473.0, and significantly worse than Path Model 2 ($\Delta\chi^2$ (4) = 58.69, p < 0.01). However, the analysis provided some noteworthy insights. Our participants report to know more about the coronavirus than the season flu, z = 12.22, p < 0.01, 95% CI [1.01, 1.39]. The effect of Viral Disease on Behavior, considering Knowledge as one of the mediators, was significant, z = 6.13, p < 0.01, 95% CI [.23, .45]. Thus, being in the coronavirus (vs seasonal flu) condition made participants perceive that they have higher knowledge and this was associated with higher self-reported engagement in self-protective behaviors.

Finally, we tested the expected effect of Control and Capability on Behavior. After controlling for the effect of Control and Capability on Behavior (i.e., Path Model 5) the relationship between our main variables (Path Model 2) remained invariant and Capability (z = 8.51, p < 0.01, 95% CI [.37, .60]) but not Control (z = 0.76, p = .446, 95% CI [-.05, .12]) showed a significant positive effect on the Behavior.

3.4 Fit of the main model separately for the three countries.

We also fitted our main model (i.e., Path Model 2) separately for the UK (χ^2 (4, N = 208) = 2.90, p = .574, RMSEA < .001, p = .77, CFI = 1.00, BIC= 2527.4), the Austrian (χ^2 (4, N = 173) = 6.48, p = .166, RMSEA = .06, p = .34, CFI = .976, BIC= 2142.9) and the Italian (χ^2 (4, N = 166) = 6.20, p = .185, RMSEA= .058, p = .36, the CFI = .990, BIC= 1927.5) samples. In the UK sample, Frame and Viral Disease had no indirect effect on Behavior. However, the Viral Disease had an indirect effect on Perceived threat and Worry had an indirect effect on Behavior. Thus, participants in the coronavirus (vs seasonal flu) condition were more worried and this led to higher Perceived threat. Higher Worry was also associated with higher Perceived threat and this led to higher engagement on self-protective behaviors.

The Austrian sample showed the same significant patterns as the UK sample. Finally, in the Italian sample, the indirect effect of Worry on Behavior and the indirect effect of Viral Disease on Perceived threat were significant and similar to the results found in the Austrian and UK sample. However, in Italy, Viral Disease had a significant indirect effect on Behavior and the Frame had an indirect effect on Perceived threat (not significant in Austria and UK). The relationship between the variables is similar to the one reported in the main model (Figure 1 in the paper).

Appendix 2

Methodology

Attention check: Participants were presented with a list of European countries and a decoy question ("where would you like to go for a vacation?"). In the instruction above the decoy, participants were asked to skip the question and move to the next page without selecting any of the options if they were paying attention. Those who failed the attention check (i.e., selected one of the options) were excluded from the sample and replaced with new subjects.

Manipulation check: Participants were asked to select which of the six proposed mortality rates they have been presented with throughout the survey. Those who failed to correctly indicate the information format according to their condition, were excluded from the sample and replaced with new subjects.

Factor analysis TRIRISK

We performed an Exploratory Factor Analysis (EFA) on the items of the TRIRISK scale. We chose a Principal Component (PC) model because of the existing correlation between the items (Fig. A1; Fabrigar et al., 1999). The Kaiser-Meyer Olkin measure of the EFA suggested that the sample was factorable (KMO=.95). The analysis of the scree plot and the output of a parallel analysis performed using the function "*fa.parallel*" of R (R package: psych; Revelle, 2022), revealed that the group of items was best represented by two principal components (see Fig. A2 for the composition of the components and the factor loadings). The principal component analysis extracted two factors "Affective Risk" composed of the six items of the scale Affective Risk of the TRIRISK plus items 1, 3 and 6 of the original Experiential Risk scale. The second factor "Deliberative Risk" was instead composed of the six items from the original Deliberative Risk scale of the TRIRISK plus the items 2 and 4 of the original Experiential Risk scale. Item 5 of the original Experiential Risk scale was excluded since it did not sufficiently load on either of the two components.

