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How System Efficacy Affects Risk Perception: Comparison of the United States, Iran, and China throughout the COVID-19 Pandemic

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by

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ABSTRACT

The current study fills a gap in the risk and health communication literature that deals with perception of risk. The extended parallel process model (EPPM) and associated Risk Behavior Diagnosis Scale lack consideration for attenuated perceptions of risk when people believe that some agent (e.g., government agencies or first responders) will protect them from a hazard. This project's intention is to establish the validity of a new concept, system efficacy, as an addition to the EPPM model. System efficacy supplements current use of self and response efficacy. In addition, this study tries to investigate how culture affect risk perception by comparing the United States, Iran, and China. Finding show system-efficacy as an independent variable affecting risk perception and cultures affect system-efficacy especially for Iranian and American participants which show different perceptions of system-efficacy and self-efficacy.

Keywords: Extended parallel process model, system-efficacy, risk, risk perception, health communication, culture.

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DEDICATION

Thank you to my husband, Taylor, for constantly listening to me rant and talk things out, for proofreading over and over, for cracking jokes when things became too serious, and enduring this long process with me.

I would never be here without my family. My mom's constant love and support keep me motivated and confident. My accomplishments and success are because my brother believed in me. I am sad that my dad cannot see me graduate, but I know he is smiling.

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LIST OF ABBREVIATIONS

AMOS	Analysis of a Moment Structures
AVE	Average Variance Extracted
CDC	Center for Disease Control and Prevention
CFA	Confirmatory Factor Analysis
CHN	China
EFA	Exploratory factor analysis
EPPM	Extended Parallel Process Model
IBM	International Business Machines Corporation
IRA	Iran
IRB	Institutional Review Board
MCLS	Ministry of Cooperatives Labor and Social
MSV	Maximum Shared Variance
PMT	Protection Motivation Theory
PPM	Parallel Process Model
RBD	Risk Behavior Diagnosis
RMSEA	Root Mean Square Error of Approximation
SPSS	Statistical Package for the Social Sciences
USA	United States of America
WHO	World Health Organization

CHAPTER I – INTRODUCTION

Risk Perception In The Context Of COVID-19

The COVID-19 pandemic hit the world in late 2020. The spread of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) changed lives, economics, health systems, and caused more than 250 million cases around the world and five million deaths by October 2021 (Cucinotta & Vanelli, 2020). A public health emergency of international concern was declared by the World Health Organization on January 30, 2020, and a pandemic was announced on March 11. The SARS-CoV-2 virus was first identified in Wuhan, China in December 2019 and quickly spread around the world. The virus affected Asia, Europe, Africa, North America, South America, and Australia one after the other and traveled around the world with people. The United States Centers for Disease Control and Prevention (CDC) announced the first U.S. laboratory-confirmed case of COVID-19 in the U.S on January 20, 2020. Doubts existed about the spread of the virus in some countries. For example, after many reports from Iranian doctors and health workers, Iran officially recorded the first COVID-19 case on February 19, 2020 in Qom.

WHO, CDC, physicians, and health experts suggested recommendations for people in order to protect themselves and others, such as washing hands, wearing proper face covering, socially distancing, and receiving a vaccine. As witnessed for almost two years, different interpretations and opinions exist about this guidance among various communities. Hence, finding methods to construct more convincing messages is vital for public health experts.

For more than 25 years, health communication campaign designers have used the extended parallel process model (EPPM) to construct persuasive messages. EPPM, first introduced by Witte (1992), provides a framework to explain and predict individuals' behaviors in response to fear appeals. For example, anti-smoking campaigners in Canada designed warning labels on cigarettes using this model (Goodall & Roberto, 2008). Scholars have extended the approach beyond traditional fear appeals (Lewis et al., 2013). Risk-based appeals can be very persuasive, promoting individuals to act in an appropriate way under certain conditions (So et al., 2016). The EPPM model demonstrates that the appraisals of an appeal are derived from individuals' perceptions of threat and efficacy related to a hazard (Yun & Berry, 2018). Depending upon the perceived threat and efficacy (the ability to act with the intent to protect oneself and others), individuals may act to respond to the threat, to minimize their emotional response, or to avoid any act and do nothing (Witte, 1992; Witte & Allen, 2000). To increase the effectiveness of a risk-based appeal, message designers should increase an audience's awareness of a threat while simultaneously reinforcing people's perception of efficacy (Witte & Allen, 2000; Yun & Berry, 2018).

When initially reacting to a fear-based persuasive message, people engage in threat appraisal. A threat is evaluated in terms of susceptibility and severity. Susceptibility is the belief that the potential threat is relevant to the individual (Witte & Allen, 2000). For example, a male might perceive that a message about testicular cancer applies to him, while a female might not. Severity is the understanding of the extent of the impact, or the consequences if the threat manifests. A man aged 25 might perceive testicular cancer to be a greater threat than a man who is 80 (because this type of cancer

is rarely fatal when it is diagnosed at an advanced age). If susceptibility and severity are viewed as being low, the audience will likely reject the message as irrelevant.

People will continue to process the message under three conditions. When both susceptibility and severity are high, the audience will be motivated to attend to the message. When severity is very high, people might continue to pay attention, even if susceptibility is relatively low; a low likelihood but high consequence message can still elicit an intended reaction (Witte & Allen, 2000). For example, a house fire should be a rare event, but the consequences are devastating, and so people are motivated to buy insurance, install smoke detectors, and so on. Additionally, if susceptibility is very high, people may still pay attention, even if the consequences are relatively mild. For instance, soccer players may choose to wear shin guards to avoid the common annoyance and minor pain of being kicked.

If people do not reject the message during the appraisal of the threat, they next consider efficacy. EPPM identifies two types: response and self-efficacy. Self-efficacy is the extent to which someone believes that they have some way to respond to protect themselves or others. Response efficacy is the predicted effectiveness of the potential actions (Witte & Allen, 2000).

Recently, a third type of efficacy has been conceptualized (Venette, 2008; Venette & Reif-Stice, 2020). People's perception of a problem is also affected by their beliefs about what others will do to protect them from that hazard. For example, if a house is on fire, individuals are unlikely to believe that they have the sole responsibility to respond, beyond escaping and calling the fire department. Firefighters bear the responsibility to fight the fire, ultimately. Moreover, in the case of crimes, individuals call the police, and

the understanding is that law enforcement is going to solve the crime and save the day. In case of hurricane evacuation, people might rely too heavily on first responders and may not evacuate. People can believe that external entities such as friends and family, first responders, support networks, charities, and government agencies will provide relief. Thus, even if self and response-efficacy are low, people could still take a problem-solving perspective if system-efficacy is high. Hence, system-efficacy can play a crucial role in creating persuasive messages and encouraging individuals toward healthier or safer behaviors.

Models that point to two dimensions of efficacy do not consider other entities that are perceived as providing effective responses. The amount of trust people have for individuals or organizations in their environment, or "system," as well as their perception of risk and fear affect their behaviors. *System-efficacy* may come from different beliefs and for that reason may result in different outcomes (compared to self-efficacy). People's perception of the problem is also based on what they consider as others' responsibility. People believe that external entities such as friends and family, first responders, support networks, charities, and government agencies will provide relief. So that, even if self and response-efficacy are low, they could still take a problem-solving perspective if system-efficacy is high. Hence, system-efficacy is pivotal in creating persuasive messages and encouraging individuals toward healthier or safer behaviors.

When people gather, select, and interpret clues about uncertain impacts of events, through direct and indirect experience, they are processing their perception of risk (Slovic, 1987; Wachinger, 2010). Risk perceptions are interpretations of the world, based on experiences and beliefs. There are different studies that show there is a relationship

between risk perception and individuals' reaction to warning messages. In comparison with individuals with high risk perception, those with low risk perception are less likely to respond to warning messages (Liu-Lastres & Pennington-Gray, 2019; Ruin et al., 2007). In other words, high risk perception will result in personal protective actions. There are different factors that affect risk perception, such as culture, gender, and individuals' trust in public authorities (Liu-Lastres & Pennington-Gray, 2019). Therefore, system-efficacy appears to be a potentially important addition to the models that try to explain individuals' behavior facing threat, such as the EPPM. The purpose of this study is to understand how system-efficacy affects risk perception in different cultural, political, and socio-economic contexts of the United States, Iran, and China.

Because differences exist between systems that may affect an individual's processing of risk information, data will be drawn from three culturally and geographically diverse countries: the United States of America, China, and Iran. These three counties are vastly different in cultural, religious, economic, and political systems. COVID-19 hit all three strongly. China was the birthplace of the pandemic, and its communitarian response was unified but strict. Iran was one of the first countries to be affected by the spread of the disease, and its response was troubled. The U. S. response has been controversial and plagued by misinformation.

Beginning with the United States, according to the world population review website, the population as of November 10, 2021, is 333,620,638. With a population this size, one can assume that there will be many opinions and perspectives. For example, trust of the government or news outlets varies (Kalogeropoulos et al., 2019). Some conditions that may affect perceptions are social class and religious beliefs. As of 2020,

based on the Census website, the U. S. poverty rate was 11.4% of the total population, those considered rich were about 10% of the total population (possessing almost 70% of the country's net worth) which leaves about 80% of the total population in the middle-class bracket. The reason that wealth is mentioned is because the wealthier do tend to be better educated and informed on many issues (Buchholz, 2021). Protestant/Christian tradition is the majority at 48.9%, 23% identifies as Catholic following by many varieties of Christianity. Judaism is the religion of 2.1% of the population. Other religious minorities such as Islam (0.8%) and Mormonism (1.8%) exist within the US population, while smaller numbers identify as Buddhists, Hindus, Sikhs, Wiccans, and many other varieties of religious faiths. As for political affiliation, the United States is a democratic republic. This system, in theory, means the voices of citizens will be heard (democratic) by government representatives who speak and vote on their behalf (republic).

Iran is another country that was greatly impacted by COVID-19, compared with the neighboring countries, and the government response was lambasted by health care workers and activists. Criticism grew stronger after the supreme leader banned the importation of American and British vaccines.

World Population Review (2021) reports that 85,397,967 people are citizens of Iran in November 2021. Iran has a diverse society with native speakers of Farsi who have mixed ancestry. The country has Turkic, Arabic, Kurdish, Baloch, Bakhtyarian, and Luran ethnic groups. The considerable portion (89%) of the population in Iran is Shi'a Muslim, 10% are Sunni Muslim, and the remaining 1% are Christian, Zoroastrian, Baha'i and Jewish. With most of the people being Ithnā ʿAsharī, or Twelver, Shiʿi branch, which is the official state religion (Avery et al., 2021). This official religion makes the

leadership of Iran the politicized Shi'i clergy (Buchta, 2021). After the revolution in 1979 Iranian revolutionists took power and changed the country to an Islamic republic state. The president as the chief of executive does not determine the general guidelines of the countries' policy. Absolute power lies with the supreme leader, which since 1989 has been Ali Khamenei who will rule for the rest of his life.

Iran's economy is extremely unstable due to economic sanctions. Since 2018, with Donald Trump's new sanctions, Iranian people have faced huge inflation. The MCLS report estimates that 32% of Iranians were below the poverty line in 2019 (Salehi, 2021). According to World Bank Blogs (2021), In 2015-2016, more than 4.3 million students were studying in Iran's universities, in other words, more than 5% of the country's total population or were enrolled in Iran's higher education system.

China is the most populated country in the world with 1,445,974,367 people, based on the World Review Report (2021), but some confusion exists around how many people live in China. The People's Republic of China (PRC) is governed by the Communist Party in Beijing. Although China is classified as an upper middle-income country on the World Bank website (2021), nearly 10% of its population live on less than $1 a day. Fifty-six different ethnic groups live in China, more than 91.51% are Han Chinese, and except for the Zhuang, no other group has a larger than 1% share of the population. China is officially an atheist country and does not survey people about religion. However, as of 2017, there are more than 350 million religious people in China, based on independent groups' estimations, such as the research and advocacy group Freedom House. Chinese people mostly follow Taoism, Buddhism and Confucianism, with the addition to some Islam and Christianity.

This study investigates how to design persuasive health messages about COVID-19. Using extended parallel process model, this study compares three different countries, the United States, Iran, and China and their citizens' risk perception. The next chapter will explore the literature surrounding the theoretical background, risk perception, and the system-efficacy concept.

Social identity theory helps explain how people's perceptions are affected by their group memberships. Part of individuals' identity comes from their membership and interaction with different group members, resulting in the same cultural identity and values being shared by members of that group (Tajfel & Turner, 1979). What people perceive as a problem and their perception of that problem are derived from their cultural identity.

