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Framing communication messages to promote covid-19 protective behaviors in mexico: an application of protection motivation theory

(Diseñando mensajes de comunicación para promover conductas de protección ante el covid-19 en méxico: una aplicación de la teoría de motivación protectora)

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Abstract

The objective of this research was to explore which constructs of the Protection Motivation Theory (PMT) influence the individual's intentions to reinforce the COVID-19 protective behaviors to frame social communication messages that promote the voluntary adoption of these practices. An experiment was conducted by testing all combinations of the four PMT constructs at two levels, low and high, in four age-groups. The effect of the individual social responsibility and medical condition, and the contagion risk of the region of residence (high and medium) were also considered in the experimental design. The statistical analysis of the experimental data indicates the threat and appraisal components of the PMT do not act independently but interactively. If the severity is tolerable, increasing vulnerability increases the intentions to reinforce the COVID-19 protective practices in both regions. While in the case of the high contagion risk region, vulnerability dominates the intentions to strengthen protective behaviors only if self-efficacy is high. Based on these findings, we conclude that communication messages that simultaneously highlight severity and vulnerability may result in negative emotions and low perceived control that demotivate individuals to strengthen their COVID-19 protective behaviors.

Key words: Protection Motivation,Theory, Perceived risk, Communication messages, Experimentation, Mexico.

Resumen

El objetivo de esta investigación fue explorar qué constructos de la Teoría de Motivación Protectora (TMP) influyen en las intenciones de las personas para reforzar sus conductas protectoras COVID-19 con el propósito de formular mensajes de comunicación social que promuevan la adopción voluntaria de estas prácticas. Se condujo un experimento en el que se probaron todas las combinaciones de los cuatro constructos de la TMP a dos niveles, bajo y alto, en cuatro grupos de edad. El efecto de la responsabilidad social individual y la condición médica, y el riesgo de contagio de la región de residencia (alto y medio) fueron también considerados. El análisis estadístico realizado indica que los componentes de amenaza y afrontamiento de la TMP no actúan independientemente sino interactivamente. Si la severidad es tolerable, incrementar la vulnerabilidad aumenta las intenciones de reforzar las prácticas protectoras COVID-19 entre los residentes de ambas regiones. Mientras que, en la región de alto riesgo, la vulnerabilidad domina las intenciones de aumentar las conductas protectoras sólo si la auto-eficacia es alta. Con base en estos hallazgos, concluimos que mensajes de comunicación que resalten simultáneamente la severidad y la vulnerabilidad pueden producir emociones negativas y un bajo control percibido que desmotive a los individuos a reforzar sus conductas protectoras COVID-19.

Palabras clave: Teoría de la Motivación Protectora; Apelación al miedo; Mensajes de comunicación; Experimentación; México.

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Introduction

The COVID-19 pandemic has no precedents. On August 25 of 2020, the European Centre for Disease Prevention and Control (ECDC, 2020) reported a total of 23,673,902 cases of COVID-19 and 810,262 deaths worldwide. The largest number of cases is reported for America, with a total of 7,962,784 cases, a figure above the number of cases in Asia (3,437,372 cases) where the outbreak began. The American countries most affected are the United States (5,779,028 cases and 178,846 deaths), Brazil (3,669,995 cases and 116,580 deaths), and México (568,621 cases and 61,450 deaths) (ECDC, 2020; Gobierno de Mexico, 2020; University of Oxford, 2020; World Health Organization [WHO], 2020) .

The number of cases in Mexico exhibits an increasing trend since March 2020. The Health Prevention and Promotion Bureau reported 5,847 cases of COVID-19 and 449 deaths on April 15, 2020. The duplication of these numbers in only one week led to the Phase 3 (red light) declaration (Ministry of Health declares the beginning of Phase 3 of Covid-19 in Mexico, 2020).

According to the COVID-19 Regional Safety Assessment (Deep Knowledge Group, 2020), Mexico is the highest-scoring region in Central America, meaning the country registered a broader spread of infection and fatalities than expected. Although the percentage of the aging Mexican population is relatively small, a condition that helps to lessen the overall mortality risk, the high rates of obesity and diabetes, the significant lack of healthcare resources, and the high percentage of informal business and street commerce intensify the negative consequences of the pandemic.

