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Psycho-cognitive predictors of risk perception, social distancing and vaccination intention during COVID-19 outbreak: the case of Italy

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To Cayro, my unordinary dog.

Introduction

The current dissertation was developed during the outbreak of the COVID-19 pandemic in Italy. The central theme of the present work focuses on the belief that, during this time of extreme difficulty for the world's population, COVID-19 pandemic can be brought under control mainly by massive and rapid behaviour change. One way to achieve this goal is to systematically monitor and understand how different individuals perceive risk and adhere to protective behaviours. The main aim of the present work is to understand whether there exist cognitive, social and psychological predictors of protective behaviours against COVID-19.

The dissertation comprises seven chapters: the first three chapters provide an extensive literature review on the topics concerned, the other three describe the series of studies carried out. Finally, the last chapter provides a general discussion of the results obtained, pointing out possible limitations of the work and suggesting directions for future studies.

In particular, the first chapter (Chapter 1) gives an overview of the different components of risk perception: a) the meaning of risk perception; b) the factors that modulate risk perception; c) risk perception in the past pandemics and d) risk perception of COVID-19 in the world and in Italy.

The second chapter (Chapter 2) describes the concept of social distancing as follows: a) social distancing in relation to the COVID-19 pandemic; b) working memory as a possible predictor of adherence to social distancing behaviour; c) psychological factors modulating compliance with social distancing.

The third chapter (Chapter 3) focuses on the concept of intention/hesitation to vaccination, in particular it takes into account: a) the meaning of vaccine hesitation and intention during the COVID-19 outbreak; b) the psychological predictors of the intention to be vaccinated; c) the role of misinformation and conspiracy theories related to COVID-19 vaccine.

The series of empirical studies carried out on the above-mentioned topics are described from the fourth (Chapter 4) to the sixth chapter (Chapter 6).

The study in Chapter 4 focuses on risk perception. In particular, it addresses the psychological predictors of risk perception during the COVID-19 pandemic in a sample of Italian respondents. In this study, we consider two dimensions of risk perception: the first system is deliberate, slow, and rule-based and therefore reflects the cognitive dimensions of risk perception (risk-as-analysis). The second system is experiential and intuitive and therefore reflects the affective dimensions of risk perception (risk-as-feeling). The goals have been: 1) assessing levels of risk perceptions and anxiety in the population during this pivotal historical moment; 2) determining the variables that predict risk perceptions and anxiety; 3) understanding participants' emotional response to the COVID-19 pandemic.

The study in Chapter 5 focuses on the cognitive and psychological predictors of the adherence to social distancing behaviour during the COVID-19 outbreak in Italy. The aims have been: 1) determining the psychological predictors that influence the weight of benefits over costs of social distancing; 2) understanding the relationship between individual cognitive abilities, such as working memory, and social-distancing compliance; 3) identifying the psychological predictors of compliance with social distancing; ~~3~~ 4) determining the relationship between social-distancing compliance and risk perception.

The last study is described in Chapter 6. This study focuses on the roles of several psychological variables in predicting vaccination intention in Italy. The aims have been: 1) providing up-to-date information about vaccine acceptance rates in Italy; 2) determining the impact of different demographic variables on vaccine acceptance rates and 3) determining the roles of a series of psychological variables in predicting the intention to be vaccinated against COVID-19.

In the general discussion (Chapter 7), the results obtained in our studies are discussed in relation to models provided by the literature concerning risk perception, compliance to social distancing and intention to vaccinate during the COVID-19 pandemic. In addition, suggestions for research follow up are provided based also on possible limitations of our work.

In our view, one of the important suggestions of the present work is that understanding behavior is the basis for changing it. In that regard, behavioral insights for COVID-19 are of most importance for governments and the world's population in developing strategies to deal with COVID-19 and other possible pandemics in the future.

Chapter 1

Risk Perception

"Risk perception is a key to control outbreaks"

1.1 The meaning of Risk Perception

The human being's ability to avoid possibly dangerous environmental conditions is a key element of survival. The ability to react to adverse situations enables humans to reduce risk. In the last decade, technological innovation and progress have exposed mankind to adverse and catastrophic events. The consequences of these events and the management of them are difficult to assess through statistics or learning by trial and error. The lack of predictability and the difficulty of managing today's risks have required the emergence of a new intellectual discipline called "risk assessment". The focus of risk assessment is to circumscribe and quantify risk. A concept related to this field is risk perception, which refers to the personal risk judgments with which everyone assesses danger. Risk perception tends to be largely modulated by the media that, documenting and filtering information, influence people's perception.

Risk scholars have sought to find out what people mean when they say something is or is not "risky", in order to develop strategies to understand how people respond to risk (Slovic, 1987). Contributions from different subjects affected the understanding of risk perception. In particular, sociological, anthropological and psychological research have shown how risk perception is influenced by social and cultural components. Short, (1984) argues that the individual response to risk seems to be mediated by the social influences that are

transmitted by the family and the social context. Dugger (1978), believes that, within social groups, individuals modulate risk perception to maintain control over that social group.

Interestingly, a taxonomy of potential hazards was developed, in order to study perceived risk. Such taxonomic schemes allow to explain people's aversion to specific risks and indifference to others. The most widely used approach is the psychometric approach, developed by Starr in 1969. The aim of this method is to understand technological risks versus benefits to answer the question: "how safe is safe enough?". According to Starr, the acceptability of the risk arising from an activity is proportional to the third power of the benefits for that activity.

The psychometric approach uses psycho-physical scaling and multivariate analysis techniques to produce quantitative representations or "cognitive maps" of risk attitudes and perceptions. In this paradigm, individuals make quantitative judgments about the riskiness of specific hazards. These judgments are related to: 1) the benefits that each hazard provides to society, 2) the number of deaths caused by the hazard in an average year, 3) the benefits produced by the hazard to society. Psychometric techniques assume that perceived risk is quantifiable, and it is well suited for identifying similarities and differences among groups concerning risk perceptions and attitudes predictable (Detlof von Winterfeldt et al., 1981).

Furthermore, it has been seen that the concept of "risk" is subject to individual variability. For example, people will tend to accept risks from voluntary activities (e.g., ski) over unintentional risks, such as food preservatives (Fischhoff et al., 1978; Slovic et al., 1984). Starr (1969) argues that people are willing to tolerate higher risks from activities seen as highly beneficial for them. According to the author, the voluntariness of risk exposure is the key mediator of risk acceptance, but further studies have shown that other characteristics such as catastrophic potential, familiarity, and control may also influence the

relationship between perceived risk, risk acceptance, and perceived benefit (Fischhoff et al., 1978).

In general, risk analysis makes it possible to assess the impacts of a catastrophic event in terms of direct harm to the victims. Events of this calibre can involve not only direct but also indirect damage. According to Slovic's model, an unfortunate event can be represented as a stone falling into a pond: the ripples generated by the fall extend outwards, first to the victims directly affected, then to the company or agency responsible and, lastly, to other companies, agencies, and industries.

In the model shown in Fig.1, it is possible to observe how the characteristics associated with an event are useful in predicting the magnitude and severity of the following impacts (Slovic, 1987).

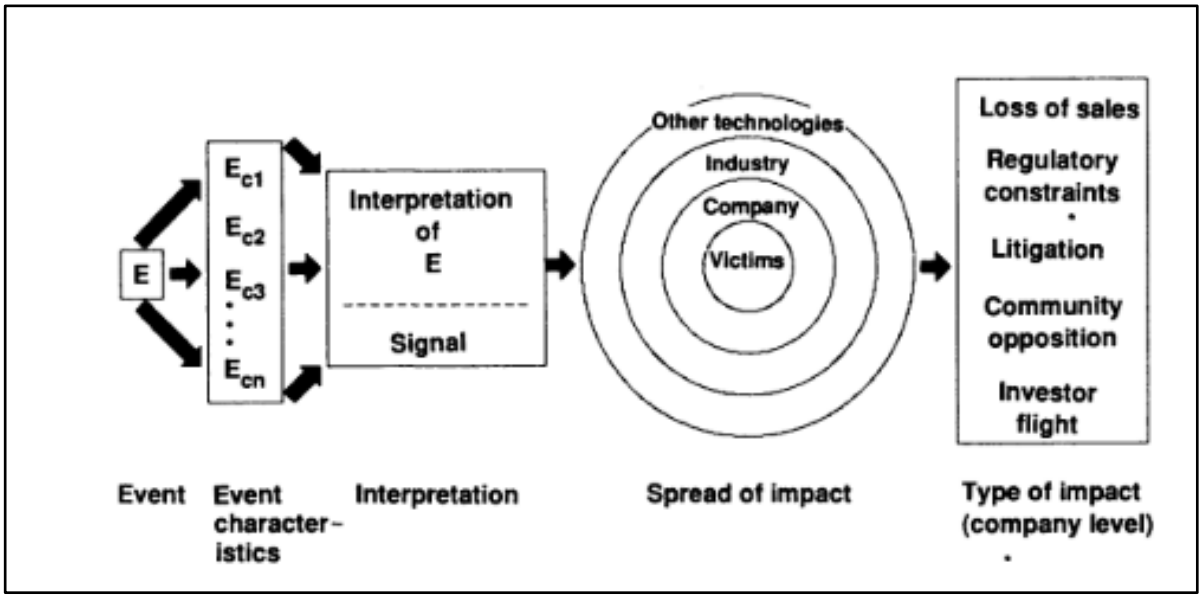

Fig 1. A model of impacts for unfortunate events (taken from Slovic, 1987, p. 284)

Research on risk perception has been widely used to understand public acceptance of the dangers of specific technologies (Fischhoff et al., 1977). When

considering nuclear energy, it has been observed that, according to individuals, these risks are uncontrollable, unknown, and likely to affect future generations. The motivation lies in the fact that anxiety about nuclear power in the population is generated by extensive unfavourable media coverage and an association between nuclear power and military technologies. Nuclear risk is therefore seen and assessed as unknown and potentially catastrophic, preventing a correct perception of the risk.

One frequently advocated approach to broadening people's perceptions is to present quantitative risk estimates for a variety of hazards expressed in some unidimensional index of death or disability, such as risk per hour of exposure, the annual probability of death, or reduction in life expectancy. Two-way communication is necessary to facilitate adequate risk communication and management. Both expert and public sides must be aligned in their understanding and appropriate perception of the risks involved (Slovic, 1987).

1.2 The factors that modulate risk perception

Risk perception is important because it includes not only what people fear and why they fear it, but also the analysis of risk exposure, risk communication, and risk management (Siegrist & Árvai, 2020). In recent research, it has been observed that people who have directly experienced adverse weather or climate-related phenomena, have a higher perception of the risk of climate change compared to people who had no experience with these phenomena (Spence et al., 2012). However, this relationship is also influenced by economic status and political orientation (McDonald et al., 2015). Similar patterns can be found in a range of risks such as: speeding in cars (Brown, 2010), nuclear power (Greenberg & Truelove, 2011; Slovic, 1987), smoking (Weinstein et al., 2005), and genetic modification (Pidgeon et al., 2005). Therefore, understanding the factors that

influence individual risk perception is important to understand and try to predict the behaviour of individuals.

To this aim, specific characteristics have been identified that may be important to understand this modulation. These are:

1) ***Sociodemographic variables***: studies highlight that gender tends not to be strongly associated with risk perception (Cullen et al., 2018; Rivers et al., 2010). The same is true for age (Bearth et al., 2019), income (Machado Nardi et al., 2020; Sjöberg, 2000) and education (Bearth et al., 2019; Machado Nardi et al., 2020).

2) ***Knowledge***: knowledge of a specific domain can be a predictor of the level of risk perception. It has been seen that, if objective and domain-specific knowledge is measured reliably and validly, there is a strong correlation between perceived risks and knowledge in vaccines (Zingg & Siegrist, 2012) and industrial chemicals (L'Orange Seigo et al., 2014). In other words, the more one knows about the mechanisms underlying a particular hazard, the more predictable and highly correlated (with domain-specific knowledge) their risk perceptions tend to be. Another element that can influence the probability of perceived risk is the ability to reason scientifically (Siegrist & Árvai, 2020). On the one hand, it has been seen that people who score high on the scientific reasoning scale perceive lower risks from vaccination, which are well-known to the scientific community (Drummond & Fischhoff, 2017). On the other hand, some individuals appear to have little faith in science but have esoteric beliefs defined as "new age beliefs", which appear to correlate with increased risk perception (Sjöberg & Af Wåhlberg, 2002). Thus, it emerges that individuals who minimise scientific reasoning and belief in paranormal powers tend to have high-risk perceptions for a wide range of hazards, such as genetic engineering and nuclear energy (Siegrist & Árvai, 2020). Interestingly, reasoning style can also influence risk perception. It has been

seen that there is a predictive relationship between people with open-minded thinking and the accuracy of predictions of a given event happening (Haran et al., 2013). Thus, it emerges that increased knowledge of a specific domain in people corresponds to realistic and concrete judgments about the risks faced (Gigerenzer & Gaissmaier, 2011).

3) ***Worldviews and values***: according to the cultural theory of risk, the perception of risk would appear to be influenced by the values and beliefs that individuals hold within a community (Mary Douglas and Aaron Wildavsky, 1982). In a study by Karl Dake (1991), both risk perception and social risks (e.g., social deviance, environmental risks) seem to be correlated with different worldviews (i.e., hierarchy, individualism, comunitarism).

4) ***Psychological Components*****:** in the field of risk perception, the psychological sphere of individuals is a valid way for understanding how risk is modulated. The study of personality using the "five-factor model" (BIG-5) seems to be the most influential approach. This model characterises individuals according to stable patterns of thoughts, feelings, and actions. The model comprises: openness (i.e., the degree of intellectual curiosity), agreeableness (i.e., the tendency to be compassionate and cooperative towards others), neuroticism (i.e., emotional stability), conscientiousness (i.e., the tendency to show self-discipline and act diligently), and extroversion (i.e., the tendency to be open towards others) (Costa & McCrae, 1997). According to Chauvin et al. (2007) and (Sjöberg, 2003), only emotional stability seems to correlate with perceived risk. Agreeableness and conscientiousness are only occasionally correlated, for example, with the perceived risk associated with unprotected sex (Chauvin et al., 2007).

Another element that seems to play a role in modulating perceived risk is anxiety. It has been observed that high levels of anxiety are associated with

higher perceived risk (Siegrist & Árvai, 2020). Nevertheless, the data on the relationship between anxiety and perceived risk vary depending on the hazard under investigation (Bouyer et al., 2001; Leikas et al., 2007). In addition to this, an interesting element that seems to correlate negatively with perceived risk is trust in others concerning a range of different hazards (Siegrist et al., 2005). It has also been shown that optimism bias can modulate perceived risks. The optimism bias concerning perceptions of risk of a tsunami and of terrorism was found to be larger in a US sample than in samples from Argentina and Japan (Gierlach et al., 2010). This result is in line with the observation that people tend to show less unrealistic optimism for events over which they have no control over (Shepperd et al., 2015).The findings reported suggest that personality is a key factor in modulating perceived risks. Understanding the psychological component of individuals allows a greater propensity to study risks and develop appropriate responses.

5) ***Cross-Cultural Differences*****:** cultural differences between countries can develop different perceptions of risk. It has been shown how a country's culture influences risk perception of different hazards (Hsee & Weber, 1998). In the case of China, people seem to perceive a lower risk than the American population in response to the same hazards (Siegrist & Árvai, 2020). According to Gaskell et al. (2011) participants from 32 European countries showed significant differences in risk perception of genetic technology. Nevertheless, there are still many unanswered questions about why we observe the large differences in perceptions as a function of nationality and culture. A possible explanation for the difference in perceived risks among different cultures and nationalities could be attributed to the different interpretations of the rating scales (e.g., the propensity to extremism in some cultures). However, future research is needed to expand the

knowledge about this aspect, which is of considerable importance for the understanding of perceived risks.

6*)* ***Heuristics*****:** making decisions requires individuals to make extensive use of heuristics (Kahneman et al., 1982). According to Siegrist & Árvai, (2020) three heuristics are used for the assessment of risk perception. These are: the availability heuristic, the affect heuristic, and the natural-is-better heuristic. It is important to note that a heuristic can lead to a judgment/preference that adheres to the principles of rationality and it can therefore lead to an accurate estimate of the situation. This happens when there is a balance between the information and the process underlying the heuristic (John von Neumann and Oskar Morgenstern, 1947).

- *The availability Heuristics:* individuals rely on the availability heuristic when they assess the probability of an event considering the "ease with which instances or occurrences can be brought to mind" (Tversky & Kahneman, 1974). In the case of deaths caused by diseases, the differences observed between subjective risk perceptions and the objective number of deaths can be attributed to the availability heuristic (Lichtenstein et al., 1978). In one study, it was observed that people who had previously experienced different hazards such as terrorist attacks or earthquakes showed higher risk perceptions than people who had not had the same experiences (Knuth et al., 2014).

- *The affect Heuristics:* Slovic et al. (2004) defined this heuristic as follows: "All the images in people's minds are tagged or marked to varying degrees with affect. The affect pool contains all the positive and negative markers associated with the images." Therefore, the affect heuristics assume that the affective meaning of a hazard influences the perception of risk (Finucane et al., 2000). In a study on

pandemic influenza by Prati et al. (2011), the level of fear, worry, anxiety, and the degree of valence associated with danger was examined. Results showed that the valence of the spontaneous associations was associated with people's risk perceptions and acceptance. It has been seen that affect heuristics can lead to biased judgments, as risk-specific information can increase fear not only about a specific risk, but also about the entire risk category (Nakayachi, 2013). Overall, studies show that people tend to perceive a higher risk in contexts that have elicited a negative affective response (Siegrist & Árvai, 2020). Nevertheless, according to Finucane et al. (2000) the use of affection heuristics has low predictive specificity, thus the explanatory power may be limited.

- *The natural Heuristic*: nature is perceived as benevolent. Therefore, people seem to rely on what is natural by evaluating it as better (Scott & Rozin, 2020). This process is also known as the *natural-is-better* heuristic, and it predicts that dangers are assessed differently if man or nature causes them. It is easy to assume that this heuristic may result in biased judgments (Campbell-Arvai, 2019). It has been observed that synthetic chemicals are perceived as much more negative compared to chemicals of natural origin (Saleh et al., 2019). Data on the nature heuristic demonstrate its potential to cause biased judgements about hazards. In this case, instead of focusing on the risks of a specific technology or a product, the focus is on who has caused it (Siegrist & Árvai, 2020).

There is a possible overlap between the various heuristics of thought. For this reason, it is difficult to understand and differentiate which specific heuristics are used by individuals. This represents a limitation of the studies mentioned above, as the relationship between risk perception and the use of heuristics is still not clear. Future studies are needed to better understand the use of heuristics in perceived risks (Gigerenzer & Gaissmaier, 2011).

To conclude, the study of the variables that can modulate the perception of risk is complex. To summarise, the Fig. 2 shows the three approaches that have characterised the history of research on risk perception: 1) the characteristics of risk-takers (i.e., demographic factors, knowledge, values, personality traits, and optimism bias); 2) the characteristics of hazards perceived as "fearsome risk" and "unknown risk", which influence how the hazard is perceived (Slovic, 1987); 3) thinking heuristics (the heuristics of helpfulness, affection, natural is better and trust), which seem to play an important role in risk perception (Kahneman et al., 1982).

In relation to this, future research should focus on the interaction between the factors that are responsible for risk perception. In particular, the aim is to understand how the characteristics of hazards, the characteristics of risk perceivers, and the underlying psychological processes may contribute to individual changes in risk perception.

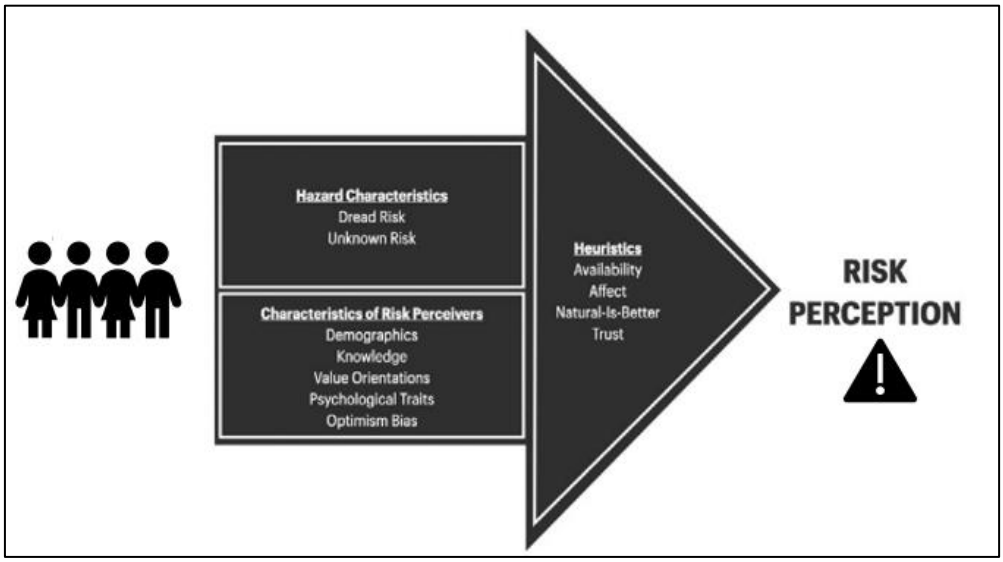

Fig 2. Components of risk perception (taken and adapted from Siegrist & Árvai, 2020, p. 2201)

1.3 Pandemic Risk Perception

This section will focus on studies that have made it possible to analyse and understand risk perception about pandemics. The aim is to understand how risk-predicting factors have contributed to changes in risk perception to pandemics throughout history. The rationale for studying and analysing pandemic-related risks is to support governments in implementing strategies, programmes, and initiatives that communicate essential recommendations for pandemic containment (Majid et al., 2020). Misjudging these factors could limit preventive behaviour and consequently reduce the ability of governments to curb pandemics. For this reason, knowledge of individuals' concerns, attitudes and behaviours during an infectious disease pandemic can contribute to better risk communication (Holmes et al., 2009).

In line with this, according to Ornell et al. (2020) perception of risk and fear of infection can contribute to increasing protective and hygienic behaviours of individuals. Therefore, it is clear how the lack of knowledge and information about a hazard influences community awareness of appropriate prevention strategies to be implemented (So et al., 2004). Fig. 2 shows possible indicators that allow a hypothetical understanding of how the population will respond to pandemics. Nevertheless, the relationships between knowledge, risk perception, and hazard awareness remain unclear (Rimal & Real, 2003).

In relation to this, there exist two broad models of risk used in the social sciences. According to the realist approach, risk is considered as an objective threat or danger that can be assessed independently of the social context in which it occurs (Kahneman et al., 1982). According to the "social constructionist" approach risk is considered as a "threat" that is structured through social and cultural processes (Washer, 2006).

Therefore, it is important to understand how populations develop defence mechanisms to control their anxiety about different risks (Joffe, 1989), such as pandemics. By examining the impact of pandemics, a contrast can be observed between what is understood from a realistic perspective (e.g., the probability of infection) versus the social perception of those probabilities as risks. Learning from past epidemics provides an invaluable opportunity to improve risk communication strategies and mitigate the impacts of future epidemics (Smith, 2006). The following paragraphs will focus on how knowledge, information sources, and misconceptions can influence risk perception and the adoption of preventive behaviour in response to pandemics.

❖ *Risk perception and knowledge during pandemics outbreaks:*

according to studies that have focused on the relationship between knowledge, risk perception, and behaviour, it has emerged that both high levels of risk perception and knowledge of the phenomenon contribute to the promotion of protective behaviour. This was found to be true in the case of Influenza A/H1N1 (Kamate et al., 2010), Ebola (Adongo et al., 2016), Severe Acute Respiratory Syndrome (SARS) (Leung et al., 2009). High-risk perception would appear to be associated with both protective behaviours and adherence to quarantine protocols during pandemics (Cava et al., 2005; Earnshaw et al., 2019). Moreover, risk perception is related to increased knowledge of the danger of that infection. As a consequence of this, individuals are motivated to change their behaviour to reduce risk (Rimal & Real, 2003). Therefore, knowledge plays a crucial role in adopting useful strategies to develop an adequate perception of risk. Knowledge is built thanks to rapid dissemination of information, accessible thanks to social media and the internet. Nevertheless, it is important to point out that also misconceptions

and conspiracies spread rapidly and easily among the community and tend to be socially shared (Buli et al., 2015).

❖ *Information sources:*

the sources of epidemic related information, along with the usefulness and credibility of that information, is important for effectively targeting risk communication channels and messages (Jehn et al., 2011). In a study conducted in Canada during the SARS pandemic in 2003 and the H1N1 in 2009, it was observed how participants referred to and relied on multiple sources of information, such as social media, government websites, and the press (Jardine et al., 2015). On average, the topics that are covered through mass communication concern information about diseases, vaccination, risk perception, and virus transmission (Bangerter et al., 2012). It has also been seen how the trust placed in information sources can influence knowledge of danger and consequent behaviour. An example of this is, the spread of misinformation on saltwater use for Ebola prophylaxis among Nigerians (Balami & Meleh, 2019). Moreover, it has been found that, not only misinformation tends to spread more rapidly than correct information (Oyeyemi et al., 2014), but also that subjects' put more trust in information coming from the family rather than in information found in social media. In the United States, it has been observed that people who support and share conspiracy beliefs show a greater distrust of the health care system and the government (Earnshaw et al., 2019). Wrong information has a great propensity of getting widely disseminated and of influencing health behaviours during an outbreak. Social media allow rapid dissemination of information and can be considered as a useful tool during pandemic events, especially when considering restricted social networks. Nevertheless, government control of health agencies is needed to monitor the circulation of correct information.

❖ *Misconception:*

misconceptions can develop in regions where a pandemic spreads, affecting both individuals' views of the real risks and how those risks are perceived. Therefore, the dissemination of relevant information should be facilitated to promote correct social learning about the risk. There are various types of misconceptions in the case of a pandemic:

1) Misconception about infection: it has been observed how, during the pandemic influenza in India in 2009, participants showed confusion regarding the nature of the disease and its transmission. This confusion was created due to the similarity between the symptoms of this disease and those of other diseases. Adongo et al., (2016) highlighted how participants confused Malaria, Typhoid and Ebola, because they were accompanied by coughing. Another well-known belief was that mosquitoes and houseflies were able to transmit Ebola from infected people to non-infected individuals (Adongo et al., 2016).

2) Misconception about mortality: some studies showed the presence of the strong belief that contracting the disease would lead to immediate death (Balkhy et al., 2010; Nyakarahuka et al., 2017). During the SARS pandemic, the belief that infection would lead to immediate death persisted even during the H1N1 pandemic (Siu, 2010).

3) Misconception about the origin of the virus: in various studies people claimed that the infection came from another country, from God, or that it did not exist at all (Adongo et al., 2016; Buli et al., 2015). According to Abramowitz et al. (2017), Ebola had been introduced by the West to exterminate African populations.

4) The just-world misconception: this refers to a belief that people get what they deserve based on their actions. In other words, the just-world hypothesis is the

attribution of consequences to a universal force whose role is to restore moral balance. This belief implies the existence of cosmic justice, destiny, or divine forces (Hafer & Bègue, 2005).

Misconceptions require monitoring of the sources from where they originate. Social media, families and the government play a pivotal role in disseminating correct information about pandemics. It was observed how during SARS in the US, the media reported that a Vietnamese restaurant owner had died from SARS, which led to the rise of stigmatizing beliefs towards the Asian community (Eichelberger, 2007). Authorities need to communicate all information to the population in a relevant manner, even information they do not know, to build and sustain public confidence (Rudd et al., 2003). Hence, the media are crucial for rapid health communication during a pandemic, but if these are not monitored, they can contribute to the spread of misconceptions that foster both misperceptions of risk and the development of erroneous beliefs. Even though there are numerous studies on the risks associated with infectious diseases, they do not provide a complete understanding of the phenomenon (de Zwart et al., 2009). It is important to point out that studies regarding individuals' responses to pandemics are exploratory and descriptive in nature. Consequently, they: a) are not based on established models of risk perception; b) rely only on single measures of risk perception, c) do not include international comparisons.

The following paragraphs aim at clarifying these points, focusing on risk perception towards the pandemic we are currently experiencing, COVID-19. The aim is to observe and analyse different aspects of risk perception.

1.4 Risk Perception of COVID-19

In 2020, the world faced one of the most significant pandemics of the last two generations. Thousands of people are dying every day around the world and many more are being infected by this new virus called (SARS-Cov-2), which caused the COVID-19 pandemic (Clemente-Suárez et al., 2021). As deaths from COVID-19 have increased, it has become increasingly important to understand the population's perception of risk. The rapid transmission of the virus has challenged governments and institutions around the world, from Asia to Europe, Africa, Latin America, and the Middle East (Wu & McGoogan, 2020).

During the almost two years of the pandemic, governments responded in different ways, implementing measures such as social distancing, hygiene advice, color coding nations according to the severity of the pandemic, and complete population lockdowns. Most of the measures implemented globally are aimed at trying to mitigate the effects of the pandemic (Wu & McGoogan, 2020). It is evident from past studies that the outcome of a pandemic depends, in part, on the population's perception of personal and social risk factors and the behaviours that are enacted (Bavel et al., 2020; Reluga, 2010). According to Floyd & Prentice-Du (2000), threat assessment and risk perception are two key components of the theory of protection motivation. Hence, they are important determinants of the population's willingness to adopt health protection behaviours during pandemics. It is evident that the strategies implemented by governments to mitigate the effects of the COVID-19 pandemic were partly successful in slowing transmission, but they also had serious impacts on society (Nicola et al., 2020), economy (Ahmed et al., 2020), society (Ruiu, 2020), culture (Nicola et al., 2020) and psychology (Kim & Hwang, 2020). The following paragraphs focus on different aspects related to risk perception.

❖ *Risk perception of COVID-19 around the world:*

Van der Linden's model (2015, 2017) includes clusters of variables designed to study risk perception. These are: cognitive tradition (i.e., personal experience), socio-cultural paradigm (i.e., social amplification of risk, trust, values, and cultural theory) and individual differences (i.e., gender, education, ideology). This model allows a "holistic" approach to identify the different variables underlying risk perception. The first study that carried out an international analysis of COVID-19 risk perception was conducted by (Dryhurst et al., 2020). This study was performed on a sample of 46,991 participants in 10 different countries (United Kingdom, United States, Australia, Germany, Spain, Italy, Sweden, Mexico, Japan, and South Korea), between March and April 2020. These specific countries were chosen for their cultural and geographical diversity and to represent the progress of the pandemic at different stages. The COVID-19 risk perception index was measured by considering three dimensions: cognitive, affective and spatio-temporal. This index included a) the perceived likelihood of contracting the virus in the next 6 months; b) the perceived likelihood of family or friends catching the virus; c) the current level of concern about the virus. The psychological predictors considered were based on van der Linden's (2015) model and included the following variables: a) cognition, b) affective/personal experience, c) social/cultural norms. Compared to Van der Linden (2015), the authors also included measures of trust (in government, science, and doctors) and of collective/personal efficacy. The results showed that risk perception ranged between 4.78 and 5.45 on a 7-point Likert scale, indicating a high level of risk perception in all countries (see Fig. 3 below).

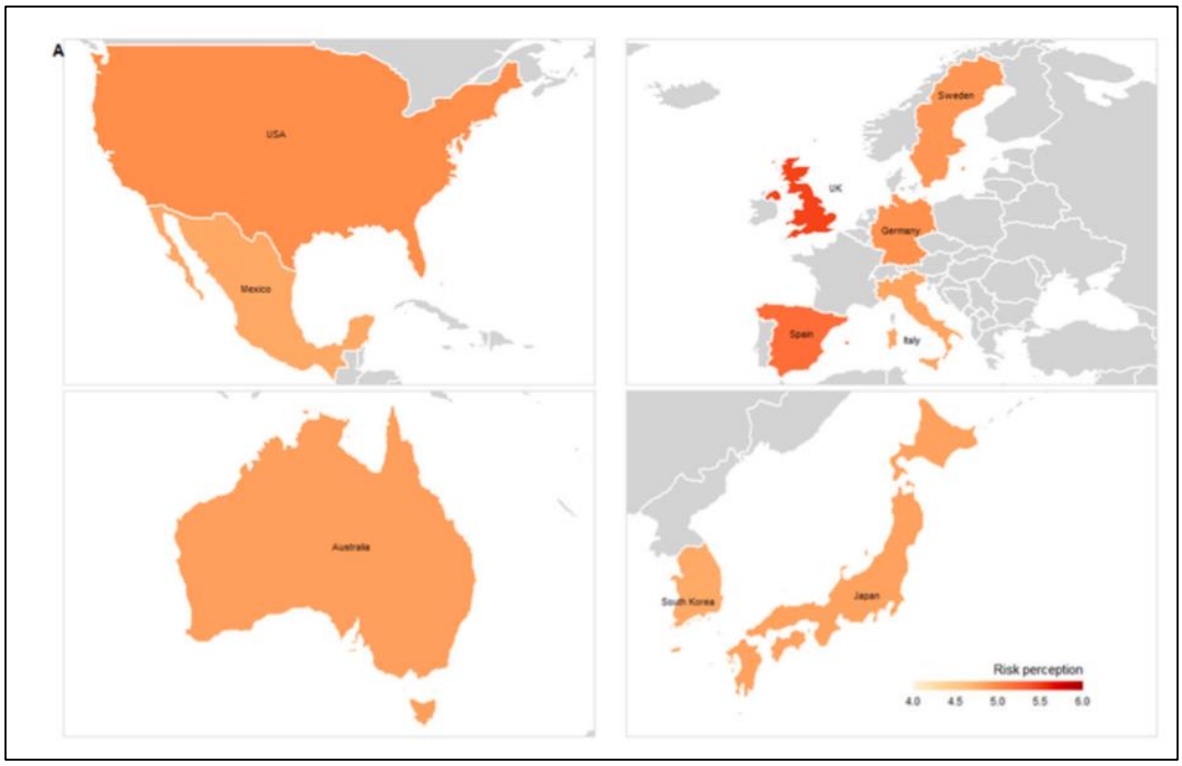

Fig 3. Map of COVID-19 risk perception around the world (taken and adapted from Dryhurst et al., 2020, p. 999)

The 3 dimensions of risk perception were all found to be significantly associated with risk perception. Specifically, prosociality, social amplification (hearing about the virus from family members), and direct experience with the virus all contributed to higher risk perception. Direct contact with the virus feeds the affective experiential system in the process of risk processing (Slovic et al., 2004; van der Linden, 2015). In line with the relationship between risk perception and protective behaviour during pandemics (Wise et al., 2020), it was observed that the risk perception index correlated positively with infection prevention health behaviour (e.g., physical distancing, wearing a mask, washing hands).