In different cultures, cultural identity is divergent. For example, in collectivist countries, the values and goals of "the group" is more important than those of individuals. As a result, the support members of collectivist countries get from their society is more important for them than those who live in individualistic countries (Kim, 2013). Iran and China are countries with collectivist societies (Hoftestede, 1997) which means in these cultures, people rely more on "others" in problematic situations. This study focus is on how people trust of "others" (system efficacy) can affect their perception of risk and eventually their reactions to persuasive messages regarding the risk.

CHAPTER II – LITERATURE REVIEW

Leventhal (1970, 1971) proposed a danger control versus fear control framework, suggesting two distinct responses to health risk messages, focusing on both cognitive and emotional processes (Witte et al., 2001). Thus, when facing a health condition or a disease, people use two different mechanisms, called danger control (cognitive process) or fear control (emotional process), to plan an action (Daley et al., 2009). Leventhal (1970) explained danger control as the attempt to reduce exposure to a threat, changing the attitude, intentions, or behaviors cognitively. When someone perceives that a threat is legitimate, and they believe that they have a reasonable response that will control the consequences, then they move to danger control (Witte & Allen, 2000). In this mode, people have accepted the message and are motivated to engage in behavior change. If the audience sees the recommended action presented in the message as efficacious, then they are likely to participate. People are likely to adopt a healthy behavior and make recommended behavioral changes if they think they are in control of the danger. Previous studies have demonstrated that this approach applies to a variety of persuasive campaigns, such as for AIDS prevention, skin cancer and tractor safety (Morrison, 2020). However, current scholarship does not consider how perceived efficacy of agents other than the self might influence danger control.

Alternatively, fear control occurs when people avoid or deny the threat to manage their discomfort associated with the hazard (Leventhal, 1970). Fear control exists when someone is motivated to attenuate the negative emotions or unpleasant feelings associated with the threat. In response to a threat, if someone does not believe that they have a course of action that would be effective, and they do not believe that others will

protect them, they often engage in fear control (Witte & Allen, 2000). Fear control leads to maladaptive responses that often move people away from the message's suggested response (Leventhal, 1970,1971; Witte et al., 2001). A smoker, not believing that they can quit smoking, might simply joke that they "have to die of something." Denial is a common coping mechanism when people are in fear control mode. Perceptions that "no one can help me" is consistent with fear control motivation. Fear control can also result from messages that contain "gruesome content" (O'Keefe, 1990) such as pictures of smokers' lungs or photographs of crash victims.

Extended Parallel Process Model

The extended parallel process model (EPPM) expanded the parallel process model (PPM) by explaining why fear appeals do not always work, putting fear as a central variable, and specifying the relationship between threat and efficacy (Witte, 1992). The parallel process model employs the two directions for individuals' response to a threat articulated by Leventhal (Witte, 1992). Danger control is a cognitive process that individuals employ to control the danger by changing intentions, attitudes, and behaviors; fear control, however, happens when individuals deny or avoid the threat when facing it (Witte, 1992; Witte & Allen, 2000).

Protection motivation theory (PMT) was based on the parallel process model. This approach focuses on danger control response. According to PMT, the highest level of four message components (one's vulnerability to the threat, severity of the threat, perceived self-efficacy, and response-efficacy) builds the greatest protection motivation that results in the highest level of adaptive changes in attitude and behavior (Popova, 2012; Rogers, 1975, 1983).

EPPM is also based on the fear-as-acquired-drive model (Hovland et al., 1953). Fear-as-acquired-drive model as a learning theory tries to explain human behavior in terms of learned responses and reward (Popova, 2012). Based on this theory, people are motivated to reduce the unpleasant emotion of fear by taking actions, if they learn to fear a threat first. If their actions result in reduction of fear, they will resort to habitual responses because of the reward they have received from past experiences. The reduction of fear could happen both by adaptive (reassuring recommendations) or maladaptive (defensive avoidance) actions (Hovland et al., 1953; Popova, 2012). EPPM uses maladaptive action to explain what happens when people are in fear control mode (Popova, 2012). In other words, people are motivated to control their negative feelings rather than reducing exposure to the hazard.

Three basic concepts influence perceptions of a fear appeal: fear, threat, and efficacy (Witte, 1992). In numerous campaigns, fear has been used as a potential motivator for getting the intentional response. A fear appeal in persuasive messages exists when the message shows some fear that is a result of a threat then gives some recommendation for deterring the hazard (Witte, 1992). Fear is a highly defensive and negative emotion that is a response to a potential negative event. A threat is a hazard that exists regardless of whether a person knows it or not (Witte, 1992). The cognition or thought about the threat is a perception that should be distinguished from real hazard (Witte, 1996). Threat is conceptually different from perceived threat. Perceived threat is a cognitive perception about a danger or harm in the environment (Popova, 2012). Perceived threat is made of severity of the threat (Lung cancer can kill you) and susceptibility of the threat (I am a smoker, I am at risk for lung cancer) (Witte, 1992).

Studies show that perceiving threat is a key variable in persuasive messages (Witte, 1996). Thus, messages with this element normally show four different aspects; threat severity (the impact of the hazard generally; e.g., opioid abuse can lead to death), perceived severity of the threat (e.g., opioid abuse can lead to *your* death), threat susceptibility (e.g., everyone who takes opioids can have an adverse reaction) and finally perceived susceptibility is people's belief about their chances of experiencing the threat (i.e., the receiver of the message is an opioid user). When people become frightened, they can deny or avoid a threat, change their behavior, or even become motivated to reduce the threat (Witte, 1991).

Perceived efficacy is about one's beliefs of the capability to respond to a threat, whether that is their belief about suggested responses and how they will help them avoid the threat (response-efficacy; e.g., I strongly believe quitting smoking will prevent lung cancer) or their beliefs about their own capabilities to organize and execute the courses of action required (self-efficacy; e.g., I am able to quit smoking) (Bandura, 1977; Witte, 1992). Since efficacy is a message characteristic, it is often the variable that is manipulated in EPPM studies. Usually, high efficacy messages are compared to low efficacy messages, or specific messages produce high efficacy for qualitative studies (Popova, 2012).

The extended parallel process model's focal point is the effect of perceived threat and perceived efficacy on changes in attitude and behavior (Thompson et al., 2011). Based on EPPM, how individuals change their intentions, attitudes, and behaviors in response to a fear appeal is affected by their perceived threat and perceived efficacy (Witte, 1996; Witte & Allen, 2000). Perceived threat has two dimensions: first, perceived

severity is about how significant individuals think the threat is. Second, perceived susceptibility is about individuals' beliefs of how they are at risk for the threat (Thompson et al., 2011). In general, EPPM suggests two cognitive appraisals, an assessment of threat and an evaluation of the efficacy of the recommended response (Witte et al., 2001). Perceived efficacy determines whether people will engage in danger control or fear control processes. Danger control processes lead to acceptance of a health risk message, and fear control processes usually lead to rejection of the health risk message (Witte, 1992; Witte et al., 1993).

The EPPM posits that fear appeals can have a persuasive effect, but only under certain conditions: receivers must perceive the threat, they must feel vulnerable to the threat, they must believe that the recommended action is effective in preventing the threat and that they also are able to perform the action (Ooms et al., 2015). Depending on one's level of perceived threat and efficacy different outcomes are possible. If the perceived threat is low, the person is not motivated to listen to the message, as a result, no response will occur (Thompson et al., 2011) and they will ignore the risk message (Witte et al., 2001). Regardless of efficacy, intents, attitudes, and behaviors will change the least in case of low perceived threat (Witte, 1991). In other words, the greater they perceive the threat the more they are motivated to begin the second appraisal and evaluate the efficacy to the suggested response (Witte, 1992). In contrast, when people feel vulnerable about the threat and believe it will harm them, they will be fearful and motivated to act (Witte et al., 2001).

In case of high perceived threat and low perceived efficacy, people will engage in fear control, take steps to decrease the fear, and show defensive avoidance, denial, or

reactance (Thompson et al., 2011). Fear control process happens when individuals emotionally respond and cope with their fear but not the danger (Witte, 1992). At this point after thinking about the efficacy and recommended response "people believe they are not able to do anything about the threat or their response would not be enough to protect them from the threat. They try to control their fear by surpassing the thought of danger or even attacking the message and communicator" (Witte, 1993, p.116). A recent example for fear control is how some people act toward COVID-19 messages, calling it a hoax or a controversy. Lastly, if individuals believe that they are at risk for a threat, they can perform the recommended response, and the response will be successful in averting the threat, they will cognitively confront the danger to control it (Thompson et al., 2011; Witte, 1992; Witte et al., 2001). The more perceived efficacy dominates the perceived threat, the more people are motivated to control the danger. Fear appeal messages with a high level of perceived threat and efficacy tend to have the highest acceptance rate (Kleinot & Rogers, 1982; Maddux & Rogers, 1983; Rogers & Mewborn, 1976; Witte, 1992).

EPPM shares some assumptions with other studies, and contains some specific assumptions, such as those that individuals are not aware of the threat before receiving fear appeal messages (Popova, 2012). Some researchers believe that some of EPPM propositions have not been investigated or supported empirically. In her study, Popova (2012) reviewed all propositions of EPPM to verify them for empirical support. She reported that none of the EPPM's propositions has received unequivocal support, half of them had not been tested extensively or if tested they have been operationalized incorrectly (Popova, 2012; Ooms et al., 2015). Further, Ooms, Jansen, and Hoeks (2015)

found that threat did not mediate the effect of fear on intention. These results raised scholars' concerns about the accuracy of EPPM propositions and heightened the crucial importance of conducting more empirical analysis on the model. For decades, the theory has had utility for health communication and persuasive risk and crisis communication concerning constructing persuasive messages. This theory "could serve as a foundation for a covering law theory of negative emotions and persuasion" (Popova, 2012, p. 468). In addition, EPPM could build bridges between the theories of emotions and persuasion (Popova, 2012).

EPPM is not the simplest theory, as it has 12 propositions, but it is successful in explaining the model in a way that is understandable, usable, and more importantly possible to develop, expand, and grow. This theory tries to explain behaviors in relation to a major emotion of fear and is one of the strengths of EPPM; however, it is hard to measure fear separately from the assessment of threat. Witte (1992) conceptualized fear as a subjective experience; thus, she measures fear by using self-reporting (Popova, 2012) that can be a weakness for the model.

Fear is not the only emotion aroused by a fear appeal. Responses can often be accompanied by anger (Dabbs & Leventhal, 1966; Leventhal et al., 1965) and are correlated with feelings of surprise, puzzlement, sadness, and decreased happiness (Dillard et al., 1996). Dillard (1994) states that instead of developing a theory for each emotion and simply controlling for effects of other emotions in empirical tests, "a far more productive task would be to broaden our sights beyond a single emotion and to aim for a general theory of affect and persuasion" (p. 316). However, it seems like EPPM works well for other negative emotions as well. Basil et al. (2008) used it as a foundation

for assessing guilt appeals, and EPPM was found to explain almost 60% of behavioral intentions.

System-Efficacy

The concept of system-efficacy in relation to EPPM and risk behavior diagnosis was developed by Venette (2008). System-efficacy is the belief that some entity outside of one's self can provide effective support and/or mitigate harm (Anthony et al., 2018; Bagley, 2019; Macpherson et al., 2014; Venette, 2008). The amount of trust people have in their society or "system" affects their risk behaviors. For example, when they believe that they cannot or should not attempt to respond to a negative event, people call emergency services. Hence, one does not have to worry about the threat if someone else will take care of it. In their study, Bichard and Kazmierczak (2012) found that most people believe that authorities are mainly responsible for flood protection, and it is the system's obligation to alleviate the burden from the residents of taking protective action themselves. This perception combined with their own experience affects their response to the hazardous situation (Wachinger et al., 2013) because an individual's decision to act is determined by how he or she interprets the given information based on previous experiences (Paton, 2008).

System-efficacy can play a key role in individuals' decision making. Low perception of system-efficacy can be the reason parents reject vaccination for their children, simply because they are questioning the intentions of governments and companies involved (Bagley, 2019). Based on Bagley's (2019) research on individuals' desire to purchase the Narcan nasal spray, system-efficacy is a strong predictor of behavioral intent, even better than self-efficacy (Bagley, 2019). People's perception of

solving the problem is affected by what they consider as “other’s” responsibility. For instance, people expect the government, caretakers, scientists and society to take responsibility during the COVID-19 pandemic. However, the level of trust each individual has in organizations varies. If a person’s self-efficacy is low and system-efficacy is high, they are unlikely to be persuaded to use personal protection such as masks. Depending on the context, people believe external entities, such as friends and family, first responders, support networks, charities, and government agencies will provide relief. This concept is important because even if self and response-efficacy are low, people can still take the problem-solving perspective if their system-efficacy is high. Hence, system-efficacy’s role to make persuasive messages and encourage individuals’ healthier behaviors is significant.