Even though the number of cases increased 35 times from April to July and the estimated mortality rate is 11%, above the reported rate in other countries, many Mexicans do not follow the protection practices recommended by the WHO and the national health authorities (WHO, 2020a). These protective behaviors have been promoted in several mass communication media to increase the awareness of the population. However, national public policies mandate them later than other regions and have not declared their compliance compulsory, thus resulting in an insufficient voluntary acceptance (Ramírez-Coronel, 2020).

This work aims to explore what elements of the Protection Motivation Theory (PMT) are more influential on the intention of continuing and reinforcing the practice of the protective behaviors recommended to prevent the coronavirus infection. The PMT is one of the several social and behavioral theories that have been proposed to explain and predict the adoption of health-protective behaviors. These theories are relevant to the design of public health interventions, social marketing campaigns, and communication messages that inform and encourage individuals to voluntarily adopt protective behaviors to combat the effects of the health emergency of the COVID-19 pandemic (Glanz & Bishop, 2010; Weston, Ip, & Amlôt, 2020; Urzúa, Vera-Villarroel, Caqueo-Urízar, & Polanco-Carrasco).

The close observance of COVID-19 protective behaviors is critical to reducing the contagion and avoiding the overload of the national health systems (OMS, 2020b). However, the maintenance of these behaviors is difficult for a population whose income depends on day-jobs, are not fully vaccinated against other infections (e.g., influenza) and have limited access to an austere healthcare system (Alvarez & Harris, 2020). Consequently, framing effective mass communication messages that clearly communicate the risk and convince the population of the effectiveness of the strict observance of the protective measures must be part of the public health strategy aimed to defy the pandemic (Moreno, 2020; National Academies of Sciences, Engineering, and Medicine, 2020). The effects of the individual's age, health status, individual social responsibility, and the overall regional contagion risk were also considered to enhance the understanding of the individual and social factors that drive the individual's decision to follow the recommended practices.

Protection Motivation Theory in predicting intention to engage in protective behaviors

Perceptions of risk are positively related to preventive health behaviors. When making heath-decisions, individuals weigh the risk of their action consequences with the benefits of preventive, but possibly inconvenient, behaviors (Ferrer & Klein, 2015). The National Safety Council (2014) defines risk as the probability an event has adverse consequences given its frequency. Perceived risk is a psychographic concept defined as an individual's ability to understand the threats represented by events, decisions, and behaviors. During a health crisis such as the COVID-19 pandemic, people form risk perceptions about the situation that comprise cognitive and affective (emotional) dimensions (Harper, Satchell, Fido, & Latzman, 2020; Scholten et al., 2020). Research provides evidence that individuals who are more capable of understanding and processing the objective information about the threat are less susceptible to emotional bias. Additional factors that contribute to risk perception are the salience of information, the frequency a threat is exposed in mass media, and the extent to which a health threat is seen as uncontrollable (Ferrer & Klein, 2015; Scholten et al., 2020).

Protection Motivation Theory has been applied to explain different health-protective behaviors and to design more effective social marketing campaigns (Cismaru & Lavack, 2007; Cismaru, Lavack, Hadjistavropoulos, & Dorsch, 2008; Floyd, Prentice-Dunn & Rogers 2000). The PMT proposes the individual's motivations or intentions to adopt a heath protective behavior depends on four critical cognitions or perceptions: the severity of the threat, the personal vulnerability to the risks, the response efficacy of the risk-reduction behavior, and the self-efficacy at performing

the risk-reducing behavior (Rogers 1983). Self-efficacy, a central concept of the Theory of Social Learning proposed by Bandura (1977), is acknowledged as a critical enabler of behavior. It refers to the beliefs about one's ability or capacity to execute a behavior successfully. People with high self-efficacy are more likely to perform a behavior because they are confident about their abilities. The four components of the PMT are organized into two mediating sub-processes:

1) the threat-appraisal process that evaluates the severity and vulnerability of the threat refers to the potential harm to oneself or others if not doing anything. The difference between the feelings concerning the seriousness of the threat (severity) and the perception of personal vulnerability increases the risk perception and the probability of selecting the adaptive response (e.g., practicing the COVID-19 protective behaviors). These components are akin to the health belief model's susceptibility and severity dimensions, proposing that people are motivated to undertake protective behaviors to minimize risk (Chin & Mansori, 2019).

2) the coping appraisal process influences the selection of the (mal)adaptive response depending on the difference between the efficacy of the health-protective behavior, and the perceived belief one has the abilities to perform it, and the cost (economic, time, social, degree of inconvenience) of modifying current behaviors.