Moreover, regarding political ideology, it was found that, in the United Kingdom and in the United States, a more conservative orientation was associated with a lower risk perception (Dryhurst et al., 2020). Therefore, COVID-

19 risk perception strongly correlates with experiential and socio-cultural factors. As a consequence of this, a better understanding not only of the subjective knowledge of risk, but also of the socio-cultural factors is needed to help governments develop adequate risk communication strategies during pandemics.

❖ *Risk communication during COVID-19:*

public health epidemics, being uncertain and unpredictable in their course, cause a complex risk communication, which results in difficulties in developing effective strategies for public health protection (Kenis et al., 2019). Effective risk communication implies that all risk messages must be shared transparently and quickly, in a way that bridges the gap between those who provide the messages and those who receive them and respond to risk at the right time (Arvai and Rivers, 2014). It has been observed how during the SARS outbreak in China in 2003 and the COVID-19 outbreak, the lack of transparency in the communication of information reduced the effectiveness of risk communication contributing to a worsening of the situation (Kavanagh, 2020; Sin, 2016). Risk communication comprises two aspects, namely internal communication, and external communication. Internal communication refers to the communication process between governments and the academic community, whereas external communication refers to the sharing of information between the government and the public (L. Zhang et al., 2020). In line with this, the communication of information related to the COVID-19 pandemic outbreak in Wuhan was analyzed by Zhang and colleagues (2020). Three aspects of communication were considered:

a) *risk communication and policy decisions*: the Wuhan Government initially considered the outbreak as a simple public health problem without relying on scientific communication. This communicative choice was believed to be caused by the desire to avoid altering the country's social stability (L. Zhang et al., 2020),

b) *miscommunication of epidemiological data*: little transparency was observed in reporting infected cases,

c) *banning information from non-governmental informants*: limiting the dissemination of misinformation on social media.

Effective risk communication requires accessibility and transparency of risk information. In the case of Wuhan, reluctant government disclosure amplified the impact of the pandemic. To be functional, the disclosure must be rapid and begin as soon as information is available (Lundgren & McMakin, 2013). It is fundamental to consider the heterogeneity of the groups receiving the information and target communication to make it understandable for less educated people (Covello et al., 1989). Zhang (2020) put forward a model of risk communication (See figure 4).

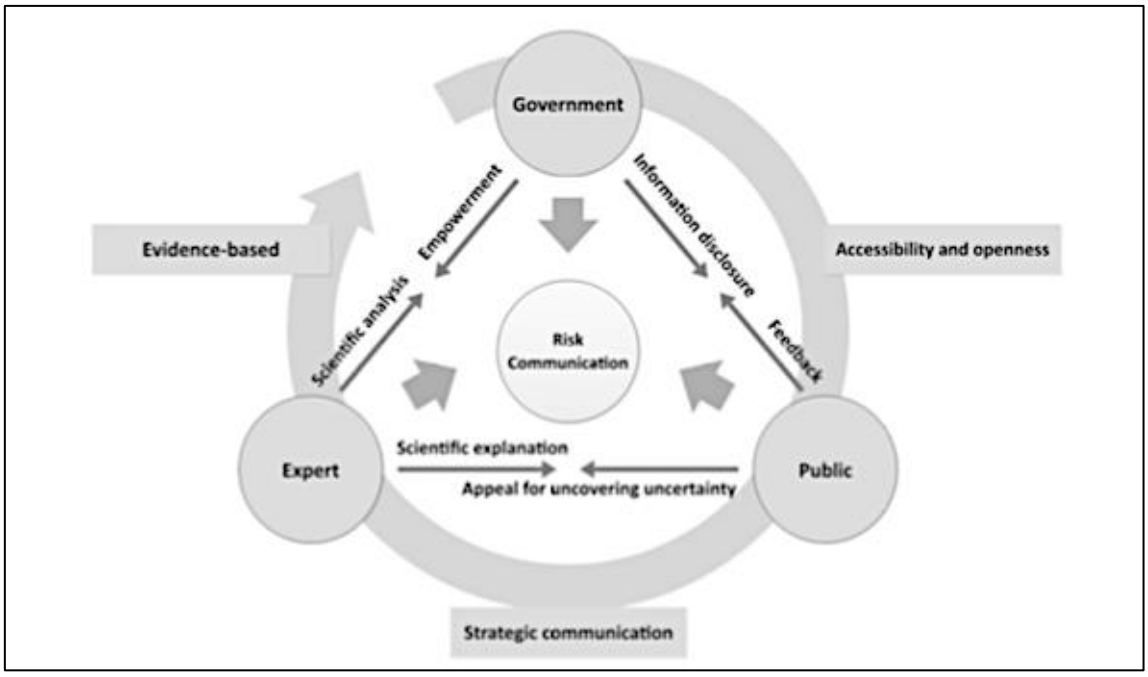

Fig 4. Risk communication model (taken from Zhang et al., 2020, p. 9)

This model comprises three components of communication: *government-expert, government-public, expert-public*. The government is the main decision-maker in risk communication and its decisions have a strong impact both on the experts and the public. In government-to-public communication, there must be accuracy and accessibility of information. These allow receiving feedback from the public, which improves future release of information by the government (Charlebois & Summan, 2015). Government-expert communication is based on scientific analysis of real data. This allows for accurate assessment that enables rational decision making, minimizes negative outcomes and maximizes positive outcomes (French, 2012; Renn, 2009). Expert-public communication is strategic. This meant that it must convey knowledge and enable the public to make health-based decisions (Gesser-Edelsburg et al., 2015). Experts need to translate complex information and make it understandable by different audiences. Therefore, when communicating risk, the collaboration between the responsible parties (government-expert-public) is necessary. Importantly, the concept of

transparency of information must be limited. According to Boholm (2019), complete transparency can lead to unjustified fears in the public. In line with this, it is possible that the Wuhan Government wanted to protect social stability in the first phase of the pandemic by not providing detailed information on the severity of the situation.

❖ *Fact-checking as risk communication of COVID-19:*

The World Health Organisation (WHO) has described the COVID-19 information landscape as an "information overload", declaring the existence of a "huge infodemic" (World Health Organization, 2020). Therefore, it is necessary to consider the risks produced by misinformation as a danger to be monitored in parallel with those produced by the pandemic itself. Krause et al. (2020) defined misinformation as any message that conflicts with the best available evidence on COVID-19 and is likely to not be corrected before being disseminated. As a consequence of this, the best strategy to control misinformation is fact-checking, i.e. investigating claims that are already in the news on social media and debunking myths using scientific institutions and agencies (e.g., https://stacks.cdc.gov/view/cdc/89938) (Graves, 2016). With the dissemination of COVID-19, fact-checking has increased by approximately 900% since March 2020 (Brennen et al., 2020).

Nevertheless, fact-checking suffers from the uncertainty of information. For example, in the case of the origin and nature of SARS-CoV-2, there is still little clarity (Kuznia and Griffin, 2020). This makes the establishment and dissemination of correct information more complex. In a survey conducted in Spain, around 37.57 % of the sample rated the idea that the virus had been artificially created in the laboratory as somewhat reliable (Roozenbeek et al., 2020). Furthermore, 16% rated the 5G conspiracy as reliable. Even though this

percentage is small it should be taken seriously, as there exists an association between violent actions and beliefs about 5G (Jolley & Paterson, 2020). Social media are the easiest platforms to read and share fake news, including those about COVID-19 (Duffy & Allington, 2020). Conspiracy beliefs are more common among "those who are more marginalized, with lower levels of psychological well-being, education and income" (van Prooijen et al., 2018).

Reduced susceptibility to misinformation would appear to be associated with greater trust in scientists and greater ability in calculation and critical thinking (Roozenbeek et al., 2020). These data together highlight the need to control the information that is disseminated, in order to reduce susceptibility to misinformation in the population. It is important to consider the public's trust in fact-checkers, as they are often internal to newspapers and influenced by political views (Krause et al., 2020).

1.5 Risk Perception of COVID-19 in Italy

After reviewing the concept of risk perception and its underlying factors, this section will examine how risk perception has influenced individuals' behaviour in response to COVID-19 in Italy. As in the rest of the world, the first information regarding COVID-19 arrived in Italy in December 2019. On 7 January 2020 the WHO communicated the arrival of a new coronavirus (SARS-CoV-2), on 23 January Wuhan and other cities in Hubei requested a lockdown. Lastly, the WHO declared the outbreak of a new global pandemic. In Italy, the situation seemed to be stable until 23 January 2020, when a couple of Chinese tourists show the first symptoms of COVID-19. This represents the first case of transmission of SARS-CoV-2, which led the Italian government to declare a state of emergency (Giovanetti et al., 2020).

In the following days, on February 6, an Italian citizen repatriated from China was admitted to the hospital and tested positive for SARS-CoV-2. The first Italian patient to contract SARS-CoV-2 in Italy was a 38-year-old man admitted to the hospital in Codogno (Lodi, Lombardy) on February 20, 2020. In the following months, the Italian government closed all schools and universities across the country to curb the spread of the virus. During the night of 9 March 2020, the Prime Minister Giuseppe Conte proclaimed a state of emergency across the country with the "IoRestoaCasa" decree, allowing people to leave their homes only for necessities, work activities, and health reasons (Motta Zanin et al., 2020). Despite the restrictions, the number of contagions and victims continued to rise (Fig. 5 shows the number of contagions and deaths in Italy). Subsequently, as the pandemic progressed, by 15 March 2020, the number of victims of SARS-CoV reached more than 10 people per million inhabitants in many regions, such as Lombardy, Marche, Liguria, Piedmont, etc.

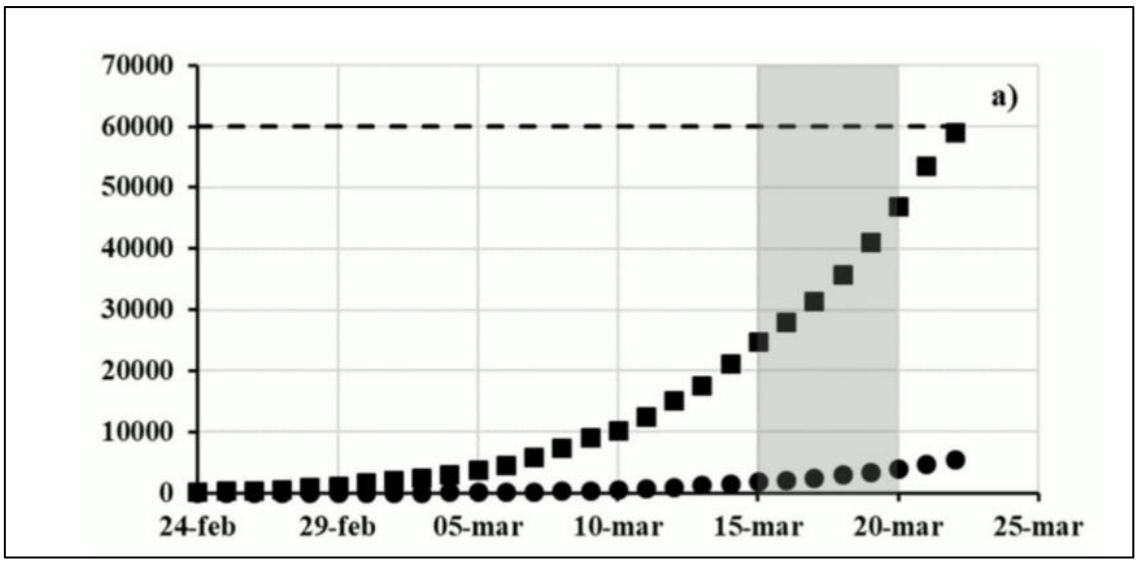

Fig 5. Cumulative trend of the number of infected people (■) and death (•) in Italy (taken and adapted from Zanin et al., 2020, p. 4)

1.5.1 Factors influencing the degree of COVID-19 risk perception in Italy

Zanin et al. (2020) administered a questionnaire during the lockdown and quarantine period to about 9000 Italians both resident in Italy (ILI) and abroad (ILA) dividing those who lived in the regions most affected (ILI-MAR) and least affected (ILI-RAR) by COVID-19. The results showed that the main source of information regarding the spread of SARS-Cov-2 used by ILI were television (44.31%) (as in Guastafierro et al., 2021), social networks (23.45%), and newspapers (14.04%). ILA referred to newspapers (29.93%), social networks (28.07%) and television (13.23%) (see Fig. 6).

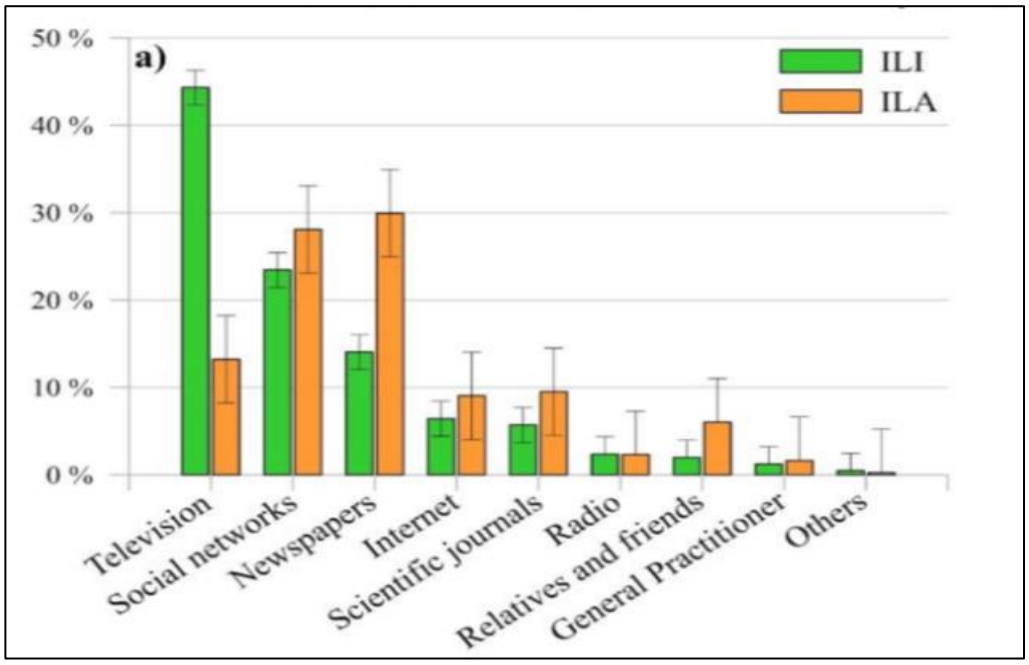

Fig 6. Comparison among ILI and ILA to their main source of information about SARS-CoV-2 (taken and adapted from Zanin et al., 2020, p. 12)

In particular, the ILI-MAR group who chose newspapers as their primary source of information showed a higher awareness of the COVID-19 pandemic. While those who used of social networks and television as a source of information, showed a lower level of knowledge about the situation and a lower

state of fear. These results demonstrate the key role of risk communication management in fostering risk perception.

Risk perception is also modulated by people's emotions. In a study by Savadori & Lauriola (2021), it was observed that the affective attitude associated with COVID-19 is used to formulate risk judgments. When the risk of infection in Italy was increasing rapidly (March 2020), affective judgment guided both affective perceptions of risk and their perceived likelihood judgments. This is in line with the theory of affective heuristics as a possible moderator of risk perception (Finucane et al., 2000; Slovic et al., 2004). Interestingly, affective attitude did not imply direct protective behavior towards COVID-19. This seems to be against the idea that affection induces an automatic approach/avoidance action tendency ("if I like something, I approach it; if I dislike something, I avoid it") (Finucane et al., 2000). In addition to this, it was seen that the indirect experience of COVID-19 (hearing about COVID-19 as a cause of death/suffering) through the media contributed to shaping one's emotional attitude in a negative way (Savadori & Lauriola, 2021).

Another study assessed the perception of COVID-19 risks in a population of elderly people over 60 years of age living in Lombardy. Data collection took place during the lockdown period. The results showed that the perceived risk of COVID-19 was lower than the perceived risks associated with other hazards, such as cancer and common influenza (Guastafierro et al., 2021). These results are in line with studies that observed a decrease in risk perception in the elderly population during pandemics (Fielding et al., 2005; Pasion et al., 2020). A decrease in risk perception in this population is probably due to a decrease in the fear of death with increasing age (de Bruin, 2021). In addition to this, the deterioration of executive functions in the elderly (Giorgio et al., 2010) could also explain reduced risk perception, as executive functions are important in processing perception of risk (Capone et al., 2016).

Health workers had one of the most important role during the pandemic. Interestingly, it has been observed that health workers reported higher risk perception, level of worry, and knowledge about COVID-19 infection compared to the general population (Simione & Gnagnarella, 2020). In addition to this, Burrai et al. (2020) assessed the perceived risk of being infected with COVID-19 in psychiatric patients. They found higher scores and higher level of anxiety compared to controls. It is possible that the training received in the community regarding the specifics of COVID-19 contributed to greater knowledge and relative increase in perceived risk.

Vai et al. (2020) found that the Italian population's perception of risk during the first phase of the pandemic (March 2020) was significantly lower than risk perception experienced in early phases of the pandemic in Vietnam and Hong Kong (Huynh, 2020a; Kwok et al., 2020). Moreover, lower perceived threat was also associated with lower perceived usefulness of containment measures (de Bruin, 2021; Dryhurst et al., 2020). Thus, perceived threat is a key factor in shaping adherence to protective behaviours, but during the different phases of a pandemic, risk perception can change abruptly.

In addition to this, in a study carried out by Vai et al. (2020), about 60% of the sample stated that both themselves and others can take effective action against COVID-19. This is considered an “optimistic bias”, (i.e., the illusion of being less at risk than others towards adverse events and diseases) (Dolinski et al., 2020). Perceived efficacy plays a role in modelling perceived risk. However, there must be an adequate level of knowledge of the risk in question. When beliefs of effectiveness are not realistic, we tend to overestimate the ability to control events and develop an "illusion of control". According to this concept, people are convinced that they are in control of the situation, due to an excessive belief in personal efficacy. This can contribute to a misperception of risk (Langer, 1975).

1.5.2 Conspiracy theories in Italy

A huge infodemiological effort has been made to study the information circulating on the web and try to monitor the spread of fake news (Tsao et al., 2021). Pre-existing conspiracies are defined as those conspiracies that existed before COVID-19 and their generation is not directly linked to it. In Italy, during the pandemic, a lot of fake news spread and continue to influence protective behaviour and risk perception today.

During the pandemic outbreak, studies have focused on describing the spread of misinformation, to understand their social impact and to improve health communication. Moscadelli et al. (2020) used keywords related to the most frequent fake news regarding COVID-19 ("vitamina C" (vitamin C), "vitamina D" (vitamin D), "5G", "laboratorio" (laboratory), "HIV") and gathered the most shared links on the internet concerning the pandemic in Italy. Results showed that links containing false information were shared 2,352,585 times, accounting for 23.1% of the total shares of all the articles reviewed. For most of the search topics, the percentage of shares for fake articles was greater than that of verified new articles. In addition to this, Rovetta (2021) analyzed the impact of COVID-19 on web interest about conspiracy hypotheses and on the risk perception of Italian web users. The data collection was carried out using Google Trends, which is used to monitor users' interest in specific topics. Keywords and queries related to typical topics (i.e., conspiracy hypothesis, vaccine side effects) were identified. The results showed that the advent of COVID-19 has increased the phenomenon of conspiracies and the interest towards them in the web to its highest level in the last 5 years. Fig. 7 shows heat maps comparing the web's interest in conspiracy hypotheses and anti-hoax services from 2016 to 2021. The index shows the percentage of infodemic queries (e.g., 70 means 70% conspiracy-related queries vs 30% anti-fuzz-related queries).

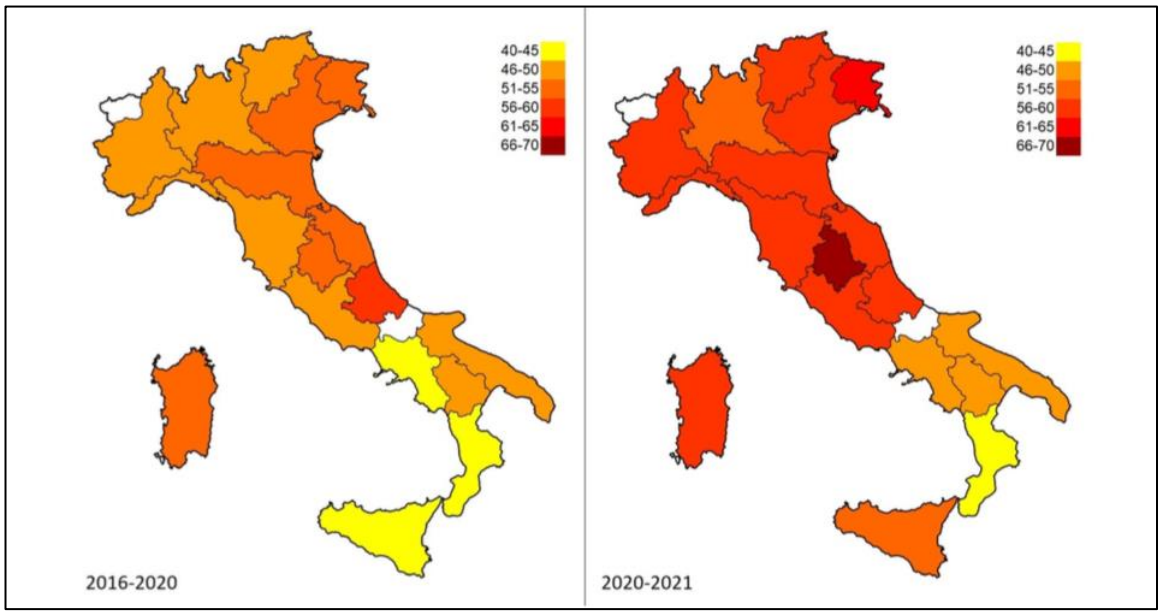

Fig 7. Heat maps comparing web interest in conspiracy hypotheses in Italy (taken from Rovetta, 2021, p. 7)

It is reasonable to conclude that the large amount of fake news distorted the risk perception of the Italian population. Vai et al. (2020) observed that in the first phase of the pandemic, participants predominantly used the internet to obtain information on COVID-19, but government websites were considered more reliable. This means that, despite the increased use of social networks, the level of reliability and credibility towards them was low. This suggests that, even though fake news circulating on the internet are easily accessible, the information given by the government is considered as more reliable. One way to fight the spread of misinformation could be to vehiculate scientifically proven information in a clear manner and make it more accessible than fake news.

1.5.3 Psychological determinants of risk perception

Health crises and global disasters can have devastating effects on people's physical and psychological well-being (Rajkumar, 2020; Silver et al., 2013). Therefore, it is extremely important to assess and understand people's

psychological and emotional response. Analysing how psychological factors can determine and modulate risk perception is crucial to understand how people behave and how they emotionally perceive risk (affect heuristics, see section 1.2). In a study by Rubaltelli et al. (2020) high COVID-19 risk perception was associated with a higher level of state anxiety in participants, resulting in greater adherence to protective behaviours. It was also seen that people who regulated their emotions engaged in a high number of protective behaviours regardless of their risk perception. In this study, a mediation model showed that the relationship between risk perception and protective behaviour was mediated by anxiety. This in line with the results of a study by Tagini et al. (2021), who found that high levels of anxiety were associated with a higher perceived risk. In the same study, a higher level of openness was associated with a reduced perception of risk. This suggests that a more "creative" trait results in more optimistic scenarios about the future. People with an external locus of control, (i.e., people who believe that their health depends on external factors, such as God or fate, also reported higher levels of risk). In summary, people who tend to worry and overreact emotionally are more likely to perceive a high risk and adhere more to protective behaviour. Individuals who are less anxious, emotionally disengaged, reflective and open to new experiences seem to have a lower perception of risk and are consequently less motivated to engage in precautionary measures.

Finally, in a study conducted during the second wave of COVID-19 in, it was observed that a low level of trust in the governmental organisation is associated with high levels of anxiety about the future (Scandurra et al., 2021), a trait that might lead to the development of "social burnout" (Queen & Harding, 2020). Interestingly, the uncertainty caused by the pandemic emergency has created a new type of mental fatigue, defined as "pandemic fatigue" (WHO, 2020). This fatigue is considered to be the natural long-term response to the

adversity caused by a pandemic. One of the possible consequences of it could be the reduction of the populations' commitment to protective behaviours.

It can be concluded that risk perception for COVID-19 is a complex and multifaceted phenomenon, which comprises sociodemographic, epidemiological, and psychological factors. For this reason, future studies should consider that this phenomenon is based on the simultaneous and intricate interaction of several variables.

Chapter 2

Social Distancing

"Don't get it or don't spread it?"

A key aspect of public health epidemiology is how individual and community actions can help mitigate and manage the costs of an epidemic. Social distancing is an aspect of human behaviour that is particularly useful for epidemiology because of its universality. Everyone can reduce their rate of contact with other people, which can, in turn, reduce the transmission of diseases (W. Xie et al., 2020).

Limiting human interactions to a close range is an effective measure to contain transmission (Chinazzi et al., 2020). Social distancing enforces behaviours such as avoiding crowded environments, mass gatherings, and maintaining distance from others (CDC, 2020) and it can limit the spread of virus if initiated quickly and if it's maintained over time (Glass et al., 2006). It has been seen that, during the initial phase of the COVID-19 pandemic, social distancing remained a voluntary behaviour to which the population did not always respond accordingly (Betsch, 2020). This is because adherence to distancing behaviours have inherent costs, and the weighing between the benefits and costs of this social norm is a critical mental process (Reluga, 2010). Nevertheless, in past pandemics, isolation and quarantine (more extreme forms of distancing) have contributed to increased levels of anxiety and depression (Hawryluck L, 2004).

The analysis and study of social distancing remain a major challenge for science. While adherence to this norm protects us from COVID-19, there are strong effects on mental health. However, the current literature provides insight

into what are the possible predictors of social distancing adherence behaviour. It is evident that the phenomenon remains unclear due to its multifaceted nature.

For this reason, the following paragraphs will consider the cognitive processes and psychological predictors that may influence adherence to social distancing. The degree of risk perception influencing adherence to protective behaviours against COVID-19 will be analysed. Furthermore, the psychological impacts of social distancing on public health will be examined.

2.1 Social distancing and COVID-19

Prevention of COVID-19 relies on physical distancing and avoidance behaviours until safe vaccines or effective pharmacological interventions are available. Therefore, governments around the world have implemented social distancing to prevent the spread of the disease (K. Xie et al., 2020). The rules of social distancing and related mobility restrictions differ among governments. This is because risk perception of the pandemic varies across cultural contexts (Huynh, 2020b).

For example, China, Japan and other Asian countries have chosen to impose strict restrictions on freedom during COVID-19 outbreaks. In contrast, several countries, such as the United States (US) and Brazil, adopted less rigid rules of social distancing (see Table 1), (K. Xie et al., 2020).

Delikhoon et al. (2021) observed how droplet transmission occurs in particles with diameters > 5 μm, that can be rapidly deposited by gravity on surfaces (1-2 m), whereas fine and ultrafine particles (airborne transmission) remain in the air for a period of time (≥ 2 h) and can be transported further up to 8 m by simple diffusion mechanisms. For this reason, the US Centers for Disease Control and Prevention (CDC) recommended wearing face masks while maintaining a social distance of 2 m.

The following paragraphs focus on several aspects that might influence social distancing behaviours in the population.

Country	Affiliation	Social Distancing Definition and Rules
Australia	Government Department of Health	"Physical distancing in public means people should keep 1.5 m away from others wherever possible."
Brazil	Ministry of Health	"Keep at least 2 m away from anyone who coughs or sneezes."
Canada	Public Health Agency	"Physical distancing is one of the most effective ways to help prevent the spread of COVID-19, and keep at least 2 arms lengths (approximately 2 m) apart when around other people."
China	National Health Commission	"Reduce mass gatherings such as activities of entertainment, catering, etc. and stay more than 1 m from others."
Japan	Ministry of Health, Labour and Welfare	"Carefully avoid 3Cs (closed spaces, crowded places, and close-contact settings) and maintain a distance of at least 1.8 m between people."
South Africa	National Department of Health	Social distancing refers to limiting public gatherings as much as possible (keep distance at least 1 m).
U.K.	National Health Service	"Avoid close contact with anyone you do not live with at least 2 m (3 steps) away."
U.S.	Centers for Disease Control and Prevention	"Remaining out of congregate settings, avoiding mass gatherings, and maintaining distance (approximately 6 feet or 2 m) from others when possible."
	World Health Organization (WHO)	"Maintain at least 1 m (3 feet) distance between yourself and others."

Tab 1. Social distancing definitions and rules by country and affiliation (taken from, K. Xie et al., 2020, p. 2)

❖ *Social distancing and risk perception*: the existence of risk is objective, while its perception and related behavioural decisions are subjective (Aven, 2016). The literature indicates how the perception of health risk can significantly influence self-protective behaviours (Dionne et al., 2018; Lin & Lagoe, 2013). According to K. Xie et al.'s (2020) findings, increased risk perception motivates people to comply with social distancing. Only by increasing the level of risk perception people take protective measures. According to the authors, perceived understanding of COVID-19 directly predicts adherence to social distancing. Furthermore, trust in science (safety climate) would promote adherence to social distancing (see. Fig 8). Moreover, according to Xie et al. (2020), trust in science, risk perception and social distancing are interacting factors, highlighted by the

moderating effect of trust in science on the relationship between risk perception and social distancing (also found in Koetke et al., 2021).

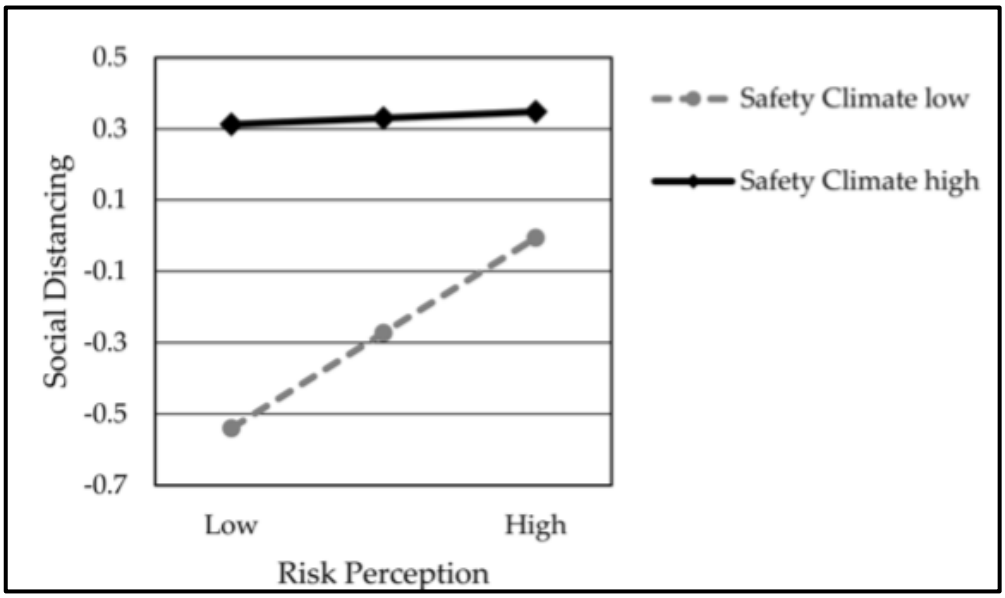

Fig 8. Interaction between Safety Climate, Risk Perception and Social Distancing (taken from K. Xie et al., 2020, p. 13)

Adiyoso & Wilopo, (2021) conducted a study on the Indonesian population in March 2020. The aim was to explore the factors that determine whether people adopt social distancing measures. The results showed that: a) risk perception influenced attitudes, subjective norms and perceived behavioural control, by influencing adherence to social distancing behaviours; b) both print and digital media influence the level of risk perception, attitudes and social norms concerning social distancing policies; c) the relationship between risk perception, media use and perceived behavioural control was greater for people living in rural areas compared to those living in urban areas. It is likely that people in rural areas have access only to official government information sources compared to urban residents, who have access to more sources of information, which often lead to misinformation. In accordance with these findings, a study conducted by

McCreesh et al. (2021) on the levels of social distancing adopted in a South African community (KwaZulu-Natal) during the COVID-19 outbreak, showed that there was a substantial decrease in the number of close contacts and time spent in indoor places.