Culture and Risk Perception

Finding a simple and distinctive definition for risk is almost unfeasible. Lowrance (1976) defines risk as a measure of the probability and severity of adverse effects. Uncertainty is the main part of multiple risk’s definition. Dorofee et al. (1996) suggest a definition for risk which consists of two aspects; 1) some loss must be possible and 2) there must be uncertainty associated with that loss. Proutheau and Heath (2009) put uncertainty as their main part of risk: “risks are defined as probabilistic occurrences that can have positive or negative outcomes of various magnitudes" (p. 576). All forms of risk, whether they are speculative or hazard risks, share basic elements of context, action, conditions, and consequences (Alberts, 2006).

Those who study risk perception look into individuals’ judgments of hazardous situations and how they characterize and evaluate them. People’s perception of risk varies

based on how they describe it. Media affects risk perception by influencing societies' intuitive risk experience. What comes to individuals' minds when they think of something "risky" determines what their perception of risk is (Slovic, 1987). Wogalter et al. (1986) found that people with higher risk perception in a case are more likely to check the warnings regarding that case. Therefore, studying specific demographic's risk perception is a crucial for communication scholars designing persuasive messages.

There is a gap in the literature studying how culture affect risk perception in communication field which needs to be filled. Culture is a set of characteristics shared by a group of people that shape their behavior (Vredenburgh & Cohen, 1995). Singer (1998) defined culture as learned perceptions absorbed in groups that are expected and acquired by identity groups. With culture, individuals process, evaluate, and organize stimuli from the environment (Singer, 1998). Cultures are constantly changing due to persistent changing of the environments around individuals. Hence, their perception and experience of the world, and their behaviors are constantly changing. As a result, there is a spectrum of likenesses in peoples' perceptions especially if they are in the same identity groups (Singer, 1998).

Social identities cause the creation and recreating of discourse and social cognition structures. Simultaneously they are formed and entitled by the social products they are associated with (Hopf, 2002). "Social construction means our social context informs identity and action, or who we are and what we do" (Srivastava, 2020, p. 325). From another point of view, social construction is an intellectual movement that is embedded in a relational view of reality and supplies a definite view of decision making (Cottone, 2001). Social construction begins not with the actor but the action. Based on

constructivism the decision-making process happens in interaction (Cottone, 2001). "Social constructivism takes decision making out of the head of the decision maker and places it into the social context itself " Cottone, 2001, p. 40). A decision is "simply an action taken within a social context deriving from biological and social forces" (Cotton, 2004, p. 7). As a result, our behaviors affected and came out of our social relationships (Cook-Cottone, 2004).

According to the cultural cognition thesis, people understand risk more based on their values and belief system than the risk itself. This thesis argues that people perceive risks and related facts in relation to personal values, and individuals analyze and evaluate risks regarding the cultural values and conceptions of ideal society (Kahan et al., 2009). The cultural cognition thesis argues that public disagreement over key societal risks (e.g., climate change, nuclear power) arises not because people fail to understand the science or lack relevant information, but rather as a result of the fact that "people endorse whichever position reinforces their connection to others with whom they share important ties" (Kahan, 2010, p. 296).

Based on this theory people who belong to individualistic cultures (such as the United States and Sweden) tend to disregard claims of threats, since the acknowledgment of the hazard would threaten the authority of social elites (Kahan et al., 2007). A cultural cognition approach thesis explains the formation of risk perception and suggests implications for the attribution of responsibility; hence, it studies how individuals preexisting values and beliefs affect their response to: "who is (or should be) responsible for responding to a given risk?" (Yang, 2016, p.1081). In her study Yang (2016) concluded that the "self vs. others" and the "us vs. them" mentality is evident towards

shaping individualistic-hierarchical worldviews. Yang suggests that risk communication messages are more supporting when they are aimed towards finding common issues and goals rather than separating those in risk and the responders (Yang, 2016).

Hypothesis and Research Question

Since system-efficacy appears to increase the explanatory power of EPPM, this study intends to study the effect of the variable in different cultures. Thus, system-efficacy is tested as a unique concept, distinct from self and response-efficacy in three different societies. To test the proposal, one research question and one hypothesis was posited:

RQ: How does the perception of risk associated with COVID-19 vary culturally?

H: System-efficacy affects peoples' perception of the risk of COVID-19.

Ultimately, a model was constructed that reflects the relationships posited by EPPM and the RBD scale, with the addition of system-efficacy. The final model for the study is presented in figure 1. A circle icon in the model is used to draw the unobserved variable. A single headed arrow in the model is used to draw the cause effect relationship between the observed and unobserved variables.

Summary

Chapter two reviewed the literature around the theory of extended parallel process model, the system-efficacy construct, and the culture and risk perception in dept. This review shows a gap in the literature of risk perception. How cultures affect this perception and how the environment and other people in society play a role in individuals' responses to persuasive message. After the review one hypothesis and one

research question have been proposed. The next chapter is about the research methodology of the study.

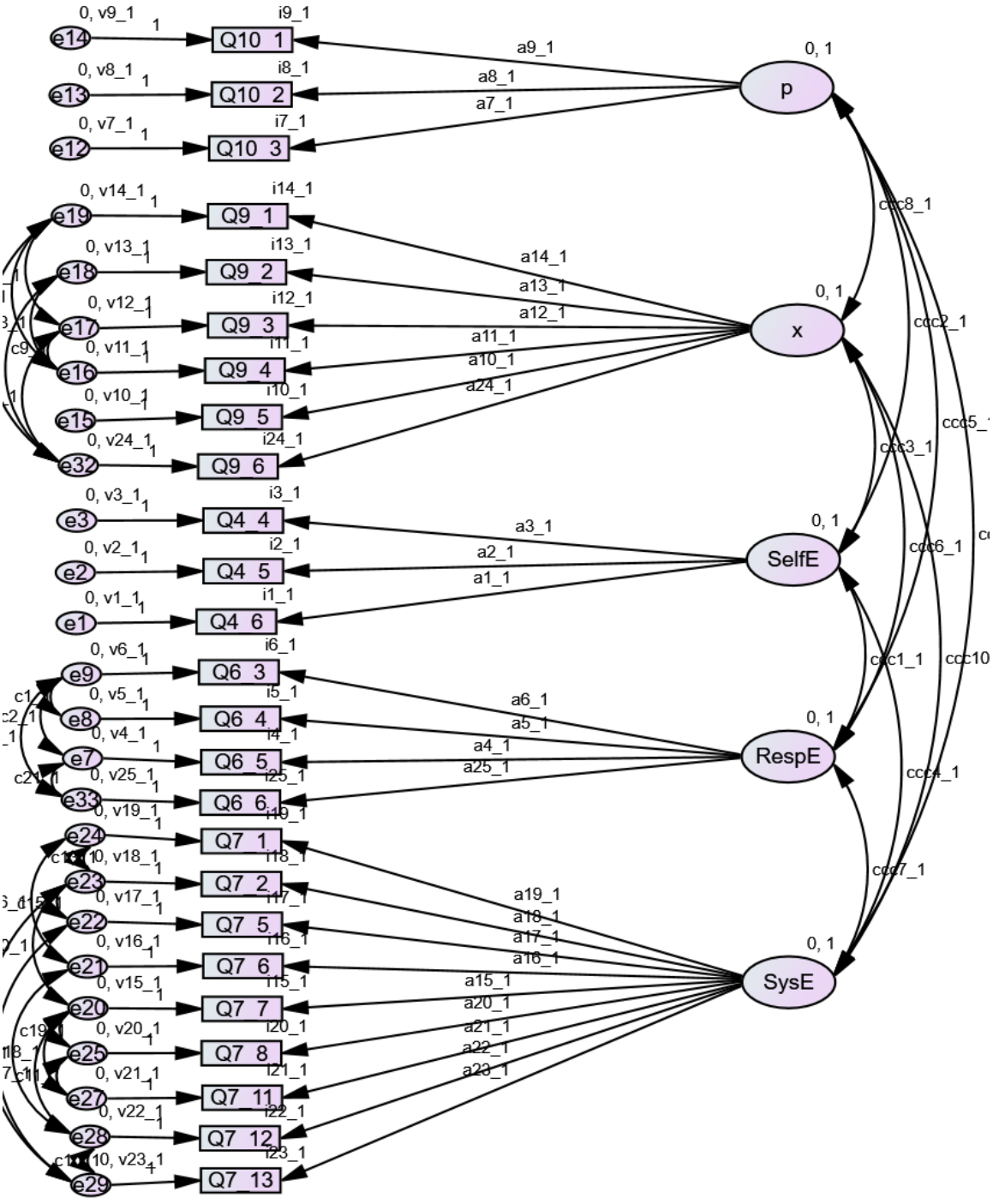

Figure 1. Final model

SelfE: Self-efficacy

ResE: Response-efficacy

SysE: System-efficacy

Figure 1 continued

Q_10_1: My loved ones are at risk for catching COVID-19

Q_10_2: It is possible that one of my loved ones will catch COVID-19

Q_10_3: I believe that I could be a victim of COVID-19

Q_9_1: COVID-19 poses a serious risk to my loved ones

Q_9_2: COVID-19 is potentially harmful to people's health

Q_9_3: COVID-19 is a severe threat to my loved ones

Q_9_4: My friends or family members could die from COVID-19

Q_9_5: COVID-19 is a legitimate threat to me

Q_9_6: I could die if I contracted COVID-19

Q_4_4: I can use social distancing

Q_4_5: If I am exposed to COVID-19, I can quarantine myself

Q_4_6: I can take action to protect myself from COVID-19

Q_6_3: Personal protection, such as masks, are effective reducing the threat of COVID-19

Q_6_4: Social distancing is effective in reducing the threat of COVID-19

Q_6_5: Actions that I take are effective in protective myself from COVID-19

Q_7_1: I would rely on first responders, such as paramedics or the police, to save me

Q_7_2: I would rely on hospitals (including emergency rooms) to provide treatment

Q_7_5: Government agencies provide resources that help me respond to the outbreak

Q_7_6: Organizations or agencies exist that will save people who catch the disease

Q_7_7: The medical system can respond effectively to the disease

Q_7_8: Hospitals and emergency rooms can provide effective care

Q_7_11: Government services are available to help me respond to COVID-19

Q_7_12: My friends and family will protect me from COVID-19

Q_7_13: Pharmaceutical researchers and scientists want to protect me from COVID-19

e: error

i: intercept

a: factor loading

v: variance

c: covariance

CHAPTER III – METHOD

This chapter explains the methodology of conducting the research. Starting with contexts, following with the participants and their demographics, the process of gathering data and cleaning the data set, and lastly, the instrument and detailed explanation of how each variable has been measures. The analysis of EFA and CFA, reliability and validity of the items are presented in the tables. The results of the analysis will be presented in next chapter.

Context

Risk perception is contextual (Hevey, 2005). Therefore, a context was given to the respondents to measure risk perception. The context of COVID-19 was the focus of this study. Participants from the United States, Iran, and China answered questions related to their perceptions of COVID-19 using RBD scale, with and without system-efficacy. COVID-19, as a global pandemic, should be relevant to all participants and was therefore considered a reasonable context for this investigation.

Participants

Between May 2021 and April 2022, the researcher gathered 2,282 original responses (1,500 from the US, 548 from Iran, and 234 from China). All participants were older than 18 years old and lived in the country which they are representing (Americans in the US, Iranians in Iran, and Chinese in China). A participant's responses were excluded if they were incomplete (if one or more entire subscales were left blank), had no variance (e.g., a respondent selected “agree” for all items), or were completed in less than four minutes. Because of the time needed to properly answer the questions, participants that completed in under four minutes were omitted as this was not deemed sufficient time

to accurately reflect reliable responses. After cleaning, a total of 1,002 American surveys were analyzed. The Iranian dataset had a total of 257 surveys. The Chinese dataset ended up with a total of 82 surveys. The total number of surveys being analyzed is 1,341. Subsequent missing data was replaced by the mean for the respondent's existing responses for the appropriate subscale.

Of the 1,002 American participants, two were missing at least one whole subscale and were eliminated for the analysis. Of the remaining, 56.7% (n = 568) were male, 41.6% (n = 417) were female, and 0.3% (n = 3) were non-binary or preferred not to disclose their biological sex. American participants have been asked to identify their race, 64% (n = 641) identified as white, 8.6% (n = 86) identified as Black or African American, 2.1% (n = 21) identified as American or Alaska native, 21.8% (n = 218) identified as Asian, 0.4% (n = 4) identified as Native Hawaiian or Pacific Islander, 1.5% (n = 15) identified as "other" and 1.4% (n =14) did not answer the question. Hispanic/Latinx were 28.6% (n = 287), 69.4% (n = 695) were not Hispanic/Latinx, and 2% (n = 20) did not answer the question about the Hispanic/Latino heritage.