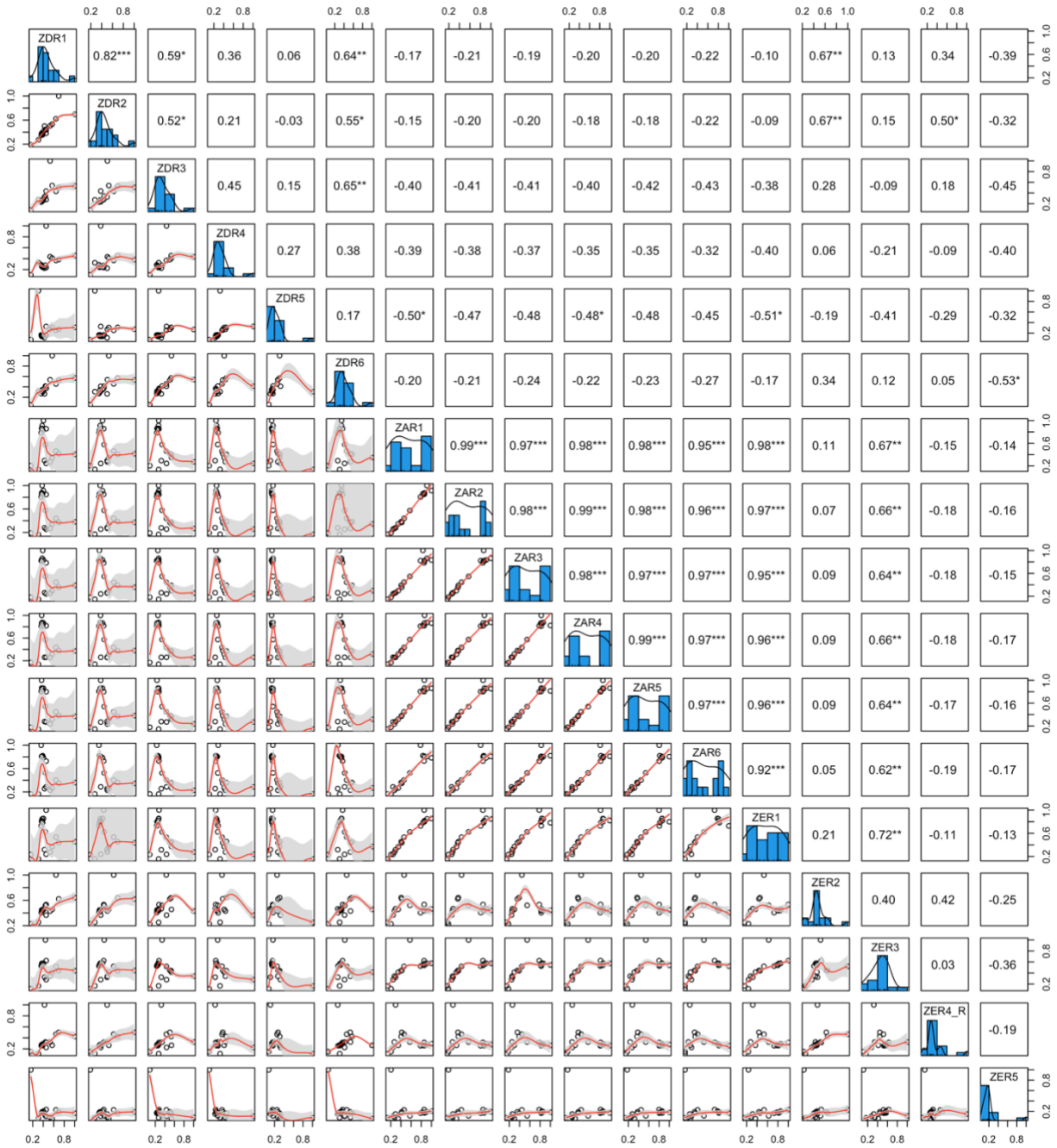


Figure A1. Correlation matrix between all the TRIRISK items. ZAR refers to the standardized ("Z") items of the original scale Affective Risk ("AR"), ZDR to the standardized items of the original scale Deliberative Risk and ZER to the standardized items of the original scale Experiential Risk. The numbers from 1 to 6 refer to the number assigned to the items in the original TRIRISK scale. **p*-value <.05, ***p*-value <.01, ****p*-value <.001

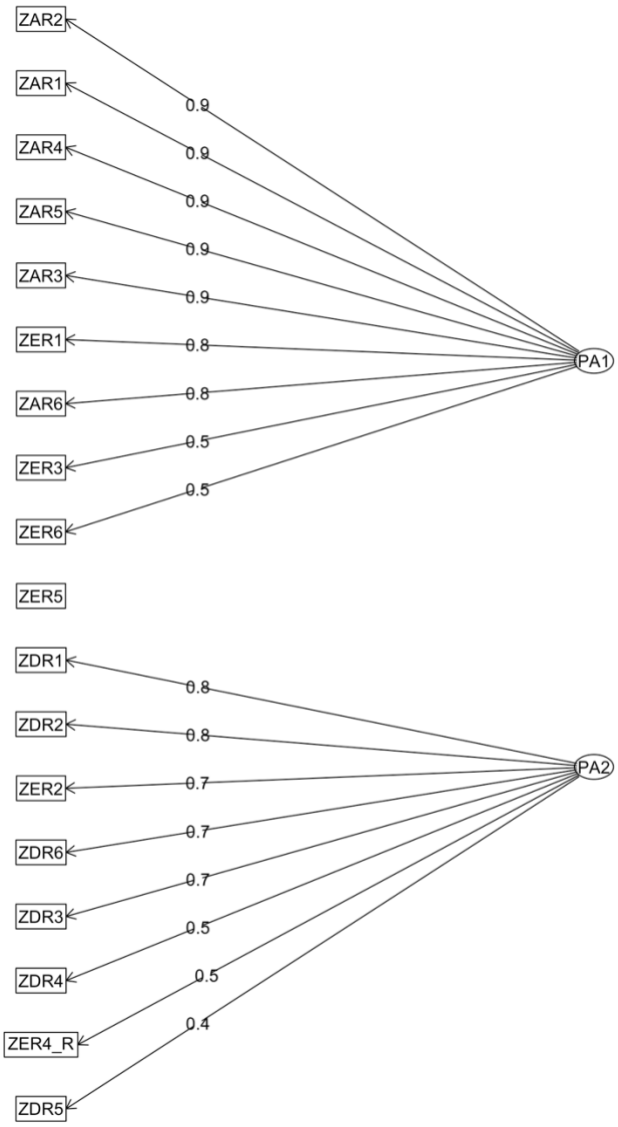


Figure A2. Principal components and the highest loadings, cross-loadings were acceptable, of the EFA on the items of the TRIRISK scale. ZAR refers to the standardized ("Z") items of the original scale Affective Risk ("AR"), ZDR to the standardized items of the original scale Deliberative Risk and ZER to the standardized items of the original scale Experiential Risk. The numbers from 1 to 6 refer to the number assigned to the items in the original TRIRISK scale. PA1 PA2 refers to the two components identified by the program.

References

Fabrigar, L. R., Wegener, D. T., MacCallum, R. C., & Strahan, E. J. (1999). Evaluating the use of exploratory factor analysis in psychological research. *Psychological methods*, *4*(3), 272.