Better risk communication can change risk perception, attitudes, and subjective norms. This can encourage people to practice social distancing and counteract the SARS-CoV-2 pandemic (Adiyoso & Wilopo, 2021). Poletti et al. (2012), developed a mathematical model applicable to any type of outbreak (e.g., due to influenza, Smallpox, SARS, etc.). It states that: 1) if the perceived risk associated with an outbreak is sufficiently large, a reduction in the number of potentially infectious contacts can mitigate the impact of an outbreak; 2) the spread of the disease/virus is highly sensitive to how quickly people adopt social distancing; 3) if individuals' risk perception is based on a memory mechanism and the risk of infection is overestimated, it is possible to slow down the pandemic. Thus, these data highlight the key role of risk perception in relation to the effectiveness of behavioural changes in response to a pandemic. Most of these studies were conducted during the critical phase of the pandemic.

However, recent research has assessed how risk perception and adherence to social distancing changed in the post-epidemic phases. In one study, data were collected for 1064 Chinese residents in January 2021. The results showed that public guidance on social distancing from the government and the media can foster better public perception of risk (Yuan et al., 2021). This is because public perception and expectations have become key factors for active participation in public crisis management. To facilitate this, government institutions should increase public awareness of pandemic risk, with the aim of encouraging people to voluntarily observe social distancing (Khan et al., 2021).

Furthermore, risk perception was found to have a mediating effect in the relationship between public guidance and obedience to social distancing

behaviour (Yuan et al., 2021). Thus, even in a post-epidemic phase, monitoring levels of risk perception and encouraging adherence to social distancing are necessary for pandemic control. Nevertheless, the relationship between risk perception and protective behaviour remains poorly understood. Further studies are needed to understand whether there are cognitive variables that can modulate risk perception.

❖ *Measuring Social Distancing*: Although the COVID-19 pandemic is constantly evolving, adherence to social distancing is still necessary. Mathematical models have been developed to incorporate information on social distancing interventions, with the aim of limiting hospitalisations, cases, and deaths (Dehning et al., 2020). According to Chen et al. (2020), the reduction of restraints depends on 3 factors: 1) the rate of spread of COVID-19; 2) the management of patients with COVID-19 in relation to the rate of recovery from hospitalisation or self-isolation; 3) the capacity of intensive care units. These three factors were used to quantify a social distancing index (LSD). The simultaneous assessment of the three interrelated factors (cases, cures and deaths) provides an overview of the relationship between LSD and the impact of the pandemic.
The aim is to help governments decide when to reopen the borders and whether the spread of SARS-CoV-2 can be contained even with small cluster infections.

Fig. 9 represents the LSD formula, where the numerator is the cumulative number of cases up to time (t) and the denominator is derived from the cumulative number of recoveries and the mortality rate based on the corresponding date.

$$\mathrm{LSD}=\left[\frac{\text{Cumulative number of cases}}{(\text{Cumulative number of recovery})\times(1-\text{case fatality})}\right]-1$$

Fig 9. LSD formula (taken from Chen et al., 2020, p. 6)

According to the authors, a reduction in social distancing is not conceivable as long as the LSD value reaches 0. This index was then standardised and validated, using data from the literature on SARS, MERS and Ebola (Y. M. Yang et al., 2017). The results of the study showed that the time taken for countries to change LSD from greater than 1 to less than 1 ranged from 3 weeks to more than 4 months. Surveillance of LSD indices in different countries can help governments assess the severity of the epidemic phase and understand when to decrease social distancing in the post-pandemic period (Chen et al., 2020).

❖ *Psychological and social factors of social distancing*: social distancing is considered a "rational" behaviour in the context in which we are living. However, this behaviour is exactly the opposite of human tendencies when humans are faced with a crisis. In fact, it is well known that human beings tend to seek social contact and closeness (Dezecache et al., 2020). For this reason, an understanding of the psychological and social factors underlying social distancing is necessary for promoting greater adherence to the norm.

According to Christner et al. (2020) social distancing can be considered according to two approaches: 1) *egoistic*, (i.e., fear of infection or fear of punishment are motivations for norm adherence in individuals) (Harper et al., 2020). In other words, fear of infecting themselves drives social distancing behaviours. 2) *prosocial*, (i.e., a form of other-oriented behaviour that aims at the well-being of others) (Jordan et al., 2021). Focusing on the benefit of protective behaviour in terms of prosociality would increase intentions to engage in protective behaviour. Indeed, people's levels of empathy seem to have a positive effect on social distancing compliance (Christner et al., 2020). According to

Hubbeling (2012), empathy describes concern for the well-being of others and leads to an increase in the well-being of others.

Social distancing, conceived as avoiding meetings with friends, before the pandemic was a matter of personal preference. However, as the spread of COVID-19 increased, these morality-driven behaviours, took on a key public health role. In the study by Cristhner et al, (2020) it was observed how factors such as moral judgement, moral identity and empathy for loved ones were positively correlated with adherence to social distancing norms see (Fig. 10).

Fig 10. Interaction between moral judgement and moral identity in relation to social distancing. (taken from Christner et al., 2020, p. 7)

Pfattheicher et al. (2020) also investigated the role of empathy (i.e., a person's responses to another individual's experience) as a factor related to motivation for physical distancing and whether the level of empathy for those most vulnerable to the virus (old people) would increase motivation to adhere to physical

distancing. Results showed that in the US, UK, Germany, physical distancing was motivated by empathy (see Fig. 11).

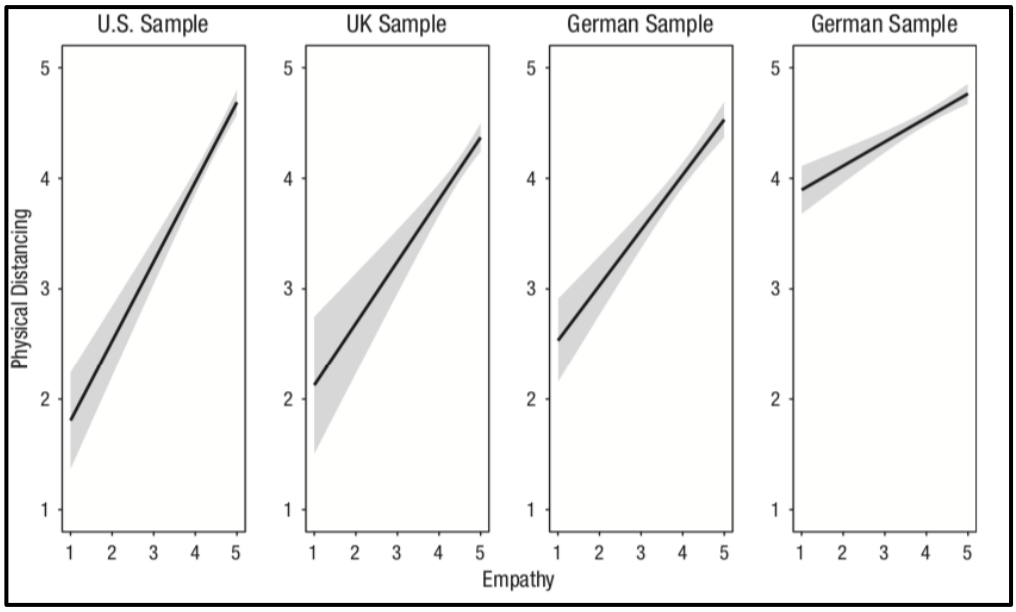

Fig 11. Physical distancing as predicted by empathy level in U.S, UK, German (taken from Pfattheicher et al., 2020, p. 1366)

Furthermore, the authors tried to test whether empathy can be used to promote physical distancing in text-messages. They presented participants with three conditions: 1) in the information-only condition participants red a text about the social distancing benefits, 2) in the information + empathy condition, in addition to the information, they showed participants a 1-min video in which a 91-year-old man sadly reports that he stopped visiting his chronically sick wife because of the virus, 3) in the control condition, no information and video were given. The result showed that inducing empathy for people most vulnerable to the virus promotes the motivation to adhere to physical distancing.

Overall, these data demonstrate that it is possible to use empathy to promote motivation in people to follow protective behaviours. As a result, when designing communication interventions to promote change protective

behaviours during the COVID-19 pandemic, messages should be developed with emotional content and not just only information contents.

A study by Guo et al. (2021) investigated the relationship between social distancing and mental health factors. They found that depressive symptoms and psychological distress were identified as predictors of compliance with social distancing. Specifically, psychological distress regarding COVID-19 can lead people to practice social distancing, probably because stress is a consequential response to the pandemic outbreak (Douglas et al., 2009). Conversely, depressive symptoms were identified as a negative predictor to keep social distancing. This result is in line with the idea that depressive symptoms can worsen individuals' health care behaviors (Witt et al., 2009). In addition to this, depressive mood plays a key role in mediating compliance to social distancing (Marot et al., 2021), whereas reading information about COVID-19 on social media has a moderating role between psychological stress and social distancing (Guo et al., 2021).

- *Effect of social distancing behavior on mental health*: COVID-19 is a social phenomenon, and successful containment depends on the effective limitation of social contacts. Protective behaviours that have been developed by governments have helped to slow the spread of the disease. Studies on previous pandemics have shown how these social interventions can negatively affect mental health, for example during the H1N1 epidemic (Pfefferbaum et al., 2012) and SARS (Mak et al., 2009). The rationale is that the social processes responsible for mental health, such as the availability of social support and daily interaction, are reduced during pandemics (Marroquín et al., 2020). A recent study on COVID-19 show that self-isolation results in reduced social interaction, unintentional changes in daily routine and sleep disturbances, and can lead to mental distress symptoms (Brooks et al., 2020). In China, the abrupt interruption of work activities resulted in a higher level of anxiety and psychological distress (Cao et al., 2020). In the

USA, symptoms of health anxiety, financial worries and loneliness emerged after the introduction of social distancing (Tull et al., 2020). According to Bavel et al. (2020), as COVID-19 progresses, mental disorders will increase. In a study conducted by Marroquín et al, (2020), between mid- and late-February 2020, an increase in symptoms of depression and anxiety was observed as COVID-19 increased in the US and in relation to the progression of social distancing norms. Fig. 12 shows the relationship between anxiety, depression, and social distancing.

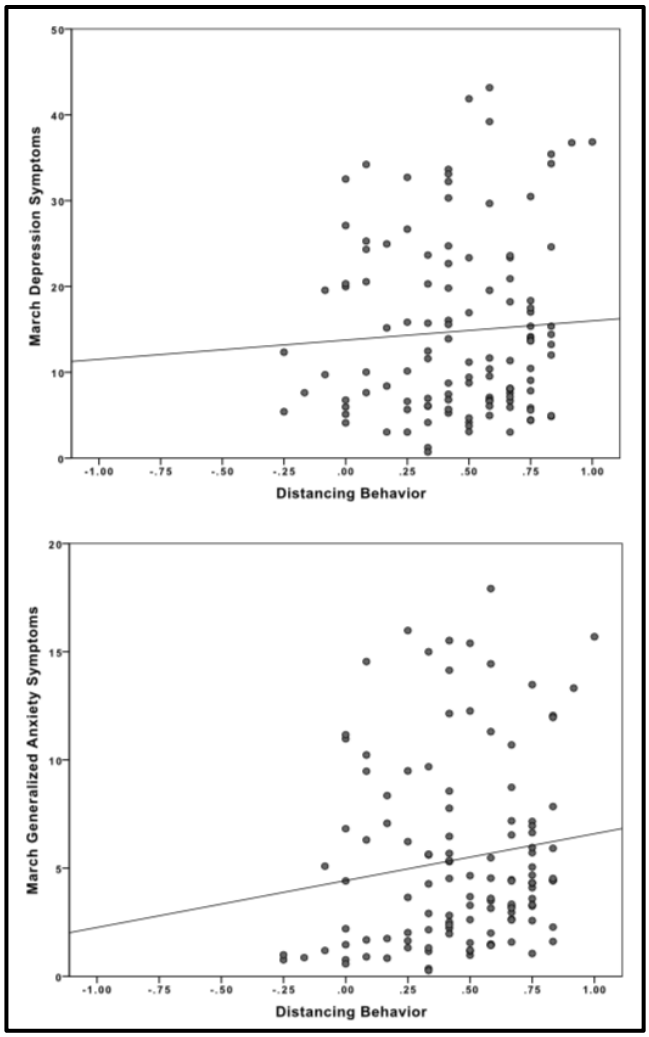

Fig 12. Relation between social distancing and increases in depression and anxiety symptoms from february to march 2020 (taken and adapted from Marroquín et al., 2020, p. 6)

These findings replicate early evidence that the COVID-19 pandemic could have an impact on public health (Cao et al., 2020; Tull et al., 2020). Also, in a review by Sepúlveda-Loyola et al. (2020) on the effects of social distancing in the elderly population (>60 years), higher levels of anxiety, depression and sleep disturbances were found. Given these data, the COVID-19 pandemic is expected to have profound effects on mental health. These symptoms could be caused by the fact that confined people are detached from their loved ones, deprived of personal freedoms and lacking projectivity (Bai et al., 2004). Such factors may contribute to the development of depressed mood (Venkatesh & Edirappuli, 2020). Moreover, anxiety may result from fear of infection and inadequate clarity about social distancing guidelines. Unreliable media sources contribute to this phenomenon, increasing confusion and fear and consequently reduced access to useful psychiatric services. With the current vaccination campaign around the world, it is not excluded that periodic and cyclical outbreaks will emerge in the coming years. This will not prevent governments from being able to reduce norms governing preventive behaviours such as social distancing and mask wearing. Therefore, behavioural science will have to develop strategies to protect public mental health.

2.2 Social distancing and working memory

Apart from the psychological aspects, behavioural science is able to tackle further aspects of human functions, which can have a relationship with social distancing compliance. One of these functions is working memory (WM).

WM was coined in the 1970s after a lengthy debate on the fact that a traditional dichotomous approach of short-term and long-term memory was not sufficient to explain all memory capacities. Since then, the vocabulary of "short-term" memory has been moved away and instead towards the vocabulary of

"working memory". Although WM is multifunctional and adaptable to its perceptual environment, it has a limited capacity and functioning. Some models of WM classify memory capacity into temporal categories such as short-term and long-term, while others focus on the type of information perceived, called modules. These modules are ordered by type of information, for example, verbal, auditory and visuospatial. The most widely accepted model of WM today involves a three-component model of WM with a partial modular configuration. It consists of the central executive, the phonological loop, and the visuospatial sketchpad (Baddeley, 1992). The visuospatial sketchpad is considered responsible for the storage and manipulation of visual and spatial information. It functions as a support system alongside the articulatory cycle, and everything is controlled by the central executive. The central executive is thought to be responsible for decision-making, reasoning, and coordinating the functions of its specialised systems. The articulatory loop (also known as the Phonological Loop, (Baddeley, 1992; Baddeley & Logie, 1992) is known for the storage and manipulation of verbal information.

The relationship between social distancing and working memory implies that, being social distancing a new norm, it needs to be stored and internalised using memory processes. It has been found that WM is associated with a better ability to follow a rule (Duncan et al., 2012). Furthermore, according to Fukuda et al. (2010), better WM is associated with better cognitive outcomes. Finally, WM allows for a better assessment of the costs and benefits of an action under conditions of uncertainty (Czernatowicz-Kukuczka et al., 2014).

W. Xie et al. (2020) investigated whether WM was associated with individual differences in social distancing adherence during the first phase of the COVID-19 pandemic in America. These studies were conducted within the first 2 weeks (March 13 to 26, 2020) following the United States federal government's declaration of national emergency due to the COVID-19 pandemic. In a sample

of 850 participants, compliance with social distancing was assessed using a questionnaire and WM capacity was assessed using a change memory localization task. Results showed that: 1) WM significantly predicted individual differences in social distancing compliance (see Fig. 13B). 2) Participants' understanding of the benefits of social distancing mediated the relationship between WM capacity and social distancing compliance. This significant mediating effect considered individual differences in gender, age, education, income level, depressed mood, anxiety, personality traits and fluid intelligence as underlying confounders (see Fig. 13C).

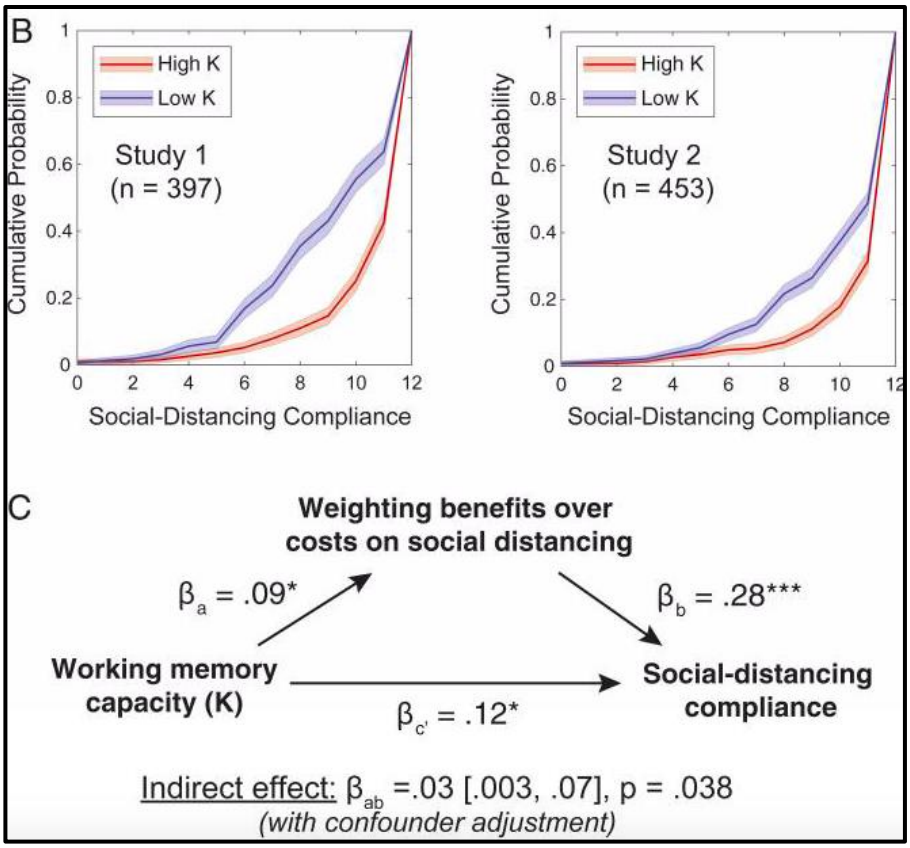

Fig 13. **B**) Median distribution of WM capacity defined as (K-capacity). Higher WM correlates significantly with higher compliance with social distancing. **C**) The relationship between WM capacity and compliance with social distancing is partly mediated by understanding the benefits versus costs of social distancing. Participants with higher WM capacity may be able to better assess

the benefits of social distancing (taken and adapted from W. Xie et al., 2020, p. 17668)

Overall, this is the first study to reveal a cognitive component in the adherence to social distancing. Deciding whether to follow the social norm of distancing and weighing its benefits more heavily than its costs, would appear to be mediated by WM's ability. Xie et al. (2020) suggest a possible cognitive locus for the development of strategies to address and mitigate the challenge of COVID-19. Interestingly, according to Spitzer et al. (2007) the relationship between WM and social distancing may be driven by shared neurocognitive mechanisms in prefrontal regions. Processes underlying adherence to social norms occur in prefrontal regions and WM is also closely related to prefrontal mental processes, such as decision making and cognitive control (Murray et al., 2017).

Since the present results are correlational in nature and reveal a behavioural association between WM and distancing, other possible variables must also be considered. For this reason, Marot et al. (2021), after re-analysing the data of W. Xie et al. (2020) suggested that: 1) depressed mood and agreeableness may be as good predictors of compliance with social distancing as WM; 2) in the mediation model the analysis of benefits versus costs strongly mediated the relationship between depressed mood and social distancing. Hence, the authors suggest that targeted interventions to reduce depressed mood (rather than to improve WM skills) offer a more promising strategy for increasing social distancing adherence. In response to this, Xie & Zhang, (2021) stated: "Our goal was therefore to reveal the critical role of working memory in social cognition, especially in people's early responses to the COVID-19 pandemic [...]", and "our article states that our observations are correlational in nature. Any causal statement, such as the

assertion that higher working memory capacity or less depressed mood has increased social-distancing compliance, is unwarranted and misleading".

Overall, these findings show that the study of psychological predictors of social distancing is multifaceted and complex. On the one hand, there are variables (such as depression) that influence adherence to a specific norm (such as social distancing); on the other hand, the same variables may be impaired by that norm. In fact, it has been shown that social distancing in the first phase may benefit psychological well-being and memory performance. At the same time, prolonged social distancing generates negative states that have a negative impact on mood and false memories, but not on true memories (W. Zhang et al., 2021). In addition to this, Fabio & Suriano, (2021) in a study conducted during the lockdown in Italy, found that high levels of anxiety have a negative influence on the performance (reaction times) of both visual and auditory working memory tasks. Understanding how we feel and in relation to the risks of COVID-19 and the protective behaviours we enact is a challenge that behavioural sciences can and should address (Betsch, 2020).

Further studies are needed to understand the role of cognitive components in relation to social distancing behaviour. It is important for future research to gain a better understanding of how WM capacity can be used to predict cognitive decision-making and subsequent compliance behaviour in everyday socio environmental activities. Behavioural science can provide a basis for understanding how populations respond to a pandemic. Since we do not know the duration of the COVID-19 emergency, being able to develop effective communication messages based on empirical data may in the future improve adherence to social distancing behaviour.

2.3 Compliance with Social Distancing

The importance of adhering to social distancing norms was consistently emphasised to the population during the COVID-19 emergency. As the pandemic progresses, it remains fundamental to follow these rules and monitor people's behaviour, as there exists cases of non-compliance. Therefore, it is important to try to understand what social, psychological and motivational factors predict social distancing compliance. The *Health Belief Model* (HBM) is one of the most used approaches for studying these concepts. The HBM is used to describe and predict public health behaviours and the prevention and monitoring of diseases in global contexts (Siddiqui et al., 2016). The model is based on the theory that individuals adopt healthy behaviours to avoid a health threat. These behaviours are based on individual perceptions of: 1) motivation (disease severity, disease susceptibility), 2) response efficacy (perceived benefits), 3) psychological factors (COVID-19 anxiety, stress) (see fig. 14 below for details).

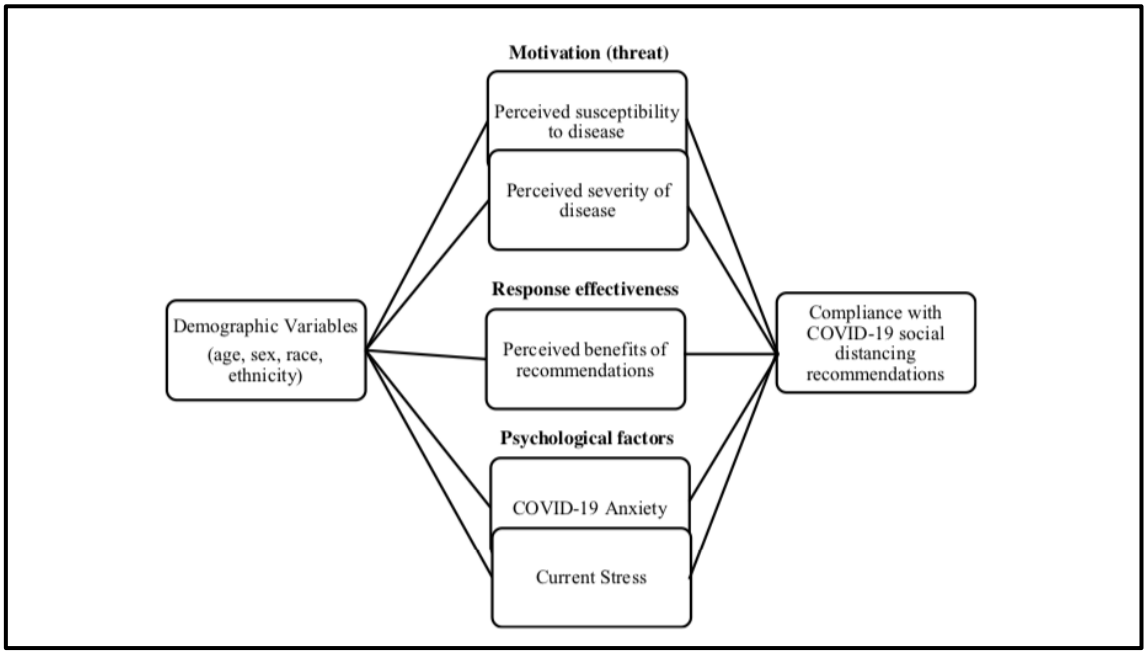

Fig 14. HBM applied to predicting compliance with social distancing (taken from Hansen et al., 2021, p. 3)

In the situation caused by COVID-19, the potential role of HBM concepts in increasing preventive health behaviour is widely recognized (Hansen et al., 2021). According to Webster et al. (2020) adherence to quarantine may be influenced by the perceived benefits of precautionary measures and the risk of contracting the disease. Also, in comparison to past SARS and Ebola pandemics, it has been seen that people were more likely to adhere to quarantine protocols when they perceived this behaviour to be helpful in reducing transmission (Siddiqui et al., 2016). The HBM model has also been used in relation to vaccination intention in Malaysia. The results of Hansen et al. (2021), showed that perceived susceptibility to COVID-19 and perceived benefits of social distancing measures are the most significant predictors of compliance with social distancing norms. In addition to this, a correlation emerged between level of anxiety and stress in relation to the primary predictors of HBM.

These data highlight that, until now, the focus has been on the effects of COVID-19 in relation to mental health, but mental health should also be considered as a potential predictor of compliance (Mukhtar, 2020). A recent study examined the associations between compliance with social distancing and mental health symptoms (i.e., stress level, anxiety, and depressive symptoms) in Hong Kong. Results showed that adoption of social distancing behaviours were associated with lower levels of anxiety and depression (Zhao et al., 2020). In a study on young people in the United States, the authors found that anxiety level may contribute to greater engagement in social distancing norms (Oosterhoff et al., 2020). In this context, anxiety can be conceptualised as a mean of amplifying the perception of danger by inducing protective behaviours. The level of fear of COVID-19 was also identified as a predictor of social distancing compliance (Harper et al., 2020). During a pandemic, "fear" behaves as a normal, context-dependent response. Therefore, it is necessary to understand the context in which

negative emotional states occur, because they can act as good predictors of prevention behaviour.

Taken together, these studies reflect on how the entire population has been asked to engage in an immediate change in behaviour, in accordance with an urgent directive to protect public health. Understanding who chooses to practice social distancing, and why, is crucial to the development of effective public service campaigns aimed at promoting behavioural change both now and during the occurrence of future pandemics (Russel 2020). It should be borne in mind that the difficulty of studying social distancing compliance lies in self-assessment. These procedures can lead to an overestimation of one's own level of social distancing, in order to convey a socially desirable impression to others and oneself (Balcetis 2008). For this reason, Fazio et al. (2021) developed an approach aimed at measuring social distancing in an innovative way, by simulating social distancing behaviour with graphical representations. These "virtual" social distancing scenarios required concrete, real-time responses from participants. For example, the participant is asked to choose whether to cross a park via a winding but isolated path versus a more direct but crowded path see (fig. 15a-b). All behavioural scenarios can be viewed on the website http://psychvault.org/social- distancing/.

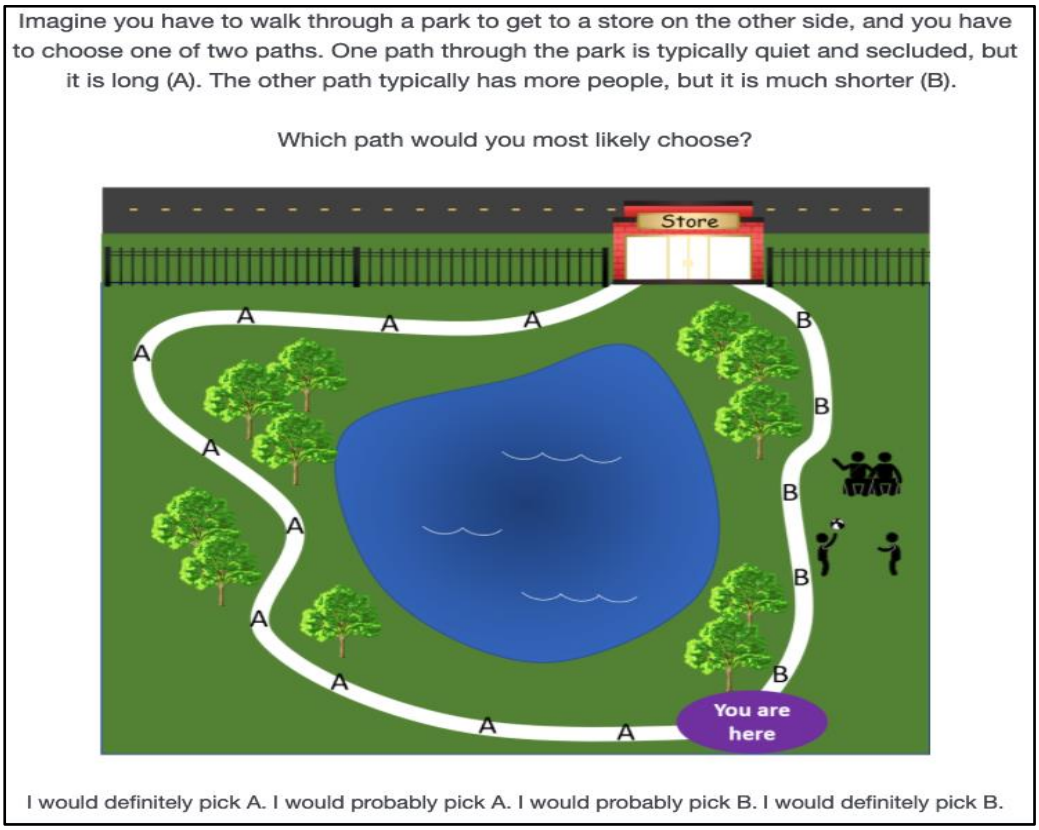

Fig 15a. Example virtual behavior scenarios of social distancing (taken from Fazio et al., 2021, p. 6)

Fig 15b. Example virtual behavior scenarios of social distancing (taken from Fazio et al., 2021, p. 6)

According to the authors, these simulated scenarios correspond to real-life situations. They offer a clever way to index the extent to which individuals make decisions with respect to the concept of social distancing.

The results of the study showed that: 1) beliefs about the pandemic were correlated with social distancing; 2) knowledge about COVID-19 was positively correlated to behavioral compliance; 3) interpersonal compassion and concern about others' vulnerability to the virus were associated with higher social distancing; 4) more conservative individuals also reported lower trust in the value of science and lower trust in scientists; 5) belief in conspiracy theories was associated with lower social distancing adherence. Regarding the complementarity between virtual scenarios and self-rated measures of social distancing, a positive but weak correlation emerged, suggesting that the two

social-distancing assessment methods cannot be used to measures the same construct. This study highlights how an integration of self-report measures and virtual reality is necessary for a better understanding of the cognitive predictors of protective measures. The aim is to provide a behaviour-related index of social distancing that is consistent and comprehensive.

Chapter 3

Vaccine Hesitancy

"We need to get vaccines in arms and to smother this virus before it blows up in our face again"

The COVID-19 pandemic continues to have a major impact on mortality, disrupting societies and the global economic system. Governments are developing equitable, large-scale vaccination programmes to mitigate and reduce the COVID-19 pandemic. Clearly, at a time of great misinformation, it can be difficult to achieve high levels of vaccination uptake. This is because the concept of vaccination is associated with the perceived risk associated with vaccine side effects (Bauch et al., 2003) and media coverage has the capacity to trigger panic if the vaccine is imperfect (Tchuenche et al., 2011). Overcoming the pandemic will require adequate health system capacity and effective strategies to increase vaccine confidence and acceptance (Joshi et al., 2021). In the past, vaccines have been an effective measure to eliminate and prevent different infections. However, vaccine hesitancy and misinformation can be obstacles in achieving high vaccination coverage and population immunity (Lane et al., 2018; Larson et al., 2014). Concerns about vaccine hesitation are growing globally, prompting the World Health Organisation (WHO) to declare it among the top ten public health threats of 2019 (Westmoreland et al., 2021).