Of the 274 Iranian participants (all of whom lived in Iran at the time of the survey), 17 were missing at least one whole subscale and were eliminated from the analysis. 63.1% (n = 173) were male, 28.8% (n = 79) were female, and 2.2% (n = 6) preferred not to disclose their biological sex and 5.8% (n = 16) did not answer the question about their biological sex. Participants were 53.6% (n = 147) Persian, 15% (n = 41) Turk, 7.3% (n = 20) Kurd, 5.1% (n = 14) Mazani, 4% (n = 11) Arab, 4.4% (n = 12) Lur, 4% (n = 11) Gilak, 1.5% (n = 4) Baloch, 1.8% (n = 5) Bakhtyari, and 2.6% (n = 7) preferred not to answer. 68.6% (n = 188) were Shia Muslim, 1.5% (n = 4) were Sunni

Muslim, 0.7 (n = 2) were Zoroastrian, 4% (n = 11) were other, and 25.1% (n = 69) prefer not to answer. 56.6% (n = 155) were infected by COVID-19 by the time of the survey, 16.1% (n = 44) did not know if they got infected, and 23.7% (n = 44) were not infected by the time of the survey. 90.5% (n = 248) got vaccinated by the time of the survey, 6.2% (n = 17) did not get vaccinated, and 3.3% (n = 9) preferred not to answer the question.

Of the 82 Chinese participants (all of whom lived in China at the time of the survey), 32.9% (n = 27) were male, 63.4% (n = 52) were female, and 1.2% (n = 1) preferred not to disclose their biological sex and 2.4% (n = 2) did not answer the question about their biological sex. 98.1% (n = 81) were infected by COVID-19 by the time of the survey, 1.2% (n = 1) did not answer the question. 96.3% (n = 79) got vaccinated by the time of the survey, 2.4% (n = 2) did not get vaccinated, and 1.2% (n = 1) preferred not to answer the question.

Data Collection Procedure

Participants answered a questionnaire using a URL link to a Qualtrics survey either through Amazon's online crowdsourcing platform or by being contacted through a snowball sampling approach. Amazon Mechanical Turk's (Mturk) use in research has increased exponentially during the last decade (Walter et al., 2018) due to the large and diverse participant pool, ease of access and speed of data collection, reasonable cost, and flexibility regarding research design choice (Aguinis et al., 2021). However, Mturk has its own disadvantages that could affect research projects, such as inattention, self-misrepresentation, self-selection bias, high attrition, inconsistent language fluency, non-naivete, growth of MTurker communities, vulnerability to web robots (or "bots"), social desirability bias, and perceived researcher unfairness (Aguinis et al., 2021). Careful data

cleaning was used to counter these limitations. Amazon is also not vastly available to Chinese and Iranian users. Hence, the Iranian and Chinese participants were recruited using snowball sampling.

With IRB approval, a questionnaire was provided to Amazon's online crowdsourcing marketplace. Participants were provided a URL link to the Qualtrics survey. After providing consent to participate in the study and confirming their age to be more than 18 years old, respondents started the survey questionnaire. During participation in the questionnaire, a question was provided three times during the survey to check respondents' attention ("I am taking a survey"). Participants who did not answer all three questions the same were eliminated from the sample. The survey has been translated by colleagues who are familiar with the study. Due to vast government restrictions and filtering in Iran and China, Amazon does not provide services to these countries. Therefore, Iranian and Chinese Qualtrics links in Chinese and Farsi were sent by email, Facebook pages, WhatsApp, and email to 53 individuals while data has been gathered by snowball sampling. Snowball sampling is a nonrandom sampling which means not all members of the society have the same chance to participate in the study. In this sampling method, participants who were picked by the researcher sent the questionnaire to other qualified individuals, and thus sample size accumulates like a snowball. Usually, this method is used when random sampling is not possible for some societies. Because of government controlling in Iran and China, snowball sampling has been used for this study. To ensure accuracy of translated versions of the questionnaire, versions both to and from English have been verified by disinterested third parties.

Potential participants were provided a URL link to the Qualtrics survey. After providing consent to participate in the study, respondents completed the survey questionnaire. After answering the questions, American respondents were instructed to type a code of their choosing into a corresponding dialogue box and to also type the same code into the MTurk assignment page. This code was used to verify completion of the assignment to provide incentives to participants. Iranian and Chinese respondents answered the survey without any financial incentive.

Instruments

The risk behavior diagnosis scale is a trustable measure that has been guided theoretically by EPPM. It was designed for health care providers and practitioners (Witte et al., 1996) to help identify which types of health risk messages would be most appropriate for a given individual or audience. This scale can help practitioners rapidly to identify beliefs about risks and make effective responsive messages (Witte et al., 1996). This scale has items measuring severity, susceptibility, response-efficacy, self-efficacy (the scale has been adapted in various contexts with different numbers of items). A study conducted by Witte et al. (1996) suggests that the RBD scale holds content, construct, and predictive validity. That means the items represent the theoretical constructs they are intended to measure.

The self-efficacy scale was compromised of six items. Each item asked for respondent's level of agreement with the statement. The first item stated if the treatment for COVID is easily available to the respondents. Second item stated if the respondent has the ability to receive the COVID vaccine. The third item stated if there is anything preventing the respondent from using personal protection, such as a mask or face shield.

The fourth item states if the respondent can use social distancing. The fifth item reads if the respondents was exposed to COVID, they can quarantine themself. And finally, the sixth item states if the respondent can take action to protect themself from COVID.

The Response-efficacy scale was compromised of eight items. First item perceived respondents' perception if the medical services can effectively treat someone who has COVID. Second item reads if respondents perceive their loved ones are less likely to die from COVID if they receive a vaccination. Third item reads respondents' perception of personal protection, such as masks, and if they are effective in reducing the threat of COVID. Fourth item reads respondents' perception of social distancing and if it is effective in reducing the threat of COVID. Fifth item reads respondents' perception of Actions they take and if they are effective in protective themselves from COVID. Sixth item reads the actions that respondents take and if they are effective at protecting others from COVID. The system-efficacy scale was compromised of 15 items. Each item asked for respondent's level of agreement with the statement. First item stated respondent's perception on first responders, such as paramedics or the police, to save them. Second item reads respondent's perception on hospitals (including emergency rooms) to provide treatment. Third item reads respondent's assumption of taking actions based on others actions. Fourth item reads if the respondent believe they are to blame, and if they would not act to protect others. Fifth item reads respondent's perception on government agencies and how they help provide resources that help them to respond to outbreak. Sixth item reads respondent's belief on organizations and agencies and if they exist to save people who catch the disease. Seventh item asks if the respondent believe the medical system can respond effectively to the disease. Eighth item reads if the respondent

believe that hospitals and emergency rooms can provide effective care. Ninth item reads if the respondent believes their actions will make any difference. The Tenth item reads if the respondent believes sick people's friends and families can respond effectively. The Eleventh item reads if the respondent believes medical service providers would be effective in providing treatment for someone has contracted COVID-19. The Twelfth item reads if the respondent believes that there are organizations or agencies that want to protect me from COVID-19.

The thirteenth item reads if the respondent believes if the government services are available to help them to respond to COVID-19. The Fourteenth item reads if the respondent believes that their family and friends will protect them from COVID-19. The Fifteenth item reads respondent believe if pharmaceutical researchers and scientists want to protect me from COVID-19. Threat severity scale was compromised of nine items. First item read if the respondent believes that COVID poses a serious risk to my loved ones. Second item reads if the respondent believes if COVID is potentially harmful to people's health. Third item reads if the respondent believes COVID is a severe threat to their loved ones. Fourth item reads if the respondent believes their friends or family members could die from COVID. Fifth item reads if the respondent believes that COVID is a legitimate threat to them. Sixth item reads if the respondent believes they could die if they contracted COVID. Seventh item reads if the respondent believes if COVID is a serious threat to people's health. Eighth item reads if the respondent believes people could face severe economic consequences if they caught COVID. Threat susceptibility scale was compromised of nine items. First item reads if the respondent believes their loved ones are at risk for catching COVID. Second item reads if the respondent believes

that it is possible that one of their loved ones will catch COVID. Third item reads if the respondent believes that they could be a victim of COVID. Fourth item reads if the respondent believes anyone could potentially catch COVID. Fifth item reads if the respondent believes if they are at risk from COVID. The last item reads if the respondent believes if they will be exposed to COVID.

Exploratory factor analysis (EFA)

EFA has been used extensively for years as a statistical technique (Costello et al., 2005) which mainly helps researchers in early stages of a research program with more than one latent variable to develop measurement instruments (Fabrigar, 2012). As a measurement model, EFA investigates the relationship between latent variables (factors) and observed variables (indicators or measurement items) by using a correlation matrix between items. This relationship is presented as factor loadings, which are conceptually the same as standardized regression weights. EFA helps the researcher determine which variables load on which factors (Papantoniou, 2015). By this technique the researcher can eliminate items on each subscale that were not loading sufficiently on the correct dimension. EFA functions as a check of validity by exploring "the degree to which the measured variables used in the study represent the hypothesized constructs" (Heppner et al., 1992; p. 47). In other words, EFA helps the researcher to confirm if the instrument's items are consistently measuring the intended concept. In this research, IBM SPSS was used to conduct EFA to screen the data, clear the missing data, and determine the items which were not loaded with other items.

Confirmatory factor analysis (CFA)

CFA is another statistical tool that examines the relationships between latent constructs to test the hypothesis about the relationships among the observed variables (Jackson et al., 2009). CFA is a type of structural equation modeling that has been frequently used in social science research to process measurement instruments, examine construct validity, identify method effects, and assess invariance among factors across different groups (Brown, 2006). CFA provides important theoretical constructive evidence such as convergent validity and discriminant validity which helps validate the construction of a model; "CFA is almost always used in the process of scale development to examine the latent structure of a test instrument" (Brown & Moore, 2012). Confirmatory factor analysis. *Handbook of structural equation modeling*, *361*, 379.). Unlike EFA, in which all items freely load on each factor (and all of the loadings are provided for interpretation), in CFA items only load on the factors they have been assigned to measure (Hancock & Mueller, 2001). This tool helps investigate if the data fit a specific model based on a theory. In this study, IBM AMOS was used to perform CFA to validate the model derived from EFA factor loading analysis by confirming the fit of the model.

Convergent Validity and Discriminant Validity

Convergent validity was assessed using confirmatory factor analysis. Items were only included in the model if their standardized factor loading was greater than 0.7 The goal for average variance extracted (AVE) value was more than 0.5 (as recommended by Hair et al., 2013). Response-efficacy was slightly below this target. Composite reliabilities of the dimensions should be greater than 0.8 (Hair et al., 2013). But self-

efficacy and response-efficacy were slightly lower than the .8 target, even though they are well-established concepts; however, system-efficacy, the focus of the study, was well above the .8 goal. Maximal reliability, or coefficient H, was calculated to assess the stability of the dimension over repeated administrations (as suggested by Singh & Aggarwal, 2017). A construct with H coefficient more than 0.8 indicates good stability (Hancock & Mueller 2001). Again, self-efficacy and response-efficacy were slightly lower than the goal. Ultimately, the predicted model and relationships between items functioned well, excepting small deviations in response and self-efficacy. System-efficacy measured well in terms of convergent validity.

To determine discriminant validity, maximum shared variance (MSV) values were examined to determine if they were lower than AVE, along with whether square root of AVE values were greater than off-diagonal correlations (as recommended by Fornell & Larcker, 1981; Hair et al., 2013; and Singh & Aggarwal, 2017). The coefficients for validity were calculated using the master validity plug-in for AMOS (Gaskin & Lim, 2016), and results are presented in Table 1 below. The only problem was between *susceptibility* (p) and *severity* (x), suggesting that respondents had some difficulty at times separating those two concepts. Importantly, system-efficacy functioned well as a distinct concept.

The survey items can be found in the Appendix section. All items were measured using a six-point Likert-type scale ranging from 1 (strongly disagree) to 6 (strongly agree). For each variable, Cronbach's alpha was calculated as a measure of reliability. Additionally, the exploratory factor analysis was conducted to ensure that items were

loading in the predicted manner in terms of initial structure before the confirmatory model was tested.

Table 1

Subscale Intercorrelation for CFA (N=1339) Analysis

Variable	CR	AVE	MSV	H	System-efficacy	Severity	Susceptibility	Self-efficacy	Response-efficacy
System-efficacy	0.909	0.526	0.417	0.911	**0.726**				
Severity	0.873	0.535	0.567	0.879	⁂	**0.731**			
Susceptibility	0.816	0.598	0.567	0.828	⁂	0.753	**0.773**		
Self-efficacy	0.768	0.525	0.418	0.775	0.646***	⁂	⁂	**0.725**	
Response-efficacy	0.769	0.458	0.418	0.786	0.533***	⁂	⁂	0.646***	**0.677**

Note: *** indicates statistical significance ($p < .001$).