Revelle, W. (2022) psych: Procedures for Personality and Psychological. Research, Northwestern University, Evanston, Illinois, USA, https://CRAN.R-project.org/package=psych Version = 2.2.5.

Factor analysis Behaviors

In order to perform the exploratory factor analysis, we reversed 10 items (item 3, item 4, item 5, item 6, item 9, item 10, item 11, item 12, item 13, item 14) so that high scores indicated riskier behavioral intentions for all items. The item that measured the use of the IMMUNI app as well as the item that measured the intention to get vaccinated were excluded from the factor analysis because they were created as single items.
We performed an EFA (exploratory factor analysis), not fixing the number of factors. The examination of the Kaiser-Meyer Olkin measure of the EFA with a Varimax (orthogonal) rotation suggested that the sample was factorable (KMO=.849). The results showed 3 factors, "OMS Guidelines" (eight items, factor loadings >.480), "Social Engagement" (four items, factor loadings > .517) and "Insurance" (two items, factor loadings > .811).

Results

Regressions

Table A7. Regression model of the effect of Numerical formats on the Deliberative Risk (reference group =Probability).

					95%Cl	
Variable	B	SE	T	*p*	LL	UL
			Deliberative Risk			
Absolute	.02	.10	.25	.802	-.17	.22
Raw	.08	.10	.79	.430	-.12	.27
1 in X	.07	.10	.70	.485	-.12	.26
Verbal	-.03	.10	-.33	.741	-.23	.16
Percentage	.05	.10	.51	.611	-.14	.24
R^2	.003					

Note. Affective Risk and Deliberative Risk factors are standardized (z-scores; 1= highest risk perception, -1= lowest risk perception).

Table A8. Regression model of the effect of Numerical formats on the Behavior (reference group =Probability).

					95%Cl	
Variable	B	SE	t	*p*	LL	UL
			WHO Guidelines			
Absolute	.17	.14	1.26	.210	-.10	.43
Raw	.26	.14	1.90	.058	-.01	.53
1 in X	.19	.14	1.37	.170	-.08	.45
Verbal	**.27**	**.14**	**2.01**	.045	.01	-.54
Percentage	.16	.14	1.16	.248	-.11	.43
R^2	.009					
			Social Engagement			
Absolute	.14	.14	1.05	.295	-.13	.41
Raw	-.09	.14	-.67	.504	-.36	.18
1 in X	.10	.14	.72	.470	-.17	.37
Verbal	.50	.14	.33	.745	-.23	.31
Percentage	-.01	.14	-.07	.945	-.28	.26
R^2	.006					
			Insurance			
Absolute	.40	.22	1.80	.073	-.04	.83
Raw	.09	.22	.42	.676	-.34	.53
1 in X	.10	.22	.45	.654	-.34	.53
Verbal	.02	.22	.09	.929	- .41	.45
Percentage	.18	.22	.80	.423	- .26	.61
R^2	.007					
			Vaccine			
Absolute	.35	.28	1.25	.210	-.20	.89
Raw	.21	.28	.73	.461	-.34	.75
1 in X	.25	.28	.90	.371	-.30	.79
Verbal	.23	.28	.82	.410	-.32	.77
Percentage	.29	.28	1.03	.305	-.26	.83
R^2	.003					

Note. Behavioral Intentions were assessed on a scale ranging from 1= “Extremely unlikely” and 7= “Extremely likely”.

Analysis 3 factors Risk

Table A9. Means and standard deviations (in brackets) of the main variables by condition.

	Emotions	Risk			Behavioral Intentions			
	Negative Emotions	Affective Risk	Deliberative Risk	Experiential Risk	WHO Guidelines	Social Engagement	Insurance	Vaccine
Absolute	30.82	.16	.00	.04	6.05	3.45	2.66	5.80
	(7.52)	*(.87)*	*(.75)*	*(.67)*	*(1.02)*	*(1.09)*	*(1.63)*	*(1.84)*
Raw	30.20	.14	.02	.06	6.14	3.22	2.36	5.66
	(7.44)	*(.96)*	*(.68)*	*(.71)*	*(.95)*	*(.87)*	*(1.61)*	*(1.86)*
1 in X	29.03	-.06	.02	.05	6.07	3.41	2.36	5.70
	(7.89)	*(.89)*	*(.71)*	*(.62)*	*(.84)*	*(1.08)*	*(1.53)*	*(1.95)*
Verbal	29.66	.00	-.04	-.06	6.16	3.35	2.28	5.68
	(6.94)	*(.86)*	*(.72)*	*(.70)*	*(.86)*	*(.90)*	*(1.57)*	*(2.03)*
Percentage	27.64	-.09	.04	.00	6.04	3.30	2.44	5.74
	(8.23)	*(.98)*	*(.81)*	*(.81)*	*(.96)*	*(.97)*	*(1.51)*	*(1.98)*
Probability	25.30	-.15	-.04	-.10	5.88	3.31	2.26	5.46
	(8.47)	*(.10)*	*(.71)*	*(.68)*	*(1.13)*	*(.91)*	*(1.56)*	*(2.11)*

Note. Affective Risk and Deliberative Risk factors are standardized (z-scores; 1= highest risk perception, -1= lowest risk perception). Negative Emotions were assessed on a scale ranging from 1= "Not at all" to 5= "Extremely", and the scores of 10 items for the Negative Emotions scale were summed (50= highest score, 10= lowest score). Behavioral Intentions were assessed on a scale ranging from 1= "Extremely unlikely" and 7= "Extremely likely".