Strong beliefs of severity, vulnerability, self-efficacy, and response efficacy will arouse the protection motivation, resulting in the abandonment of maladaptive behaviors and the adoption of protective ones (León-Rubio & Medina-Anzano, 2016). Cismaru et al. (2008) enhance the PMT with other theories to show how social messages may help sustain high-risk perceptions and persuade individuals they can sustain the protective behavior until the emergency ends.

The PMT postulates significant main effects for each component and interaction effects among them (Cismaru & Lavack, 2007). Empirical research supports that threat, and coping components interact. For example, high levels of self-efficacy or response efficacy combined with higher perceptions of severity and vulnerability strengthen the intentions to engage in protective behavior. Additive and multiplicative models have been proposed to explain the complex effect of these interactions on behavioral intentions.

The multiplicative model anticipates interaction effects among the PMT variables but assumes no protection motivation arouses if any of the variables is zero. Meanwhile, the additive model presupposes compensatory effects that imply high levels of some of the PMT components compensate for others' low value. To overcome both models' weaknesses, Cismaru and Lavack (2007) suggest a non-compensatory strategy: the individual ranks the variables according to their perceived importance and sets minimum cutoffs for each one. If any of the variables does not exceed the established bound, the individual would decide not to continue processing the information they receive. This proposal is relevant to designing communication materials aimed to change behavior. The communication strategy is more likely to be persuasive if all variables that stimulate protection exceed their threshold levels.

The PMT does not assume that individuals make rational decisions. Each of the cognitive appraisal processes can be biased by a heuristic judgment regarding its importance. Given the magnitude of the COVID-19 pandemic, fear appeal messages can be more effective in reinforcing protective behaviors among individuals that are already practicing them (Cismaru et al., 2008). Then, we propose our first set of research hypotheses:

H1: The likelihood of strengthening the protective practices (staying at home, going out only if strictly necessary, social distancing, washing hands frequently, usage of face mask, and increased home hygiene) recommended to prevent the spread of the COVID-19 increases as the perceived severity of the disease increases above a minimum cutoff level.

H2: The likelihood of strengthening the protective practices recommended to prevent the spread of the COVID-19 increases as the vulnerability to become infected by COVID-19 increases above a minimum cutoff level.

H3: The likelihood of strengthening the protective practices recommended to prevent the spread of the COVID-19 increases as the perceived efficacy of the protective behaviors increases above a minimum cutoff level.

H4: The likelihood of strengthening the protective practices recommended to prevent the spread of the COVID-19 increases as the self-efficacy of performing and bearing the cost of these behaviors increases above a minimum cutoff level.

H5: There are significant two-way interactions between the threat and coping appraisal components of the PMT.

Extant research using PMT shows both the threat appraisal and the coping appraisal affect various health-protective and healthcare behaviors (Floyd et al., 2000; Milne, Sheeran, & Orbell, 2006). However, the PMT variables can operate differently depending on the situation. For example, the threat variables have been shown to have a stronger effect if a medical condition is present. In comparison, the coping variables have a stronger effect when risk exposure is low. Additionally, the PMT does not explain why some individuals disregard the seriousness of a threat or do not feel responsible for damaging others. To respond to the inquiry of what PMT variables have a stronger effect under different contexts and why individuals do not feel responsible for spreading the COVID-19, contextual, and individual variables were considered in this research. They are the region's perceived security/risk, the individual

social responsibility, and the biological vulnerability of the individual (age group and health condition).

Individual and social factor influencing risk perceptions

The social context can also influence risk perceptions. The Social Action Theory (SAT) emphasizes social interdependence and interactions influence the personal control on health-endangering behavior, and proposes mechanisms by which the social context affects cognitive action schemes, self-goals, and practiced routines that facilitate the change of behavior (National Safety Council, 2014). SAT views the choice of engaging in risk behaviors as influenced by personal environmental influences and self-regulatory skills/deficits. For example, an individual may not take protective actions because others do. The multi-country study performed by Dryhurst et al. (2020) shows that socio-cultural factors significantly explain risk perceptions toward COVID-19 across countries.