⁂ Correlation is not specified in the model.

Discriminant Validity: The square root of the AVE for severity is less than its correlation with susceptibility.

Convergent Validity: The AVE for response-efficacy is less than 0.50.

T-test

T-test is a parametric statistical test comparing the means of two groups determining if differences exist. Using a t-test the researcher finds out if there is a significant difference between the means of two groups. Employing IBM SPSS, a t-test was used to determine if there is a difference in the RBD scale's calculated discriminating values with or without system-efficacy. One discriminating value was calculated in the traditional way. In other words, the average score for the hazard perception (susceptibility and severity) was calculated, as was the score for efficacy perception (response and self-efficacy). The hazard score was subtracted from the

efficacy score to determine the first discriminating value. The score was calculated in largely the same manner, except that system-efficacy was included in the efficacy score by averaging it with the other two efficacy subdimensions. Averages were used so the number of items did not influence the difference in the mean values. The mean of the discriminating value and standard deviation with system-efficacy excluded has been compared to the mean and standard deviation when system-efficacy is included. A statistically significant difference provides evidence that system-efficacy plays an important role in risk perception and should be included when measuring such perceptions.

Invariance Testing

Scholars use measurement invariance for testing multigroup confirmatory factor analysis (Cheung & Rensvold, 2002). Measurement invariance is necessary to compare groups when differences exist between those groups (such as culture, ethnicity, gender, and age). Since the measure may not have the same meaning for different groups, the conclusion drawn from one instrument from culturally different groups may be biased or invalid (Chen, 2007). Different CFA tests exists to establish measurement invariance and investigate if different populations have the same understanding of the measured constructs (Schmitt & Kuljanin, 2008). These steps start with testing of the variance-covariance metrics of items across the groups. If this test does not result in invariance there will be no further testing. The second step demonstrates if the factor structure is the same for separate groups of participants. The third step is to test "that the values of the factor loadings of each variable on each factor are the same across groups" (Schmitt & Kuljanin, 2008, p. 211).

This chapter explained the method to study persuasive messages about COVID-19 in three different countries, how the participants were picked, data collection, instruments, and the statistical tests have been run. The next chapter will discuss the results and analysis of these test and how to can explain them

CHAPTER IV – ANALYSIS

This Chapter begins with analysis addressing the hypothesis posited in chapter II, followed by analysis responding to the research questions.

A t-test has been used to determine if there is a difference between discriminating values and with and without system-efficacy. With all respondents included (N = 1339), the differences of the means between discriminating values with (.17, SD = .85) and without system-efficacy (.20, SD = .74) was significant (Δmean = 0.032, SD = 0.210, and SE = 0.006, t [1338] = 5.656, $p < 0.001$).

If system-efficacy is a valid concept, it must be measured when calculating perception of risk. The RBD score should be different with and without the system-efficacy. Central to determining if system-efficacy is indeed a separate type of efficacy, distinct from response and self-efficacy, not only should discriminating values change, but the effect should change the "diagnosis" from the RBD for a meaningful portion of the sample. Hence, participants' RBD scores have been compared with and without system-efficacy. Twenty (7.1%) shifted from a fear control diagnosis to a prediction of danger control, and 69 (5.2%) shifted from danger control to fear control diagnoses of the remainder, 441 (32.1%) stayed in fear control, 714 (53.3%) stayed in danger control, and 95 (1.5%) had overall score of 0 (i.e., no diagnosis). Interestingly, 35 participants had a score of 0 without system-efficacy, and 29 were at 0 with system-efficacy. Sixteen participants' scores changed from an uninterpretable 0 to a non-zero value, while only ten went from a non-zero score without system efficacy to a value of zero. Put another way, the addition of system efficacy improved the RBD's ability to make a diagnosis about whether a person would be in fear or danger control. The efficacy score without system

efficacy ranged from 1 to 5 with a mean of 4.15 and standard deviation of .65. With system efficacy, the scores ranged from 1.47 to 5 with a mean of 4.18 and standard deviation of .57. The average negative shift in discriminating value was .18. In other words for all those whose discriminating value shifted from danger toward fear control, on average, by 2.8%. The average positive shift in discriminating value was .19. For people whose discriminating value shifted from fear toward danger control, on average, by 3%.

Table 2

Item Means, Standard Deviations, and Skewness and Kurtosis for RBD Items (N = 1339), Perception of Threat Susceptibility Scale

				Skewness		Kurtosis	
Items	N	Mean	SD	Statistic	SE	Statistic	SE
My loved ones are at risk for catching COVID-19	1339	3.81	.970	-.977	.067	.819	.134
It is possible that one of my loved ones will catch COVID-19	1339	3.98	.975	.942	.067	.552	.134
I believe that I could be a victim of COVID-19	1339	3.76	1.074	-.827	.067	.140	.134

Table 3

Item Means, Standard Deviations, and Skewness and Kurtosis for RBD Items (N = 1339), Perception of Threat Severity Scale

				Skewness		Kurtosis	
Items	N	Mean	SD	Statistic	SE	Statistic	SE
COVID-19 poses a serious risk to my loved ones	1339	4.00	.956	-1.086	.067	1.086	.134
COVID-19 is potentially harmful to people's health	1339	4.34	.827	-1.346	.067	1.896	.134
COVID-19 is a severe threat to my loved ones	1339	4.09	.941	-1.092	.067	1.002	.134
My friends or family members could die from COVID-19	1339	3.97	1.016	-.939	.067	.413	.134
COVID-19 is a legitimate threat to me	1339	4.07	.970	-1.109	.067	1.048	.134
I could die if I contracted COVID-19	1339	3.68	1.165	-.647	.067	-.467	.134

Table 4

Item Means, Standard Deviations, and Skewness and Kurtosis for RBD items (N = 1339), Perception of Self-Efficacy scale

				Skewness		Kurtosis	
Items	N	Mean	SD	Statistic	SE	Statistic	SE
I can use social distancing	1339	4.18	.982	-1.364	.067	1.539	.134

Table 4 *Continued*

If I am exposed to COVID-19, I can quarantine myself	1339	4.24	.916	-1.353	.067	1.651	.134
I can take action to protect myself from COVID-19	1339	4.19	.929	-1.228	.067	1.265	.134

Table 5

Item Means, Standard Deviations, and Skewness and Kurtosis for RBD Items (N 1339), Perception of Scale, Perception of Response-Efficacy Scale

				Skewness		Kurtosis	
Items	N	Mean	SD	Statistic	SE	Statistic	SE
Personal protection, such as masks, are effective reducing the threat of COVID-19	1339	4.25	.887	-1.387	.067	2.145	.134
Social distancing is effective in reducing the threat of COVID-19	1339	4.31	.842	-1.486	.067	2.728	.134
Actions that I take are effective in protective myself from COVID-19	1339	4.23	.780	-.965	.067	1.105	.134
Actions that I take are effective at protecting others from COVID-19	1339	4.27	.788	-1.148	.067	1.780	.134

Table 6

Item Means, Standard Deviations, and Skewness and Kurtosis for RBD items (N 1339), perception of Scale, Perception of System-Efficacy Scale

				Skewness		Kurtosis	
Items	N	Mean	SD	Statistic	SE	Statistic	SE
I would rely on first responders, such as paramedics or the police, to save me.	1339	3.67	1.095	-.834	.067	.055	.134
I would rely on hospitals (including emergency rooms) to provide treatment	1339	3.96	1.007	-.879	.067	.252	.134
Government agencies provide resources that help me respond to the outbreak	1339	3.65	1.143	-.782	.067	-.100	.134
Organizations or agencies exist that will save people who catch the disease	1339	3.74	1.016	-.782	.067	.275	.134
The medical system can respond effectively to the disease	1339	3.69	1.068	-.723	.067	-.116	.134
Hospitals and emergency rooms can provide effective care	1339	3.84	1.035	-.867	.067	.347	.134
If someone has contracted COVID-19, I believe medical service providers would be effective in providing treatment	1339	3.87	.947	-.855	.067	.628	.134
I believe there are organizations or agencies that want to protect me from COVID-19	1339	3.91	.993	-.958	.067	.735	.134
Government services are available to help me respond to COVID-19	1339	3.83	1.054	-.941	.067	.468	.134

Exploratory Factor Analysis and Hypothesis Testing

Perception of threat severity

This variable was measured using the modified version of a scale by McGlone et al. (2013) as used by Bagley (2019). The original scale has three items with favorable reliability ($\alpha = 0.82$). All items were measured by a six-point Likert type scale ranging from 1 (strongly disagree) to 6 (strongly agree). After reliability analysis, three items "My health could be permanently damaged if I contracted COVID," "People could face severe economic consequences if they caught COVID," "COVID-19 is not a serious threat to people's health" were removed from the scale to increase the final Cronbach's alpha. With 6 items Cronbach alpha was .91. Table 7 to table 10, show the EFA factor loading and reliability for each variable.

Table 7

Validity and Reliability for Perception of Threat Severity Scale

Item	EFA Factor Loading
COVID-19 poses a serious risk to my loved ones	0.812
COVID-19 is potentially harmful to people's health	0.699
COVID-19 is a severe threat to my loved ones	0.820
My friends or family members could die from COVID-19	0.773
COVID-19 is a legitimate threat to me	0.808
I could die if I contracted COVID-19	0.698

Note: Cronbach's alpha was 0.91

Perception of self-efficacy

This variable was measured using the modified version of McGlone, Bell, Zaitchik, and McGlynn's, (2013) scale. The original scale was a three-item scale with good reliability ($\alpha = 0.82$). A fourth item was added to the scale to reflect the respondents' perceptions of whether they have the personal ability to successfully use social distancing. One more item was added by Venette (2021), "If I am exposed to COVID-19, I can quarantine myself," and "I can take action to protect myself from COVID-19." Two items were removed from the scale because of the negative effect they had on reliability, "Treatment for COVID-19 is easily available to me," and "I have the ability to receive the COVID-19 vaccine." One item did not load with any factor and was deleted from the scale, "There is nothing preventing me from using personal protection, such as a mask or face." The resultant three-item scale (see Table 8) performed reliably ($\alpha = 0.779$).

Table 8

Validity and Reliability for Perception of Self-Efficacy Scale

Item	EFA Factor Loading
I can use social distancing	0.834
If I am exposed to COVID-19, I can quarantine myself	0.794
I can take action to protect myself from COVID-19	0.847

Note: Cronbach's alpha was 0.779

Perception of response-efficacy

This concept was measured using Bagley's modification of the scale used by McGlone et al. (2013). The original scale has three items with good reliability (α = 0.77). A fourth item was added to the scale to reflect the respondents' perceptions of whether social distancing is effective in reducing the threat of COVID-19. Two more items were added by Venette (2021), "Actions that I take are effective in protecting myself from COVID-19," and "Actions that I take are effective at protecting others from COVID-19." One item was deleted from the scale since it did not load with any factor in EFA analysis, "Medical services can effectively treat someone who has COVID-19." Another item, "there is nothing preventing me from using personal protection, such as a mask or face cover," was loading with self-efficacy but worsened its Cronbach alpha, hence it has been deleted from the model. Cronbach alpha for the four items was high (α = 0.801).

Table 9

Validity and Reliability for Perception of Response-efficacy Scale

Item	EFA Factor Loading
Personal protection, such as masks, are effective reducing the threat of COVID-19	0.732
Social distancing is effective in reducing the threat of COVID-19	0.796
Actions that I take are effective in protective myself from COVID-19	0.782
Actions that I take are effective at protecting others from COVID-19	0.781

Note: Cronbach's alpha was 0.801

Perception of system-efficacy

As the primary focus of the study, and as a relatively new scale, this variable was measured using fifteen items (as items often are eliminated due to validity and reliability concerns). The items were based on Reif-Stice, Venette, Frigero, and Iverson's (in process) measurement of the perception of COVID-19 risk. This version of the diagnostic scale includes items associated with system-efficacy.

The scale was designed to measure the respondent's perception of how well systems protect their loved ones during the COVID-19 crisis. Three items were deleted from the scale to increase the Cronbach alpha, "I assume that I do not need to take action because others will," "I am not to blame, and so I would not act to protect others," and "My actions will not make a difference." Three more items were deleted, "Sick people's friends and families can respond effectively," "Pharmaceutical researchers and scientists want to protect me from COVID-19," "My friends and family will protect me from COVID-19" were dropped because they did not load high enough with any factor.