Table A10. Correlations among Negative Emotions, Risk, and Behavioral Intentions

	Negative Emotions	Affective Risk	Deliberative Risk	Experiential Risk	WHO Guidelines	Social Engagement	Insurance	Vaccine
Negative Emotions	-							
Affective Risk	.739**	-						
Deliberative Risk	.364**	.426**	-					
Experiential Risk	.574**	.718**	.624**	-				
WHO Guidelines	.354**	.482**	.055	.372**	-			
Social Engagement	-.072	-.112**	.057	-.098*	-0.92*	-		
Insurance	.254**	.260**	.235**	.202**	.206**	.238**	-	
Vaccine	.177**	.264**	.099*	.232**	.276**	-.105*	.092*	-

Note. *p-value <.05, **p-value <.01

Table A11. Regression model of the effect of Numerical formats on Negative Emotions and Affective Risk.

Variable	B	SE	t	*p*	95%Cl LL	95%Cl UL
			Negative Emotions			
Absolute	5.52	1.09	5.06	**<.001**	3.38	7.67
Raw	4.90	1.10	4.48	**<.001**	2.75	7.05
1 in X	3.73	1.09	3.42	**.001**	1.59	5.88
Verbal	4.37	1.09	3.40	**<.001**	2.22	6.51
Percentage	2.34	1.10	2.14	**.033**	.19	4.49
R^2	.054					
			Affective Risk			
Absolute	.31	.13	2.34	**.020**	.05	.56
Raw	.29	.13	2.19	**.029**	.03	.54
1 in X	.09	.13	.71	.477	-.16	.35
Verbal	.15	.13	1.15	.251	-.11	.42
Percentage	.06	.13	.447	.655	-.20	.32
R^2	.015					

Note. Bold: Significant results, (reference group= Probability). Affective Risk and Deliberative Risk factors are standardized (z-scores; 1= highest risk perception, -1= lowest risk perception). Negative Emotions were assessed on a scale ranging from 1= "Not at all" to 5= "Extremely", and the scores of 10 items for the Negative Emotions scale were summed (50= highest score, 10= lowest score).

Table A12. Regression model of the effect of Numerical formats on the Deliberative and Experiential Risk (reference group = Probability).

Variable	B	SE	T	*p*	95%Cl LL	95%Cl UL
			Deliberative Risk			
Absolute	.04	.10	.42	.676	-.16	.25
Raw	.06	.10	.57	.570	-.14	.26
1 in X	.07	.10	.65	.516	-.14	.27
Verbal	-.00	.10	-.02	.982	-.20	.20
Percentage	.09	.10	.84	.399	-.12	.29
R^2	.002					
			Experiential Risk			
Absolute	.14	.10	1.39	.165	-.06	.33
Raw	.15	.10	1.54	.123	-.04	.35
1 in X	.15	.10	1.51	.131	-.04	.34
Verbal	.04	.10	.39	.696	-.16	.23
Percentage	.10	.10	1.04	.298	-.10	.30
R^2	.007					

Note: Affective Risk and Deliberative Risk factors are standardized (z-scores; 1= highest risk perception, -1= lowest risk perception).

Figure A2. Path model testing the direct and indirect effects of Numerical Format and on Behavioral Intentions mediated by Negative Emotions and Risk. Coefficients presented are standardized. The dotted lines show non-significant direct paths. Model fit: χ^2 (37, N = 604) = 36.87, p = .475; RMSEA < .0001, p = 1.00, CFI = 1.000, BIC = 15186.7. *p-value <.05, **p-value <.01, ***p-value <.001