Therefore, governments and societies need to understand current levels of acceptance towards COVID-19 vaccines and identify factors that predispose to vaccine hesitancy. The reasons behind the acceptance and hesitation of the

COVID-19 vaccine remain complex. As new SARS-CoV-2 variants emerge, updated versions of the vaccines are expected to come into the market (Abdool Karim & de Oliveira, 2021). Therefore, it will be important for proper promotion of vaccination intention to maintain a delicate balance in communicating what is known and recognising the uncertainties that remain.

This chapter will explore the psychological factors that determine people's attitude towards COVID-19 vaccination, with the aim of reducing misinformation and facilitating effective strategies to overcome the high levels of hesitation. Understanding what factors contribute to COVID-19 vaccination intention could lead to increasing vaccine uptake.

3.1 Vaccine Hesitancy in the era of COVID-19

According to the Strategic Advisory Group of Experts on Immunization (SAGE), vaccination hesitation is the "delayed acceptance or refusal of vaccination despite the availability of vaccination services" (MacDonald, 2015). Factors influencing vaccination acceptance include: complacency, convenience and confidence and comprise the so-called "Three C's model" (see Figure 16 below).

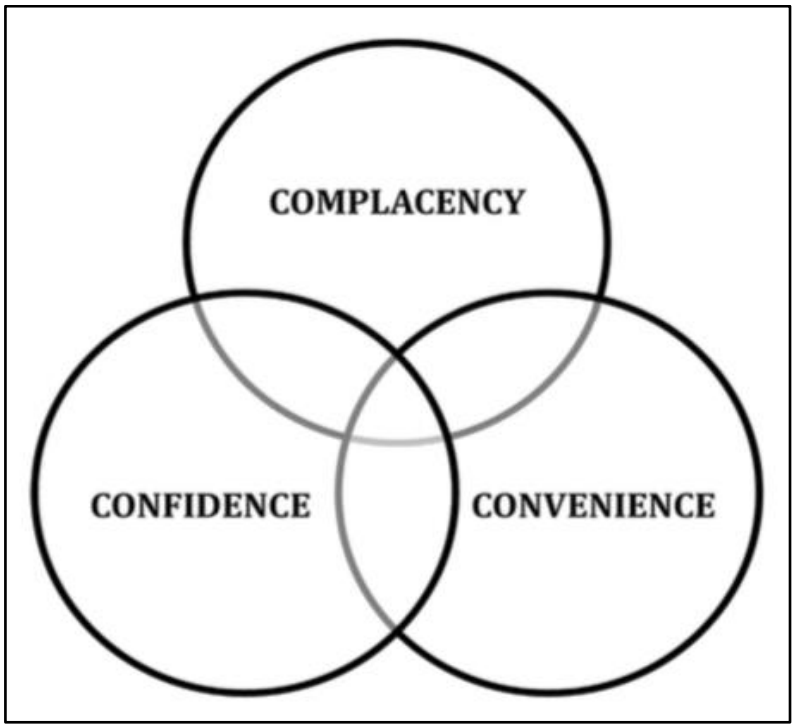

Fig 16. The three Cs model (taken from MacDonald, 2015, p. 2)

In the "Three Cs model", confidence is defined as trust in 1) the efficacy and safety of vaccines; 2) the system that delivers them, referring to the reliability and competence of health services; and 3) the motivations of policy makers who decide on the vaccines needed.

Vaccination complacency exists when the perceived risks of vaccine-preventable diseases are low and vaccination is not considered a necessary and useful action to limit disease. Thus, the success of a vaccination campaign may result in complacency and hesitation because of the tendency to evaluate the risks of vaccination as greater than the risks caused by the disease. The convenience of vaccination refers to factors such as: geographical accessibility, economic resources, population's ability to understand (language and health literacy), degree to which vaccination services are provided at a given time, etc. These factors together can contribute to vaccination uptake and may contribute to vaccination hesitation.

Another element considered by MacDonald (2015) - not represented in (fig. 16) - is communication. It was found that poor or inadequate communication can reduce vaccination intention. It has been seen how miscommunication of certain vaccine preserving components has contributed to reduced public trust leading to vaccine hesitation/rejection (Offit et al., 2002). This model was first proposed to the WHO EURO Vaccine Communications Working Group in 2011.

In addition to the above model, numerous studies have shown that the processes underlying vaccine hesitation can be analysed by considering three elements: 1) environmental factors (public health policies, media, etc) (Daley et al., 2018; Dubé et al., 2014); 2) vaccine-related factors (safety, efficacy, perceived susceptibility etc); 3) host factors (education, past experience, knowledge etc) (Kumar et al., 2016). In line with this, Karlsson et al. (2021) highlighted that the strongest predictor to intention to vaccinate against COVID-19 was confidence in the safety of the vaccine. Those who perceived COVID-19 as a serious disease were also slightly more likely to get a COVID-19 vaccine.

Studying and understanding the impact of COVID-19 vaccine hesitancy requires the analysis of cognitive, psychological, socio-demographic and cultural factors that contribute to it (Murphy et al., 2021).

Previous studies assessing attitudes towards vaccines have revealed that there is variability between countries in perceiving the efficacy and safety of vaccination (Larson et al., 2014). High-income countries were the least confident about vaccine safety (North America and Northern Europe), whereas most people in low- and middle-income areas (LMICs) agreed that vaccines are safe, with the highest percentages observed in South Asia and East Africa (Wagner et al., 2019).

Also, according to Solís Arce et al. (2021), a higher willingness to take a COVID-19 vaccine was observed in LMICs (80.3%) compared to the US (64.6%)

and Russia (30.4%). Vaccine acceptance in LMICs is explained by the interest in personal protection against COVID-19, while concern about side effects is what prompts hesitation. This study in LMICs suggests that prioritising vaccine distribution in the South should yield high returns in advancing global vaccination coverage. Increased global vaccination coverage is the only weapon to combat the emergence of new COVID-19 variants (Callaway & Ledford, 2021).

In a systematic review by Sallam, (2021) the intention to vaccinate against COVID-19 worldwide was examined. Thirty studies were reviewed from February 2020 until December 2020. The results showed that the highest vaccine acceptance rates (> 90%) among the general public were found by Ecuador (97.0%) (Sarasty et al., 2020), Indonesia (93.3%) (Harapan et al., 2020) and China (91.3%) (Wang et al., 2020). In contrast, the lowest vaccine acceptance rates (<60%) among the general public were found in Italy (53.7%) (la Vecchia et al., 2020), Russia (54.9%) (Lazarus et al., 2020), Poland (56.3%) (Neumann-Böhme et al., 2020). Variability in vaccine acceptance rates was also observed in the UK, the US and Canada during the pandemic (Fisher et al., 2020; Reiter et al., 2020; Taylor et al., 2020) (Fig. 17 shows COVID-19 vaccine acceptance rates per country).

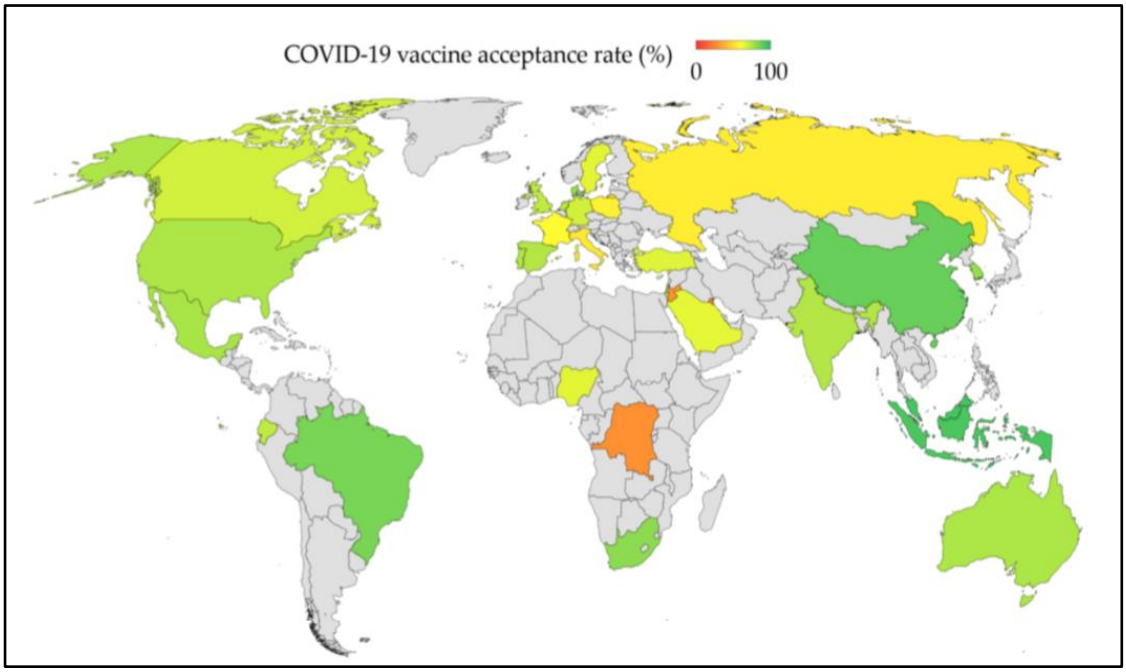

Fig 17. COVID-19 acceptance rate worldwide (taken and adapted from Sallam, 2021, p. 7)

Overall, the relatively high COVID-19 vaccine acceptance rates could be related to increased confidence in the safety and efficacy of the vaccine, as reported in Asia (Larson et al., 2014). Clearly, intention to receive COVID-19 vaccination may vary depending on the stage of the pandemic, but it is a complex and multifaceted phenomenon.

Aw et al. (2021) indicated the predictors of people's unwillingness to vaccinate. Results showed that lack of a recent history of influenza vaccination, lower perception of contracting COVID-19, lower fear of COVID-19, belief that COVID-19 is not serious and does not lead to serious medical conditions were the individual/group factors associated with increased vaccine hesitancy. Specific factors found in the population were the belief that the vaccine was unsafe/effective and increased concern about the rapid development of COVID-19 vaccines. Hence, is clear that these factors continue to hinder vaccination programmes implemented by governments globally. In addition to this, the

greatest hesitation was found in high-income countries, confirming the findings of Solís Arce et al. (2021), where the average willingness to take the COVID-19 vaccine was higher in the population from lower-income countries or regions such as Nepal (97%), than in high-income countries or regions, such as the USA (6%).

The main differences in vaccination hesitancy are found between countries with different incomes. The reasons could be attributable to the fact that: in middle - or low -income regions there is a disparity in access, costs and awareness of vaccines (Wiysonge et al., 2012). Conversely, individuals in high-income countries tend to be more vaccine hesitant due to concerns about vaccine safety (Crocker-Buque et al., 2017). This could be driven by the awareness that vaccines made with recent and little-known technology have raised long-term safety concerns and doubts (Dror et al., 2021).

Aw et al. (2021) summarised the most frequent determinants of Covid-19 vaccine hesitancy (see Figure 18 below).

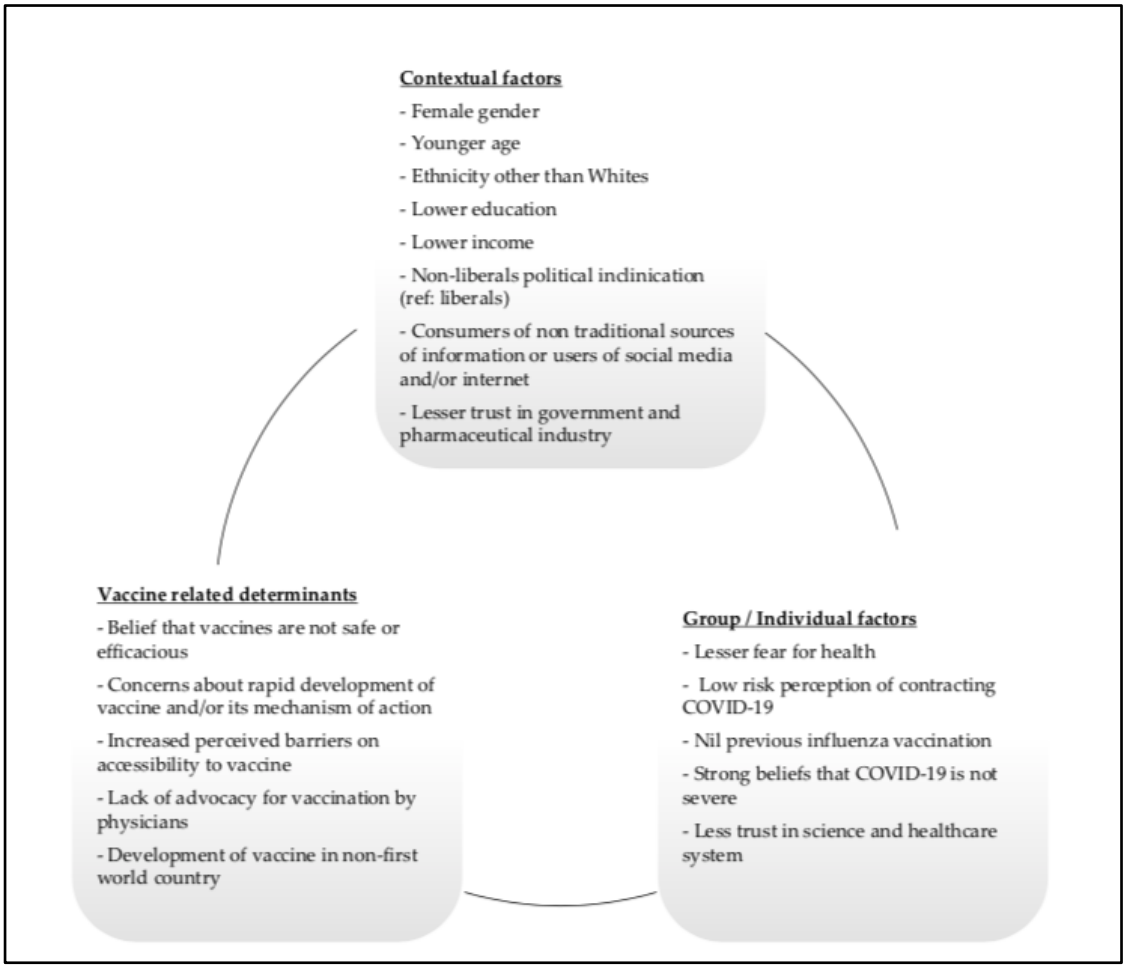

Fig 18. Determinants of vaccine hesitancy in high-income countries (taken from Aw et al., 2021, p. 13)

Greater vaccine hesitancy has been found in women, possibly because they are more likely to believe conspiracy theories (Sallam et al., 2020). In addition, searching for information about COVID-19 via social media/internet would increase vaccination hesitancy (Aw et al., 2021).

Overall, these data demonstrate how the analysis and study of the determinants of vaccination intention can support governments in developing effective communication messages. Given that vaccines reduce disease severity, but not transmissibility, identifying targeted groups for vaccination is useful for public health. Therefore, understanding vaccine hesitation across patient

subgroups with higher mortality and morbidity related to Covid-19 infections will be of paramount importance (Aw et al., 2021). In addition to this, vaccine hesitancy may undergo temporal changes due to the different pandemic waves of COVID-19. Future studies should conduct longitudinal analyses to understand changes over time and provide the basis for the development of appropriate communication strategies.

At the time of writing, an ECDC report (ECDC – Covid-19 Vaccine Tracker) states that vaccination levels in Europe are progressing rapidly. As shown in Fig.19, the reduction in the number of deaths in the respective states compared to the percentage of people vaccinated is evident. A special case is Belgium (BE), which shows a high number of vaccinated persons (87%), but also a high number of deaths (29%). This difference could be attributable to several factors (i.e., risk perception, protective behaviour, etc). This seems to be in line with van den Broek-Altenburg & Atherly, (2021), who found that the Dutch were more likely to wash their hands than the Flemish during the early stages of the pandemic.

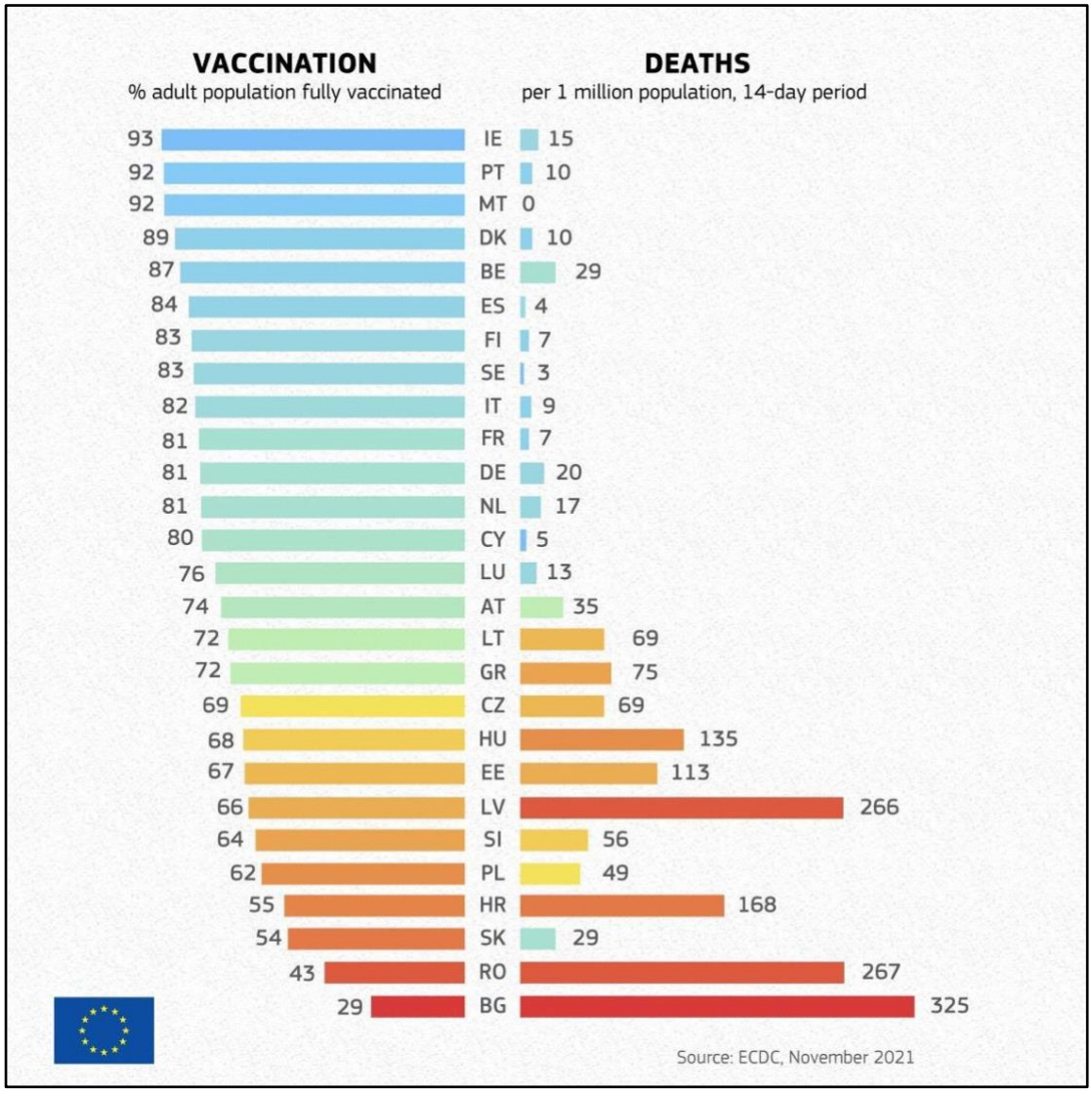

Fig 19. ECDC- Report of vaccination and deaths in Europe (taken from https://www.ecdc.europa.eu/ - November 2021)

3.2 Psychological predictors of the intention to be vaccinated

As for social distancing, understanding the psychological factors that facilitate hesitation to vaccinate against COVID-19 is of paramount importance. To overcome public concerns about vaccines, robust public health campaigns must

be developed. Effective public communication requires knowledge of individual attitudes, beliefs and perceptions about health that give rise to COVID-19 vaccine hesitation. Thus, identifying public concerns about the safety of COVID-19 vaccines is crucial. Such concerns may relate to vaccine efficacy, personal susceptibility in the assessment of COVID-19 severity, and belief in conspiracy theories. Logan et al, (2018) showed how people who know the benefits of vaccination and the significance of herd immunity are more accepting of vaccines. Similarly, believing conspiracy theories about vaccines may increase vaccination hesitation (Jolley & Douglas, 2014). Salali & Uysal, (2020) showed that beliefs regarding the SARS -CoV-2 origin (i.e., natural – versus - artificial) are potential determinants of vaccine acceptance. In a study conducted by Ruiz & Bell, (2021) vaccination reluctance emerged due to fear of vaccine safety and efficacy. In line with this, it emerged that the groups most at risk of COVID-19 (elderly aged 65 years and over) were more likely to accept a future vaccine.

Thus, it is evident how levels of distrust in science/medicine can influence groups with greater hesitation to vaccinate (Palamenghi et al., 2020). In another study by Barello et al. (2021) in Italy, psychological predictors of vaccine acceptance and hesitation were investigated, based on the 5Cs model developed by Betsch et al. (2018). According to this model, vaccine hesitancy is assessed according to 5 elements: *trust* (confidence in safety/efficacy of vaccines), *complacency* (feeling that vaccines are not actually necessary), *constraints* (obstacles involved in vaccination), *calculation* (benefit vs cost), and *collective responsibility* (the social utility of the vaccine). The results showed that confidence in vaccine safety was associated with intention to vaccinate in line with the findings of (Larson et al., 2018). Furthermore, a lower sense of collective responsibility is associated with lower intention to vaccinate against COVID-19 (Barello et al., 2021). These data suggest the importance to consider the underlying psychological determinants of vaccination, in orde to understand the

motivations of individuals behind their hesitation and to provide relevant public communication messages.

Other elements that play a key role in predicting vaccination were identified by Bendau et al. (2021). The authors conducted a study on levels of fear, anxiety and individual risk as possible predictors of vaccine acceptance. The study was conducted in a sample of 1779 adults in Germany, from 1 to 11 January 2021 (a few days after the start of vaccination in Germany). The results showed a high acceptance of the vaccine, similarly to the UK (Freeman et al., 2021) and France (Detoc et al., 2020). These results are in line with temporal changes in vaccine acceptance at different stages of the pandemic. Moreover, regarding risk perception, there was no positive association with vaccination intention, but this can be partly explained by taking into consideration the methodological diversity across the studies. With respect to COVID-19-related anxiety and health fears, an association was found with vaccination readiness. Interestingly, fears related to economic aspects showed an inverse effect, (see Table. 2 for more details).

Anxiety and stress-related variables	Vaccination willingness Correlation coefficient r_S (p)	95% confidence interval of r_S
C-19-A (COVID-19-related anxiety)	0.156 (<0.001***)	[0.110; 0.201]
PHQ-4 (unspecific anxiety and depressive symptoms)	0.030 (0.208)	[−0.017; 0.077]
GAD-2 (unspecific anxiety symptoms)	0.031 (0.198)	[−0.016; 0.078]
PHQ-2 (depressive symptoms)	0.024 (0.320)	[−0.023; 0.071]
Several aspects of fear regarding the COVID-19 pandemic		
Fear of the consequences of the pandemic in general	0.009 (0.715)	[−0.038; 0.056]
Fear of infection with COVID-19	0.238 (<0.001***)	[0.194; 0.281]
Fear of the health-related consequences for oneself	0.178 (<0.001***)	[0.132; 0.223]
Fear of the health-related consequences for loved ones	0.166 (<0.001***)	[0.120; 0.211]
Fear of the social consequences of the pandemic	−0.066 (0.006*)	[−0.112; −0.019]
Fear of the economic consequences of the pandemic	−0.098 (<0.001***)	[−0.144; −0.052]
Risk perception		
Subjective risk perception to get infected	0.055 (0.023)	[0.008; 0.101]

Table 2. Associations of anxiety and fear with vaccination willingness (taken from Bendau, Plag, et al., 2021, p. 3)

These results seem to confirm the findings of Harper et al. (2020) who found that functional fear predicted adherence to public health. Finally, regarding anxiety/depression constructs in general terms, no relationship emerged. This highlights two fundamental points: 1) general anxiety and depressive symptoms might not have a direct relationship with vaccine acceptance; 2) excessive fear of the pandemic is a risk factor that may lead to an inability to engage in preventive measures (as in Bendau, Kunas, et al., 2021).

Finally, in a recent study by Simione et al. (2021), existential and general anxiety increased the propensity to vaccinate, whereas it decreased in the

presence of paranoid ideation. These results are in line with Bendau et al. (2021), highlighting the key role of anxiety and fear as possible predictors of vaccination intention. In contrast, perceived stress does not seem to be associated with vaccine propensity (Simione et al., 2021). Moreover, death anxiety was the only psychological variable to show a direct effect on vaccine propensity. This is because death anxiety might increase vaccination adherence by mitigating existential fears and worries (Pastorino et al., 2021).

In addition to this, it is important to consider the emotional aspects (e.g., fear, anger, etc.) of effective communication. This can help to build trust and credibility in health agencies and scientific experts and encourage greater adherence to vaccination. According to Perugini & Bagozzi (2001), the emotional component has assumed a central role in modulating health behaviour change. Emotional content has been used effectively in the development of health messages for behaviour change (Dillard & Nabi, 2006). It is evident that the emotionally charged nature of the COVID-19 pandemic, coupled with anti-vaccination concentrations, cause confusion, apathy and other emotions may influence decisions to vaccinate (Chou & Budenz, 2020). Specifically, with respect to COVID-19 vaccines, there are elements that favour the emergence of indecision towards vaccinating.

According to Fisher et al. (2020), vaccine safety, possible side effects and rapid development are possible barriers to vaccination. It has been seen that emotionally charged information about vaccines is more influential than statistical information (Betsch et al., 2011). According to Chou & Budenz, (2020) it is therefore necessary to develop messages that promote adherence to vaccination, promoting altruism and the positive impacts of vaccination on the community in line with the concept of "prosociality" (Jordan et al., 2021).

Future studies are needed to better understand the psychological predictors of vaccination intention, because focusing the psychological characteristics of the population may be useful in developing communication messages that encourage vaccination.

3.3 Misinformation and conspiracy theories related to COVID-19 vaccine

The dissemination of false and/or misleading information can lead to harmful consequences, such as the proliferation of anti-Vax groups on social media (Johnson et al., 2020). Objectively false stories about Covid-19, such as the non-existent link between 5G radiation and Covid-19 symptoms (Jolley & Paterson, 2020) have been identified. Similarly, not completely false, but highly misleading reports have been spread. For example, the US Center for Disease Control (CDC) stated that there is a "plausible causal relationship between the J & J vaccine and a rare and serious adverse event - blood clots, which caused deaths". The CDC went on to explain the likelihood of an adverse event: 'As of 12 July 2021, over 12.8 million doses of the J & J vaccine were given in the United States. CDC and Food and Drug Administration (FDA) have identified 38 confirmed reports of people who got the J&J/Janssen Covid-19 vaccine and later developed (Thrombocytopenia Syndrome). " As of mid-July 2021, there were 38 confirmed cases of vaccine-related thrombosis out of 12.8 million vaccinations. This example explains how the risk of adverse events following COVID-19 vaccination exists but is relatively very small.

Nevertheless, the dissemination of information of this kind can contribute to panic and facilitate the formation of erroneous beliefs about vaccines. Interestingly, distrust and belief in conspiracy theories are linked to psychological factors. Conspiracy beliefs, distrust and misinformation influence

a decrease in vaccine acceptance. According to Chou & Budenz, (2020) these factors could potentially mediate the effect of psychological state on vaccine acceptance by increasing fear of vaccination.

In line with this, a study conducted by Simione et al. (2021) found that people who believe in conspiracy theories also tend not to trust science or medicine. Moreover, scepticism towards science and politicians could lead to the acceptance of conspiracy theory beliefs. This is especially so when a particular group is identified as "responsible" (van Prooijen, 2020). In fact, the scientific evidence on COVID-19 has been contradictory to the extent that it has changed the social representation of scientific knowledge (Provenzi & Barello, 2020).

It has also been seen that people with higher scientific literacy are less likely to believe in conspiracy theories (Yang et al., 2021). It was found that problem-specific knowledge protects people from a negative impact of conspiracy theories on their intention to vaccinate. In relation to this, Yang et al.'s (2021) study aimed at investigating whether: 1) scientific literacy and vaccine knowledge can change the intention to vaccinate against COVID-19; 2) the intention to vaccinate can be negatively affected by conspiracy theories. Interestingly, the study was conducted in China from April 1-8, when many conspiracy theories were spreading; for example, that the virus escaped from a virology laboratory in Wuhan or that the virus was of foreign origin. The results of the study showed that Chinese people were more likely to believe to the theory that SARS-CoV-2 appeared earlier in the US, i.e. the US is more likely to be the source of the virus', rather than in the research institute in Wuhan. These results seem to be in line with the idea Chinese patriotism moderates the perception of conspiracy theories (Luo & Jia, 2021).

Overall, it emerged that belief in conspiracy theories relating to the COVID-19 pandemic did not influence the Chinese public's intention to be vaccinated. The level of vaccine knowledge increased the intention to be

vaccinated, while the level of scientific literacy showed no significant effect. It is evident how the impact of conspiracy theories on human behaviour may differ depending on the cultural environment. Similar results were obtained by Wang & Kim, (2021) in a study conducted in Korea. In this study, the direct and indirect impacts of beliefs in conspiracy theories on vaccination intentions related to COVID-19 was analysed. The results showed that beliefs in conspiracy theories increased COVID-19 preventive actions and vaccination intentions. Again, the results could be explained by the fact that Korea has a strong collectivist culture. As a result, people tend to have a positive orientation towards actions taken by the government (Wang & Kim, 2021).

These results might not be reproduced in countries with different cultural backgrounds (i.e., US, Europe). In collectivist Eastern culture, public welfare is amplified by considering the health of others as well as one's own. In the individualistic Western culture, vaccination and health behaviour depend on individual will and choice (Wang & Kim, 2021).

Contrary to the above studies, hesitation about vaccines is still present in Europe and the USA. In these countries, one of the biggest problems related to vaccination is the so called "infodemic" (Cardenas 2021), which is the development of widespread misinformation and conspiracy theories about COVID-19 and vaccines is. In a study conducted by Kalichman (2021), 2060 Facebook posts that spread misinformation and conspiracy theories were analysed weeks before the US government launched the vaccine development program. The results showed how “anti-vaccine” campaigns confused public health information and hindered the development of COVID-19 vaccines. Specifically, recurring themes were identified by anti-Vax groups, such as 1) "government and pharmaceutical industry communications about COVID-19 are lying to exaggerate the severity of the new virus; 2) "vaccines are tools of government and industry to control, track and harm people". The same was

observed in Europe where "infodemic" in the social media was found to negatively influence the willingness to be vaccinated. Therefore, is clear that governments must seek to limit conspiracy theories and "infodemic" by developing strategic cooperation that harnesses the global response to COVID-19. These elements are crucial to the success of COVID-19 vaccination campaigns and could be implemented through the dissemination of correct information in social media.

Considering the literature reviewed in the previous chapters, the following part of the thesis focuses on the individual aspects characterizing risk perception, social distancing and vaccine hesitancy in the Italian population during the outbreak of COVID-19.

Chapter 4

STUDY 1

Predictors of COVID-19 Risk Perception, Worry and Anxiety in Italy at the End of the 2020 National Lockdown

4.1 Abstract

The present study examined the psychological predictors of four measures assessing the cognitive and emotional reactions to the COVID-19 pandemic in a sample of Italian respondents (N = 497). Using a snowball sampling strategy, an online questionnaire was disseminated through various social media between 29th April and 29th May 2020, that is at the end of the period of national lockdown. Correlational and regression analyses indicated that a) cognitive risk was higher for participants who were younger and had direct experience with the virus; b) affective risk was higher for participants who were female, followed COVID-19-related information closely, and thought that the restrictive measures adopted by the Italian government were not sufficient; c) experienced worry was higher for participants who were female, had higher levels of prosociality and thought that the risks of COVID-19 were exaggerated; and d) state anxiety was higher for participants who were female, younger and had lower levels of prosociality. Taken together, these results support the notion that the cognitive and affective dimensions of risk perception should be analyzed as separate variables and that worry can be regarded as a construct partially independent of anxiety.

4.2 Introduction

At the beginning of 2020, a rapid outbreak of a novel strain of Coronavirus (named SARS-COV-2 by the WHO on the 11th of February 2020) was reported in Wuhan, China (Rocco, 2021), and started spreading all over the world, causing the disease called COVID-19 (WHO, 2020). It reached Italy by the end of January 2020, with the first patient, a 38 years old man, being diagnosed on the 18th of February 2020 (Puliatti et al., 2020). Italy, along with Spain, became epicenters of the infection in Europe (Ruiu, 2020). The Italian government declared a "state of emergency" in February, implementing the first localized restrictions to stop the spread of the virus, which spread rapidly in Northern Italy and down into Central Italy (Ruiu, 2020). Within a few weeks, the World Health Organisation (WHO) classified COVID-19 as a global public health emergency and categorized it as a Global Pandemic on 7 March. In response, Italian Prime Minister Giuseppe Conte instituted a national quarantine starting on the 10th of March 2020 (Lazzerini & Putoto, 2020). Overall, the Italian response to the pandemic has been characterized by two phases. Phase I began on the 10th of March with the total lockdown. During phase I people were allowed to leave home only for "essential" reasons and "non-essential" shops were shut down. Phase II started on the 4th of May 2020, as the government decided to re-open some non-essential shops, with enhanced social distancing measures.