Table 10

Validity and Reliability for Perception of System-Efficacy Scale

I would rely on first responders, such as paramedics or the police, to save me	0.713
I would rely on hospitals (including emergency rooms) to provide treatment	0.703
Government agencies provide resources that help me respond to the outbreak	0.785
Organizations or agencies exist that will save people who catch the disease	0.753
The medical system can respond effectively to the disease	0.796

Table 10 Continued

Hospitals and emergency rooms can provide effective care	0.799
If someone has contracted COVID-19, I believe medical service providers would be effective in providing treatment.	0.779
I believe there are organizations or agencies that want to protect me from COVID-19	0.747
Government services are available to help me respond to COVID-19	0.813

Note: Cronbach's alpha was 0.886

Confirmatory factor analysis

CFA was used to test the hypothesized structure and to check if the items measured the correct concepts. CFA has been used to determine if system-efficacy is perceived by respondents as being different compared to response-efficacy and self-efficacy. The model identified by the EFA was first tested then refined using the USA data, then the CFA continued to the Iranian and Chinese datasets. Ultimately all the data were combined for the final CFA. During CFA several different measures have been used to evaluate model fit: the comparative fit index (CFI), Tucker-Lewis index (TLI), root-mean-square error of approximation (RMSEA), standardized root mean square mean residual (SRMR). Table 11 to 15 show CFA factor loadings for each item categorized by the factors. Items that did not load highly on any factor were eliminated, and the data has been used for the final analysis contains the items in these tables.

Table 11

CFA factor loadings for each country and overall for threat severity

Items	USA	IRA	CHN	Overall
COVID-19 poses a serious risk to my loved ones	.818	.681	.510	.781
COVID-19 is potentially harmful to people's health	.618	.869	.736	.656
COVID-19 is a severe threat to my loved ones	.779	.797	.784	.743
My friends or family members could die from COVID-19	.774	.754	.846	.731
COVID-19 is a legitimate threat to me	.737	.889	.597	.736
I could die if I contracted COVID-19	.729	.544	.818	.652

Note: USA: United States of America - IRA: Iran - CHN: China

Table 12

CFA factor loadings for each country and overall for threat susceptibility

Items	USA	IRA	CHN	Overall
My loved ones are at risk for catching COVID-19	.836	.722	.903	.837
It is possible that one of my loved ones will catch COVID-19	.738	.847	1.013	.781
I believe that I could be a victim of COVID-19	.705	.642	.759	.694

Table 13

CFA factor loadings for each country and overall for self-efficacy

Items	USA	IRA	CHN	Overall
I can use social distancing	.609	.696	.725	.732
If I am exposed to COVID-19, I can quarantine myself	.588	.710	.678	.658
I can take action to protect myself from COVID-19	.646	.760	.764	.779

Table 14

CFA factor loadings for each country and overall for response-efficacy

Items	USA	IRA	CHN	Overall
Personal protection, such as masks, are effective reducing the threat of COVID-19	.708	.569	.832	.665
Social distancing is effective in reducing the threat of COVID-19	.727	.583	.652	.683
Actions that I take are effective in protective myself from COVID-19	.660	.660	.771	.680
Actions that I take are effective at protecting others from COVID-19	.662	.630	.489	.675

Table 15

CFA factor loadings for each country and overall for system-efficacy

Items	USA	IRA	CHN	Overall
I would rely on first responders, such as paramedics or the police, to save me	.570	.569	.165	.663
I would rely on hospitals (including emergency rooms) to provide treatment	.657	.583	.313	.650
Government agencies provide resources that help me respond to the outbreak	.673	.660	.671	.754
Organizations or agencies exist that will save people who catch the disease	.698	.630	.876	.728
The medical system can respond effectively to the disease	.642	.775	.848	.750
Hospitals and emergency rooms can provide effective care	.655	.785	.736	.746
If someone has contracted COVID-19, I believe medical service providers would be effective in providing treatment	.665	.815	.784	.728
I believe there are organizations or agencies that want to protect me from COVID-19	.647	.731	.807	.715
Government services are available to help me respond to COVID-19	.726	.718	.879	.775

Invariance Testing and Research Question

Invariance testing by country was conducted with the same sample used for CFA. Model comparisons and fit statistics for the EPPM and its subscales across the United States (N = 1000, 74%), Iran (N = 257, 19%), and China (N = 82, 6%) are presented in

Table 12. Since chi square has been demonstrated to depend on sample size (Brannick, 1995; Kelloway, 1995), this study does not rely on chi square to look at invariance testing. There is a significant difference between the United States and other two countries' sample sizes; however, the United States sample size provides enough power to test the invariance (MacCallum et al., 1996). Models show satisfactory fit with freely estimated factor loadings. A value of RMSEA less than .05 indicates a close fit, and a value less than .08 indicates the reasonable model fit (Browne & Cudeck, 1993; Jöreskog & Sörbom, 1993). The RMSEA indicates close fit for all models, except for measurement residuals, which shows the reasonable model fit. Based on Bentler and Bonett (1980) recommendation, TLI greater than .90 indicates an acceptable fit; however, TLI is generally preferred for smaller samples (Byrne, 1994). Hu and Bentler (1999) suggested CFI greater than .95 for a relatively good model.

Comparing the freely estimated and constrained model shows the measurement residual has a meaningful difference in CFI (Δ CFI = .012). In other words, a constrained model lowers the CFI by .012, and the fit has gotten meaningfully worse which requires item-by-item constraining the model and comparing it to the freely estimated model. Since there is a significant difference between the CFI of freely estimated and constrained model, additional invariance testing had to be conducted with constrained parameters for each factor (Scully et al., 2018). The red numbers are those that were compared to unconstrained (CFI = .930).

Table 16

Invariance testing results by country

Model	P	Df	CFI	FMIN	RMSEA	TLI
Unconstrained	.000	726	.930	1.357	.033	.913
Measurement weights	.000	776	.918	1.528	.035	.905
Measurement plus intercepts	.000	826	.842	2.442	.047	.828
Structural covariance	.000	846	.821	2.707	.050	.809
Measurement residual	.000	942	.744	3.663	.056	.756
USA*IRA	.000	751	.891	1.824	.041	.869
USA*CHN	.000	751	.920	1.482	.035	.905
IRA*CHN	.000	751	.915	1.540	.036	.899

Note: RMSEA: root mean square error of approximation (Steiger, 1990; Steiger & Lind, 1980)

CFI: comparative fit index (Bentler, 1990)

TLI: Tucker–Lewis index (Bentler & Bonett, 1980; Tucker & Lewis, 1973)

USA*IRA: USA and Iran data are constrained

USA*CHN: USA and China data are constrained

IRA*CHN: IRA and China data are constrained

Red numbers are those that have been used in the comparison

Since the weighted constrained model lowers the CFI by at least .012, and the fit has gotten meaningfully worse, I constrained the models for each group first. Fit index CFI values for models for each two groups without intercepts are presented in Table 17. There is no significant change in the constrained models between each group.

Table 17

Model	CFI
Unconstrained	.930
Measurement without intercepts USA*IRA	.922
Measurement without intercepts IRA*CHN	.924
Measurement without intercepts USA*CHN	.926

The CFI for USA*IRA fixed model (CFI = .855) is significantly different from measurement model (CFI = .918); hence, the model should be measured while constraining each latent variable for this model. The results are presented in Table 15. The fit got worse for the models for self-efficacy and the model for system-efficacy. As a result, I constrained the models for each. As presented in Table 16, one item from self-efficacy shows significant differences from .918 ("I can use social distancing"), and five items from system-efficacy show significantly difference from .918 ("I would rely on first responders, such as paramedics or the police, to save me;" "government agencies provide resources that help me respond to the outbreak;" "the medical system can respond effectively to the disease if someone has contracted COVID-19;" "hospitals and emergency rooms can provide effective care;" "Pharmaceutical researchers and scientists want to protect me from COVID-19"). In other words, these items exceeded corresponding critical values, and are not invariant for Iran and the United States. Thus, the current model for the EPPM cannot be interpreted as invariant for American and Iranian participants.

Table 18

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Measurement plus intercepts	.800	.782	.843	.828	.842
Measurement only	.875	.855	.919	.905	.918
Measurement plus intercepts USA*IRA	.814	.791	.856	.837	.855
Measurement plus Intercepts USA*IRA-P	.872	.853	.916	.902	.915
Measurement plus Intercepts USA*IRA-X	.866	.845	.909	.895	.909
Measurement plus Intercepts USA*IRA-SelfE	.853	.830	.895	.878	.894
Measurement plus intercepts USA*IRA-ResE	.872	.852	.915	.901	.915
Measurement plus Intercepts USA*IRA-SysE	.841	.818	.884	.866	.883

Table 19

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Measurement plus intercepts	.800	.782	.843	.828	.842
M only	.875	.855	.919	.905	.918
Measurement plus intercepts USA_IRA	.814	.791	.856	.837	.855
M plus I USA_IRA_SE_q.4	.859	.837	.902	.886	.901
M plus I USA_IRA_SE_q.5	.869	.849	.913	.898	.912
M plus I USA_IRA_SE q.6	.867	.845	.910	.895	.909
M plus I USA_IRA_SYE_q.1	.859	.837	.902	.886	.901
M plus I USA_IRA_SYE_q.2	.867	.845	.910	.895	.909
M plus I USA_IRA_SYE_q.5	.855	.832	.898	.881	.897
M plus I USA_IRA_SYE_q.6	.869	.849	.913	.898	.912
M plus I USA_IRA_SYE_q.7	.861	.839	.904	.888	.904
M plus I USA_IRA_SYE_q.8	.863	.842	.906	.891	.906
M plus I USA_IRA_SYE_q.11	.869	.848	.912	.897	.911
M plus I USA_IRA_SYE_q.12	.867	.846	.911	.896	.910
M plus I USA_IRA_SYE_q.13	.864	.843	.907	.892	.907

Note: M: measurement

I: intercepts

Q: item

The CFI for IRA*CHN fixed model (CFI = .892) is significantly different from measurement model (CFI = .918); as a result, I measured the model constraining each latent variable for this model. The results are presented in Table 20. The fit got worse for the model for system-efficacy. As a result, I constrained the models for each item for system-efficacy. As it presented in Table 21, no critical value differences reached

statistical significance, and there were no changes in CFI values. Despite exceeding the critical value difference at the subscale level, no items on the system-efficacy subscale exceeded corresponding critical values. Thus, the current model for the EPPM can be interpreted as invariant for Iranian and Chinese participants.

Table 20

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Measurement plus intercepts	.800	.782	.843	.828	.842
M only	.875	.855	.919	.905	.918
M plus I IRA_CHN	.849	.830	.893	.878	.892
M plus I IRA_CHN_p	.869	.849	.913	.899	.912
M plus I IRA_CHN_x	.871	.852	.915	.902	.915
M plus I IRA_CHN_SE	.865	.845	.909	.894	.908
M plus I IRA_CHN_RE	.875	.855	.918	.905	.918
M plus I IRA_CHN_SYE	.860	.840	.904	.889	.903

Table 21

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Measurement plus intercepts	.800	.782	.843	.828	.842
M only	.875	.855	.919	.905	.918
M plus I IRA_CHN	.849	.830	.893	.878	.892
M plus I IRA_CHN_SYE	.860	.840	.904	.889	.903
M plus I IRA_CHN_SYE_7.1	.872	.852	.916	.902	.915
M plus I IRA_CHN_SYE_7.2	.874	.854	.918	.904	.917
M plus I IRA_CHN_SYE_7.5	.865	.844	.908	.893	.908
M plus I IRA_CHN_SYE_7.6	.869	.849	.913	.898	.912
M plus I IRA_CHN_SYE_7.7	.867	.846	.911	.896	.910
M plus I IRA_CHN_SYE_7.8	.871	.851	.915	.900	.914
M plus I IRA_CHN_SYE_7.11	.870	.850	.914	.899	.913
M plus I IRA_CHN_SYE_7.12	.869	.849	.913	.898	.912
M plus I IRA_CHN_SYE_7.13	.867	.846	.910	.895	.909

The CFI for USA*CHN fixed model (CFI = .904) is significantly different from measurement model (CFI = .918); as a result, I measured the model constraining each latent variable. As it presented in Table 22, none of the factors reached significant

difference, which means the current model for the EPPM can be interpreted as invariant for Iranian and Chinese participants.