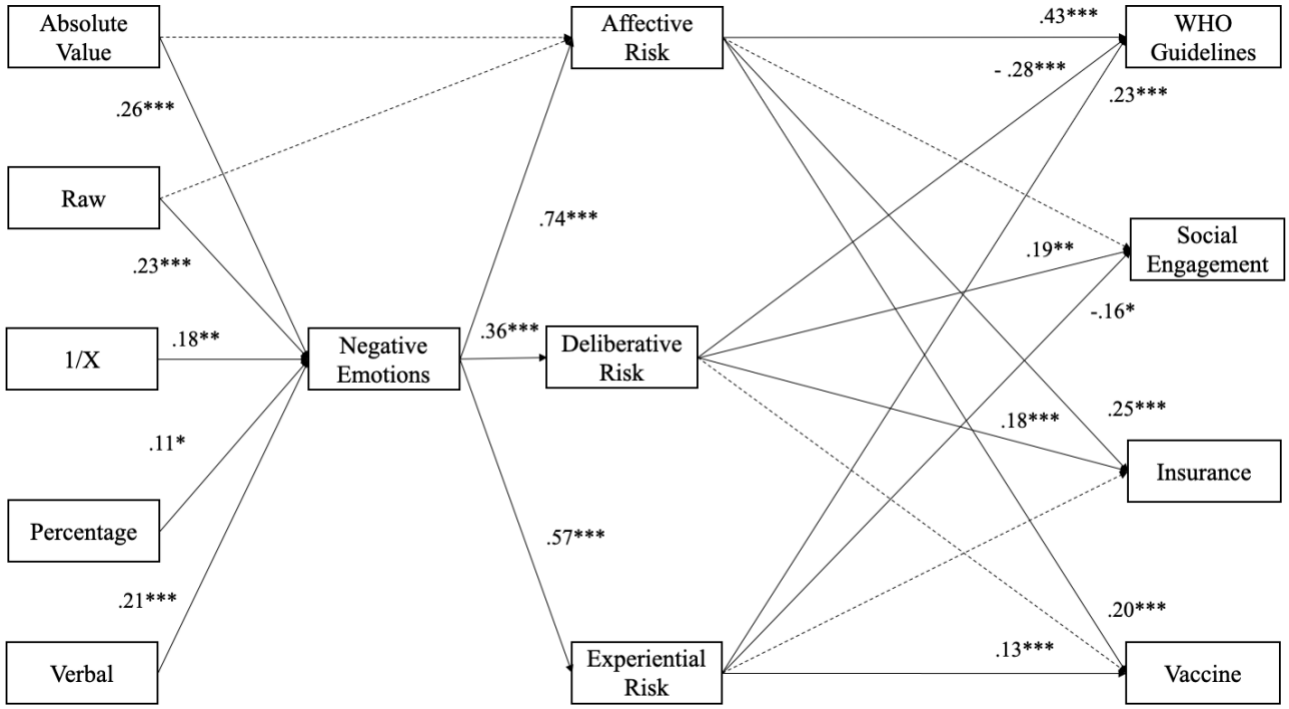


Table A13. Indirect effects of Numerical formats on Risk through Negative Emotions

	Affective Risk	Deliberative Risk	Experiential Risk
Absolute Value	z = 4.99, p <.001	z = 4.49, p <.001	z = 4.87, p <.001
Raw	z = 4.44, p <.001	z = 4.07, p <.001	z = 4.35, p <.001
1/X	z = 3.41, p =.001	z = 3.23, p =.001	z = 3.37, p =.001
Percentage	z = 2.14, p =.032	z = 2.11, p =.036	z = 2.13, p =.033
Verbal	z = 3.97, p <.001	z = 3.71, p <.001	z = 4.84, p <.001

Table A14. Indirect effects of Numerical Formats on Behavioral Intentions through Negative Emotions and Risk

Numerical Format	Negative Emotions	Risk	Behavioral Intentions	Indirect effect
Absolute Value	Negative Emotions	Affective Risk	WHO Guidelines	$z = 4.33$, $p < .001$
			Insurance	$z = 3.31$, $p = .001$
			Vaccine	$z = 2.89$, $p = .004$
		Deliberative Risk	WHO Guidelines	$z = -3.64$, $p < .001$
			Social engagement	$z = 2.86$, $p = .004$
			Insurance	$z = 2.89$, $p = .004$
		Experiential Risk	WHO Guidelines	$z = 3.12$, $p = .002$
			Social engagement	$z = -2.16$, $p = .031$
Raw	Negative Emotions	Affective Risk	WHO Guidelines	$z = 3.95$, $p < .001$
			Insurance	$z = 3.13$, $p = .002$
			Vaccine	$z = 2.76$, $p = .006$
		Deliberative Risk	WHO Guidelines	$z = -3.41$, $p = .001$
			Social engagement	$z = 2.74$, $p = .006$
			Insurance	$z = 3.31$, $p = .001$
		Experiential Risk	WHO Guidelines	$z = 2.89$, $p = .003$
			Social engagement	$z = -2.77$, $p = .035$
1/X	Negative Emotions	Affective Risk	WHO Guidelines	$z = 3.17$, $p = .002$
			Insurance	$z = 2.70$, $p = .007$
			Vaccine	$z = 2.46$, $p = .014$
		Deliberative Risk	WHO Guidelines	$z = - 2.87$, $p = .004$
			Social engagement	$z = 2.43$, $p = .015$
			Insurance	$z = 2.45$, $p = .014$
		Experiential Risk	WHO Guidelines	$z = 2.59$, $p = .010$
Percentage	Negative Emotions	Affective Risk	WHO Guidelines	$z = 2.08$, $p = .037$
		Deliberative Risk	WHO Guidelines	$z = -1.99$, $p = .047$
			Insurance	$z = 2.45$, $p = .014$
Verbal	Negative Emotions	Affective Risk	WHO Guidelines	$z = 3.61$, $p < .001$
			Insurance	$z = 2.95$, $p = .003$
			Vaccine	$z = 2.64$, $p = .008$
		Deliberative Risk	WHO Guidelines	$z = -3.18$, $p = .001$
			Social engagement	$z = 2.62$, $p = .009$
			Insurance	$z = 2.64$, $p = .008$
		Experiential Risk	WHO Guidelines	$z = 2.82$, $p = .005$
			Social engagement	$z = -2.05$, $p = .041$

Note. Only significant effects are presented in the table.

Appendix 3

Contents:

- Factors predicting estimates of the outlook of the Italian economy.
- Effect of trait EI, feelings towards the financial markets on risk estimates.
- Separate analyses of the effect of trait EI and feelings on expected returns and risk estimates for each of the five companies.
- Effect of expected returns, trait EI, feelings towards the financial markets and experience on risk estimates.
- Effect of trait EI and feelings on expected returns, with covariates.
- Effect of risk estimates, trait EI, and experience on estimates of expected returns, with covariates.

Factors predicting estimates of the outlook of the Italian economy.

We ran three different linear regression models to assess whether participants' trait EI scores predicted their expectations about the outlook of the Italian economy. In the first model, we only entered trait EI. Consistent with the correlations reported in the main text, we found that trait EI had a significant effect on the expectations about the Italian economy (see Table A15, panel 1). In the second model, we tested both the effect of trait EI and the effect of feelings towards the financial markets as predictors. Despite finding a significant effect of feelings, this model revealed that the effect of trait EI was also significant (Table A15, panel 2). Finally, we tested the model while controlling for political orientation since this variable might be related to how people perceive the outlook of the national economy, which could depend on their opinions of how the parties in power are working. The effect of political orientation was not significant, whereas the effects of both trait EI and feelings were still significant (Table A15, panel 3).