In this context, the present study aimed at a) assessing the risk perceptions and anxiety levels of a subsample of the Italian population during this pivotal historical moment and b) determining what variables can be used to predict them. Regarding the first point, consistent literature indicates that the effectiveness of governmental measures in preventing the spread of novel viruses is strongly influenced by people's behavior (Funk, Gilad, Watkins, & Jansen, 2009; Van Bavel et al., 2020). Health-protective behaviors, such as hand

washing, physical distancing, wearing a face mask, etc. are influenced by subjective perceptions of risk (Bish & Michie, 2010; Poletti, Ajelli, & Merler, 2011; Rubin, Amlôt, Page, & Wessely. 2009; Rudisill, 2013). For example, a large-scale study by de Bruin and Bennett (2020) showed that, in the U.S., the perceived risks of COVID-19 infection and infection fatality were significantly related to the frequency of preventative behaviors. Specifically, people's reports of handwashing and avoiding public spaces or crowds increased from 83% to 94% and from 45% to 67% between the quartile of respondents perceiving the lowest risk for COVID-19 infection and the quartile perceiving the highest risk for COVID-19 infection. Furthermore, the overall levels of COVID-19 infection risk, the frequency of protective behaviors, and their relationship increased among participants who responded later (versus earlier) to the survey. Similar research was recently conducted in Italy (Carlucci, D'Ambrosio, & Balsamo, 2020). The results showed that women, most educated people, residents of Southern Italy, middle-aged individuals, and health workers were more likely to adhere to the quarantine protocols. Most interestingly for the present purposes, people who reported high levels of risk perception and anxiety were more likely to comply with the recommended behaviors. Thus, studying the determinants of risk perceptions and anxiety feelings during respiratory infectious disease epidemics (such as that produced by COVID-19) can inform public communication and interventions aimed at improving adherence to preventative behaviors (Bish & Michie, 2010; Leppin & Aro, 2009; Liao, Cowling, Lam, Ng & Fielding, 2014).

While the associations between psychological states and protective behaviors are well-known among researchers, relatively few studies have attempted to identify the determinants of general risk perceptions. An outstanding exception is an investigation conducted by Dryhurst and colleagues (2020), who assessed public risk perception of COVID-19 in ten countries across Europe, America, and Asia between mid-March and mid-April 2020. The overall levels of risk perception

were fairly high, ranging from 4.78 to 5.45 on a 7-point scale. In the pooled model, most predictors turned out to be significant, including direct personal experience (participants who had, or thought to have, COVID-19 perceived more risk compared to those who had no direct experience with the virus), social amplification (participants who received information on the virus from family and friends perceived more risk compared to those who had not), prosociality (the more people thought that it was important to do things for the benefit of others, the more risk they perceived), individualistic worldview (the more people thought that the government interfered far too much in their everyday lives, the less risk they perceived), personal efficacy (the more people thought that their personal actions were effective in limiting the spread of virus, the more risk they perceived), collective efficacy (the more people thought that the actions taken by their countries were effective in limiting the spread of virus, the less risk they perceived), trust in science and medical practitioners (the more people trusted scientists, medical doctors and nurses, the more risk they perceived), trust in government (the more people trusted their countries' politicians, the less risk they perceived), personal knowledge (the more the people felt they understood the government's strategy to deal with the pandemic, the more risk they perceived), and finally gender (females perceived more risk than males). However, in the Italian subsample ($N = 700$), only direct experience, prosociality, individualistic worldview, and age (the higher the age, the lower the perceived risk) made significant contributions to risk perception.

In the present study, we attempted to replicate and extend the results reported by Dryhurst et al. (2020) in two ways. First, unlike Dryhurst et al. (2020), we chose to consider the cognitive and affective dimensions of risk perception as separate variables. Typically, the cognitive risk is measured by asking participants to rate the perceived likelihood of themselves, their families, and friends catching the virus, whereas affective risk is measured by asking

participants to report the degree to which they are personally concerned about the possibility of being infected (Barr et al., 2008; Carlucci et al., 2020; Liao et al., 2014; Park, Cheong, Son, Kim, & Ha, 2010; Prati, Pietrantoni, & Zani, 2011; Rubin et al., 2009; Yang & Chu, 2018). Our rationale for analyzing these measures as separate variables was based on previous evidence showing that responses to external threats such as the spreading of infectious diseases are based on two different processing systems (Liao et al., 2014; Loewenstein, Weber, Hsee, & Welch, 2001; Slovic, Finucane, Peters, & MacGregor, 2004). The first system is deliberate, slow, and rule-based and therefore reflects the cognitive dimensions of risk perception (risk-as-analysis). The second system is experiential, quick, and intuitive and therefore reflects the affective dimensions of risk perception (risk-as-feeling). Studies conducted during previous infectious disease epidemics (the 2009 H1N1 swine flu pandemic, the Ebola outbreak, and the SARS and Avian influenza epidemics) suggest that the adoption of protective behaviors is more strongly predicted by affective than by cognitive measures of risk (Leung et al., 2005; Liao et al., 2014; Karademas, Bati, Karkania, Georgiou, & Sofokleous, 2013). We, therefore, expected that cognitive and affective measures of risk perception should be related to different predictors. Secondly, to further understand participants' emotional response to the COVID-19 pandemic, we assessed their experienced worry and state anxiety. The inclusion of these variables was justified by prior research showing that anxiety and worry measures were differentially related to behavioral indices. Specifically, Liao et al. (2014) reported that "anticipated worry", "experienced worry" and "current worry" specific to H1N1 risk predicted the frequency of protective behaviors, whereas state anxiety made no significant contribution. These results are consistent with theoretical positions suggesting that worry and anxiety are two different facets of emotional processing (Borkovec, Ray & Stober, 1998; Gana, Martin, & Canouet, 2001; Zebb

& Beck, 1998). We thus expected that the predictors of state anxiety should be at least partially different from the predictors of risk and worry measures.

4.3 Method

Participants

The sample included a total of 497 Italian-speaking participants, of which 187 males (37.6%) and 308 females (62.0%) – two participants did not report their gender. Regarding age, 196 (39.4%) participants were between 18-24 years, 158 (31.8%) were between 25-34 years, 41 (8.2%) were between 35-44 years, 53 (10.5%) were between 45-54 years, and 50 (10.1%) were between 55-59 years. Educational levels were distributed as follows: 10 (2.0%) participants had a primary school certificate, 204 (41.0%) had a high school diploma, 111 (22.3%) had a Bachelor's degree, 110 (22.1%) had a Master's degree and 62 (12.5%) had a postgraduate degree. Marital status was 363 (73.0%) unmarried, 102 (20.5%) married, 20 (4.0%) divorced and 10 (2.0%) widowed (2 participants did not report their status). Finally, regarding residence, 403 participants (81.1%) lived in Central Italy (mostly in Rome: N = 335), 54 (10.9%) lived in North Italy and 39 (8.0%) lived in South Italy.

The sample size was adequate according to current methodological standards. This was verified in two ways. First, a widely-accepted rule of thumb is that, for regression equations using six or more predictors, an absolute minimum of 10 participants per predictor variable is appropriate (Tabachnick, Fidell, & Ullman, 2007). However, to have sufficient power to detect even small effect sizes, approximately 30 participants per predictor are required (VanVoorhis & Morgan, 2007). Since our study included a maximum of 13 potential predictors (3 demographic and 10 psychological variables), these rules

dictated a total of 130 and 390 participants, respectively – two sample sizes which are lower than that actually recruited. Second, we computed an a-priori analysis of the required sample size using the software G*Power3 (Faul, Erdfelder, Buchner, & Lang, 2009). The to-be-detected R^2 was estimated from the study by Dryhurst et al. (2020), who used many of the predictors included in the current study (0.199 for Italy). With N = 497 and 13 predictors, the results showed that we needed a sample size of N = 161 to achieve a power of .95 in a test based on α = 0.05.

Procedure

The questionnaire was prepared using Google Forms and disseminated through different social media (e.g., Facebook, Instagram, Twitter, etc.), in line with the Italian government's recommendations on limiting face-to-face interactions. All data were collected between 29th April 2020 and 29th May 2020, that is between the end of Phase I and the beginning of Phase II. We used a snowball sampling strategy: the links were initially shared with a sample of university students who were encouraged to pass them on to others, with a focus on recruiting the general public. The present study adhered to the recommended standards for conducting and reporting web-based surveys – i.e., the Checklist for Reporting Results of Internet E-surveys (CHERRIES – Eysenbach, 2012). In particular, the questionnaire was open to each visitor of the site, was advertised as research aimed at studying the relation between perceived risk and anxiety during the COVID-19 pandemic, participation was voluntary and no financial incentive was offered. Finally, the research was approved by the IRB of the Department of Psychology, Sapienza University of Rome (Protocol #0000658) and all respondents signed an informed consent before participating.

Instruments and measures

Criterion variables

Cognitive risk. Cognitive risk was measured with a single item: "What do you think is the possibility that you or someone in your home will contract Coronavirus / COVID-19?". Participants responded on a five-point scale, ranging from "very low" (1) to "very high" (5).

Affective risk. Affective risk was measured with a single item: (a) "How concerned are you about the risk that you or someone in your household may contract Coronavirus/COVID-19?". Participants responded on a five-point scale, ranging from "not concerned at all" (1) to "very concerned" (5).

Experienced worry. Experienced worry was measured with three items: (a) "Thinking back, how worried were you about Coronavirus/COVID-19 1 week ago?", (b) "Thinking back, how worried were you about Coronavirus/COVID-19 1 month ago?", and (c) "Thinking back, how worried were you about Coronavirus/COVID-19 2 months ago?". Participants responded on a five-point scale, ranging from "not worried at all" (1) to "very worried" (5). For each participant, we computed the overall mean of the three questions (Cronbach's alpha was acceptable: $\alpha = 0.63$).

State-Trait Anxiety Inventory. The Spielberger State-Trait Anxiety Inventory (STAI: Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983) is a self-report 40-item instrument, measuring respectively transient and enduring levels of anxiety. For the purposes of the present study, we used only the 20 items assessing state anxiety (STAI-S), since we were interested in measuring this variable during the specific period of the COVID-19 outbreak. The 20 items were divided into two groups: ten items recorded the presence of anxiety symptoms

(e.g., "I feel frightened"), whereas the other ten items recorded the absence of anxiety symptoms (e.g., "I feel calm"; reverse coded). For each item, participants responded on a four-point scale going from "not at all" (1) to "very much" (4). Thus, sum scores ranged between 20 and 80. A cut-off point of 39–40 has been generally suggested to detect clinically significant symptoms of anxiety (e.g., Knight, Waal-Manning, Spears, 1983). However, in the present study we did not exclude participants having scores higher than the cut-off point, because the available studies suggested that high levels of anxiety were to be expected during the COVID-19 pandemic. For example, Maaravi and Heller (2020) reported that the mean STAI score in a sample of 407 adults from the United Kingdom was 52.18 (SD = 12.09). Similarly, Lin, Hu, Alias and Wong (2020) found that, in a sample of 2446 residents of mainland China, the mean score of the STAI-S was 48.7 (SD = 10.8) and 78.3% of the participants showed high levels of anxiety (as defined by a score of 40 or higher). In the present study, Cronbach's alpha was excellent (α = 0.94).

Psychological predictors

Information. The participants' level of attention towards Coronavirus information was measured with a single item: "How closely would you say you are following the news about Coronavirus/COVID-19". Responses were given on a four-point scale going from "not at all" (1) to "very closely" (4).

Personal experience. Personal experience with Coronavirus was examined with a single item: "Have you ever had, or thought you might have, the Coronavirus/COVID-19?". Participant had three response options: "I think I might have COVID-19 at the moment, but I have not been tested", "I thought I might have COVID-19, but I have been tested as negative", and "No". Following

Dryhurst et al. (2020), this item was dichotomized by considering the first two options as "yes" responses (1) and the last option as a "no" response (0).

Prosociality. Prosociality was investigated with a single item to maintain more similarity with the model developed by Dryhurst et al., 2020: "To what extent do you think it's important to do things for the benefit of others and society even if they have some costs to you personally?". Participants responded on a five-point scale going from "not at all" (1) to "very much so" (5).

Personal understanding. Personal knowledge was investigated with a single item (Dryhurst et al., 2020): "How much do you feel you understand the government's strategy to deal with the coronavirus/COVID- 19 pandemic?". Participants responded on a five-point scale going from "not at all" (1) to "very much" (5).

Trust in government. Trust in government was measured with two items: (a) "I trust the government to protect us from COVID-19", and (b) "The actions taken by the government to counter Coronavirus are adequate". Participants responded on a five-point agreement Likert scale going from "strongly disagree" (1) to "strongly agree" (5). For each participant, we computed the mean of the two responses. Cronbach's alpha was good ($\alpha = 0.76$).

Trust in science. Trust in science and medical professionals was assessed with two items: (a) "How much do you trust the country's national scientific and medical advisors to know the best measures to take in the face of the pandemic?", and (b) "How much do you trust the World Health Organization to know the best measures to take in the face of the pandemic?". Participants responded on a five-point scale going from "not at all" (1) to "very much" (5). For each participant, scores in the two items were averaged. Cronbach's alpha was good ($\alpha = 0.84$).

Collective efficacy. Collective efficacy was assessed with two items: (a) "How effective do you think the official response has been up until now in dealing with the pandemic?", and (b) "To what extent do you feel the actions that your country is taking to limit the spread of coronavirus make a difference?". Participants responded on a five-point scale going from "not at all" (1) to "very much" (5). For each participant, we computed the mean score across the two items. Cronbach's alpha was good ($\alpha = 0.85$).

Social amplification. Social amplification was assessed with a single item having nine response options. The general question was: "What are the sources that you consult to get information about the Coronavirus / COVID19?". Participants responded by ticking the following options: "newscasts", "your employer", "official websites of the Ministry of Health", "social media, blogs and online forums", "online newspapers", "Civil Protection bulletin", "your general practitioner or other physicians", "family and friends", and "World Health Organization". We computed, for each participant, the total number of options selected.

Attitude towards restrictive measures. Individual perceptions about the use of restrictions by the government were examined with three items. The general question was "What do you think of the actions taken by the government in response to the Coronavirus / COVID19?", followed by three items: "I think the response in the past few weeks was...", "I think the planned response in the next few weeks is..." and "I think the planned response for the next few months is...". Participants responded on a five-point scale going from "not firm enough with restrictions on people" (1) to "Putting too many restrictions on people" (5). Scores in the three items were averaged. Cronbach's alpha was good ($\alpha = 0.82$).

Risk overestimation. The idea that the risks associated with the Coronavirus were overestimated was investigated with a single item: "Do you think that the risks on Coronavirus have been greatly magnified?". Responses were given on a five-point agreement Likert scale going from "strongly disagree" (1) to "strongly agree" (5).

4.4 Results

Table 3 reports descriptive statistics for the measures examined in the present study, including asymmetry and kurtosis. According to Mallery and George (2010), values for asymmetry and kurtosis between −2 and +2 are considered acceptable in order to prove normal univariate distribution. As can be noted, our variables satisfied these constraints, with the exception of "personal experience" and "prosociality". For these variables, statistical analyses were performed with both parametric and non-parametric tests: since the conclusions were comparable, only the former results will be reported in the following sections.

Table 3. Descriptive statistics for the variables measured in the present study

Measures	*M*	*SD*	Min	Max	Asym	Kurt
Cognitive Risk	2.52	0.85	1.00	5.00	0.01	0.00
Affective risk	3.02	0.99	1.00	5.00	−0.01	−0.25
Experienced worry	3.01	0.95	1.00	5.00	0.06	−0.61
Anxiety	46.48	11.20	20.00	77.00	0.24	−0.50
Information	3.37	0.63	1.00	4.00	−0.53	−0.38
Personal experience	0.14	0.35	0.00	1.00	2.03	2.14
Prosociality	4.57	0.72	1.00	5.00	−1.72	2.78
Personal understanding	3.28	1.12	1.00	5.00	−0.55	−0.33
Trust in government	2.71	0.98	1.00	5.00	−0.12	−0.71

Trust in science	3.57	1.05	1.00	5.00	−0.55	−0.37
Collective efficacy	3.35	1.01	1.00	5.00	−0.48	−0.34
Social amplification	2.92	1.23	1.00	8.00	0.70	1.38
Attitude toward restrictions	2.83	0.93	1.00	5.00	0.19	−0.09
Risk overestimation	2.34	1.05	1.00	5.00	0.48	−0.27

Note. Asym: asymmetry; Kurt: kurtosis.

As a first step, we examined the impact of demographic variables (gender, age, and education) on cognitive risk, affective risk, experienced worry and state anxiety. We used a) *t*-tests for independent samples for examining differences between males and females, and b) one-way ANOVAs for examining the differences between age and educational groups. For gender, a series of *t*-tests showed that females ($M = 3.28$) were more affectively concerned with the risks of Coronavirus, as compared to males ($M = 2.84$), $t(493) = -3.89$, $p < 0.001$. In addition, females scored higher than males on both experienced worry ($M = 3.14$ vs. $M = 2.81$, $t(493) = -3.81$, $p < 0.001$) and state anxiety ($M = 48.27$ vs. $M = 43.67$, $t(493) = -4.59$, $p < 0.001$). On the other hand, cognitive risk scores did not differ between females and males ($M = 2.50$ vs. $M = 2.55$, $t(493) = 0.59$, $p = 0.55$). For age, a series of one-way ANOVAs revealed no significant difference between the five age groups – $F(4, 492) = 1.12$, $p = 0.33$ for cognitive risk, $F(4, 492) = 0.15$, $p = 0.96$ for affective risk, $F(4, 492) = 0.61$, $p = 0.65$ for experienced worry, and $F(4, 492) = 1.86$, $p = 0.12$ for state anxiety. Finally, for education, the one-way ANOVAs revealed no differences for cognitive risk, $F(4, 492) = 0.29$, $p = 0.88$, affective risk, $F(4, 492) = 0.30$, $p = 0.87$, and experienced worry, $F(4, 492) = 0.81$, $p = 0.51$. There was however a significant difference for state anxiety, $F(4, 492) = 3.29$, $p = 0.011$. Post-hoc comparisons with the Bonferroni adjustment showed that participants having a postgraduate degree ($M = 42.24$) were less anxious than participants

having a high school diploma (M = 46.79, p = 0.044) or a Bachelor's degree (M = 47.36, p = 0.034).

As a second step, we computed Pearson's correlations between the psychological predictors and the four criterion variables. Table 4 shows the results. Cognitive risk was a) positively associated with personal experience (r = 0.12, p = 0.010), suggesting that participants who had, or thought to have, the Coronavirus/COVID-19 perceived a higher personal probability of contracting the virus, and b) negatively correlated with collective efficacy (r = −0.09, p = 0.051) and trust in government (r = −0.08, p = 0.070), suggesting that participants who had confidence in politicians and felt that the official response of Italy was effective in limiting the infection perceived a lower probability of catching the virus. On the other hand, affective risk was positively associated with information (r = 0.12, p = 0.009) but negatively associated with attitude towards restrictive measures (r = −0.16, p < 0.001). Thus, participants who paid more attention to Covid-19 information and thought that the Italian government was not firm enough with imposing restrictions on people were more strongly concerned with the risk of contracting the virus.

Regarding experienced worry and state anxiety, we found that worry was positively correlated with information (r = 0.16, p = 0.001), prosociality (r = 0.15, p = 0.001), trust in science (r = 0.09, p = 0.042) and overestimation (r = 0.09, p = 0.051), but negatively correlated with attitude towards restrictive measures (r = −0.12, p = 0.007) and social amplification (r = −0.08, p = 0.061). These results suggest that worry was higher for participants who paid much attention to Covid-19 information, were highly prosocial, trusted scientists, agreed with the idea that the impact of the disease was overestimated, thought that the restrictions adopted by the Italian government were not firm enough, and got information about the virus from a low number of sources. For anxiety, our analyses revealed significant negative correlations with prosociality, personal knowledge, trust in

government, trust in science and collective efficacy. Thus, anxiety was lower in participants who were high in prosociality, had a good understanding of the government's strategy, trusted politicians, scientists and medical advisors, and thought that the official responses adopted in Italy were adequate to counter Coronavirus. Table 4 (bottom) shows also the correlations between the four criterion variables. Not surprisingly, we found that cognitive and affective risk were positively related to each other ($r = 0.46$, $p < 0.001$), as they were experienced worry and state anxiety ($r = 0.21$, $p < 0.001$). However, while affective risk was strongly associated with experienced worry ($r = 0.32$, $p < 0.001$) and state anxiety ($r = 0.35$, $p < 0.001$), the same correlations were much more reduced for cognitive risk ($r = 0.08$, $p = 0.083$ with experienced worry and $r = 0.14$, $p = 0.002$ with state anxiety).

Table 4. Pearson's correlations between psychological predictors and the four criterion variables. Significant correlations ($p \leq 0.05$) are shown in bold.

Measures	CR	AR	EW	ANX
1. Information	0.07	**0.12**	**0.16**	0.06
2. Personal experience	**0.12**	−0.01	0.08	0.02
3. Prosociality	−0.01	0.06	**0.14**	**−0.15**
4. Personal understanding	−0.06	−0.05	0.07	**−0.14**
5. Trust in government	−0.08	−0.06	0.06	**−0.16**
6. Trust in science	0.03	0.04	**0.09**	**−0.12**
7. Collective efficacy	**−0.09**	−0.05	0.07	**−0.17**
8. Social amplification	0.07	−0.06	−0.08	−0.01
9. Attitude toward restrictions	−0.00	**−0.16**	**−0.12**	−0.06
10. Risk overestimation	0.03	0.04	**0.09**	0.04

11. Cognitive risk	1.00			
12. Affective risk	**0.46**	1.00		
13. Experienced worry	0.08	**0.32**	1.00	
14. State anxiety	**0.14**	**0.35**	**0.21**	1.00

Note. CR: cognitive risk; AR: affective risk; EW: experienced worry; ANX: anxiety

In the third step we performed a series of simultaneous regression analyses to determine which variables predicted cognitive risk, affective risk, experienced worry and state anxiety. In both cases, demographic variables (gender, age and education) were included in the first step, followed by the predictors that showed significant correlations in the former analyses. Gender was coded as a dichotomous variable (1 = male, 2 = female), whereas age and education were coded as ordinal variables (for age: 1 = 18-24 years; 2 = 25-34 years; 3 = 35-44 years; 4 = 45-54 years; 5 = 55-59 years; for education: 1 = primary school certificate; 2 = high school diploma; 3 = Bachelor's degree; 4 = Master's degree; 5 = postgraduate degree). Table 5 illustrates the results. As can be noted, cognitive risk was negatively predicted by age and positively predicted by personal experience; affective risk was positively predicted by gender and information, but negatively predicted by attitude towards restrictive measures; experienced worry was positively predicted by gender, information, prosociality and overestimation; finally, state anxiety was positively predicted by gender and negatively predicted by age and prosociality.

Table 5. Hierarchical regressions predicting risk perception and anxiety.

Criterion		*Predictors*	*β*	*t*	R^2	*F Change*
Cognitive risk	Step 1	Gender	−0.01	−0.30	0.01	F = 1.13
		Age	−0.10	**−2.03***		
		Education	0.03	0.69		
	Step 2	Personal experience	0.12	**2.71****	0.03	F = 5.75**
		Collective efficacy	−0.09	−1.88		
Affective risk	Step 1	Gender	0.16	**3.61****	0.03	F = 5.32**
		Age	−0.03	−0.65		
		Education	−0.03	−0.68		
	Step 2	Information	0.12	**2.89****	0.07	F = 9.30**
		Attitude toward restrictions	−0.14	**−3.21****		
Experienced worry	Step 1	Gender	0.16	**3.50****	0.03	F = 5.12**
		Age	−0.00	−0.02		
		Education	0.01	0.28		
	Step 2	Information	0.15	**3.35****	0.09	F = 6.12**
		Prosociality	0.10	**2.23***		
		Trust in science	0.07	1.57		
		Use of restrictions	−0.07	−1.62		
		Risk overestimation	0.09	**2.12***		
State anxiety	Step 1	Gender	0.24	5.49**	0.06	F = 10.76**
		Age	−0.13	**−2.74****		
		Education	−0.06	−1.39		
	Step 2	Prosociality	−0.14	**−3.15****	0.12	F = 6.92**
		Personal understanding	−0.02	−0.42		
		Trust in government	−0.06	−1.03		
		Trust in science	−0.03	−0.52		
		Collective efficacy	−0.10	−1.48		

Note. *: $p \leq 0.05$; **: $p \leq 0.01$.

4.5 Discussion

The present study examined the psychological predictors of four measures assessing different aspects of COVID-19 risk perception in a sample of 497 Italian respondents at the end of the I phase of national lockdown (between April and May 2020). Our study differed from those previously published (e.g., Dryhurst et al., 2020) for two primary reasons. First, separate analyses were performed for the cognitive and affective measures of risk perception, expecting that they should be associated with different sets of predictors (Leung et al., 2005; Liao et al., 2014; Karademas et al., 2013). Second, to provide a better understanding of the emotional consequences of the pandemic, measures of experienced worry and state anxiety were also included in the survey. Based on previous evidence (Liao et al., 2014) and the hypothesis that worry and anxiety should be regarded as two different facets of emotional processing (Borkovec, Ray & Stober, 1998; Gana, Martin, & Canouet, 2001; Zebb & Beck, 1998), we expected to find a partial dissociation in the way in which psychological predictors related to these constructs.

Regarding the first point, our analyses confirmed that, although the cognitive and affective dimensions of risk perception were moderately related to each other[1], they were predicted by different variables. Cognitive risk was negatively associated with age, and positively associated with direct experience; in contrast, affective risk was positively associated with gender and information, but negatively associated with attitudes towards restrictive measures. The finding that cognitive risk estimates decreased in older adults is consistent with the results reported by de Bruin and Bennett (2020), who found that the perceived risk of COVID-19 infection was lower in at-risk (> 65 years) than in not-at-risk (< 65 years) participants, and by Dryhurst et al. (2020), who showed that age was a significant negative predictor of COVID-19 risk perception in the Italian model

(although age did not play a significant role in the pooled model across all countries). Furthermore, Ceccato et al. (2020) have recently conducted an online survey comparing self-reported emotions and attitudes toward the COVID-19 emergency in a sample of Italian young (18–29 years), middle-aged (30–50 years), and older (65–85 years) adults. They found that older adults reported lower scores on the negative affect scale and were less worried about infection than both young and middle adults – a conclusion that is in line with our finding that state anxiety was negatively predicted by age. Taken together, these data can be explained by the Socioemotional Selectivity Theory (Carstensen, Fung, & Charles, 2003), which states that older people are more present-focused, have selective attention to positive stimuli, and tend to avoid negative emotions: thus, they are expected to have a more positive approach towards the pandemic. In this respect, it seems worth noting that none of our participants was older than 60 years: thus, it appears that the negative relation between age and cognitive risk perception holds even when the distribution is restricted to young and middle-aged adults. Adolescents younger than 18 were also excluded from the present sample, potentially affecting our results. A study by Commodari and La Rosa (2020) reported that perceived risk, perceived susceptibility, and perceived seriousness of COVID-19 were all very low in a sample of 978 Italian adolescents. However, other studies found different results, showing that substantial fear of COVID-19 was reported by 85.4% of the females and 63.5% of the males of a sample of 2996 students of secondary and high schools living in 13 different Italian Regions (Esposito et al., 2022).

The positive association of cognitive risk with direct experience is also in line with the conclusions drawn by Dryhurst et al. (2020) since this variable was among the most important predictors of risk perception in both the Italian and the pooled models. The authors proposed that having had direct contact with the virus engaged the affective experiential system, which is known to dominate risk

processing during emergency situations (Loewenstein, Weber, Hsee, & Welch, 2001; Leiserowitz, 2006; Slovic, Finucane, Peters, & MacGregor, 2004; van der Linden 2014, 2015; Weber 2006). This account predicts, however, that direct experience should be more strongly related to the affective than to the cognitive dimension of risk perception, whereas we found a positive association only with cognitive risk (no significant relation was observed with affective risk). Such a discrepancy might be accounted for by the observation that about 89% of our participants came from Central and Southern Italy, in which the spread of the virus was quite limited at the time in which the survey was conducted (during the first wave of the infection, the region most strongly affected was Lombardy, in Northern Italy). The pandemic situation may not have been concrete and close enough to these individuals to observe a direct relation between experience and affective risk. This hypothesis is supported by the results of a recent survey, in which participants from Central and Southern Italy judged themselves less likely than participants from Northern Italy to be at risk of infection when the first cases were discovered in Italy (Simione & Gnagnarella, 2010).

On the other hand, affective risk was positively predicted by gender, such that women were more strongly concerned than men about the possibility of catching the virus. This finding has now been replicated several times, in relation to both the COVID-19 pandemic (Dryhurst et al., 2020; Gerhold, 2020) and past healthy emergencies (Leung et al., 2003, 2005; Rubin et al., 2009). Simione and Gnagnarella (2020), for example, investigated the perception of risk and the worries about COVID-19 infection in both healthcare workers and the general population in Italy. The results showed that women perceived a higher risk of being infected, compared with men; furthermore, they were more likely than men to report that risky behavior should be punished more severely, that containment measures should be strengthened, and that it would be right to limit people's freedom in this situation. In the present study, gender was also

associated with experienced worry and anxiety, such that women were more worried and anxious than men. In agreement, Pieh, Budimir and Probst (2020) examined mental health during COVID-19 lockdown in Austria and found that women were more burdened than men with anxiety and depressive symptoms. Although in the present study female participants were not asked to indicate their pregnancy status, there is evidence indicating that pregnant women suffered a substantial decrease in health-related quality of life (Bivià-Roig et al., 2020) and showed high levels of post-natal depression and anxiety during the COVID-19 outbreak (Hessami, Romanelli, Chiurazzi and Cozzolino (2020). Thus, specific psychotherapeutic interventions should be developed to guarantee the mental health of pregnant women. In addition, women were also more likely to exhibit significant links between COVID-19-related perceived threat and psychological distress with drinking behavior. Specifically, Rodriguez, Litt and Stewart (2020) reported that psychological distress related to the COVID-19 pandemic was consistently related to the number of drinks consumed during the recent heaviest drinking occasion and the number of drinks consumed on a typical evening by women, but not by men. In this respect, it is interesting to note that several studies found an increase in alcohol consumption and the number of hours spent on the internet and smartphones during the lockdown period (e.g.,Rodriguez et al., 2020); furthermore, participants who reported excessive internet use during the lockdown had higher scores for traumatic stress and dissociation (La Rosa, Gori, Faraci, Vicario & Craparo, 2021).

In addition to gender, affective risk was also predicted by information, suggesting that participants who attended COVID-19-related information more closely were significantly more concerned about the risk of contracting the virus. In addition, they reported higher levels of experienced worry. Comparable results have been obtained by Nekliudov et al. (2020) through a cross-sectional survey of a large Russian population (examined in the period between the 6th

and 15th April 2020). Their analyses showed that time spent following news about COVID-19 was correlated with higher anxiety scores in the STAI. In a similar vein, Lanciano et al. (2020) found that news seeking was associated with a higher frequency of negative affective states, as well as with anxiety and uncertainty feelings in a survey of 980 Italian respondents conducted in the middle of Phase I of the Italian lockdown. Turning to the attitude towards restrictive measures, we found that participants who felt that the measures adopted in Italy were not firm enough were more likely to report high levels of affective concern and experienced worry. The same conclusion has been drawn by Mækelæ et al. (2020) in a study aimed at assessing the perceived efficacy of a range of restrictions during the early phase of the outbreak in Brazil, Colombia, Germany, Israel, Norway, and the USA. Their results converged in showing that participants who believed that their country reacted too mildly perceived a higher risk of contracting COVID-19, were more worried and expressed reduced beliefs in the ability of their governments to control the outbreak.