Table 22

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Measurement plus intercepts	.800	.782	.843	.828	.842
M only	.875	.855	.919	.905	.918
M plus I USA_CHN	.860	.843	.904	.892	.904
M plus I USA_CHN_p	.870	.850	.914	.900	.913
M plus I USA_CHN_x	.869	.849	.913	.899	.912
M plus I USA_CHN_SE	.875	.855	.918	.905	.918
M plus I USA_CHN_RE	.874	.855	.918	.904	.917
M plus I USA_CHN_SYE	.872	.853	.916	.903	.915

The EPPM model and RBD scale have been analyzed in this section for the United States, Iran, and China. T-test and EFA were conducted using IBM SPSS software and CFA using IBM AMOS. The results indicated Iranian and American participants have different perceptions of self-efficacy and system-efficacy. In Chapter Five, I review the results and consider the implications on current scholarship and investigative approaches.

CHAPTER V – DISCUSSION

The purpose of this study was to test system-efficacy and investigate the risk perception properties of RBD, in other words, this study aims to investigate if people's perception of the problem is also based on what they consider as others' responsibility. Additionally, culture's effects on risk perception was examined. This study was designed to test the system efficacy scale factor, test invariance across cultures, and evaluate validity indices. The following section includes hypothesis and research question analysis, followed by discussion, limitation, future studies, and ending by the conclusion.

RQ: How does the perception of risk associated with COVID-19 vary culturally?

I found significant differences for self-efficacy and system-efficacy when I compared Iran and the United States, as can be seen in table19. The United States and China were not significantly different in any factors, nor were Iran and the United States. The AMOS model presented in figure 2, show the differences in Iran and the United States model.

One hypothesis was proposed: System-efficacy affects peoples' perception of the risk of COVID-19. Based on the results, not only is system-efficacy an independent variable affecting individuals' risk perception, but also system-efficacy affects if people stay in fear control or danger control. The results show support for the hypothesis. These results are consistent with previous findings. Bagely (2019), found that system efficacy is a significant predictor for peoples' behavior, in response to persuasive health messages. Bagely (2019) argues that when a threat is more likely to affect the loved ones, system-efficacy is better predictor for individuals' responses than self-efficacy. In this study, I concluded that system-efficacy is a significant variable affecting peoples' risk perception

especially when the messages include government and its organizations. With that in mind, in addition to the effect of culture on system-efficacy perception in non-democratic countries, health campaigners should consider system-efficacy along with self and response-efficacy when designing persuasive health messages.

Extended Parallel Process Model

Based on the results, respondents perceived system-efficacy as being different from self-efficacy and response-efficacy. In fact, individuals were able to distinguish between system-efficacy and other efficacy types. This form of efficacy can affect receivers' responses to risk messages, and as a result, is worthy of measuring independently or with other variables when trying to understand risk perceptions. When knowing how system-efficacy can affect risk perception, health communication researchers are able to tailor the messages based on the societies' perception of system efficacy.

According to EPPM, perceived efficacy determines whether people will engage in danger control or fear control processes (Witte & Allen, 2000). Both the appraisal of threat and appraisal of the efficacy of recommended responses affect individuals' reactions to fearful situations (Yun & Berry, 2018). High perceived system-efficacy in a message could result in audiences acting to reduce danger instead of thinking about denying the fear itself. Additionally, elevated perceptions of system-efficacy might explain why people fail to take action in some cases; they perceive that they do not need to do anything because something in the system will protect them.

Thus, system-efficacy can help scholars and practitioners understand why individuals might respond in a danger control manner even when the threat is perceived

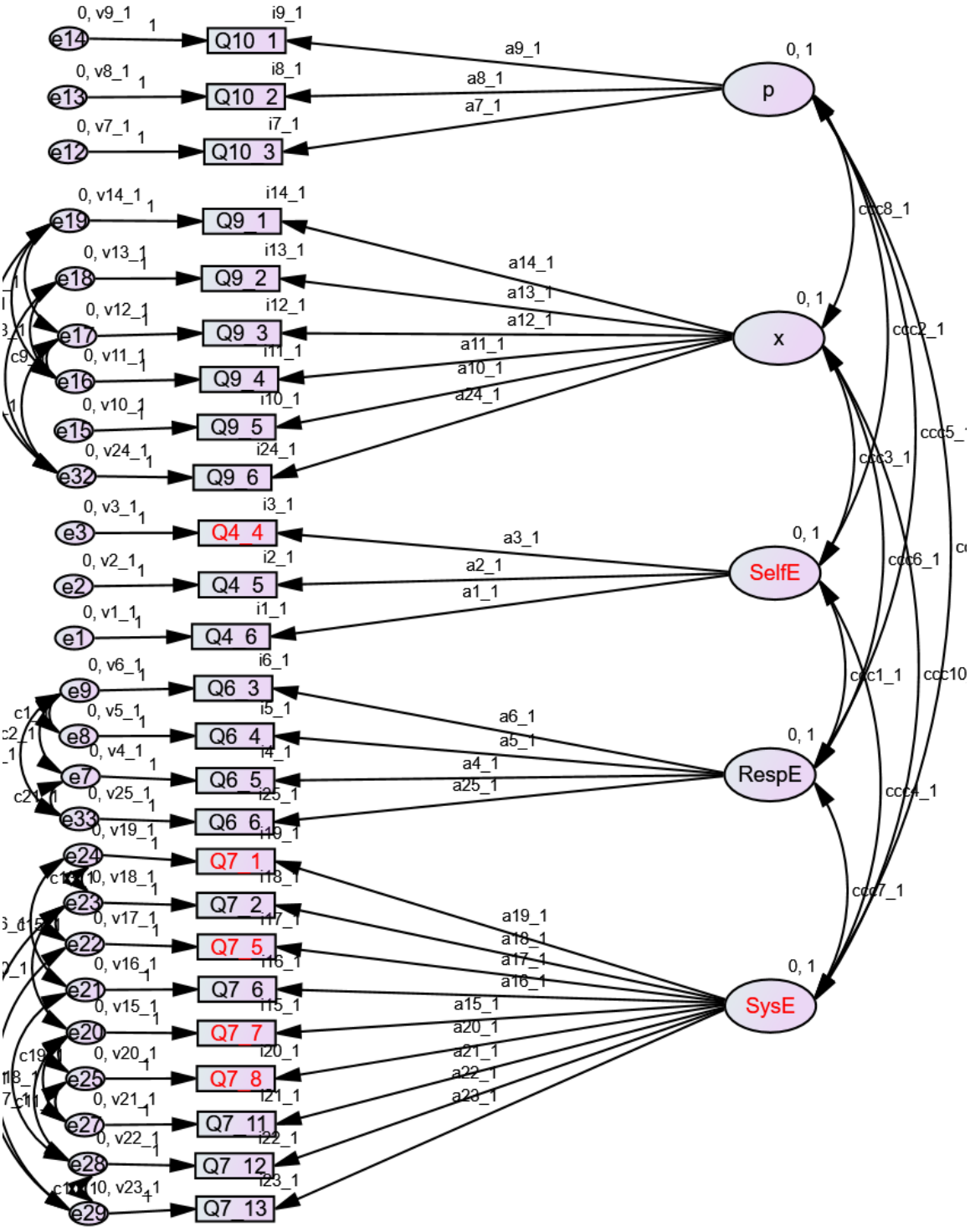

Figure 2. Final Model 2

to be high, but self and response efficacies are low. EPPM has been used for years as a framework for health campaigners to construct persuasive messages; however, system-efficacy can be one of the missing parts of the model that could improve communication effectiveness and play a crucial role in encouraging individuals to engage in health behaviors or reduce risks. Including system-efficacy in the analysis, communication scholars are able to design messages to increase people's awareness of service available in the community. Some people's perception of COVID-19 was in "adaptive" danger control because they believed that the medical system would be effective, even when they perceived that their self-efficacy was low. The messages could adapt to address system-efficacy, for example, messages that encourage hurricane evacuation should stress the emergency services as well, or in case of COVID-19 the messages that encourage vaccination should place emphasis on health centers available to provide information and vaccination.

Risk communication can enhance the public's knowledge about risk, encourage changes in attitudes and behavior, and increase public confidence towards agencies in charge of managing the risk (Wachinger et al., 2013). Even though extant literature suggests effective communication can alter perceptions of organizations and other risk managers, little work has been conducted to evaluate whether those perceptions have an impact on the audiences' understanding of hazards. The gap exists in the literature may be filled, at least partially, with system-efficacy. Government, nonprofit agencies, even family and friends, are all important when it comes to hazardous situations. The level of trust individuals have with those people and organizations around them affects their behaviors and how they manage a crisis. As an example, Bagley (2019) studied how

people alter their behavior for the safety and protecting others, including their friends and family, by having access to Narcan.

Fear Control and Danger Control

System-efficacy influenced people's RBD diagnosis score shifting from fear control to danger control. Even if the effect is limited, shifting from fear control to danger control through health messages has a vast desirable outcome for health campaigners. Witte (1994) proposed that fear control is an emotional process affected by fear, but danger control is a cognition process regarding how people think about responding to a threat. When danger control is high, individuals cognitively try to avert the threat and generally accept persuasive messages with recommendation perceived as effective to control the danger. By adding system-efficacy to RBD, messages can be designed more effectively based on the audiences' perception of the threat. Using system efficacy in the calculation of the RBD discriminating value affects individual scores, but more importantly has a bigger impact on interpreting group perceptions. This affect is crucial when assessing a group to design health messages.

Cultures might affect risk perception in different ways. Culture plays a role in problem solving as a combination of symbols and beliefs (Vredenburgh & Cohen, 1995). People from different cultures assign dissimilar meanings to situations, events, and objects including risk perception (Dake, 1992). Risk perceptions are usually perceived with bias because of social grouping, institutions, and social interactions (Dake, 1992). Sivak et al., (1989) studied risk perception in different cultures and found that there is a huge difference between American and Spanish drivers in risk rating which affect their decision making in risky situations, for example. The present study showed that risk

perception is different between the two macro-cultures of Iran and America. Self-efficacy and system-efficacy are two factors which showed the most differences potentially due to the different cultural, political, and societal structure of the two countries.

Self-Efficacy

Self-efficacy is the trust that someone possesses that they are able to respond to a persuasive message to reach a goal (Bandura, 1997). Self-efficacy is the first variable which should be raised for individuals to react positively to a persuasive health message. According to the analysis, the self-efficacy scale was invariant among all the groups except for the model of Iran and the United States. The item that made the models different was "I can use social distancing," which had a different meaning for Iranian and American participants. This item's descriptive statistics for Iranian (M = 3.26, SD = 1.255) and Americans (M = 4.41, SD = .748) show that Iranian people beliefs about their ability of using social distancing is significantly less than American participants. Since the social and governmental structure of the two countries are hugely different, this invariance could be the result of many factors. With that in mind, a persuasive message about social distancing for Iranian participants should include the concept of their ability to use social distancing, as an example a good message for Iranian society could be, "even if we stand 6 fts away, we are still close."

Cultures affect peoples' self-efficacy through the systems and institutions such as family, the school, and the community (Urdan & Pajares, 2006). Based on Hofstede (1986), families and schools reflect the social role patterns of a culture. Families in collectivistic cultures teach their children to like and respect the needs of their group to create a social reality and make their performance acceptable by their collectives

(Hofstede, 1986; Hofstede, 1997). Individualistic cultures are more focused on how to learn to make outcomes for one's potentials (Hofstede, 1986). Hoftstede (1986) also demonstrated that in societies with large power differentials, children learn how to obey and respect any person in higher power, including teachers and parents; however, in cultures with small power differentials children learn how to express their voice and speak out. As a result, people are not allowed to make decisions with uncertainty, since they ought to know everything and avoid making. In contrast, in societies with less uncertainty avoidance, asking questions and making mistakes are not perceived as taboo (Hofstede, 1986; Hofstede, 1997). The differences of culture between Iran and the United States affects people's perception of their self-efficacy and the trust they have in their abilities.

In addition to self-efficacy differences, personal distances in Middle Eastern countries are closer than in the United States (Kreuz & Roberts, 2020). Hence, using social distances for Iranian participants reflects a bigger behavioral change than for American participants. In addition, the effect of translation on the different meaning of social distancing for Iranian participants cannot be overlooked. The lack of invariance between the United States participants and the Iranian one may be due to subtle differences in language that were "lost in translation."

China's rapid economic growth (making it the second highest GDP after the United States; Silver, 2022) certainly affects its culture and social structure. Chinese perceptions of COVID-19 may be closer to other developed countries like the United States. Evidently, economy may be a bigger player in people's perceptions than political structure, especially regarding Chinese perception of self-efficacy.

System-Efficacy

Messages provided by health campaigns appear to overlook the role of system-efficacy on people's risk perception and behavior. For example, current messages about COVID-19 ask individuals to get vaccinated without considering the perception the role that other entities play, such as scientists and health care workers. People may be in a danger control mind frame regarding COVID-19 if they believe that first responders or medical providers are capable of handling the problem, even if they do not have self-efficacy. These findings could help design more effective messages to both educate and manage responses to hazards.