Table A15. Effect of trait EI, feelings towards the financial markets and political orientation on participants' expectations regarding the outlook of Italian economy

	(1)						(2)						(3)					
	B (SE)	*t*	*p*	*β*	*95%CI*		*B (SE)*	*t*	*p*	*β*	*95%CI*		*B (SE)*	*t*	*p*	*β*	*95%CI*	
					LL	*UL*					*LL*	*UL*					*LL*	*UL*
Intercept	1.35 (.69)	1.96	.051		-.01	2.72	1.41 (.69)	2.11	.04		.09	2.73	.81 (.75)	1.07	.29		-.68	2.29
Trait EI	.36 (.13)	2.74	.007	0.20	.10	.63	.27 (.13)	2.10	.04	.15	.02	.53	.27 (.13)	2.05	.04	.14	.01	.52
Feelings							.25 (.07)	3.68	< .001	.26	.12	.39	.27 (.07)	3.92	< .001	.28	.13	.41
Political orientation													.20 (.12)	1.71	.09	.12	-.03	.43
Adj. R^2	.03						.09						.10					

Effect of trait EI and feelings towards the financial markets on risk estimates

We ran a regression model to assess the effect of trait EI, feelings, and their interaction on the estimates of risk. As shown Table A16, none of these effects was significant.

Table A16. Effect of trait EI, feelings towards the financial markets on risk estimates.

	B	SE	*t*	*p*	β	*95%CI*	
						LL	*UL*
Intercept	5.32	1.03	5.16	< .001		3.29	7.37
Trait EI	.06	.21	.23	.82	.02	-.31	.46
Feelings	-.10	.49	-.21	.83	-.09	-1.07	.87
Trait EI x Feelings	.03	.10	.29	.77	.01	-.16	.22
Adj. R^2	-.01						

Separate analyses of the effect of trait EI and feelings on expected returns and risk estimates for each of the five companies.

Below are reported the results of the regression models run separately for the expected returns (left panel) and risk (right panel) estimates for each company. For expected returns, the interaction between trait EI and feelings was significant for two companies (Enel and Generali) and it was in the same direction, but not quite as significant for all other companies. For risk, the interaction between trait EI and feelings was never significant.

Table A17. Separate analyses of the effect of trait EI and feelings on expected returns and risk estimates for each of the five companies.

ENEL	Expected returns							Risk						
	B	SE	*t*	*p*	*β*	*95%CI*		B	SE	*t*	*p*	*β*	*95%CI*	
						LL	*UL*						*LL*	*UL*
Intercept	7.16	.85	8.46	< .001		5.49	8.83	4.36	1.26	3.47	< .001		1.88	6.85
Trait EI	-.49	.17	-2.86	.01	-.27	-.82	-.15	.19	.25	.75	.45	.07	-.31	.69
Feelings	-.72	.40	-1.78	.08	-.77	-1.51	-.08	.28	.60	.46	.64	.20	-.90	1.46
Trait EI x Feelings	.17	.08	2.12	.04	.09	.01	.33	-.07	-12	-.57	.60	-.03	-.30	.17
Adj. R^2	.02							-.01						
GENERALI	Expected returns							Risk						
	B	SE	*t*	*p*	*β*	*95%CI*		B	SE	*t*	*p*	*β*	*95%CI*	
						LL	*UL*						*LL*	*UL*
Intercept	6.95	.93	7.52	< .001		5.13	8.79	5.37	1.31	4.11	<.001		2.79	7.95
Trait EI	-.43	.19	-2.31	.02	-.22	-.79	-.06	-.05	.26	-.20	.84	-.02	-.57	.47
Feelings	-.87	.44	-1.99	.05	-.87	-1.74	-.01	-.07	.62	-.12	.91	-.05	-1.30	1.15
Trait EI x Feelings	.18	.09	2.08	.04	.09	.01	.35	.04	.12	.29	.77	.01	-.21	.28
Adj. R^2	.02							-.01						

GEOX	Expected returns							Risk						
	B	SE	*t*	*p*	*β*	*95%CI*		B	SE	*t*	*p*	*β*	*95%CI*	
						LL	*UL*						*LL*	*UL*
Intercept	5.84	.99	5.88	< .001		3.88	7.80	6.38	1.35	4.72	< .001		3.71	9.04
Trait EI	-.29	.20	-1.44	.15	-.14	-.68	.11	-.12	.27	-.45	.65	-.04	-.65	.41
Feelings	-.06	.47	.12	.91	.05	-.88	.99	-.64	.64	1.00	.32	-.44	-1.90	.63
Trait EI x Feelings	.01	.09	.11	.91	.01	-.17	.19	.16	.13	1.23	.22	.06	-.09	.40
Adj. R^2	.01							0.003						
POSTE ITALIANE	Expected returns							Risk						
	B	SE	*t*	*p*	*β*	*95%CI*		B	SE	*t*	*p*	*β*	*95%CI*	
						LL	*UL*						*LL*	*UL*
Intercept	6.47	1.01	6.40	< .001		4.48	8.47	4.47	1.41	3.17	< .01		1.68	7.26
Trait EI	-.43	.20	-2.14	.03	-.20	-.83	-.03	.25	.28	.87	.39	.09	-.31	.80
Feelings	-.66	.48	-1.38	.17	-.59	-1.61	.29	.17	.67	.25	.80	.11	-1.15	1.49
Trait EI x Feelings	.18	.10	1.86	.07	.08	-.01	.36	-.05	.13	-.38	.70	-.02	-.31	.21
Adj. R^2	.04							-.01						
PIAGGIO	Expected returns							Risk						
	B	SE	*t*	*p*	*β*	*95%CI*		B	SE	*t*	*p*	*β*	*95%CI*	
						LL	*UL*						*LL*	*UL*
Intercept	6.69	1.00	6,67	< .001		4.71	8.67	6.07	1.28	4.76	< .001		3.55	8.58
Trait EI	-.43	.20	-2.15	.03	-.21	-.83	-.03	-.03	.26	-.12	.91	-.01	-.53	.47

Feelings	-.53	.48	-1.12	.26	-.49	-1.47	.41	-.25	.61	-.41	.68	-.18	-1.44	.95
Trait EI x Feelings	.12	.09	1.30	.19	.06	-.06	.31	.07	.12	.56	.58	.03	-.17	.30
Adj. R^2	.01							-.01						

Effect of expected returns, trait EI, feelings towards the financial markets and experience on risk estimates.