From the PMT perspective, individuals are less tolerant of others' risk than to the risks they assume. That is, if people are aware and conscious of the risk they impose on others, they are less prone to take risks. Concerning the COVID-19 outbreak, the adoption of protective behaviors can be affected by personal risk perceptions, and the risk of infecting others. Individuals who are not perceived to be at risk (low vulnerability) of being infected and infecting others will have lower intentions to change their current lifestyles and adopting preemptive measures. Conversely, when people observe others strengthen their health-protective behaviors, they are more receptive to social pressure to abandon risky behaviors (Lewis as cited in National Academies of Sciences, Engineering, and Medicine 2020, p. 9).

In Mexico, state and municipal authorities declare different lights (red, orange, yellow, and green) according to four parameters: number of available beds in hospitals, rate of hospitalization, contagion rate, and number of infected people (Hernández, 2020). The number and intensity of the economic and social activities authorized depend on the light, thus increasing individuals' mobility and social interaction, and the number of people who perceive a less risky environment and decide not to follow the protective measures. Therefore, we formulate the next research hypothesis:

H6: The effect of the threat appraisal components of the TPM depends on the COVID-19 environmental risk. Specifically, the effect of vulnerability and severity on the intentions to reinforcing the adoption of protective practices will be higher for regions with red light with respect to regions with less alarming lights (orange and yellow).

The adoption of health-protective behaviors has also been related to individual social responsibility, which is a moral principle that leads an entity (person, private, governmental, and non-governmental organizations) to do something to improve the welfare of others (Harper et al., 2020). Individual social responsibility (ISC) refers to a person's responsible behaviors in society, either by avoiding actions that affect others or supporting activities with social impact. ISC involves personal, ethical, and philanthropic decisions to contributing to social welfare. Researchers have tried to explain why some individuals perform imprudent and egoistic behaviors ignoring collective well-being (Pacesila, 2018). For example, Dryhurst and collaborators (2020) found that individuals with prosocial values hold higher risk perceptions toward COVID-19 than individuals with individualistic views, while the National Academies of Sciences, Engineering, and Medicine (2020) recommends to highlight the social disapproval of the noncompliance of protective behaviors and appeal to collective welfare.

The Social Cognitive Theory of Morality explains irresponsible and risky behaviors in terms of a moral disconnection or misunderstanding of social responsibility. The moral disconnection process refers to the total or partial deactivation of the regulative cognitive system that distorts the relationship between the behavior and its potential harm, thus justifying the reprehensible behavior (Bandura, 1991; Bandura, 2002). As a result, individuals convince themselves that ethical standards do not apply to themselves. The deactivation can occur through several mechanisms (Bandura, Barbaranelli, Caprara, & Pastorelli, 1996). For example, moral justification defends reprehensible behavior by arguing socially and morally valued intentions. An illustration is the organization of family reunions to celebrate important occasions (mother's day, grandparents' birthdays, etc.), ignoring the COVID-19 preventive measures. Based on this rationale, the next hypothesis follows:

H7: The likelihood of strengthening the protective practices to prevent the spread of the COVID-19 increases as the individual social responsibility (ISR) rises.

Finally, biological factors such as the person's health status also affect risk perceptions. The age of a person and the presence of non-transferable chronic diseases (NCD) -cardiovascular diseases, diabetes, high blood pressure, immunodeficiency disorders, and respiratory diseases- increase the risk of severe illness from COVID-19. Enriquez, Perez-Lloret, and Szyld (2020) found significant differences between the age groups of 40-49 and 30-39 years old concerning the need for hospitalization and intensive care, but not for the number of deaths from COVID-19. Findings also indicate that the mortality rate triplicates after 50 years old, thus suggesting that the risk of infection of the virus is more significant amog groups above this age above this age. Then, we formulate the following hypothesis:

H8: The intention of reinforcing the protective measures to prevent the COVID-19 spread depends on objective factors. Specifically, the intentions to strengthen the pro-

tective practices increase with the age of the individual and the presence of a medical condition.

Summarizing, different theoretical perspectives that incorporate risk as a determinant of behavior propose a determinant of behavior support communication campaigns that induce fear appeal and decrease risk tolerance at the individual and community level will effectively increase the awareness and consciousness of individuals about the consequences of not modifying their risk behaviors (Rimal & Real, 2013; Salazar, Crosby, Noar, Walker, & DiClemente, 2013). Research also provides evidence that when health interventions successfully change risk perceptions, health behavior change often results. However, these programs should also stress how to effectively change the behavior and increase the beliefs about the behavior's low costs and effectiveness (Van der Pligt, 1996). Thus, the empirical testing of the research hypotheses formulated would help design a more effective communication campaign to convince Mexicans of the need to support and maintain the protective behaviors recommended to prevent the spread of COVID-19.