A second aim of our study was to determine whether experienced worry and anxiety were predicted by different variables. According to previous studies, worry can be viewed as a construct separate from anxiety and depression (Gana et al., 2001; Meyer, Miller, Metzger, Borkovec, 1990; Stöber & Joorman, 2001). In particular, worry is related to adaptive, problem-focused coping strategies and an information-seeking cognitive style, whereas anxiety is typically associated with poor psychological outcomes (i.e., poor problem-solving confidence, poor perceived personal control, avoidance coping strategies, etc.) (Davey, Hampton, Farrell, & Davidson, 1992; Davey, 1994). In line with this characterization, our data indicate that prosociality was differentially linked with experienced worry (positive relation) and state anxiety (negative relation). The negative association between prosociality and anxiety might be explained by the assumption that participants who are high in prosociality are also more confident about other

people's compliance with containment measures. Kanovsky and Halamová (2020) reported that participants with higher levels of confidence in others' behaviors perceived the spread of COVID-19 to be less threatening, both cognitively (less perceived likelihood of contraction) and affectively (less fear of contraction). On the other hand, the positive association between prosociality and experienced worry is similar to that found by Dryhurst et al. (2020) and may be attributed to cognitive appraisal processes (Lanciano et al., 2020). That is, highly prosocial participants might be more likely to recognize the existence of an objective risk and its impact on their own and others' lives. This appraisal may in turn sustain continuous feelings of worry, as this construct has been regarded as an affective dampening strategy motivated by avoidance of distressing cognitions and associated negative emotions (Stapinski, Abbott, & Rapee, 2010). In addition to prosociality, the experienced worry was also positively predicted by the perceived overestimation of COVID-19 risks, suggesting that participants who thought that the risks associated with the spreading of the virus were exaggerated reported higher levels of subjective worry. A potential explanation might be that those participants were also more likely to use suppression strategies when dealing with the negative emotions triggered by the pandemic (compared to participants who thought that COVID-19 risks were not overestimated). In a recent study by Petzold et al. (2020), participants who agreed with the item "My anxiety concerning coronavirus is exaggerated" were found to use emotional suppression strategies to a greater extent. Our findings would be therefore in line with the afore mentioned idea that anticipatory worry could serve as a strategy to avoid negative emotional states (Stapinski et al., 2010).

Two additional points should be noted. First, correlational analyses indicated that cognitive variables (related to a personal understanding of the government's strategy) and socio-cultural variables (related to trust in government, trust in science, and collective efficacy) were negatively associated

with anxiety, although these relations did not explain significant portions of variance in the following regression analyses. Dryhurst et al. (2020) have similarly reported that trust in government and collective efficacy were negative predictors of perceived risk. However, for personal understanding and trust in science, the associations reported by Dryhurst et al. (2020) were positive, not negative, perhaps due to the use of different dependent variables (our correlations were focused on anxiety, rather than on risk perception). Second, we found that both experienced worry and state anxiety were strongly related to affective risk (and less strongly related to cognitive risk). While these correlations were not the primary focus of our research, it seems important to mention that transient mood alterations can have a significant impact on individuals' perceptions of the health risks associated with COVID-19 (Dratva et al., 2020; Malesza & Kaczmarek, 2021; Rubaltelli, Tedaldi, Orabona, & Scrimin, 2020). In agreement, Lanciano et al. (2020) showed that anxiety increased health, interpersonal and psychological risks connected to COVID-19.

4.6 Limitation and future directions

The present study has several limitations that must be acknowledged. Our convenience sample was not representative of the general Italian population in terms of gender, age, and geographical distribution. We had almost twice as many female respondents as male respondents, no respondents aged 65 or over, and most participants came from central Italy. These problems might have potentially affected our results, although we previously noted that the gender- and age-related differences in risk perception were largely consistent with the conclusions of previous studies. We used a cross-sectional design with all data collected within a restricted period of time; the absence of a follow-up did not allow us to examine the causal relationships between the psychological

predictors and the four criterion measures assessing risk perception (cognitive and affective), worry, and anxiety. Many of our variables were assessed through single (rather than multiple) questions and therefore might have limited validity. Furthermore, we only examined state anxiety, defined as a temporary reaction to adverse events: additional data are needed to determine whether the present results apply to trait anxiety, defined as a stable personality disposition to respond with concerns, troubles, and worries to various situations.

That said, we believe that our study contributes to a better understanding of the determinants of risk perception in the Italian population during the transition from Phase I to Phase II. We showed that, although the cognitive and affective reactions to the COVID-19 pandemic were moderately correlated to each other, they were nonetheless predicted by different variables. A clear comprehension of the psychological processes involved in these reactions may be crucial to inform both the politicians' decisions and the organization of advertising campaigns aimed at promoting preventive behaviors (Bish & Michie, 2010; de Bruin & Bennett, 2020; Carlucci et al., 2020; Poletti et al., 2011; Rubin et al., 2009; Rudisill, 2013).

Chapter 5

STUDY 2

The Psychological and Cognitive Predictors of Adherence to Social Distancing Behaviour: data from an Italian Sample

5.1 Abstract

Social distancing is one of the most recommended policies to reduce the diffusion of the COVID-19 pandemic. The present study aims at determining the roles of several psychological variables in predicting social distancing compliance in Italy. Non-compliance behaviours partly reflect people's concerns about the intrinsic costs of social distancing, compared to its public health benefits. The data was collected from 373 Italian speaking participants between March and August 2021, using an internet-based survey. The results showed that the decision to follow the norm of social distancing in prioritizing the benefits to society over personal costs positively correlates with emotional intelligence and extroversion, but negatively with age. Also, our results show that higher scores in social distancing compliance are associated with a higher risk perception of COVID-19. In addition, we didn't find any relationship between working memory capacity and social distancing compliance. We found that participants' adherence to social distancing at late stages of the pandemic could be predicted by individual differences in anxiety levels, partly due to greater awareness of the costs versus benefits of social distancing among individuals with high anxiety. Further studies are needed to better understand the characteristics of individuals

who choose to practice social distancing, as this is critical for the development of public service campaigns to promote behaviours during possible future pandemics

5.2 Introduction

Over the past two years, COVID-19 rapidly spread across the globe. At the time we are writing, more than 5,000,000 people have lost their lives (*COVID-19 Data in Motion - John Hopkins University*). A key aspect of public health epidemiology is how individual and community actions can help mitigate and manage the costs of an epidemic. Limiting close human interactions is an effective measure to contain transmission (Chinazzi et al., 2020), as everyone can reduce their rate of contact with other people, which can in turn reduce disease transmission (W. Xie et al., 2020).

However, it has been seen that, during the initial phase of the COVID-19 pandemic, social distancing remained a voluntary behaviour to which the population did not always respond accordingly (Betsch, 2020). Thus, informed decision weighting benefits over costs is a critical mental process underlying social-distancing compliance (Reluga, 2010).

A key factor seems to be the perception of health risk, which can significantly influence self-protective behaviours (Dionne et al., 2018; Lin & Lagoe, 2013). According to Xie et al. (2020), increased risk perception motivates people to comply with social distancing, during COVID-19 pandemic. Yuan et al. (2021) collected data from 1064 Chinese residents in January 2021. The results showed that public guidance from the government and the media on social distancing can foster better public perception of risk. Furthermore, risk perception was found to have a mediating effect in the relationship between public guidance and obedience to social distancing behaviour.

Being social distancing a key preventive behaviour during pandemic outbreaks, understanding the individual factors underlying is necessary to increase adherence to the norm. According to Christner et al. (2020) social distancing can be conceptualized according to two approaches: 1) egoistic, (i.e., fear of infection or fear of punishment are motivations for norm adherence in individuals) (Harper et al., 2020). In other words, fear of infection drives social distancing behaviours. 2) prosocial, (i.e., a form of other-oriented behaviour that aims at the well-being of others) (Jordan et al., 2021).

For example, Cristhner et al. (2020) observed how factors such as moral judgement, moral identity and empathy for loved ones were positively correlated with adherence to social distancing norms. In relation to this, Pfattheicher et al. (2020) showed that inducing empathy for people most vulnerable to the virus promotes the motivation to adhere to physical distancing.

Overall, these data suggest that understanding the factors that determine and promote the analysis and study of social distancing represents an enduring mission for psychological research. The present study sought to contribute to this field by investigating the psychological and cognitive factors underlying the adherence to social distancing. The study was conducted in Italy in the period between March and August 2021 – that is, shortly after the beginning of the vaccination campaign.

The aims of this work are:

1) Understanding which psychological predictors influence the benefits-costs evaluation of social distancing. In a previous study by Xie et al. (2020), conducted during the early days of the United federal government's declaration of national emergency due to the COVID-19 pandemic, results showed that weighting benefits over costs mediates the relationship between Working Memory (WM)

and social-distancing compliance. In our study we used two different working memory tasks and we expected to replicate and expand Xie and colleagues' findings. We were also interested in understanding whether other psychological factors would influence the weight of benefits on the costs of social distancing (i.e., emotional intelligence, personality traits).

2) Determining the role of different psychological variables in predicting risk perception of COVID-19 and investigating whether there is an association between risk perception and compliance. Following a theoretical framework originally applied to the study of risk perception and prosociality (Van der Linden, 2015), several psychological predictors were selected to assess the cognitive dimension of risk perception. Previous research has provided evidence supporting the involvement of risk perception in predicting adherence to social distancing (e.g., K. Xie et al., 2020; Koetke et al., 2021; Adiyoso & Wilopo, 2021; Yuan et al., 2021). Thus, it is evident how perceptions of health risk can significantly influence self-protective behaviours (Dionne et al., 2018; Lin & Lagoe, 2013).

3) Identifying psychological and cognitive predictors of social distancing compliance. Recent research has shown that the level of depression may contribute to greater commitment to social distancing norms (Marot et al., 2021). In our study we wanted to consider anxiety as a possible predictor of adherence to social distancing. This is because anxiety can be conceptualised as a means of amplifying the perception of danger by inducing protective behaviours (Oosterhoff et al., 2020). Our hypothesis is that a level of anxiety might facilitate one's ability to perform benefits-costs analyses of social distancing practice, which subsequently facilitates compliance with social distancing. Thus, participants' understanding of the benefits versus costs of social distancing

mediates the relationship between level of anxiety and compliance with social distancing.

In order to investigate these aims, we performed two studies: one taking into account the psychological predictors that can modulate the influence the weight of benefits on the costs of social distancing and risk perception, the other one taking into account to identify psychological and cognitive predictors of compliance with social distancing.

Given the recent emphasis in enhancing social distancing compliance from Italian Government, we expected that the present study would provide a better understanding of the cognitive and psychological individual predictors of adherence to social distancing behaviours in Italian population.

5.3 Method

Participants

Across the two experiment, 373 Italian-speaking participants (55 males and 318 females) took part. Participants' mean age was 31.58 ± 10.02 [mean ± SD] (males=34.05 ± 10.01, females=32.34 ± 10.05). Participants' education level (years of education) was: (males=15.6 ± 1.66, females=15.8 ± 1.63). Further details about the demographic information about these participants can be found in Table 6-10. No statistical methods were used to predetermine the sample sizes.

Procedure

The experiment was designed using the Psytoolkit platform (Stoet, 2010, 2017). We used a snowball sampling strategy: the links were initially shared with a sample of university students who were encouraged to pass them on to others,

with a focus on recruiting the general public. The study was only accessible to participants with a specific operating system (Mozilla, Chrome and Firefox). All data were collected between 3rd March 2021 and 3rd August 2021. Participants first completed a demographic survey, which included age, gender, education. Subsequently, participants completed a series of questionnaires, measuring: 1) differences in the interpretation of the costs and benefits of social distancing, 2) COVID-19 risk perception, 3) personality traits and 4) emotional intelligence. Participants in study 2 completed the same tasks and questionnaires with additional ones. First, we included a questionnaire to assess compliance with social distancing. Next, participants completed two tests measuring working memory (verbal and visuospatial).

Finally, a series of questionnaires captured differences in depressed mood and feelings of anxiety. The research was approved by the Ethical Committee of the University Sapienza of Rome (Protocol #0002194) and all respondents signed an informed consent before participating. Briefly, before participants decided to continue with the study by clicking a 'proceed' button on the Psytoolkit webpage, detailed information was presented including the aims, procedures, potential risks/benefits, confidentiality, and compensation of the study. All participants were informed that they could withdraw from the study at any time by closing the web browser. There were no rewards for participating in the study.

Study 1

Criterion variables

Benefits and costs of social distancing. To assess the benefits and costs of social distancing, we took the questions from Xie et al. 2020: (a) costs; "Not being able to hang out makes me upset", (b) benefits: "Social distancing stops coronavirus

from spreading around" (for more details see the supplementary material – Table S1). Participants responded to each statement on a four-point scale ("I don't think it is true" = 0 to "It is very true" = 3). We then calculated the sum of the scores within each category (benefits/costs) and calculated the difference between the benefits and costs scores. This allowed us to generate an index assessing the perceived benefits and costs of social distancing. (Cronbach's alpha was acceptable: $\alpha = 0.61$)

Risk perception. Affective risk was measured with a single item: "How concerned are you about the risk that you or someone in your household may contract COVID-19?". Participants responded on a five-point scale, ranging from "not concerned at all" (1) to "very concerned" (5). Information risk was measured with a single item: "How closely would you say you are following the news about Coronavirus/COVID-19". Responses were given on a four-point scale going from "not at all" (1) to "very closely" (4).

Psychological predictors

Prosociality. Prosociality was investigated with a single item (Dryhurst et al., 2020): "To what extent do you think it's important to do things for the benefit of others and society even if they have some costs to you personally?". Participants responded on a five-point scale going from "not at all" (1) to "very much so" (5).

Emotional Intelligence. Emotional intelligence was measured with the Italian version of the Emotional Intelligence Scale (EIS: (Gavazzi et al., 2009; Schutte et al., 1998). This 24-item scale includes items such as "I know when it is time to talk about my personal problems to others", "I am aware of the emotions I feel", "I expect positive things to happen" etc. for more details (see supplementary material). The participants responded on a 5-point agreement Likert scale

ranging from 1 (strongly disagree) to 5 (strongly agree). The subscales are: (a) Evaluation and expression of emotions in relation to others; (b) Evaluation and expression of emotions in relation to self; (c) Regulation and use of emotions. (Cronbach's alpha was good: $\alpha = 0.84$)

Personality traits. To account for personality covariates associated with the assessment of the costs and benefits of social distancing, we included an abbreviated Big Five personality test BFI-10 (Guido et al., 2015): Participants were asked to indicate the extent to which they agree with a statement about themselves (e.g., "I see myself as someone who is relaxed handles stress well) from "strongly disagree" to "strongly agree" on a five-point agreement Likert scale. These ratings allowed us to assess participants' scores on five predefined personality dimensions: extroversion (Cronbach's alpha was questionable $\alpha = 0.66$), agreeableness (Cronbach's alpha was good $\alpha = 0.79$), conscientiousness (Cronbach's alpha was questionable $\alpha = 0.81$), emotional stability (Cronbach's alpha was good $\alpha = 0.84$), and openness (Cronbach's alpha was questionable $\alpha = 0.67$).

Study 2

Criterion variables

Social distancing compliance. To assess the degree of compliance, we took questions from Xie et al. (2020). We asked participants to report how closely they followed a range of social distancing practices (in the last three months). Participants responded on a five-point frequency Likert scale going from "never" (1) to "very often" (5). This questionnaire includes items such as: "held no social gathering with friends", "cancelled events or plans to go to an event", "stopped going to the church or attending other community activity" and "had no

handshakes, hugs, or kisses when greeting". Into order to estimate the validity of these measures, we separately asked participants how often they had washed their hands in the past week on a four-point scale (for more details, see the supplementary material – Table S2). (Cronbach's alpha was acceptable: $\alpha = 0.62$)

Risk perception. Affective risk was measured with a single item: "How concerned are you about the risk that you or someone in your household may contract COVID-19?". Participants responded on a five-point scale, ranging from "not concerned at all" (1) to "very concerned" (5).

Psychological predictors

Anxiety. To assess anxiety, we used the The Symptom Checklist-90 (SCL-90-R: Derogatis et al., 1973, 1976), a self-report 90-item. The scale evaluates a broad spectrum of psychological problems and psychopathological symptoms, measuring both internalizing symptoms (depression, somatization, anxiety) and externalizing ones (aggression, hostility, impulsivity). For the purposes of the present study, we only used the 10 items assessing state anxiety, since we were interested in measuring this variable during the specific period of the COVID-19 outbreak. For each item, participants responded on a four-point scale going from "not at all" (1) to "very much" (4). (Cronbach's alpha was excellent: $\alpha = 0.91$)

Depression. As a measure of depression, we only used 10 items of the SCL-90-R scale, assessing state of depression, during the specific period of the COVID-19 outbreak. For each item, participants responded on a four-point scale going from "not at all" (1) to "very much" (4) (Derogatis et al., 1973, 1976). (Cronbach's alpha was excellent: $\alpha = 0.93$)

Cognitive predictors

N-Back. In the N-back task, participants are presented with a sequence of stimuli one by one. For each stimulus, they have to decide whether the current stimulus is the same as the one presented N trials ago (Jaeggi et al., 2010). In our experiment, all participants completed a 2-back task. Before starting the recording phase, they were shown the instructions and performed a trial block (25 trials). The experiment consisted of 3 blocks of 25 trials each. The stimuli that were presented were a total of 15 letters (A, B, C, D, E, H, I, K, L, M, O, P, R, S, T). Participants had 3 seconds (500 ms + 1500 ms) to decide if the letter matches the letter two-trials ago. This timing is used in many N-back studies (e.g., Kane et al., 2007). Responses were recorded and feedback was given to the participant in the case of a correct/wrong response. Participants were asked to use a computer with a keyboard and to click on the letter 'm' to indicate their answer (see the supplementary material – Fig. S1). The task was developed and adapted with instructions in Italian language on the Psytoolkit platform (Stoet, 2010, 2017). The percentage of correct answers allowed us to generate a score assessing the working memory capacity, taking into account false alarms and missing items.

Corsi. The Corsi test is a short-term memory task (Kessels et al., 2000). In this task, participants are presented with a sequence of fixed squares, which light up in a specific sequence. The task is to retrace using the mouse the correct order of the squares. In our experiment, before starting the recording phase, they were shown the instructions and performed a test block. The experiment comprised a 2-block phase. At the beginning of the trial, participants heard the word "go" and were asked to keep the speakers on. Once they had indicated the squares in the correct order, they were asked to click on the green 'done' button. Participants received instant feedback on their performance (smiling smiley vs. sad smiley). Participants had 2 chances per sequence, in case of mistake the test stopped (see the supplementary material – Fig. S2)

The task was developed and adapted with instructions in Italian language on the Psytoolkit platform (Stoet, 2010, 2017). The score was calculated based on the number of correct sequences that were achieved by the participant (The highest Corsi a span so far).

Data cleaning and analysis

Before any analysis, the data were screened for accuracy, missing data, outliers, and order effects. The floor effect in the n-back scores was eliminated. The final sample in study 2 was n=141 participants. The analyses were conducted with SPSS (version 27.0). For the mediation analysis (Hayes & Preacher, 2014) conducted in study 2, on the relationship between anxiety level and social distancing compliance, we used anxiety capacity as a predictor, social distancing compliance as an outcome variable, and participants' understanding of the benefits versus costs related to social distancing as a mediator.

5.4 Results

Study 1

Table 6 reports descriptive statistics for the measures examined in the present study, including the results of *t*-tests.

Table 6. Descriptive measures for the total sample and separately for boys and girls, together with the results of t-tests. Values in brackets are standard deviations

Measures	*Mean (SD)*	*Boys (N=31)*	*Girls (N=192)*	*t-test*
Age	30.78 (9.97)	32.68 (10.11)	30.48 (9.94)	$t = 1.14$

Education (in years)	17.22 (1.21)	17.00 (1.25)	17.26 (1.20)	$t = -1.09$
Difference benefits/costs	7.48 (4.77)	8.32 (4.33)	7.34 (4.84)	$t = 1.05$
Risk perception	6.48 (2.07)	6.00 (1.89)	6.56 (2.09)	$t = -1.40$
Prosociality	4.31 (0.84)	4.32 (0.87)	4.31 (0.84)	$t = 0.06$
Agreeableness	6.67 (1.71)	6.74 (1.71)	6.66 (1.71)	$t = 0.25$
Conscientiousness	7.93 (1.55)	7.71 (1.75)	7.97 (1.52)	$t = -0.86$
Emotional stability	**5.93 (2.36)**	**7.06 (2.20)**	**5.74 (2.34)**	***t* = 2.93**
Extrovertion	6.19 (2.01)	6.13 (2.09)	6.20 (2.00)	$t = -0.17$
Openness	7.36 (1.91)	7.42 (1.87)	7.35 (1.93)	$t = 0.18$
EIS-1 Emotions in others	40.86 (5.01)	41.23 (5.69)	40.80 (4.90)	$t = 0.44$
EIS-2 Emotions in the self	15.37 (2.89)	15.87 (2.76)	15.29 (2.91)	$t = 1.04$
EIS-3 Emotion regulation	30.60 (9.21)	33.00 (9.26)	30.21 (9.17)	$t = 1.56$

Note. Values shown in bold are significant: $p \leq 0.05$.

We used independent samples *t*-tests for examining differences between males and females. There were no differences between males and females in all the factors analysed, apart from "Emotional Stability". In this case, females reported lower scores compared to males. For our first aim, Table 7 (below) reports Pearson's correlations between the main variables assessed in the present study.

Table 7. Pearson's correlations in the total sample

Total sample	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Difference benefits/costs	1.00												
2. Age	**0.19**	1.00											
3. Education	−0.00	0.03	1.00										
4. Prosociality	0.07	0.03	0.06	1.00									
5. Risk perception COVID-19	−0.05	**−0.30**	0.02	**0.15**	1.00								
6. Agreeableness (BIG-F)	0.12	**0.27**	0.00	0.01	−0.02	1.00							
7. Conscientiousness (BIG-F)	0.08	**0.26**	0.01	0.10	−0.09	**0.13**	1.00						
8. Emotional stability (BIG-F)	**0.26**	**0.41**	**0.15**	0.06	**−0.18**	**0.22**	**0.27**	1.00					
9. Extroversion (BIG-F)	**−0.13**	**0.15**	−0.08	0.10	−0.09	**0.20**	**0.18**	**0.13**	1.00				
10. Openness (BIG-F)	0.03	0.11	0.05	**0.13**	**−0.15**	0.10	0.10	**0.15**	**0.16**	1.00			
11. EIS-1 (Emotions in others)	0.05	**0.14**	−0.05	**0.30**	0.04	**0.16**	**0.18**	**0.14**	**0.21**	**0.25**	1.00		
12. EIS-2 (Emotions in the self)	**0.20**	**0.21**	−0.00	**0.14**	−0.10	0.10	**0.37**	**0.34**	0.08	0.09	**0.40**	1.00	
13. EIS-3 (Emotion regulation)	**0.28**	**0.56**	**−0.38**	0.10	**−0.27**	**0.29**	**0.29**	**0.39**	**0.25**	**0.17**	**0.30**	**0.28**	1.00

Note. Correlation shown in bold are significant: $p \leq 0.05$.

As can be noted, the difference between costs and benefit of social distancing was positively and significantly correlated with age, emotional stability, EIS-2 and EIS-3. Thus, a greater perception of the benefits over the costs of social distancing was higher in participants who have greater emotional stability, understand, and regulate their emotions (See Fig. 20). In addition, the difference between benefit and costs was negatively and significantly associated with extroversion. Thus, participants who had higher levels of extroversion reported that they perceived more costs than benefits of social distancing (compared to participants who had lower levels of extroversion). Also, for our second aim, risk perception of COVID-19 was positively and significantly correlated with prosociality. Thus, a high perception of risk was associated with a higher level of prosociality in participants. The risk perception of COVID-19

was negatively and significantly associated with age, emotional stability, openness and EIS-3. This means that younger age is associated with lower risk perception, lower stability of emotions, lower openness personality trait, and lower ability to regulate their emotions.

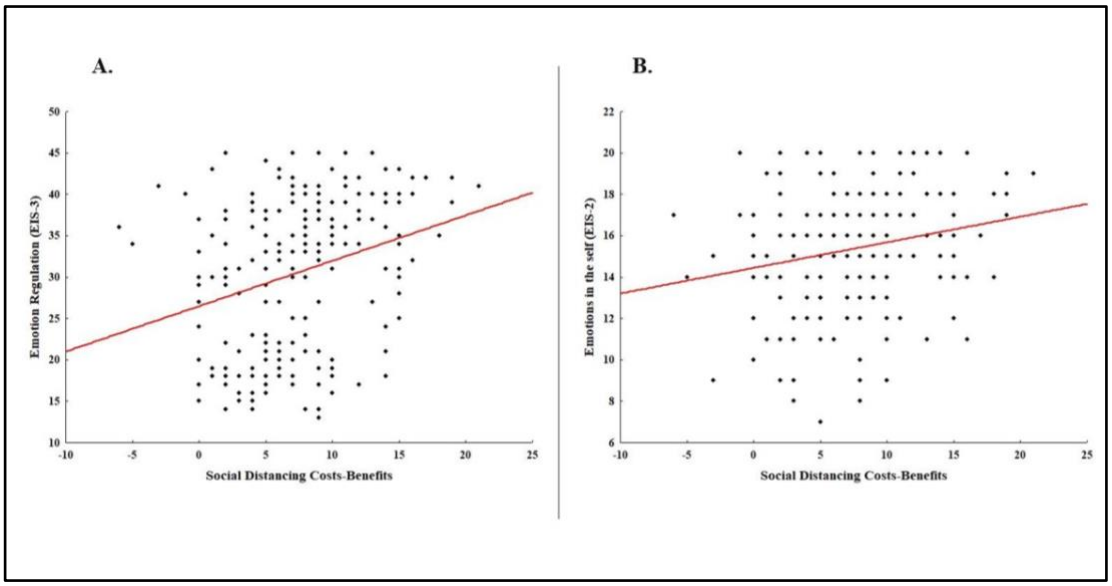

Fig 20. Scatterplot of correlation between EIS-factors and social distancing benefits/costs

In the second step, to determine the psychological predictors of the difference between costs over benefit, we ran a hierarchical regression analysis (see Table 8).

Table 8. Hierarchical regressions predicting the perceived difference between the benefits and costs of social distancing.

Predicted Measure		*Predictors*	*β*	*t*	R^2	*F Change*
Difference benefits/costs	Step 1	Age	−0.02	−0.34	0.02	***F* = 3.51**
		Education	0.08	1.04		
	Step 2	Prosociality	0.05	0.81	0.02	*F* = 0.55
		Risk perception	0.03	0.55		
	Step 3	Agreeableness	0.03	0.49	0.07	***F* = 3.61**
		Conscientiousness	−0.06	−0.91		
		Emotional stability	0.10	1.33		

		Extrovertion	**−0.22**	**−3.25**		
		Openness	−0.01	−0.18		
	Step 4	EIS-1 Emotions in others	−0.08	−1.13	0.13	***F* = 5.33**
		EIS-2 Emotions in the self	**0.15**	**2.04**		
		EIS-3 Emotion regulation	**0.34**	**3.39**		

Note. Values shown in bold are significant: $p \leq 0.05$.

Demographic factors were entered in the first step as a series of dummy variables, to control for their influence. Demographic variables (age, years of education) were included in the first step followed by the predictors that showed significant correlations in the former analyses. As can be noted, difference between costs over benefit was negatively predicted by age and extroversion. While positively predicted by emotion in the self and emotion regulation.

Finally, to determine the psychological predictors of risk perception of COVID-19 we ran another hierarchical regression analysis. Table 9 illustrates the results.

Table 9. Hierarchical regressions predicting risk perception (overall).

Predicted Measure		*Predictors*	*β*	*t*	R^2	*F Change*
Risk Perception	Step 1	Age	**−0.20**	**−2.44**	0.08	***F* = 11.39**
		Education	−0.05	−0.70		
	Step 2	Prosociality	**0.18**	**2.69**	0.10	***F* = 3.25**
		Difference benefits/costs	0.03	0.55		
	Step 3	Agreeableness	0.12	1.85	0.12	*F* = 1.81
		Conscientiousness	0.01	0.21		
		Emotional stability	−0.00	−0.03		
		Extroversion	−0.04	−0.60		
		Openness	**−0.14**	**−2.18**		
	Step 4	EIS-1 Emotions in others	0.14	1.83	0.14	***F* = 2.77**

EIS-2 Emotions in the self	−0.09	−1.28
EIS-3 Emotion regulation	**−0.23**	**−2.33**

Note. Values shown in bold are significant: $p \leq 0.05$.

In this case, demographic variables (age, years of education) were included in the first step. As can be noted, risk perception of COVID-19 was positively predicted by prosociality, but negatively predicted by age, openness and emotion regulation.

Study 2

Table 10 reports descriptive statistics for the measures examined in the present study, including the results of *t*-tests. We used independent samples *t*-tests to examine differences between males and females. There were no differences between males and females in all the factors analysed.

Table 10. Descriptive measures for the total sample and separately for boys and girls, together with the results of *t*-tests. Values in brackets are standard deviations.

Measures	*Mean*	*Boys (N=24)*	*Girls (N=126)*	*t-test*
Age	34.39 (10.09)	35.42 (9.90)	34.20 (10.15)	t = 0.54
Education	14.38 (2.05)	14.20 (2.08)	14.41 (2.06)	t = −0.45
Compliance	12.60 (2.40)	11.96 (1.98)	12.72 (2.46)	t = −1.43
Difference benefits/costs	6.93 (5.11)	6.96 (4.23)	6.92 (5.28)	t = 0.32
Risk perception of COVID-19	6.04 (2.14)	5.66 (1.99)	6.11 (2.17)	t = −0.94
Prosociality	4.33 (0.87)	4.46 (0.83)	4.31 (0.87)	t = 0.78
Anxiety	1.72 (0.71)	1.64 (0.51)	1.74 (0.74)	t = −0.61
Depression	2.07 (0.87)	1.83 (0.64)	2.11 (0.90)	t = −1.48
Agreeableness	6.92 (1.65)	6.75 (1.72)	6.95 (1.64)	t = −0.54
Conscientiousness	8.10 (1.58)	7.96 (1.73)	8.13 (1.55)	t = −0.47

Emotional stability	6.28 (2.40)	7.04 (2.19)	6.14 (2.41)	t = 1.69
Extrovertion	6.40 (2.05)	6.29 (2.21)	6.43 (2.02)	t = −0.29
Openness	7.48 (1.92)	7.25 (1.87)	7.52 (1.93)	t = −0.62
EIS-1 Emotions in others	41.91 (4.87)	42.58 (5.42)	41.78 (4.78)	t = 0.73
EIS-2 Emotions in the self	15.56 (2.91)	15.96 (2.77)	15.48 (2.94)	t = 0.73
EIS-3 Emotion regulation	36.24 (4.81)	37.17 (5.47)	36.06 (4.67)	t = 0.34
N-back correct matches	71.82 (25.06)	73.43 (23.53)	71.52 (25.41)	t = 0.34
Corsi span	4.65 (2.08)	5.00 (2.08)	4.58 (2.08)	t = 0.88

Note. Values shown in bold are significant: $p \leq 0.05$.

In our second study, we aimed to identify psychological and cognitive predictors of compliance with social distancing, Table 11 (below) reports Pearson's correlations between the main variables assessed.

Table 11. Pearson's correlations in the total sample

Total sample	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. Age	1.00																	
2. Education	**0.30**	1.00																
3. Compliance	0.00	0.10	1.00															
4. Difference benefits/costs	0.09	**0.24**	**0.27**	1.00														
5. Prosociality	−0.00	0.02	−0.02	0.02	1.00													
6. Risk perception of COVID-19	**−0.16**	−0.10	**0.17**	0.02	**0.18**	1.00												
7. Anxiety	**−0.42**	**−0.23**	0.04	**−0.21**	−0.02	0.18	1.00											
8. Depression	**−0.39**	−0.11	0.07	**−0.15**	−0.06	0.12	**0.81**	1.00										
9. Agreeableness (BIG-F)	**0.24**	0.07	0.11	0.08	−0.02	0.00	**−0.20**	**−0.16**	1.00									
10. Conscientiousness (BIG-F)	**0.25**	**0.17**	−0.02	0.08	0.05	−0.09	**−0.35**	**−0.40**	0.15	1.00								
11. Emotional stability (BIG-F)	**0.42**	**0.31**	0.06	**0.20**	0.08	−0.12	**−0.66**	**−0.64**	**0.20**	**0.35**	1.00							
12. Extrovertion (BIG-F)	0.09	−0.03	−0.13	−0.14	0.13	−0.05	−0.03	−0.09	0.14	**0.22**	0.11	1.00						
13. Openness (BIG-F)	0.09	0.10	0.10	0.03	0.12	−0.14	−0.06	−0.05	0.04	0.09	0.08	0.13	1.00					
14. EIS-1 (Emotions in others)	0.08	−0.00	0.01	0.01	**0.27**	0.08	−0.09	−0.12	0.13	0.13	0.13	**0.24**	**0.29**	1.00				
15. EIS-2 (Emotions in the self)	**0.21**	0.05	−0.00	**0.17**	0.06	−0.06	**−0.29**	**−0.39**	0.10	**0.42**	**0.35**	**0.16**	0.11	**0.42**	1.00			
16. EIS-3 (Emotion regulation)	**0.28**	0.04	0.07	**0.18**	0.13	−0.01	**−0.38**	**−0.44**	**0.25**	**0.39**	**0.47**	**0.26**	**0.21**	**0.38**	**0.47**	1.00		
17. N-back correct matches	0.05	0.02	0.94	-,017	0.96	-0.05	-0.02	0.05	0.04	0.14	0.03	0,20	0.04	0.24	**0,18**	**-0,25**	1.00	
18. Corsi span	-0.37	-0.40	-0.63	-0.95	-0.01	0.00	**0.19**	**0.21**	-0.13	**-0.27**	**-0.27**	**-0.25**	-0.10	-0.11	**-0.25**	**0.30**	**0.31**	1.00

Note. Values shown in bold are significant: $p \leq 0.05$.