In addition to the model described in the main text, we ran a linear regression with trait EI, expected returns estimates aggregated for the five companies, experience, all two-way interactions, and the three-way interaction between trait EI, expected returns, and experience with risk estimates as the dependent variable (Table A18). Results showed main effects of trait EI, expected returns estimates, and experience. Significant effects emerged also for the interactions between trait EI and expected returns, trait EI and experience, and expected returns and experience. Finally, the three-way interaction was also significant.

Table A18. Effect of expected returns, trait EI, feelings towards the financial markets and experience on risk estimates

	B	SE	*t*	*p*	*β*	*95%CI*	
						LL	*UL*
Intercept	-19.71	8.95	-2.20	.03		-37.39	2.02
Trait EI	5.33	1.72	3.10	< .01	2.49	1.94	8.73
Returns	5.14	1.88	2.75	< .01	3.50	1.44	8.84
Experience	.96	.39	2.47	.02	6.12	.19	1.73
Trait EI x Returns	-1.09	.36	-2.99	< .01	-.51	-1.80	-.37
Trait EI x Experience	-.19	.08	-2.48	.01	-.13	-.34	-.04
Returns x Experience	-.18	.08	-2.21	.03	-1.16	-.34	-.02
Trait EI x Returns x Experience	-.04	.02	2.26	.03	.02	.01	.07
Adj. R^2	.11						

A slope analysis showed that as experience increased the effect of the interaction between trait EI and expected returns on risk estimates decreased. When experience was low, the effect of expected returns on risk was significant for participants with high and average trait EI (respectively: B = -.84, SE = .21, t = -4.09, p < .001 and B = -.40, SE = .17, t = -2.34, p = .02) but not for those with low trait EI (B = .05, SE = .23, t = .22, p = .82). When experience was average, the effect of expected returns on risk was again significant only for participants with

either high or average trait EI (respectively: B = -.48, SE = .14, t = -3.35, p < .001 and B = -.31, SE = .12, t = -2.63, p = .01), but not for those with low trait EI (B = -.13, SE = .18, t = -.74, p = .46). Despite the similar pattern of results, the effects were smaller when advisors had average (vs. low) experience. No significant effects emerged when advisors had high experience (ts = -1.42 or smaller; ps = .16 or higher).

Effect of trait EI and feelings on expected returns, with covariates.

We investigated whether the interaction between trait EI and feelings predicted expected returns estimates for the aggregated index of the five companies listed in the Italian stock market. The model also included a series of covariates that are important to control for since they can influence the risk and returns assessment of Italian financial assets. We included expectations about the outlook of the Italian economy, political orientation, gender, and age as covariates. Even including these covariates, the pattern of the results was very consistent with that described in the main text when covariates were not included in the model (Table A19).

Table A19. *Predictors of expected returns estimates.*

	Expected returns						
	B	SE	*t*	*p*	β	*95%CI*	
						LL	*UL*
Intercept	6.82	.84	8.12	< .001		5.16	8.47
Trait EI	-.46	.13	-3.45	< .01	-.33	-.72	-.20
Feelings	-.62	.31	-1.99	.05	-.84	-1.24	-.00
Italian economy	.17	.06	3.00	< .01	.22	.06	.28
Political orientation	-.16	.09	-1.68	.10	-.12	-.34	.03
Age	-.00	.01	-0.06	.95	-.01	-.02	.01
Gender	.08	.17	.47	.64	.03	-.25	.26
Trait EI x Feelings	.14	.06	2.20	.03	.10	.01	.26
Adj. R^2	.08						

A slope analysis showed that the effect of feelings on expected returns was significant for participants with high trait EI (B = .18, SE = .08, t = 2.26, p = .03) but not for those with low

trait EI (B = -.03, SE = .07, t = -.38, p = .70). Increasingly negative feelings led people with high (vs. low) trait EI to estimate lower expected returns (Figure A3).