Method/Procedure

The health communication literature has tested the PMT through pre-posttest experiments to examine the effects of various types of information on risk reduction behaviors. We followed this approach and conducted a screening experiment (Dziak, Nahum-Shani, & Collins, 2012). The goal of a screening experiment is to determine which of several possible components of a proposed intervention (e.g., a communication message encompassing high versus low susceptibility and severity beliefs toward a health emergency) have a significant influence on the desired response. The results of screening experiments could be used to a) identify what components of an intervention are more effective, b) define the optimum combinations of levels of the components of an intervention, c) improve cost-effectiveness by eliminating features that do not contribute to the intervention's success.

Screening experiments are an alternative to traditional randomized controlled experiments, and they are implemented by performing 2^k designs that are experiments involving all combinations of k factors at only two levels, low and high. In engineering and natural sciences, these experiments are more commonly used than in social and behavioral sciences, where the evaluation of more than two or three factors is infrequent. Screening experiments require a reduced number of experimental runs to effectively detect the few crucial effects among a total (Collins, Dziak, & Li, 2009). The larger the number of factors (k), the most efficient is the 2^k experiment because the tests' statistical power aimed to identify the significant effects increases due to a larger number of "hidden" replications.

In this research, a 2^4 experiment was performed by manipulating the four constructs of the PMT. The low level of each PMT variable was not set to zero to consider the non-compensatory effects of its components (Cismaru & Lavack, 2007). For example, self-efficacy stimulus for the low condition states practicing health-protective behaviors is challenging but can be performed by regulating one's own emotions to the new "normality." Regarding vulnerability, the low condition provides estimated rates of infection and mortality that suggests the contagion rate of COVID-19 is not excessively alarming.

Four age-groups of subjects were selected in each region to control by the age' risk. The full 2^4 experiment was confounded in two blocks of size eight. That is, in each age group, only eight of the possible combinations of the 2^4 factorial experiment were tested, thus resulting in a resolution V factorial design that allows the estimation of all main effects and two-factor interactions (Kirk, 2013). The experiment was performed by randomly assigning a specific combination of the factors to different subjects of the same age range. Thus, the design corresponds to a between-subject study with respect to the experimental stimulus.

We selected age as a blocking variable because the severity of COVID-19 increases progressively with age. The health condition of the individual cannot be determined a priori to form the blocks, but more importantly, the severity of COVID-19, according to the complication calculator implemented by the Mexican Institute of Social Health (IMSS, 2020), increases more significantly with age. The calculator assigns a level of complications due to COVID-19 up to 15% for the age group of 18-29 years old, between 16-27% for the age group of 30-39 years old, 30-50 % for the age group of 40-54 years old, and up to 79% for people 65 and older. Based on these figures and the study of Enriquez et al. (2020), the age groups (blocks) were defined as follows: 18 to 29 years old, 30-39 years old, 40-54 years old, and 55 years old or more.

Participants

A total of sixty-four individuals, thirty-two living in a state classified with a high degree of alertness (red) at the time the experiment was performed, and thirty-two residents of a state with a medium degree of risk contagion (orange), were exposed to a unique combination of the four factors. The first region is the State of Mexico (red), ranked second in the number of confirmed cases and deaths since the pandemic began and only surpassed by Mexico City. Five counties concentrate almost half of the infections and deaths from coronavirus registered until August 25,2020 in this state. The experiment was performed in the county of Toluca, the state's capital, and the third county in the number of infections (Government of the State of Mexico, 2020). The second region is Guanajuato (orange), particularly the county of Yuriria, which registers a moderate con-

tagion rate and a low number of deaths (Ministry of Health of Guanajuato, 2020).

Each block consisted of approximately an equal number of male and female participants (47% females and 53% of males in the red region; 62% females and 38% males in the orange region). All respondents are currently working and must go to their working place at least once each week. In the red region (Toluca, Mexico), we approached the middle and general managers of five firms, the administration of a civil organization, and two municipal organizations' employees. We explain the purpose of the project to them and ask for their help to apply the questionnaire to four people, one of each of the four age groups. In region 2 (Yuriria, Guanajuato), respondents were mainly employees (22 persons) of the state university working in different areas (faculty, security, administrative area, and maintenance), and the other participants were employees of a local private security agency and a construction company. The fieldwork was performed during July and August 2020.