As can be noted, the compliance of social distancing was positively significantly correlated with benefits and costs of social distancing and risk perception of COVID-19. Thus, higher scores in social distancing compliance are associated

with a higher perception of COVID-19 risks and a perception of the benefits of social distancing over costs. In addition, the difference between benefit and costs was negatively and significantly associated with anxiety and depression levels. Therefore, lower levels of anxiety and depression were associated with a higher perception of the benefits over the costs of social distancing.

In the second step, to determine the psychological predictors of the compliance and risk perception, we ran a hierarchical regression analysis (see Table 12).

Table 12. Hierarchical regressions predicting the compliance of social distancing.

Predicted Measure		*Predictors*	*β*	*t*	R^2	*F Change*
Compliance	Step 1	Age	0.00	0.01	0.01	F = 0.81
		Education	0.03	0.34		
	Step 2	Difference benefits/costs	**0.24**	**2.82**	0.10	**F = 5.44**
		Prosociality	−0.06	−0.77		
		Risk perception	**0.17**	**2.11**		
	Step 3	Anxiety	0.08	0.54	0.01	F = 0.88
		Depression	0.14	0.92		
	Step 4	Agreeableness	0.09	1.14	0.04	F = 1.50
		Conscientiousness	−0.00	−0.02		
		Emotional stability	0.14	1.23		
		Extrovertion	−0.11	−1.36		
		Openness	0.13	1.53		
	Step 5	EIS-1 Emotions in others	−0.00	−0.02	0.00	F = 0.17
		EIS-2 Emotions in the self	−0.04	−0.44		
		EIS-3 Emotion regulation	0.06	0.63		

Note. Values shown in bold are significant: $p \leq 0.05$.

Demographic factors were entered in the first step as a series of dummy variables, to control for their influence. Demographic variables (age, years of education) were included in the first step followed by the predictors that showed significant correlations in the former analyses. As can be noted, the compliance of social distancing was positively predicted by difference benefits/costs and risk perception.

Finally, to determine the psychological predictors of risk perception of COVID-19 we ran another hierarchical regression analysis. Table 13 illustrates the results.

Table 13. Hierarchical regressions predicting the risk perception

Predicted Measure		*Predictors*	*β*	*t*	R^2	*F Change*
Risk perception	Step 1	Age	−0.10	−1.11	0.03	F = 2.37
		Education	−0.04	−0.47		
	Step 2	Prosociality	**0.19**	**2.31**	0.07	**F = 3.95**
		Difference benefits/costs	0.28	0.28		
		Compliance	**0.18**	**2.11**		
	Step 3	Anxiety	0.16	1.07	0.01	F = 0.84
		Depression	−0.08	−0.56		
	Step 4	Agreeableness	0.05	0.68	0.03	F = 1.02
		Conscientiousness	−0.00	−0.08		
		Emotional stability	−0.03	−0.29		
		Extrovertion	−0.04	−0.50		
		Openness	**−0.19**	**−2.26**		
	Step 5	EIS-1 Emotions in others	0.12	1.31	0.01	F = 0.78
		EIS-2 Emotions in the self	−0.09	−0.89		
		EIS-3 Emotion regulation	0.05	0.49		

Note. Values shown in bold are significant: $p \leq 0.05$.

Also in this case, demographic variables (age, years of education) were included in the first step. As can be noted, risk perception of COVID-19 was positively predicted by prosociality and compliance of social distancing, but negatively predicted by openness.

We then performed a formal mediation analysis using the level of anxiety as a predictor, compliance with social distancing as an outcome variable, and participants' understanding of the benefits versus costs of social distancing as a mediator (see Fig. 21).

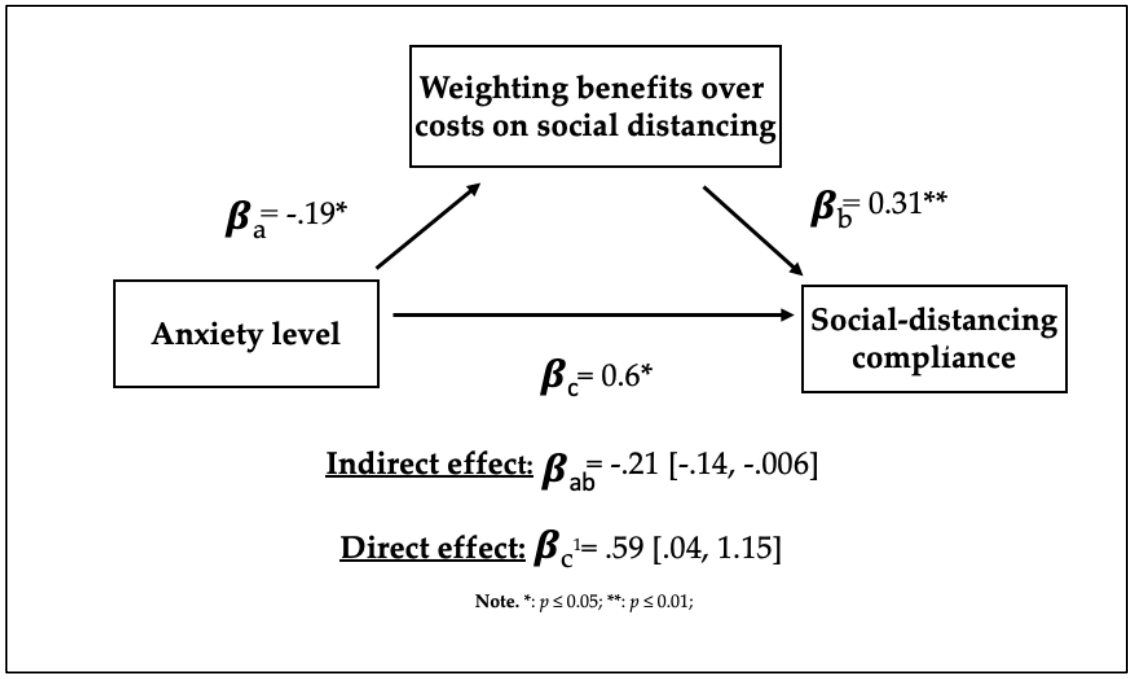

Fig 21. Mediation model of the significant association between anxiety, social-distancing compliance and an individual's understanding of benefits over costs about social distancing.

The results showed that anxiety was negatively related to benefits and costs of social distancing (a = -.19, p < .05). Benefits and costs of social distancing

negatively predicted compliance while controlling for anxiety ($b = 0.31$, $p < .05$). A bootstrap confidence interval for the indirect effect of anxiety using 5,000 bootstrap samples was -,48 to -,02 meaning that there was evidence of an indirect effect of anxiety on compliance of social distancing through benefits and costs. The direct effect of anxiety on compliance of social distancing was significant ($c' = 0.5$ $p < .05$).

5.5 Discussion

In the present study we investigated the cognitive and psychological predictors of adherence to social distancing behaviour in Italy, in the period between 3rd March 2021 and 3rd August 2021. The importance of adhering to social distancing norms was consistently emphasised to the population during the COVID-19 emergency. As the pandemic progresses, it remains fundamental to follow these rules and monitor people's behaviour.

According to Webster et al. (2020) adherence to quarantine may be influenced by the perceived benefits of precautionary measures and the risk of contracting the disease. Also, in comparison to past SARS and Ebola pandemics, it has been seen that people were more likely to adhere to quarantine protocols when they perceived this behaviour to be helpful in reducing transmission (Siddiqui et al., 2016). Hansen et al. (2021), showed that perceived susceptibility to COVID-19 and perceived benefits of social distancing measures are the most significant predictors of compliance with social distancing norms.

Regarding the first study, our results are in line with the theoretical framework that compliance with social distancing during the early outbreak of an infectious disease is driven by deliberate reflections on the costs and benefits of this practice (Reluga, 2010). Our results show that the decision to follow the norm of social distancing in prioritizing benefits to society over personal costs

significantly correlates to specific aspects of emotional intelligence. Individuals that have a better understanding of their own emotions and of situations that trigger them are the ones that better understand the weighting of benefits over costs of social distancing. In addition to this, people who better regulate their emotions also report higher levels of benefits/costs understanding. This latter aspect of emotional intelligence also includes an empathy component (Gavazzi et al., 2009). According to Hubbeling (2012), empathy describes concern for the well-being of others and leads to an increase in the well-being of others. Hence, we can hypothesise an additional association between empathy and benefits/costs. This relationship has been previously found between empathy and social distancing (Christner et al., 2020; Pfattheicher et al., 2020).

In addition to this, it is also interesting to note how personality traits can modulate adherence to social distancing behaviours. Indeed, in our results, extroversion seems to be associated with a higher perception of the costs over the benefits of social distancing. This result is in line with a study conducted in Brazil sample where higher scores for extroversion were associated with lower means for social distancing during COVID-19 outbreak (Carvalho et al., 2020).

Moreover, considering the age of the participants, a negative correlation was observed between age and the evaluation of the benefits over the costs of social distancing. This result seems to be supported by Savadori and Lauriola (2021), who reported how younger participants were less afraid of COVID-19 and were less apt to avoid social distancing than older ones.

Regarding the second study, our results show that higher scores in social distancing compliance are associated with a higher perception of COVID-19 risks and a perception of the benefits of social distancing over costs. These results therefore confirm the idea that perception of health risk can significantly influence self-protective behaviours (Dionne et al., 2018; Lin & Lagoe, 2013). According to our study, risk perception was found to be a predictor of social

distancing, one of the most effective protective behaviour during the COVID-19 pandemic (Aquino et al., 2020). This result is in line with several other studies, which have seen how risk perception predicts greater compliance with social distancing (Adiyoso & Wilopo, 2021; K Xie et al., 2020; Yuan et al., 2021). Regarding the weight of benefits over costs of social distancing in relation to compliance, our results are in line with Xie et al. (2020). We also found that a higher perception of benefits of social distancing leads to greater adherence to compliance.

Finally, the last aim of our study was to understand whether working memory (WM) was a predictor of adherence to social distancing behaviours and participants' understanding of the benefits of social distancing mediated this relationship, as previously seen in (Xie et al. 2020). In our results, there was no positive correlation between WM tasks and social distancing compliance were found. This is probably due to the use of a different task from Xie et al. (2020) and to administering the experiment at a time when the social distancing norm had already been internalised by the population. In fact, according to Duncan et al. (2012), WM improves the ability of individuals to follow a new rule, to favor internalization of it. It is interesting to note that Marot et al, (2021), after re-analysing the data of W. Xie et al, (2020) suggested that depressed mood and agreeableness may be as good predictors of compliance with social distancing as WM. In their mediation model, the analysis of benefits versus costs strongly mediated the relationship between depressed mood and social distancing. For this reason, we decided to perform a mediation analysis considering another possible mediator in the relationship between benefits and costs of social distancing: anxiety. Our mediation model (see Fig.21) suggests that the relationship between anxiety and compliance would seem to be negatively mediated by the weight of benefits over costs of social distancing.

Overall, these results show that the study of psychological predictors of social distancing is multifaceted and complex. In our opinion, therefore, not only cognitive predictors but also participants' level of anxiety should be considered in modulating greater compliance with social distancing. The role of anxiety and depression as a factor modulating compliance is also supported by recent study (Guo et al., 2021). It is therefore clear that behavioural science can provide a basis for understanding how populations respond to a pandemic. Since we do not know the duration of the COVID-19 emergency, being able to develop effective communication messages based on empirical data may improve adherence to social distancing behaviour in the future. Understanding how people feel towards the risks of COVID-19 and the protective behaviours people manage to enact is a challenge that behavioural sciences can and should address (Betsch, 2020)

5.6 Limitation and future directions

The present study has limitations that must be acknowledged. First, our sample was not representative of the general Italian population (our participants were mostly young adults, with high education levels). Second, the method was cross-sectional and correlational in nature, which means that we could not determine whether demographic and psychological factors were causally related to social distancing compliance. Third, we conducted the study in a period from March 2021 to August 2021, in which the situation of the COVID-19 emergency in Italy changed. This might have influenced the population's adherence to preventive behaviours. Moreover, compared to Xie et al. (2020) who conducted the study in the first phase of the pandemic, our results did not replicate the effect of WM on compliance. Nevertheless, we believe that this is due to the fact that the two studies were carried out in two different periods. As a result of this, when our

research was conducted, the norm had already been internalised by the population.

Lastly, as pointed outby Marot et al. (2021), the public response to a crisis situation might not be driven by a single predictor. A number of potentially relevant variables were not included in our survey, including political ideology (e.g., Calvillo et al. 2020), socioeconomic factors (Weill et al., 2020) and affective (Lammers et al., 2020). Hence, further studies are needed to understand the role of cognitive components in relation to social distancing behaviour.

Chapter 6

STUDY 3

Predictors of the Intention to Be Vaccinated against COVID-19 in a Sample of Italian Respondents at the Start of the Immunization Campaign

6.1 Abstract

COVID-19 vaccines are the most promising means of limiting the pandemic. The present study aims at determining the roles of several psychological variables in predicting vaccination intention in Italy. An online questionnaire was disseminated between 9 March and 9 May 2021. The sample included 971 participants. Results showed that most of the participants were willing to vaccinate. Acceptance rates were correlated with age, marital status, and area of residence. Intention to be vaccinated was positively correlated with perceived risk, pro-sociality, fear of COVID-19, use of preventive behaviors, and trust in government, in science, and in medical professionals. Intention to be vaccinated was negatively associated with belief in misinformation. The degree of acceptance is likely to be a result of the campaign tailored to address people's negative attitudes towards vaccines. Trust in government and trust in science were among the strongest psychological predictors of vaccination intention. Fear of COVID-19, but not perceived risk, was associated with increased vaccine uptake, suggesting that the affective component of risk perception was more important than the cognitive component in predicting participants' behaviors.

Belief in misinformation was associated with reduced vaccination intention. Future studies will take into consideration these variables, to better understand the multifaceted process underlying vaccination intention.

6.2 Introduction

To date, different vaccines against COVID-19 have been approved by regulatory agencies and are currently in use. Worldwide differences among countries exist in the type of vaccine approved and administered. Further, in some countries, the type of vaccine administered varies according to the age range of the people inoculated. As new vaccines were commercialized, the intention to get vaccinated rose in many countries. For example, a survey conducted in April 2021 on more than 10'000 respondents (https://www.ipsos.com/en/covid-19-vaccination-intent-has-soared-across-world) showed that the percentages of people who declared to accept the COVID-19 vaccine was very high in Brazil (93%), Mexico (88%), Spain (83%), and China (81%), fairly high in Italy (79%), Canada (78%), Japan (73%), South Korea (72%), and Germany (71%), middling in Australia (66%), South Africa (62%), and France (58%), and low in the United States (46%) and Russia (41%). Nevertheless, a meta-analysis of twenty-eight nationally representative samples from 13 countries concluded that, as the pandemic progressed, the percentage of people intending to vaccinate decreased (being about 60%) and the percentage of people intending to refuse vaccination increased (being about 20%; Robinson, Jones, Lesser, & Daly, 2021). At the moment in which we are writing (December 15, 2021), about 8.59 billion doses have been administered globally, but only 56.5% of the world population has received at least one dose of a COVID-19 vaccine (https://ourworldindata.org/covid-vaccinations). Shares of people vaccinated are high in countries such as United Arab Emirates (99%), Cuba (90%), Portugal

(89%) and China (84%), moderate in countries such as France (77%), United Kingdom (75%), Germany and United States (both 72%), low in countries such as Russia (48%), South Africa (31%) and Egypt (28%), and extremely low in countries such as Kenya (10%), Ethiopia (7%) and Nigeria (4%). In Italy, more than 104 million doses have been administrated and about 85% of the population (47 million people) has been fully immunized with two doses.

Overall, these data suggest that understanding the factors that determine and promote the intention to get vaccinated represents an enduring mission for psychological research. The present study sought to contribute to this field by investigating the intention to be vaccinated in Italy in the period between March and May 2021 – that is, shortly after the beginning of the vaccination campaign. There were three primary aims. First, we sought to provide up-to-date information about vaccine acceptance rates (i.e., the percentage of people willing to be vaccinated against COVID-19) in Italy. In a previous study by Palamenghi, Barello, Boccia, and Graffigna (2020), conducted during the early days of the Italian reopening after the first lockdown (May 2020), a sample of 1004 Italian citizens were asked to report their willingness to be vaccinated against COVID-19 "if a vaccine was found" on a scale ranging from 1 (not likely at all) to 5 (absolutely likely). The results showed that about 59% of the respondents were "likely" or "absolutely likely" to get vaccinated. Given the recent emphasis in enhancing public trust in COVID-19 vaccination, we expected this estimate to be substantially higher at the beginning of 2021 (see Caserotti et al., 2021, and Kerr et al., 2021). In this respect, we must note that the policy adopted by the Italian government to address vaccine hesitancy has been one of the most fruitful, at least in Europe. Generally speaking, Italy has a long-standing tradition of high coverage of vaccinations. However, in the last decade, the frequency of infant immunization has decreased alarmingly, leading to the introduction of a new law, the "Italian National Immunization Prevention Plan 2017–19" (n. 119/2017),

which prescribes mandatory vaccinations against ten diseases for preschool and school-aged children (Pivetti et al., 2021). The implementation of the law contributed to an increased awareness of the importance of vaccination in the Italian population (Cadeddu et al., 2021). During the COVID-19 pandemic, this awareness was further boosted by the broad diffusion of science-supporting messages from experts about vaccine safety and effectiveness. Pro-vaccine messages are now common in mass media, including TV, radio, magazines, newspapers, and the Internet. In addition, the Italian government has recently approved two types of green COVID-19 certificates: the Basic Green Pass (proving vaccination, recovery from COVID-19 within the last six months or a negative result for a molecular or antigenic swab in the last couple of days) and the Super Green Pass (only granted to the vaccinated and those who have recovered from the coronavirus in the last six months). The fact that the Super Green Pass is now compulsory for certain categories (including healthcare workers, schoolteachers, soldiers, and police officers), as well as for accessing an increasing number of activities and services, has produced an additional boost in vaccination rates.

Our second aim was to determine the impact of individual differences in demographic variables on vaccine acceptance rates. In this respect, common findings are that the intention to be vaccinated was higher in males than in females (Kerr et al., 2021; Robinson, Jones, Lesser, & Daly, 2021), and higher in older than in younger people (Gagneux-Brunon et al., 2021; Sherman et al., 2021). However, in the study by Kerr et al. (2021), neither age nor gender were found to be significant predictors of vaccine acceptance in a sample of 700 Italian respondents interviewed between March and October 2020. Lastly, the third aim was to determine the roles of several psychological variables in predicting the intention to be vaccinated against COVID-19. Following a theoretical framework originally applied to the study of risk perception (Van der Linden, 2015),

psychological predictors were selected in order to assess the cognitive (risk perception, prosociality), the emotional (fear of COVID-19), the experiential (direct experience, use of preventative measures, misinformation), and the sociocultural (trust in government, trust in science, trust in medical professionals) aspects of the current pandemic (Dryhurst et al., 2020).

Previous research provided evidence in support of the involvement of these variables in the prediction of vaccine hesitancy and/or the intention to be vaccinated (e.g., Kerr et al., 2021; Gagneux-Brunon et al., 2021; Loomba, de Figueiredo, Piatek, de Graaf, & Larson, 2021; Paul, Steptoe, & Fancourt, 2021; Roozenbeek et al., 2020; Sherman et al., 2021), but, to our knowledge, few studies have compared the relative importance of each of them within a single study. For example, trust in government and trust in medical professionals have been repeatedly demonstrated to play a key role in determining COVID-19 vaccine acceptance. A cross-sectional study in 19 countries showed that willingness to get vaccinated ranged from 88.6% (China) to 55.8% (Russia) and was positively and significantly associated with trust in the government (Lazarus et al., 2020; see Frank & Arim, 2020, for similar results in a Canadian sample). However, as suggested by Kerr et al. (2021), current research has not considered the possible overlap between different types of trust (trust in government, trust in science and trust in medical professionals). Perceived risk (i.e., the subjective likelihood of getting the virus) is another variable which has been often called into question in predicting the adoption of preventative behaviors and the acceptance of COVID-19 vaccines (Reiter, Pennell, & Katz, 2020; Wong, Alias, Wong, & AbuBakar, 2020), in line with the predictions following from the Health Belief Model (Rosenstock, Strecher, & Becker, 1988) and the Protection Motivation Theory (Floyd, Prentice-Dunn, & Rogers, 2006). Yet, these studies have typically failed to disentangle the roles of the cognitive and affective components of risk perception, and many did not evaluate fear or worry of COVID-19 (Yahaghi et

al., 2021). Lastly, for other predictors such as prosociality, the available evidence is mixed, with some studies reporting significant associations with vaccination intent (Jung & Albarracín, 2021; Yu et al., 2021) and other studies reporting no association (Rosman et al., 2021).

The aim of the present study was to provide an updated assessment of vaccine acceptance rates in Italy in the period between March and May 2021, at the launch of the vaccination campaign, and to further investigate the impact of a broad array of demographical and psychological factors in increasing (or decreasing) participants' willingness to be vaccinated against COVID-19.

6.3 Method

Participants

Table 14 reports the demographic characteristics of our sample. Overall, we recruited 971 Italian-speaking participants, 411 males and 558 females and two participants not reporting their gender. Most of our participants were between 18 and 30 years (N = 641), were unmarried (N = 681), lived with relatives or partners (N = 795), resided in Central Italy (N = 713), and many had a university degree (N = 380, considering both Bachelor's and Master's degrees). At the time the study was conducted, 350 participants lived in a white or yellow area (low risk), 128 lived in an orange area (intermediate risk), and 493 lived in a red area (high risk)[1]. When compared with the general Italian population, participants older than 61 years of age, with a high school diploma (or less), married, and living alone in Northern or Southern Italy were underrepresented in our sample.

Table 14. Demographic properties of the sample recruited for the present study, as compared to Italian population.

	Our sample	*Italian population*[a]
Gender		
Females	558 (57.6%)	51.3%
Males	411 (42.4%)	49.7%
Age		
18-30 years	641 (66.0%)	14.9%
31-40 years	91 (9.4%)	11.3%
41-50 years	97 (10.0%)	14.7%
51-60 years	94 (9.7%)	15.9%
>61 years	48 (4.9%)	30.2%
Education		
High school or less	465 (47.8%)	85.1%
Bachelor's degree	157 (16.2%)	3.8%
Master's degree	223 (23.0%)	10.7%
Postgraduate	126 (13.0%)	0.4%
Marital status		
Single	681 (70.1%)	42.9%
Married	251 (25.8%)	46.6%
Divorced/widowed	39 (4.0%)	10.5%
Living condition		
Alone	109 (11.2%)	32.9%
Family/Partner	795 (81.9%)	63.2%
Friends/Housemates	67 (6.9%)	3.9%
Region		
Central Italy	713 (73.4%)	19.9%
North Italy	148 (15.2%)	46.4%
South Italy	110 (11.3%)	33.7%
Type of area		
White/Yellow	350 (36.0%)	---
Orange	128 (13.2%)	---
Red	493 (50.8%)	---

Note. [a]: Data taken from https://www.istat.it/it/censimenti.

Procedure

The questionnaire was prepared using Google Forms and disseminated through different social media (including Facebook, Instagram, Twitter, LinkedIn, Telegram and WhatsApp), in line with the Italian government's recommendations on limiting face-to-face interactions. All data were collected between 9th March and 9th May 2021 – but note that 829 participants (85% of the whole sample) completed the questionnaire by 31st March. We used a snowball sampling strategy: the links were initially shared with a sample of university students who were encouraged to pass them on to others, with a focus on recruiting general public. The research was approved by the Ethical Committee of the University Sapienza of Rome (Protocol N.0000476) and all respondents signed an informed consent before participating.

Statistical analyses

Since our variables resulted from the combination of a different number of questions, they had different ranges and needed to be preliminarily standardized by transforming them into z-scores. Z-scores are measured in terms of standard deviations from the mean and thus inform on how many standard deviations a raw score is away from the mean. Positive scores indicate that the participant's raw score falls above the mean, whereas negative scores indicate that it falls below the mean.

Statistical analyses were performed in three successive steps. First, we investigated whether participants' intention to be vaccinated (measured in terms of *z*-scores) differed as a function of the demographic properties of our sample (gender, age, education, marital status, living condition, region, and type of area). A *t*-test for independent samples was used for gender (because it involved only two categories) while between-subject univariate ANOVAs were used for all other variables: when a significant result was obtained, the main analysis was

followed by post-hoc pairwise comparisons (using the Bonferroni adjustment), to determine which pairs of the factor categories were significantly different from each other. Second, Pearson's correlations were computed between the main variables, to assess which factors were associated with participants' intention to be vaccinated. Lastly, the correlational analysis was followed by a hierarchical regression analysis to determine which variables predicted participants' intention to be vaccinated. Demographic factors were entered in the first step as a series of dummy variables, to control for their influence. A dummy variable is a numerical variable used in regression analyses to represent different treatment groups. Specifically, participants were given a value of 0 if they were in the reference group (for example 'female' for gender) or a 1 if they were in the other group ("male"). For a variable having k levels, $k - 1$ dummy variables were necessary to represent all groups. For example, to represent marital status, which has three different levels (single, married, divorced/widowed), two dummy variables were required. Since we chose the 'single' category as the reference level, the first dummy variable was coded 1 if participants belonged to the 'married' category and 0 if they belonged to the 'single' or 'divorced/widowed' categories. The second dummy variable was instead coded 1 if participants belonged to the 'divorced/widowed' category and 0 if they belonged to the 'single' or 'married' categories. Psychological variables (perceived risk, prosociality, fear of COVID-19, direct experience, use of preventive behaviors, misinformation, trust in government, trust in science and trust in medical professionals) were included in the model in the second step, to ascertain whether they explained additional variance, over and above the contribution provided by demographic variables. As usual, the results of the regression analysis are presented in terms of β coefficients, which describe the mathematical relationships between each independent variable and the dependent variable. More technically, they represent the mean change in the dependent variable for

one unit of change in the predictor variable while holding other predictors constant. Each coefficient was associated with a *t*-test and a *p*-value, which indicated whether the relationship between the predictor and dependent variables was statistically significant. If the *t*-test was not significant ($p > 0.05$), then the predictor had no correlation with the dependent variable – i.e., there was no association between the changes in the independent variable and the shifts in the dependent variable. Otherwise, if the *t*-test was significant ($p \leq 0.05$), then data favored the hypothesis that there was a non-zero correlation – i.e., that changes in the independent variable were associated with changes in the dependent variable at the population level. For all analyses, the α level was set to 0.05.

Instruments and measures

Intention to be vaccinated. Intention to be vaccinated was measured with two questions taken from Palamenghi et al. (2020): "Are you willing to be vaccinated against COVID-19?" and "Do you think your family members should be vaccinated against COVID-19?". For both questions, participants responded on a five-point likelihood Likert scale, ranging from "not at all likely" (1) to "absolutely likely" (5). Scores were summed and therefore could range between 2 and 10. Cronbach's α was good ($\alpha = 0.88$).

Perceived risk. Perceived risk was assessed with three questions taken from Dryhurst et al. (2020): "How likely do you think it is that you will be directly and personally affected by the following in the next 6 months? - Catching the coronavirus/COVID-19", "How likely do you think it is that your friends and family in the country you are currently living in will be directly affected by the following in the next 6 months? - Catching the coronavirus/COVID-19", and

"How much do you agree or disagree with the following statements? - Getting sick with the coronavirus/COVID-19 can be serious". For the first two questions, participants responded on a seven-point likelihood Likert scale, ranging from "not at all likely" (1) to "very likely" (7). For the third question, participants responded on a five-point agreement Likert scale, ranging from "strongly disagree" (1) to "strongly agree" (5). Scores were summed and could therefore range between 3 and 19. Cronbach's α was acceptable ($\alpha = 0.62$).

Prosociality. Prosociality was investigated with a single item taken from Dryhurst et al. (2020): "To what extent do you think it's important to do things for the benefit of others and society even if they have some costs to you personally?". Participants responded on a five-point scale going from "not at all" (1) to "very much so" (5).

Fear of Covid-19. Feelings of anxiety towards COVID-19 were measured with the Italian version of the Fear of COVID-19 Scale (FCV-19S: Ahorsu et al., 2020; Soraci et al., 2020). This seven-item scale includes items such as "I am most afraid of coronavirus-19", "My hands become clammy when I think about coronavirus-19", and "When watching news and stories about coronavirus-19 on social media, I become nervous or anxious". Participants responded on a 5-point agreement Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree): thus, total scores ranged from 7 to 35. Cronbach's α was good ($\alpha = 0.86$).

Direct experience. Direct experience with Coronavirus was examined with a single item: "Have you ever had, or thought you might have, the Coronavirus/COVID-19?". Participant had three response options: "Yes, I had COVID-19", "I thought I might have COVID-19, but I have been tested as negative", and "No, I never had COVID-19". Following Dryhurst et al. (2020),

this item was dichotomized by considering the first two options as "yes" responses (1) and the last option as a "no" response (0).

Use of preventive behaviors. The frequency of use of COVID-19 preventive behaviors during the past three months was assessed with 10 items that were extracted from the COVID-19 preventive methods recommended by the WHO and were previously used by Lee et al. (2020). Examples of the items were: "Washed hands regularly using alcohol-based cleanser or soap and water", "Avoided social gatherings of more than 4 people", and "Avoided hand-shaking, hugging and kissing". Participants indicated the frequency of use of each behavior on a 5-point frequency Likert scale ranging from 1 (Never) to 5 (Always). Thus, total scores ranged from 10 to 50. Cronbach's α was excellent ($\alpha = 0.92$).

Misinformation. COVID-19 misinformation was assessed with 12 items taken from Lee et al. (2020) and extracted from COVID-19 misinformation reports by the WHO. Examples of the items were: "Masks can be sterilized and reused after steaming with hot water", "Drinking tea can prevent COVID-19", "Taking antibiotics can prevent or treat COVID-19", "Only the elderly would become infected with the COVID-19", and "COVID-19 is artificially developed". Participants first indicated whether they had encountered each statement in the last three months (binary responses: yes/no; total scores ranged from 0 to 12). Then, they answered the following question: "Which of the above information do you believe is correct?". Responses were provided on a 4-point scale including "none" (1), "some are correct" (2), "Most are correct" (3), and "all are correct" (4).

Trust in government. Trust in government was assessed with a single item taken from Dryhurst et al. (2020): "How much do you trust the country's

politicians to deal effectively with the pandemic?". Participants responded on a seven-point scale going from "not at all" (1) to "very much" (7).

Trust in science. Trust in science was assessed with a single item taken from Dryhurst et al. (2020): "How much do you trust each of the following? – Scientists". Participants responded on a five-point scale going from "cannot be trusted at all" (1) to "can be trusted a lot" (5).

Trust in medical professionals. Trust in medical professionals was assessed with a single item taken from Dryhurst et al. (2020): "How much do you trust each of the following? - Medical doctors and nurses". Participants responded on a five-point scale going from "cannot be trusted at all" (1) to "can be trusted a lot" (5).

6.4 Results

Descriptive measures for the variables examined in the present study are reported in Table 15.

Table 15. Descriptive statistics for the variables measured in the present study.

Measures	M	SD	Min	Max
Intention to vaccinate	9.13	1.79	2.00	10.00
Perceived risk	12.00	2.87	3.00	19.00
Pro-sociality	5.77	1.45	1.00	7.00
Fear of COVID-19	14.94	5.52	7.00	35.00
Direct experience	0.48	0.49	0.00	1.00
Use of preventive behaviors	38.23	8.03	10.00	50.00
Misinformation (number)	2.52	1.49	1.00	10.00
Misinformation (belief)	1.26	0.50	1.00	4.00
Trust in government	3.32	1.54	1.00	7.00
Trust in science	4.17	0.90	1.00	5.00
Trust in medical professionals	4.34	0.78	1.00	5.00

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In relation to our first aim, acceptance of COVID-19 vaccine was substantially high. In fact, 762 participants (78.5%) responded that they were absolutely likely to be vaccinated against COVID-19, whereas only 35 participants (3.6%) responded that they were not at all likely to get vaccination. Pooling together the first two categories (i.e., "not at all likely" and "very unlikely"), a total of 67 participants (6.9%) were hesitant about their own vaccination. Similarly, when asked about their family members, 750 participants (77.2%) responded that they should absolutely be vaccinated, whereas only 19 participants (2.0%) responded that they should absolutely not be vaccinated. Collapsing the first two categories, a total of 55 participants (5.7%) were hesitant about vaccination for their family members.

With respect to our second aim, we found that participants' intention to be vaccinated differed as a function of three demographic variables. As reported in Table 16, significant differences were observed for: i) age (post-hoc comparisons revealed that acceptance rates were lower for participants 41-50 years old than for those who were 18-30 years old, $p = 0.025$, or older than 61 years, $p = 0.039$; all other ps > 0.32), ii) marital status (post-hoc comparisons revealed that acceptance rates were lower for participants who were married or divorced/widowed than for those who were single, $p = 0.003$ and $p = 0.004$), and iii) type of area (post-hoc comparisons revealed that acceptance rates were lower for participants who resided in an orange area than for those who resided in white/yellow or red areas, $p = 0.043$ and $p = 0.010$).