The American and Iranian participants seem to perceive system-efficacy differently. "I would rely on first responders, such as paramedics or the police, to save me;" "the medical system can respond effectively to the disease;" "government agencies provide resources that help me respond to the outbreak;" "the medical system can respond effectively to the disease if someone has contracted COVID-19;" "hospitals and emergency rooms can provide effective care;" "government services are available to help me respond to COVID-19" are items which these two cultures perceived differently. It is obvious that the trust people have in the medical system is dissimilar.

The government in Iran is not democratic. Governance, media, and the health system are directly or indirectly controlled by the religious state. Many protests have been happening in the last 20 years to oppose the dictatorship which resulted in violent conflict with the government. In the last election in 2021, Iranian voters showed their distrust in the government by not showing up, and this made the election the only one since the Islamic revolution in 1979 with less than half of the eligible individuals

participating (Yee, 2021). The amount of trust people have in their society or "system" affects their risk behaviors. When pandemic was spreading around the world, Iranian officials were denying there is any cases in Iran for two weeks, later the supreme leader banned the American and British vaccine for Iranian people. Thus, Iranian citizens are facing uncertainty about how the government is handling the crisis and this negatively affected their system-efficacy. People's perception of solving the problem is affected by what they consider as "other's" responsibility. Participants' insights on system-efficacy are significantly different when items measure their trust for government institutions such as "governmental services," "medical system," and, "hospitals." The distrust in the government might be the main reason for Iranian participants not trusting the system that is connected to the government.

Culture and Risk Perception

Cultures might affect risk perception in different ways. Culture plays a role in problem solving as a combination of symbols and beliefs (Vredenburgh & Cohen, 1995). People from different cultures assign dissimilar meanings to situations, events, and objects including risk perception (Dake, 1992). Risk perceptions are usually perceived with bias because of social grouping, institutions, and social interactions (Dake, 1992). Sivak et al., (1989) studied risk perception in different cultures and found that there is a huge difference between American and Spanish drivers in risk rating which affect their decision making in risky situations, for example. The present study showed that risk perception is different between the two macro-cultures of Iran and America. Self-efficacy and system-efficacy are two factors which showed the most differences potentially due to the different cultural, political, and societal structure of the two countries.

Limitations

As always, some limitations exist. The original scale was constructed in English, and translating the questions might have had an effect on how participants in China and Iran perceived the concepts. However, the invariance testing results for most of the factors show that the translation might not have had a big effect. Secondly, accessing Iranian and Chinese participants was not as easy as Americans. Most of the social media applications, including Facebook, are filtered, or banned by the government in these two countries. In addition, there is always a fear for citizens living a society full of censorship and control to provide information in questionnaires. The sampling process was not the perfect random sampling, especially for Iran and China. Since the questionnaires were sent by social media and email, those potential participants without access to internet and social media would not be included. Thirdly, in the case of COVID-19 the role of conspiracy theories and fake news, and how different cultures absorb them, is an important factor which should be considered.

A large difference exists between the sampling size of the United States, Iran, and especially China. Chinese participants are significantly lower than American participants. Data was collected during a new wave of COVID-19 in China, and people appeared to be particularly sensitive to answering a questionnaire that included items related to the government's response, especially when data was being sent to researchers in the United States. Concurrently, China and the U.S. were engaged in conflict over the origin of COVID-19. Thus, timing was likely a large problem in the recruitment of Chinese participants.

Future Studies

Additional investigation is warranted about the role system-efficacy plays in people's perception of risk. A wide range of variables affect system-efficacy, in other words, the amount of trust people has in other individuals affects their perception of system-efficacy. These effects are mostly independent for each group of people and should be studied separately. Future studies need to study these variables and their effects on people's perception of risk. For example, the role of family and friends, government, social workers, and politicians on risk perception, each can be the subject of a research. System efficacy can divide to distinct categories, and each category can affect individuals' perception differently. Studying each group separately would give the researcher a better understanding of perceptions of risk and how to design better messages.

Finding suggest that the measurement instruments functioned well in terms of validity and reliability generally and were mainly invariant across country groups. Additional refinement of the scales could address the items where differences were seen between subsamples. For example, work should be done to determine if differences were due to translation issues, or if people in different countries perceive some other aspect of the survey items in different ways. For example, the phrase "loved ones" is used in the United States to refer to those individuals that one holds dear, such as friends and family; however, this concept was somewhat difficult to translate, and may have been understood differently by respondents.

The system-efficacy subscale intentionally included more items than the other subdimensions because it is newer and thus less tested. A subscale should be created that

has a parallel number of items to increase the balance between subsections and to reduce potential respondent fatigue. Items must be general enough to capture the concept of system-efficacy without losing more specific understanding. For instance, an item might refer to the medical system generally, but respondents might not understand or remember that this system includes doctors, nurses, medical technicians, pharmacists, first responders, and so on.

The current study includes the United States, China, and Iran. Future studies must include other nations and additional cultural groups. Interesting differences may exist between identifiable subgroups within countries, or that exist beyond political borders. The source of potential variance in the performance of RBD items should be identified. Thus, continued analysis of group differences is justified.

Conclusion

The world is experiencing the COVID-19 pandemic, and we are in need for effective persuasive health messages more than ever. Vaccine hesitancy during vaccination phase in many countries proves to be a hinderance in overcoming this health dilemma. This study expanded on retesting EPPM's after adding system-efficacy between three countries. The EPPM has been used in health campaigns for designing persuasive messages by appraising threat and efficacy. The model disregards the role of individual's perceptions of their surrounding systems and society on their actions in fearful situations. This may explain why some participants score highly in threat control but still do nothing regarding the message they have received in this study. Although the variables that measure efficacy are always based on the person receiving the message, the role of trust people have on other individuals and agencies has been eliminated in this

process so far. System-efficacy is an independent variable and has significant impact on people's reaction to health messages. This study shows that the model can work more precisely by adding system-efficacy. In a crisis, when people are under pressure of threat, their attitude toward the authorities and other agencies responsible for responding to the situation affects their behavior. Individuals' perceptions of how others respond to a threat is important to understanding if people are likely to have a fear or danger control orientation to the threat. Designing effective communication messages strongly depend on correctly identifying the potential audience's orientation, and thus system-efficacy should be included in such analysis.

In addition, there is a gap in the literature studying cultures effects on risk perception and persuasive messages, especially between countries with different political forms. This study shows that messages designed by health campaigners should be tailored for specific countries and groups regarding their political and social structures.

In conclusion, COVID-19 had a huge effect on message designing for crisis. People's responses to the messages varied and were, at times, unpredictable. This context showed the pivotal role of studying audiences and understanding their perceptions before sending a message. A well-adapted message often spells the difference between acceptance and rejection. When the messages are about what to do in response to a global pandemic, failures in communication can place people in harm's way. Effective communication helps promote smooth, meaningful response and increases the safety of individuals and the community. Therefore, system-efficacy must be included in any analysis of people's perceptions of hazards.

APPENDIX A – Survey Instrument

Optimistic Bias Items

What are the odds that one of your loved ones will catch COVID?

0 (Not likely at all) - 10 (Extremely likely)

What are the odds that the average person will catch COVID?

0 (Not likely at all) - 10 (Extremely likely)

Self-Efficacy Scale

Treatment for COVID is easily available to me.

1 (Strongly Disagree) - 6 (Strongly Agree)

I have the ability to receive the COVID vaccine.

1 (Strongly Disagree) - 6 (Strongly Agree)

There is nothing preventing me from using personal protection, such as a mask or face shield.

1 (Strongly Disagree) - 6 (Strongly Agree)

I can use social distancing.

1 (Strongly Disagree) - 6 (Strongly Agree)

If I am exposed to COVID, I can quarantine myself.

1 (Strongly Disagree) - 6 (Strongly Agree)

I can take action to protect myself from COVID.

1 (Strongly Disagree) - 6 (Strongly Agree)

Response-efficacy Scale

Medical services can effectively treat someone who has COVID.

1 (Strongly Disagree) - 6 (Strongly Agree)

My loved ones are less likely to die from COVID if they receive a vaccination.

1 (Strongly Disagree) - 6 (Strongly Agree)

Personal protection, such as masks, are effective in reducing the threat of COVID.

1 (Strongly Disagree) - 6 (Strongly Agree)

Social distancing is effective in reducing the threat of COVID.

1 (Strongly Disagree) - 6 (Strongly Agree)

Actions that I take are effective in protective myself from COVID.

1 (Strongly Disagree) - 6 (Strongly Agree)

Actions that I take are effective at protecting others from COVID.

1 (Strongly Disagree) - 6 (Strongly Agree)

Attention Validity Check Question

I am taking a survey.

1 (Strongly Disagree) – 6 (Strongly Agree)

System-efficacy Scale

I would rely on first responders, such as paramedics or the police, to save me.

COVID.

1 (Strongly Disagree) - 6 (Strongly Agree)

I would rely on hospitals (including emergency rooms) to provide treatment

1 (Strongly Disagree) - 6 (Strongly Agree)

I assume that I do not need to take action because others will.

1 (Strongly Disagree) - 6 (Strongly Agree)

I am not to blame, and so I would not act to protect others.

1 (Strongly Disagree) - 6 (Strongly Agree)

Government agencies provide resources that help me respond to the outbreak

1 (Strongly Disagree) - 6 (Strongly Agree)

Organizations or agencies exist that will save people who catch the disease.

1 (Strongly Disagree) - 6 (Strongly Agree)

The medical system can respond effectively to the disease.

1 (Strongly Disagree) - 6 (Strongly Agree)

Hospitals and emergency rooms can provide effective care

1 (Strongly Disagree) - 6 (Strongly Agree)

My actions will not make a difference.

1 (Strongly Disagree) - 6 (Strongly Agree)

Sick people's friends and families can respond effectively.

1 (Strongly Disagree) - 6 (Strongly Agree)

If someone has contracted COVID-19, I believe medical service providers would be effective in providing treatment.

1 (Strongly Disagree) - 6 (Strongly Agree)

I believe there are organizations or agencies that want to protect me from COVID-19.

1 (Strongly Disagree) - 6 (Strongly Agree)

Government services are available to help me respond to COVID-19.

1 (Strongly Disagree) - 6 (Strongly Agree)

My friends and family will protect me from COVID-19

1 (Strongly Disagree) - 6 (Strongly Agree)

Pharmaceutical researchers and scientists want to protect me from COVID-19

1 (Strongly Disagree) - 6 (Strongly Agree)

Threat Severity Scale

COVID poses a serious risk to my loved ones.

1 (Strongly Disagree) - 6 (Strongly Agree)

COVID is potentially harmful to people's health.

1 (Strongly Disagree) - 6 (Strongly Agree)

COVID is a severe threat to my loved ones.

1 (Strongly Disagree) - 6 (Strongly Agree)

My friends or family members could die from COVID.

1 (Strongly Disagree) - 6 (Strongly Agree)

COVID is a legitimate threat to me.

1 (Strongly Disagree) - 6 (Strongly Agree)

I could die if I contracted COVID.

1 (Strongly Disagree) - 6 (Strongly Agree)

My health could be permanently damaged if I contracted COVID.

1 (Strongly Disagree) - 6 (Strongly Agree)

COVID is not a serious threat to people's health.

1 (Strongly Disagree) - 6 (Strongly Agree)

People could face severe economic consequences if they caught COVID.

1 (Strongly Disagree) - 6 (Strongly Agree)

Threat Susceptibility Scale

My loved ones are at risk for catching COVID.

1 (Strongly Disagree) - 6 (Strongly Agree)

It is possible that one of my loved ones will catch COVID.

1 (Strongly Disagree) - 6 (Strongly Agree)

I believe that I could be a victim of COVID.

1 (Strongly Disagree) - 6 (Strongly Agree)

Anyone could potentially catch COVID.

1 (Strongly Disagree) - 6 (Strongly Agree)

I am not at risk from COVID.

1 (Strongly Disagree) - 6 (Strongly Agree)

I will not be exposed to COVID.

1 (Strongly Disagree) - 6 (Strongly Agree)

Demographics

What best describes your sex?

Male

Female

Other or prefer not to disclose

What best describes your race?

White

Black or African American

Asian

American Indian or Alaska Native

Native Hawaiian or Pacific Islander

Other

Are you Hispanic/Latinx?

What is your age?

APPENDIX B – IRB Approval letter

Date: 9-29-2021

IRB #: IRB-21-360
Title: Perceptions of COVID-19 generational differences
Creation Date: 8-31-2021
End Date:
Status: Approved
Principal Investigator: Steven Venette
Review Board: Sacco (Exempt/Expedited Board)
Sponsor:

Study History

Submission Type	Review Type	Decision
Initial	Exempt	Exempt

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