Materials

Experimental stimulus were essays quoting surveys and research studies (all actual studies and statistics) that strongly (high level) or weakly (low level) support the noxiousness of COVID-19 disease, the chances of being infected, the effectiveness of the protective measures, and the perceived little/great difficulty and cost of performing the recommended practices. Appendix I shows one of the essays elaborated, and Appendix II lists all the Webpages used to prepare the full set of stimuli. The essay in Appendix I corresponds to the factor combination: low severity, high vulnerability, high efficacy of protective behaviors, and low self-efficacy.

Before experimentation, a manipulation check was performed by asking a group of 32 undergraduate students to judge if a specific paragraph of the essay suggests a low/high PMT component (e.g., if following the protective measures would be very difficult and uncomfortable). Eight students rated the two paragraphs independently referring to a unique construct of the PMT and indicated if they suggest a low or high condition on a 10-point scale going from 1 = not at all to 10 = very much. For the low conditions, all ratings were below three and above six for all high conditions.

Participants were informed that researchers of the two universities were performing a research project regarding how people cope with the COVID-19 pandemic before asking for their participation. An identification number was placed on the questionnaire, and the respondent's name was not asked. Additionally, a disclosure statement was included to assure confidentiality and anonymity. Before reading the communication stimulus, respondents were asked to rate their degree of adoption of the protective practices to prevent the spread of COVID-19 on a scale going from 1 to 5 (see Appendix I). Then, subjects were instructed to read the essay carefully and to underline the most important sentences in each paragraph. This instruction was intended to ensure closer attention to the informative note. Respondents answered five questions after they finish reading the essays. The first question asks to state the probability that the respondent will increase the level of adoption of protective practices or maintain the highest protection level. The second question assesses the ISR through a scale of seven-items on a Likert scale. The third question asks about the individual's health status, specifically if he/she suffers from NCD or an immunosuppressive condition. The fourth and fifth questions ask for the age range (checking question) and gender of the individual.

Results

Several statistical analyses were performed to test the research hypotheses. First, the non-parametric Kruskal-Wallis test was used to verify if there are differences between age groups regarding the degree of the practice of COVID-19 protective behaviors. Significant differences were declared in the case of the red region (high contagion risk); elderly individuals (over 55 years old) reported the highest level of protection, thus confirming age was an appropriate blocking variable. No significant differences were declared for the region with a medium risk of contagion (orange). Table 1 describes the current level of adoption of the recommended protective measures in the two regions by age group.

Table 1
Level of the practice of protective behaviors by age group

	Red region (high contagion risk)		Orange region (medium contagion risk)	
Age group	Average	Standard deviation	Average	Standard deviation
18-29 years old	3.875	0.354	4.375	0.744
30-39 years old	4.143	0.378	4.250	0.886
40-54 years old	4.000	0.535	4.625	0.744
>55 years old	4.625	0.518	4.875	0.354
Kruskal-Wallis test	9.81 (P-value = 0.20)		3.71 (P-value =0.294)	

The second statistical analysis was an Exploratory Factor Analysis (EFA) aimed to evaluate the unidimensionality and convergent validity of the ISR scale. Items 2, 3, and 7 were negatively worded; that is, they declared low ISR. Therefore, they were recoded such that low values

correspond to a high level of individual social responsibility. The principal components and Varimax rotation methods were applied to the merged data of all collected questionnaires. EFA indicates that two uncorrelated factors account for 62% of the total variance. These factors were named as follows: Acknowledgment of own Responsibility for Social Protection (items 1 and 4 to 7) and Individual Attribution of the adoption of COVID-19 protective practices (items 2 and 3). Factor scores were computed by averaging the items grouped in the same factor. The resulting scores or variates labeled ISR_1 and ISR_2 were used as covariates in the Analysis of Variance (ANOVA) and the medical condition of the individual, denoted as the total number of declared diseases in question 3.

In the third part of the statistical analysis, an ANOVA was performed by using all 64 experimental runs. The option Power and Sample Size for 2-Level Factorial Design of MINITAB was used to compute the power of the complete experiment. An effect of 0.569 units in the response, equivalent to 0.8 standard deviations (pooled SD = 0.711) was specified. A significance level equal to 0.10, judged appropriate for social research, was set. The resulting power of the full factorial experiment (16 combinations) replicated four times, two times per region, was 0.9108, which resulted suitable to identify the most relevant effects.