Table 16. Means (and standard deviations) for intention to vaccinate (z-scores), as a function of gender, age, education, marital status, living condition, region, and type of area, together with the results of statistical analyses (*t*-test or F-test).

Categories	Intention to Vaccinate (z-Scores)	*t*-Test/F-Test
Gender		
Females (*N* = 558)	0.04 (0.97)	1.57
Males (*N* = 411)	−0.05 (1.01)	
Age		
18–30 years (*N* = 641)	0.05 (0.89)	3.77 **
31–40 years (*N* = 91)	−0.14 (1.12)	
41–50 years (*N* = 97)	−0.26 (1.32)	
51–60 years (*N* = 94)	−0.11 (1.21)	
>61 years (*N* = 48)	0.23 (0.81)	
Education		
High school or less (*N* = 465)	−0.01 (1.03)	0.27
Bachelor's degree (*N* = 157)	−0.03 (1.01)	
Master's degree (*N* = 223)	0.01 (0.95)	
Postgraduate (*N* = 126)	0.06 (0.94)	
Marital status		
Single (*N* = 681)	0.08 (0.87)	9.43 ***
Married (*N* = 251)	−0.15 (1.17)	
Divorced/widowed (*N* = 39)	−0.44 (1.56)	
Living condition		
Alone (*N* = 109)	0.07 (0.97)	1.55
Family/Partner (*N* = 795)	−0.02 (1.01)	
Friends/Housemates (*N* = 67)	0.17 (0.84)	
Region		
Central Italy (*N* = 713)	0.02 (0.97)	1.03
North Italy (*N* = 148)	−0.10 (1.15)	
South Italy (*N* = 110)	0.01 (0.92)	
Type of area		
White/Yellow (*N* = 350)	0.01 (0.94)	4.14 **
Orange (*N* = 128)	−0.23 (1.21)	
Red (*N* = 493)	0.05 (0.97)	

Note. **: $p \leq 0.01$; ***: $p \leq 0.001$.

For our third aim, Table 17 reports Pearson's correlations between the main variables assessed in the present study.

Table 17. Pearson's correlations between all variables (N = 978).

Total Sample	1	2	3	4	5	6	7	8	9	10	11
1. Intention to vaccinate	1.00										
2. Perceived risk	0.15 **	1.00									
3. Pro-sociality	0.23 **	0.16 **	1.00								
4. Fear of COVID-19	0.12 **	0.36 **	0.08 **	1.00							
5. Direct experience	0.02	0.18 **	0.01	0.07 *	1.00						
6. Use of preventive behaviors	0.20 **	0.12 **	0.20 **	0.16 **	−0.01	1.00					
7. Misinformation (number)	0.05	0.09 **	0.04	0.04	0.03	0.07 *	1.00				
8. Misinformation (belief)	−0.22 **	−0.06	−0.10 **	0.03	−0.04	−0.14 **	−0.05	1.00			
9. Trust in government	0.29 **	0.05	0.25 **	0.05	−0.05	0.07 *	0.01	−0.04	1.00		
10. Trust in science	0.47 **	0.14 **	0.32 **	−0.01	0.02	0.23 **	0.09 *	−0.14 **	0.36 **	1.00	
11. Trust in medical professionals	0.39 **	0.13 **	0.28 **	0.03	−0.02	0.22 **	0.08 *	−0.16 **	0.28 **	0.61 **	1.00

Note. *: $p \leq 0.05$; **: $p \leq 0.01$

The intention to be vaccinated was positively and significantly correlated with perceived risk, prosociality, fear of COVID-19, use of preventive behaviors, trust in government, trust in science and trust in medical professionals. Thus, acceptance of COVID-19 vaccine was higher in those participants who perceived more risk, were more prosocial, had more fear of the virus, used preventive behaviors more frequently and were more trustful of government, scientists and medical practitioners. In addition, intention to be vaccinated was negatively and significantly associated with belief in misinformation: thus, participants who had higher levels of belief in COVID-19-related misinformation stated that they were less likely to vaccinate (as compared to participants who had lower levels of belief in misinformation).

To determine the psychological predictors of the intention to be vaccinated, we ran a hierarchical regression analysis, using the simultaneous method (see Table 18).

Table 18. Simultaneous regression predicting the intention to vaccinate.

Steps	Predictors	β	*t*
Step 1	Gender		
	Males	-[a]	-
	Females	−0.08	−2.56 **
	Age		
	18–30 years	-[a]	-
	31–40 years	0.02	0.59
	41–50 years	0.04	1.27
	51–60 years	0.09	2.41 *
	>61 years	0.17	4.99 **
	Education		
	High school or less	-[a]	-
	Bachelor's degree	−0.00	−0.12
	Master's degree	0.01	0.54
	Postgraduate	0.06	2.05 *
	Marital status		
	Single	-[a]	-
	Married	−0.14	−3.23 ***
	Divorced/widowed	−0.09	−2.60 **
	Living condition		
	Alone	-[a]	-
	Family/Partner	0.01	0.24
	Friends/Housemates	0.01	0.27
	Region		
	Central Italy	-[a]	-
	North Italy	0.00	0.02
	South Italy	−0.02	−0.78
	Area		
	Red	-[a]	-
	Orange	−0.02	−0.58
	White/Yellow	−0.04	−1.17
Step 2	Psychological predictors		
	Perceived risk	0.05	1.64
	Pro-sociality	0.02	0.73
	Fear of COVID-19	0.11	3.73 ***
	Direct experience	−0.00	−0.04
	Use of preventive behaviors	0.06	2.08 *
	Misinformation (number)	−0.00	−0.09
	Misinformation (belief)	−0.16	−5.55 ***
	Trust in government	0.11	3.86 ***
	Trust in Science	0.29	7.91 ***
	Trust in medical professionals	0.14	4.07 ***

\Note. *: $p \leq 0.05$; **: $p \leq 0.01$; ***: $p \leq 0.001$; [a]: reference category.

As illustrated above, demographic factors were entered in the first step as a series of dummy variables, to control for their potential influence. The overall model was significant [$F(26, 942) = 17.14$, $p < 0.001$]. Demographic variables explained 4.7% of the variance in the intention to be vaccinated [$F(16, 952) = 2.95$, $p < 0.001$]: specifically, vaccination rates increased for participants who were

older than 50 years and had a postgraduate degree, but decreased for participants who were females, married or divorced/widowed. Psychological variables explained an additional 27.4% of the variance [$F(10, 942) = 38.02$, $p < 0.001$]: vaccination rates increased for participants who had fear of COVID-19, used more preventive measures and were trustful of science, government and medical professionals, whereas they decreased for participants who had high levels of belief in misinformation.

6.5 Discussion

In the present study we investigated the intention to get vaccinated against COVID-19 in Italy in the period between March and May 2021. With respect to this first aim, we found that vaccine acceptance rates were substantially higher than those previously reported by Palamenghi et al. (2020). The overall percentage of participants who reported to be "very likely" and "absolutely likely" to vaccinate was 86.9% ($N = 850$). Likewise, the percentage of participants who were "very likely" and "absolutely likely" to recommend vaccination for their family members was 89.0% ($N = 870$). Similar estimates have been recently reported by Kerr et al. (2021), who found that 85% of Italian respondents were likely to be vaccinated and 88% recommended vaccination to vulnerable friends or family members, and by Barello, Nania, Dellafiore, Graffigna and Caruso (2020), who estimated that 86% of Italian university students would choose to have a vaccination against COVID-19. This rapid increase in acceptance rates was expected, since the growing availability of COVID-19 vaccines has been accompanied by a widespread campaign of public health messaging specifically tailored to address people's negative attitudes towards vaccines. Our data are also consistent with the high number of doses administered so far in Italy: as

reported in the Introduction, about 85% of the population over 12 years has been immunized with two doses and about 89% has received at least one dose. On the other hand, the relative low rates of participants who declared to be hesitant about vaccination could be the result of the period in which our data were collected (in Italy, the overall number of infections was rapidly decreasing during the spring and fall of 2021 and this trend was primarily attributed by the authorities to the benefits of vaccination) and the characteristics of the sample that was recruited for the present study (most of our participants were young individuals aged between 18 and 30, with high educational levels, who might be particularly willing to get vaccination).

Our second aim was to determine the influence of individual differences in demographic variables on the intention to be vaccinated. We found that males and females did not differ in a direct comparison; however, in the following regression analysis, being female was associated with a reduced intention to get vaccinated against COVID-19. This is a common result which has been further confirmed by a recent meta-analysis (Robinson et al., 2021) and may be attributed to the fact that females have typically high levels of mistrust about vaccine benefits and more negative concerns about future unforeseen side effects, which in turn are important determinants of the willingness to be vaccinated (Paul, Steptoe, & Fancourt, 2021). In the present study, this tendency might have been exacerbated by the fact that females are more likely to use social media and were therefore overrepresented in our sample (Perrin, 2015). Replicating the conclusions reached by Palamenghi et al. (2020), we found that the middle-age group (41-50 years) was less likely to vaccinate, as compared to both the younger (18-30 years) and older (>61 years) groups. On the one hand, this outcome confirms the idea that elder people are aware of being more susceptible to the negative consequences of COVID-19 (Lazarus et al., 2021) and therefore more willing to vaccinate (Ruiz & Bell, 2021). On the other hand, the present results

echo previous data showing that Italian parents older than 35 years of age exhibited more hesitancy about the vaccination of their children and were less compliant with vaccination recommendations (compared to parents younger than 35 years: Giambi et al., 2018). Surprisingly, statistical analyses revealed that the intention to be vaccinated was significantly higher in participants who were single than in those who were married or divorced/widowed. Furthermore, vaccine acceptance rates were not significantly higher in participants who lived with others (family members, partners, friends, or housemates) than in those who lived alone. This is apparently in contrast with available evidence indicating that, in both the United Kingdom and the United States, more respondents would accept a vaccine to protect family, friends or at-risk groups than to protect themselves (Loomba, de Figueiredo, Piatek, de Graaf, & Larson, 2021). A potential explanation may be that, in the present study, marital status was confounded with age, such that participants who were single came predominantly from the youngest group (18-30 years; 88%) – i.e., a group who, as stated below, exhibited high levels of willingness to be vaccinated; in contrast, participants who were married or divorced/widowed came predominantly from the 41-50 year (25.9% and 30.8%, respectively) and 51-60 year groups (28.7% and 41.0%, respectively) – i.e. two groups in which intention to get vaccinated was substantially below the mean level of the whole sample (see Table 16).

With respect to the third aim, determining the roles of several psychological variables in predicting the intention to be vaccinated against COVID-19, our results are largely consistent with previously published findings. More specifically, we found that trust in government, trust in science and trust in medical professionals were among the strongest psychological predictors of the intention to be vaccinated. In agreement, people with high levels of trust in science have been shown to be more compliant with COVID-19 prevention guidelines (Bicchieri et al., 2021; Dohle, Wingen, & Schreiber, 2020; Hromatko,

Tonković, & Vranic, 2021; Pagliaro et al., 2021; Plohl & Musil, 2021) and more likely to get vaccinated against COVID-19 (Kerr et al., 2021; Palamenghi et al., 2020; Viswanath et al., 2021). In the cross-national study by Kerr et al. (2021), trust in medical doctors and nurses predicted vaccine acceptance in Italy, together with perceived infection risk and worry about the virus. Similarly, willingness to be vaccinated correlated with trust in scientific research in the study by Palamenghi et al. (2020).

Interestingly, we found that fear of COVID-19, but not perceived risk, was associated with increased vaccine uptake in the regression analysis, suggesting that the affective component of risk perception was more important than the cognitive component in predicting participants' behaviors during the pandemic (Dryhurst et al., 2020). Previous research examining the role of these two factors reported mixed findings. Studies conducted during the first wave typically found significant effects of perceived severity of COVID-19 on vaccination intent (Ruiz & Bell, 2021; Sherman et al., 2021). Gagneux-Brunon et al. (2021), for example, showed that fear of COVID-19 and individual perceived risk were both positively correlated with vaccine acceptance in a sample of French healthcare workers (see also Detoc et al., 2020). On the other hand, Qiao, Tam and Li (2020) found that fear of COVID-19, but not perceived susceptibility to the infection, was associated with increased willingness to be vaccinated in a sample of college students in North Carolina (see also Chu & Liu, 2021). It seems likely that variables such as the period in which the surveys were conducted, and the demographic characteristics of the recruited samples might explain these discrepancies. Specifically, our study was performed during the second wave of the COVID-19 infection and most of our respondents were young people, aged between 18 and 30. These two factors might have resulted in relatively low levels of perceived risk, which in turn contributed to the non-significant association with intention to get vaccinated.

While the effects of trust variables were positive, a variable which reduced participants' intention to be vaccinated in our study was susceptibility to misinformation. This is in line with the conclusions obtained by a randomized controlled trial conducted by Loomba et al. (2021), who found that recent exposure to misinformation induced a decline in vaccination intent of 6.2 percentage points in the UK and 6.4 percentage points in the USA. Similar findings have been reported by Roozenbeek et al. (2020), who showed that, across five different countries (UK, Ireland, USA, Spain, and Mexico), increased susceptibility to misinformation led to a significant decrease in people's willingness to get vaccinated against the virus and to recommend the vaccine to vulnerable friends and family.

Our findings have practical implications for developing interventions aimed at increasing the acceptance of COVID-19 vaccines. First, since trust in science and trust in medical professionals play a key role in predicting participants' willingness to be vaccinated, public health institutions should try to increase the feeling of cooperation between scientists and citizens (Palamenghi et al., 2020). The scientific community should create a dialogue aimed at educating and sensitizing common people towards the logic and the limits of scientific research (Provenzi & Barello, 2020). The mission of all scientists involved in the battle against COVID-19 is not simply to explain the reasons that justify the adoption of restraining measures, but to help create an enduring debate in which public concerns about the safety and effectiveness of vaccines can be expressed and properly addressed. In Italy, where most of the adult population has already received two doses, the establishment of such a climate would be particularly helpful in increasing acceptance of the so-called booster dose – which is still low (66%), according to a recent poll (https://www.ipsos.com/it-it/covid-terza-dose-vaccino-maggioranza-intervistati-riceverebbe-dose-richiamo). Along the same lines, a successful

COVID-19 vaccination campaign must actively fight against the spreading of misinformation, which seems to be especially fast on social media (Vosoughi, Roy, & Aral, 2018). This issue is particularly important since previous studies have shown that even brief exposures to misinformation can result in long-lasting negative effects on intention to get vaccination (Pluviano, Watt, & Della Sala, 2017). Social media such as Facebook and Twitter have already adopted algorithms and fact-checking platforms to ensure amplification of right and trustable sources, to direct users to reliable websites and to filter out fake news about COVID-19 (Brindha, Jayaseela, & Kadeswara, 2020). In addition, experimental evidence suggests that people tend to endorse false claims about COVID-19 because they do not spend sufficient time evaluating content accuracy and that a simple reminder at the beginning of presentation is sufficient to boost the level of trust discernment in participants who subsequently share information on social media (Pennycook et al., 2020).

6.6 Limitation and future directions

The present study has both strengths and limitations. The strengths are that we provided an updated picture of the vaccination intentions at the beginning of 2021, in a period in which the Italian government had just launched the immunization campaign, whereas previous studies were mostly conducted during the first lockdown phase (i.e., between March and May 2020; Palamenghi et al., 2020). Moreover, in line with previous international research (Dryhurst et al., 2020), we assessed a wide array of predictors, covering the cognitive, emotional, experiential and sociocultural implications of the current pandemic, whereas previous studies have been often focused on single aspects. Lastly, it is interesting that participants were recruited mainly using social media, considering that, as previously noted, the spreading of misinformation seems to

be especially fast on these media. Regarding limitations, our sample was not representative of the general Italian population because participants were recruited through different social media and were therefore mostly young, between 18-30 years of age, with high education levels. Second, the method was cross-sectional and correlational in nature, which means that we could not determine whether demographic and psychological factors were causally related to intention to be vaccinated. Lastly, despite the large number of predictors included in our survey, not all relevant variables were considered, like political ideology (e.g., Calvillo, Ross, Garcia, Smelter, & Rutchick, 2020), personality traits (Hampshire et al., 2021; Zajenkowski Jonason, Leniarska, & Kozakiewicz, 2020), and general vaccine attitudes and beliefs (e.g., Gagneux-Brunon et al., 2021; Sherman et al., 2021). Future studies should consider these variables to better understand the multifaceted process underlying people's intention to get vaccinated.

Chapter 7

Discussion

The primary aim of this dissertation was to identify the psychological and cognitive predictors of risk perception, social distancing, and vaccination hesitancy during the outbreak of the COVID-19 pandemic. During the last two years of the pandemic, numerous studies have sought to understand the psychological aspects underlying the population's adherence to preventive behaviours. One of the main reasons lies in the fact that pandemic control relies on adherence to preventive behaviour. Thus, an adequate perception of risk is a crucial element that governments must consider when developing strategies aimed at protecting public health.

In the first study, the innovative aspect was to examine affective and cognitive risk separately. Our analyses confirmed that, although the cognitive and affective dimensions of risk perception were moderately related to each other, they were predicted by different variables. Knowledge of these variables is crucial for understanding human beings' ability to avoid possibly dangerous environmental conditions, a key element of survival. To do this, it is necessary to consider underlying psychological variables, to circumscribe and quantify risk.

In our results affective risk seems to be playing a pivotal role during the present pandemic. This is in line with Short (1984), who stated that risk response seems to be mediated by family and social context. Therefore, it is evident that concern for one's family acts as a key element in the modulation of risk.

According to Slovic's model (see Chapter 1- section 1.1), an unpleasant event can be represented as a stone falling into a pond: the ripples generated by

the fall extend outwards, first to the directly affected victims, then to the indirectly affected ones. If we consider the COVID-19 pandemic, the perception of risk varies according to direct experience. As direct experience with the virus decreases, so does the perception of risk (Van Der Linden 2015). This is in line with our results, where cognitive risk is positively associated with direct experience with the virus. The association of risk perception with direct experience can be further explained by the availability heuristics. According to Tversky & Kahneman (1974), this heuristic assumes that individuals rely on the availability heuristic when assessing the probability of an event, considering "the ease with which instances or occurrences can be remembered". In other words, direct experience with the virus would facilitate the recall of information and thus influence risk perception. However, it must be considered that even if a relationship between affective risk and direct experience does not emerge in our results, past studies show how direct contact with the virus feeds the affective experiential system in the process of risk processing (Slovic et al., 2004; van der Linden, 2015). This conflicting pattern of results might be a result of considering the affective and cognitive components of risk as separate factors.

Another interesting result of our studies shows that cognitive risk estimates decrease in older adults. This result can be interpreted in several ways. On the one hand, as put forward by the Socioemotional Selectivity Theory (Carstensen, Fung, & Charles, 2003), older people are more present-focused and have a more positive approach towards the pandemic. On the other hand, a decrease in risk perception in this population is probably due to a decrease in the fear of death with increasing age (de Bruin, 2021). In addition to this, the deterioration of executive functions in the elderly (Giorgio et al., 2010) could also explain reduced risk perception, as executive functions are thought to be important in processing perception of risk (Capone et al., 2016). We believe that the study of risk perception in the elderly population is still lacking, even if the

elderly population is one of the most affective categories. Thus, further studies are needed in order to develop effective messages to encourage adequate risk perception and increase safety.

In addition to this, our first study demonstrates the key role of information in modulating risk perception. In particular, participants who followed COVID-19 information more closely were significantly more concerned about their own risk of contracting the virus. Consequently, it is crucial for governments to develop appropriate risk communication strategies to increase the level of information in the population. Effective risk communication implies that all risk messages must be shared transparently and quickly, in a way that bridges the gap between those who provide the messages and those who receive them and react to risk at the right time (Arvai and Rivers, 2014). Considering Zangh's model (Chapter 1 - Sec 1.4), communication between the government and the public must be based on complete and verified information on which the public can give feedback. According to Boholm (2019), the transparency of information communicated to the public must be limited, in order not to generate unjustified fear. Probably, the elements that need to be carefully considered in risk communication are the education levels of the target audience in addition to the transparency of the messages, to structure adequate communication.

Thus, this first study allowed us to understand how a part of the Italian population perceived the risk of COVID-19 during lockdown. Subsequently, given the general situation and the impossibility to collect data in the laboratory, we decided to continue our research trying to evaluate how the perception of risk and other cognitive and psychological variables could influence the behaviour of adherence to social distancing.

In our second study, we investigated the cognitive and psychological predictors of adherence to social distancing behaviour in Italy, in the period between 03rd March 2021 and 03rd August 2021. Our findings are in line with

the theory that respecting social distancing during the early outbreak of an infectious disease is guided by deliberate reflections on the costs and benefits of this behaviour (Reluga, 2010). In addition to this, we found that favoring the benefits for society over personal costs is associated to people's ability to understand/regulate their emotions and empathy (i.e., emotional intelligence). Stevens and Taber (2021) suggested that both affective and cognitive empathy offer the most optimal likelihood of individual engaging in prosocial behaviors. For example, according to Pfatcheinder (2020), inducing empathy for those most vulnerable to the virus promotes the motivation to adhere to physical distancing. Taken together, these findings suggest a relationship between emotional intelligence, empathy, and prosocial behaviors. Consequently, when designing communication interventions to promote change in protective behaviors during the COVID-19 pandemic, messages should carry not only information contents, but also some degree of emotional content.

We consider social distancing to be a "rational" behaviour during COVID-19. However, this is counterintuitive, as this is the opposite of human tendencies when humans face a crisis. Indeed, humans tend to seek social contact and closeness (Dezecache et al., 2020) during hazards. According to Christner et al. (2020), social distancing can be considered according to two approaches: 1) egoistic, (i.e., fear of contagion or fear of punishment are motivations for norm adherence in individuals) (Harper et al., 2020), 2) prosocial, (i.e., a form of oriented behaviour that aims at the well-being of others) (Jordan et al., 2021). Therefore, because social distancing behaviour is driven by selfishness or prosociality, understanding the psychological and social factors underlying it is necessary to better understand this phenomenon and to promote greater adherence to the norm.

Another important aspect we found in our study indicates that higher scores in social distancing compliance are associated with higher COVID-19 risk

perceptions and perceived benefits of social distancing costs. These results support the idea that health risk perceptions can significantly influence self-protective behaviours (Dionne et al., 2018; Lin & Lagoe, 2013). Thus, considering social distancing as a protective behaviour during the COVID-19 pandemic (Aquino et al., 2020), risk perception can probably be considered a predictor of social distancing. This is in line with previous studies (e.g., Adiyoso & Wilopo, 2021; K Xie et al., 2020; Yuan et al., 2021) in which risk perception influences adherence to social distancing. Moreover, our results fit into the HBM model, which is currently the most widely used model to study public health behaviour (Siddiqui et al., 2016). The model is based on the theory that individuals adopt healthy behaviours to avoid a health threat. In fact, in line with Hansen et al. (2021) (see Fig. 14, pp. 53) we observed how: a) demographic factors, b) hazard motivation (risk perception), c) perception of benefits over costs, d) psychological factors (anxiety, personality traits) contribute to influencing adherence to social distancing. These data highlight that, until now, attention has focused on the effects of COVID-19 in relation to mental health, but mental health should also be considered a potential predictor of compliance (Mukhtar, 2020).

In addition to the psychological components, our aim was to investigate whether cognitive components modulated social distancing compliance. We observed that, in contrast to the results of Xie et al. (2021), working memory does not seem to have an effect on compliance. Nevertheless, considering the positive relationship between compliance and anxiety, which can be conceptualised as the execution of protecting behaviours due to an amplified perception of danger (Oosterhoff et al., 2020), we decided to consider it as another possible mediator in the relationship between benefits and costs of social distancing. Our mediation model (see Fig. 21, pp. 112) suggests that the relationship between anxiety and compliance appears to be negatively mediated by the weight of benefits over

costs of social distancing. This shows that higher levels of anxiety are associated with a lower benefit over cost weighting and lower social distancing compliance.

Overall, we believe that the psychological and cognitive processes underlying adherence to prevention behaviour are multifaceted and complex. Taken together, these studies reflect on how the entire population is being asked to engage in immediate behavioural change, following an urgent directive to protect public health. Understanding who chooses to practice social distancing and why is critical for the development of effective public service campaigns to promote behavioural change both now and during the occurrence of possible future pandemics (Russel 2020). It should be borne in mind that the difficulty in studying social distancing lies in self-assessment. There is a risk that this procedure may lead to an overestimation of one's level of social distancing to convey a socially desirable impression to others and oneself (Balcetis 2008). Hence, in order for behavioural science to help develop useful strategies for public health protection, further studies need to assess this issue by measuring compliance in a more objective manner. One way to do this could be to the assess compliance using 'virtual' social distancing scenarios (Fazio et al., 2021) (see Fig. 15 a-b, pp. 55). These simulated scenarios correspond to real-life situations. They offer an intelligent way to index the extent to which individuals make decisions with respect to the concept of social distancing. An integration of self-assessment measures and virtual reality could provide behaviour-related indexes of social distancing, which take into account other possible cognitive functions such as decision making.

COVID-19 pandemic continues to have a major impact on mortality, disrupting societies and the global economic system. As a result, governments are developing large-scale vaccination programmes to mitigate and reduce the COVID-19 pandemic. Therefore, overcoming the pandemic will require adequate health system capacity and effective strategies to increase vaccine confidence and

acceptance (Joshi et al., 2021). However, vaccine hesitancy and misinformation may be obstacles in achieving high vaccination coverage and population immunity (Lane et al., 2018; Larson et al., 2014). Our research aimed at investigating how the impact of psychological factors and misinformation influence the increase (or decrease) in participants' willingness to be vaccinated in Italy. The study was conducted between March and April 2021, in the first phase of the vaccination campaign launch. Our results indicated a high acceptance of the vaccine. Nevertheless, it should be noted that our sample consisted mainly of young people. Probably, this might be explained by the development of a strong media campaign by the Government, which contributed to an increase in the adherence to get vaccinated in young people. In addition to this, our results confirm the validity of the 3c model (MacDonald, 2015 - see Chapter 3 - Section 3.1). Indeed, trust in science, in medicine and in the government were found to be good predictors of vaccination intention. In particular, trust seems to be a key factor for adherence. Moreover, in line with the 3c model, the "convenience" factor (i.e., the ease of availability of the vaccine) is indeed useful in promoting greater adherence. In the case of Italy, our study show that “convenience” influenced vaccination adherence, in a period where vaccination campaign proceeded quickly, and the accessibility of the vaccine was optimal.

Another interesting finding of our study concerns fear of COVID-19 as a predictor of intention to be vaccinated. This is in line with previous literature, showing that a lower perception of contracting COVID-19, a lower fear of COVID-19 and the belief that COVID-19 does not lead to serious medical conditions were associated to greater vaccination hesitancy (Aw et al., .2021). Thus, during a pandemic, 'fear' behaves as a normal, context-dependent response. Therefore, it is necessary to understand the context in which negative

emotional states occur, because they can act as good predictors of prevention behaviour.

Moreover, according to the "3c" model, vaccination complacency exists when the perceived risks of vaccine-preventable diseases are low, and vaccination is not considered a necessary and useful action to limit the disease. Therefore, the success of a vaccination campaign may cause complacency and hesitation due to the tendency to evaluate the risks of vaccination as greater than the risks caused by the disease.

Finally, we observed how beliefs associated with misinformation decreased the intention to vaccinate in our sample. It is evident the information coming from not credible and certified sources contribute to generating false beliefs and decrease our adherence to vaccination. These findings are supported by Johnson et al. (2020), who found that the dissemination of false and/or misleading information can lead to harmful consequences, such as the proliferation of anti-Vax groups on social media. The dissemination of such information can contribute to panic and facilitate the formation of misconceptions about vaccines.

Interestingly, distrust and belief in conspiracy theories are also linked to psychological factors. According to Chou & Budenz, (2020) conspiracy beliefs, distrust and misinformation could potentially mediate the effect of psychological state on vaccine acceptance, by increasing fear of vaccination. Moreover, people with higher scientific literacy are less likely to believe in conspiracy theories (Yang et al., 2021). Thus, these data support the idea that vaccination hesitation and misinformation may be obstacles in achieving high vaccination coverage and population immunity (Lane et al., 2018; Larson et al., 2014). For this reason, institutions should monitor the information that is disseminated on social media. The speed with which information spreads on the web is fast, therefore it is necessary to develop fact checking strategies that monitor the truthfulness of the

information. Thus, the scientific community should create a dialogue aimed at educating and sensitising the general public towards the logic and limits of scientific research (Provenzi & Barello, 2020). Indeed, the mission of scientists involved in the battle against COVID-19 should not be to only explain the reasons for adopting restrictive measures, but also to help create a lasting debate in which the public's concerns about the safety and efficacy of vaccines can be properly expressed and understood. In our country, where most of the population has already received two doses, the establishment of such a climate would be particularly helpful in increasing the acceptance of the so-called booster dose - which is still low (66%), according to a recent survey (https://www.ipsos.com/it-it/). This will enable the population to protect their own lives and those of others.

Overall, we are convinced that the relationship between perception of risks, protective behaviors and intention to vaccinate are elements that must be understood in more details. Future studies are needed to understand the psychological and cognitive components that are responsible for changing people's attitudes in the face of a health emergency.

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Supplementary material

Supplementary Table S1. Statements of Benefits and Costs about Social Distancing (taken from Xie et al., 2021)

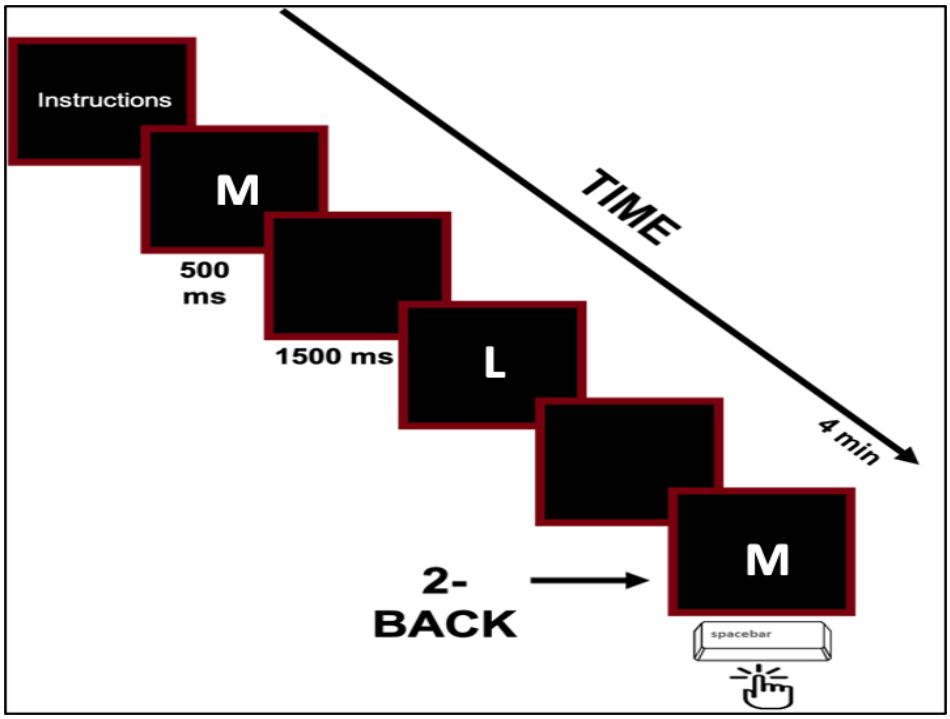
Category	Statement	Note
Benefit	Social distancing can prevent to me from catching COVID-19.	Self-related interest
Benefit (Reverse code)	Young adults do not need to practice social distancing.	Social distancing among young adults is beneficial not only to stop virus from spreading, but also to free up medical resource
Benefit	Social distancing stops COVID-19 from spreading around.	General benefit
Benefit	Older adults should stay at home because they are more vulnerable.	Benefit for vulnerable populations
Benefit	Social distancing may minimize the burden on medical resources, so people in need can use them.	Social benefit
Cost	Not being able to hang out makes me upset.	Self-related cost
Cost	Small business (e.g., local restaurant and bars) could not survive if people keep social distancing.	Societal cost
Cost	Social distancing makes people lose their job.	Financial cost
Cost	I practice social distancing because people around me do so.	Social cost

Supplementary Table S2. Statements of Compliance to Social Distancing

Category	Statement	Note
Compliance	"held no social gathering with friends"	"never" (1) to "very often" (5)
Compliance	"cancelled events or plans to go to an event"	"never" (1) to "very often" (5)
Compliance	"stopped going to the church or attending other community activity"	"never" (1) to "very often" (5)
Compliance	"had no handshakes, hugs, or kisses when greeting"	"never" (1) to "very often" (5)
Protective behaviour	"how often they had washed their hands in the past week"	"never" (1) to "¾ times per day"

Note. How closely they followed a range of social distancing practices in the last three months

Supplementary Fig 1. Nback memory task



Supplementary Table Fig 2. Corsi task