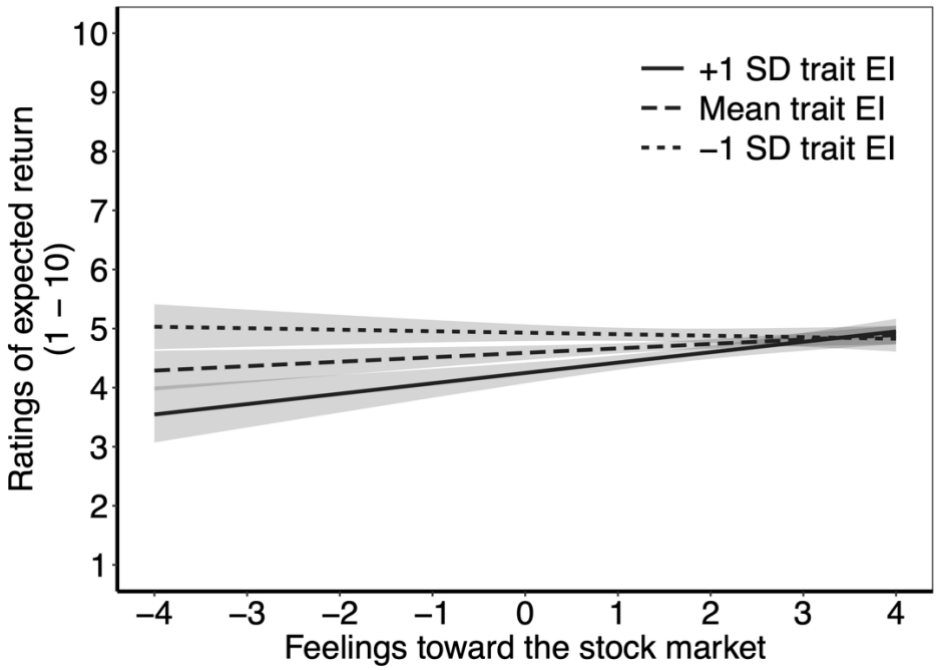


Figure A3. Interaction between trait EI and feelings towards the stock market predicting participants' estimates of the average expected returns of five companies listed in the Italian stock market.

Effect of risk estimates, trait EI, and experience on estimates of expected returns, with covariates

We ran a linear regression with trait EI, risk estimates aggregated for the five companies, experience, all two-way interactions, and the three-way interaction between trait EI, risk, and experience with expected returns estimates as the dependent variable (Table SM6). As in the previous section, covariates were added to the model since we believed they could influence how people perceive the risk and returns of assets and especially assets exchanged in the Italian stock market. Results showed main effects of trait EI, risk estimates, and experience. Significant effects emerged also for the interactions between trait EI and risk, trait EI and experience, and risk and experience. Finally, the three-way interaction was also significant. The only significant covariate was gender.

Table A20. *Predictors of expected returns.*

	B	SE	*t*	*p*	*β*	*95%CI*	
						LL	*UL*
Intercept	-8.25	5.52	-1.49	.137		-19.15	2.65
Trait EI	2.74	1.04	2.63	.009	1.89	.68	4.80
Risk	2.79	.91	3.08	.002	4.11	1.00	4.58
Experience	.55	.25	2.21	.029	5.20	.06	1.05
Political orientation	-.19	.10	-2.00	.047	-.15	-.39	-.00
Age	-.01	.01	-1.08	.283	-.11	-.04	.01
Gender	-.04	.18	-.22	.826	-.02	-.40	.32
Italian economy	.19	.06	3.45	.001	.25	.08	.31
Trait EI x Risk	-.56	.17	-3.26	.001	-.38	-.90	-.22
Trait EI x Experience	-.10	.05	-2.19	.030	-.15	-.19	-.01
Risk x Experience	-.11	.04	-2.60	.010	-1.00	-.19	-.02
Trait EI x Risk x Experience	.02	.01	2.57	.011	.01	.00	.03
Adj. R^2	.20						

We then ran a slope analysis to probe the three-way interaction between trait EI, risk estimates, and experience. Consistent with Hypothesis 3, results revealed that as experience increased the effect of the interaction between trait EI and risk on expected returns estimates decreased. For advisors who have low experience and judged the risk as high, we found a significant slope indicating that, those who have high (vs. low) trait EI are more likely to expect a negative correlation between risk and expected returns (B = -.82, SE = .19, t = -4.24, p < .001; Figure SM2). Among low experience advisors, the effect of trait EI on expected returns estimates was not significant when participants judged risk to be average (p = .08) or low (p = .18). For participants with high experience, instead, the effect of trait EI on expected returns estimates was never significant regardless of the estimates of risk of the investment (ps = .40 or higher). In all these cases, an estimate of high risk led to the expectation of lower returns compared to when risk was estimated to be low.

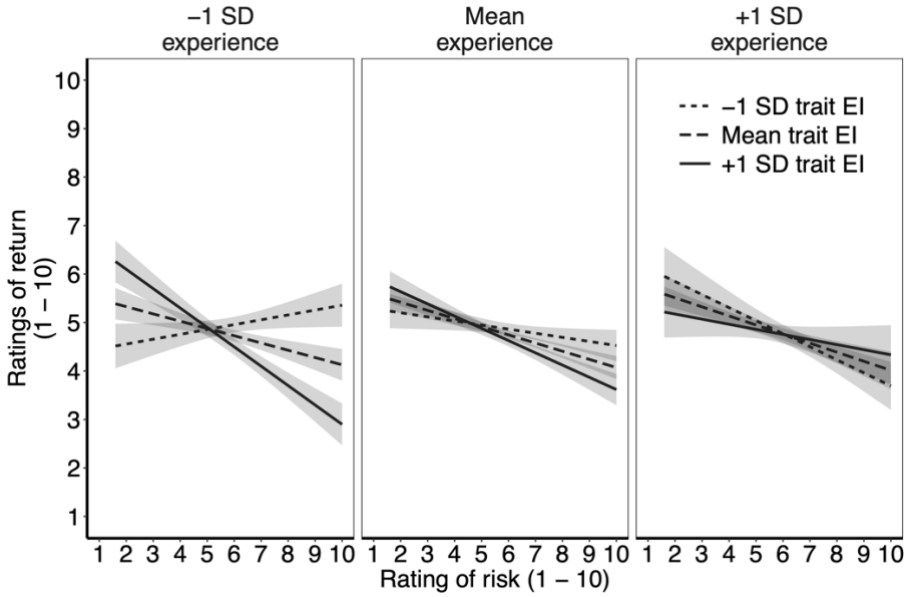


Figure A4. Three-way interaction between trait EI, risk estimates, and experience predicting expected returns estimates.