Significant differences below the 10% level of significance between the two regions were declared in the ANOVA ($F(1,46) = 3.12$, $p = 0.084$). Therefore, separate ANOVAs were conducted per region to examine how the four PMT components influence individual behavioral intentions. The results of the two separate ANOVAs are reported in Table 2.

Table 2

ANOVA results. Response = Probability of strengthening protective practices

Effects	df	Red region (high contagion risk)		Orange region (medium contagion risk)	
Model	16	F-value	P-value	F-value	P-value
Covariables	3				
ISR_1	1	0.3	0.591	2.25	0.154
ISR_2	1	1.4	0.255	0.09	0.764
Medical condition	1	2.47	0.137	0.31	0.588
Age group	3	0.69	0.571	0.46	0.718
Main effects	4				
A = Severity	1	0.03	0.867	0.31	0.587
B = Vulnerability	1	0.22	0.649	2.41	0.142
C = Effectiveness	1	0.47	0.505	1.68	0.215
D = Self-efficacy	1	0.27	0.611	0.65	0.433
2-letter interactions	6				
A*B					
A*C	1	5.06	0.040*	2.94	0.101[a]
A*D	1	2.05	0.173	0.33	0.573
B*C	1	0.22	0.646	0.43	0.521
B*D	1	1.58	0.228	0.61	0.407
C*D	1	3.61	0.077[a]	0.11	0.739
	1	0.27	0.610	0.01	0.907
Error	15	R^2 = 60.43%		R^2 = 53.23%	

*Significant at the 5% level. *Significant at the 10% level.

The last statistical analysis was applying the non-parametric Mann-Whitney test to compare the two regions in terms of the level of practice of the protective measures to prevent COVID-19 disease. Significant differences in the current level of protection against COVID-19 disease between the two regions were declared (Mann-Whitney test = 815.5, p = 0.007). Surprisingly, the highest median level corresponds to the region with a medium risk of contagion (Median = 5). The lower limit of the one-sided 95% confidence interval for the median difference equals -1, meaning the current degree of protection of the residents of the county of Toluca, Mexico is at least one level (Median = 4) below than the degree of protection of the residents of Yuriria, Gto. The averages and standard deviations of current and future levels of protective practices are described in Table 3.

Table 3

Descriptive statistics per region. Responses: Current level of protection and chances of increasing the practice of protective behaviors

	Red region (high contagion risk)		Orange region (medium contagion risk)	
Response variable	Average	Standard deviation	Average	Standard deviation
Level of the practice of protective behaviors	4.161	0.523	4.531	0.718
Probability of strengthening the protection level	4.422	0.661	4.531	0.718

Discussion

According to the two ANOVA results, the four basic constructs of the PMT (vulnerability, severity, efficacy, and self-efficacy) do not have a direct main effect on the intentions of reinforcing current COVID-19 protective behaviors. Therefore, there is no empirical support to hypotheses H1 to H4. However, this does not imply that the PMT variables cannot be useful for designing communication messages to promote the adoption of health-related behaviors (Cismaru & Lavack, 2006, 2007). Two first-order interactions were declared significant: vulnerability and severity for the two regions, and vulnerability and self-efficacy only in the case of the red region. Thus, the research hypothesis H5 is partially supported.

Graphs of the average responses at each treatment combination of severity and vulnerability were constructed to assist with interpreting interaction effects. Figure 1 and Figure 2 graphically describe vulnerability by severity interaction for the red and orange regions. The significant interaction is indicated by the lack of parallelism of the two lines shown in the graphs. For example, in the case of Figure 1, the changing from low to high vulnerability in the message increases the protective-behavior intentions by 0.327 units in average (positive slope of the solid line) if the severity is low. In contrast, if the severity is high, protective-behavior intentions decrease 0.593 units in average (negative slope of the dashed lie) if the vulnerability is increased. The crossed lines in both graphs reveal an antagonistic effect of similar size in both regions (V*S effect red region = 0.920 = 0.327-(-0.593)), V*S effect orange region = 1.195 = 0.122-(-1.073)). Therefore, hypothesis H6 is not empirically supported, meaning the threat appraisal components' effect does not depend on the acknowledged contagion risk of the region of residence. According to the graphs in Figures 1 and 2, the largest average in protective-behavior intentions corresponds to high severity and low vulnerability.

Figure 1

Region red: vulnerability by severity

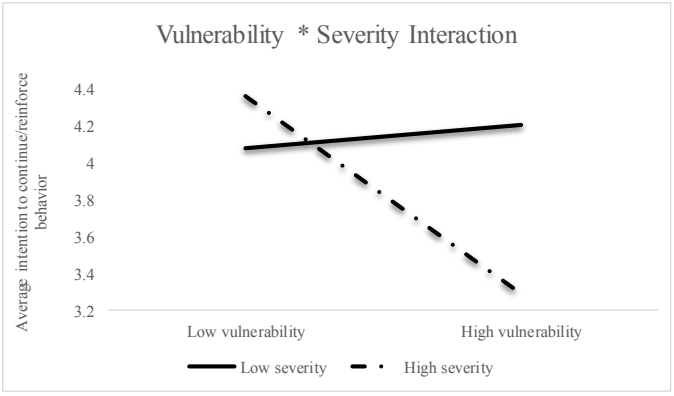
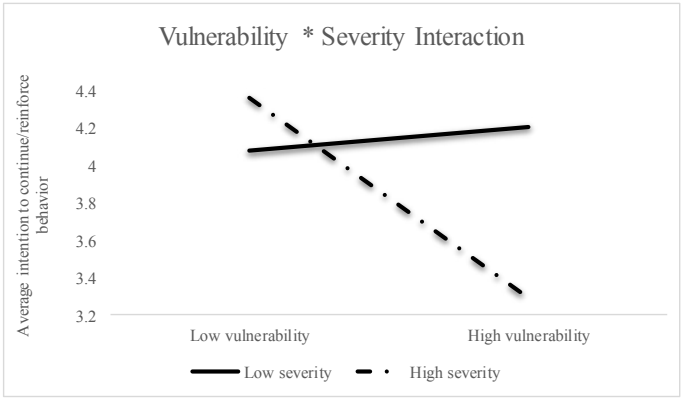


Figure 2

Region orange: vulnerability by severity

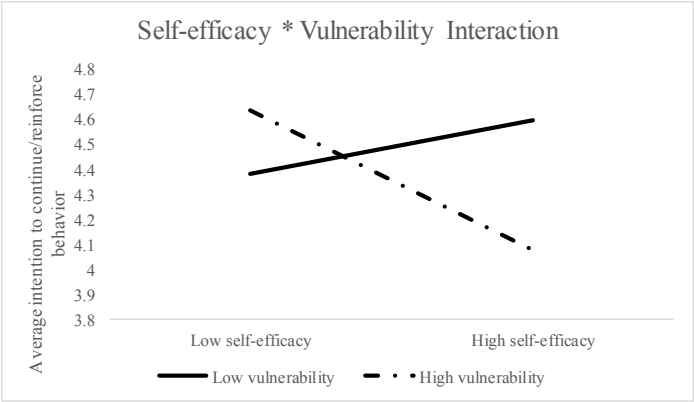


Conforming to the interaction plots, individuals were responsive to vulnerability mainly on conditions of low severity. A higher perceived vulnerability was associated with increased intentions to reinforcing (see Figure 1) or maintaining (see Figure 2) protective behaviors only if the severity is tolerable. However, if vulnerability and severity are highlighted (high condition for both variables), it seems individuals feel they have lost control of the situation, and their intention to strengthen/maintain their protective behaviors decreases notably.

Loss of control refers to the "lack of the ability to provide conscious limitation of impulses and behavior as a result of overwhelming emotion" (Griffin, 1990, p. 918), thus resulting in intense fear. The use of fear arousal communications to advocate protective health-behaviors has been criticized because they have a short-term triggering effect on behavioral intentions, and they cause distress to the most vulnerable segments of the population (Hastings, Stead, & Webb, 2004). A health crisis like the COVID-19 pandemic could reduce an individual's perception of control over the situation due to negative emotions such as fear and anxiety, thus demotivating individuals to heighten or maintain the COVID-19 protective practices (Harper et al., 2020; Stolow, Moses, Lederer, & Carter, 2020).

The other two-way interaction declared significant only for the red region is graphically described in Figure 3.

Figure 3
Region red: self-efficacy by vulnerability interaction



The perceived threat to oneself and self-efficacy are factors previously examined in the context of exposure to fear appeal of health information. Fear arousal has been claimed to motivate individuals to look for relevant information about how to act to reduce their vulnerability. According to the interaction graph of Figure 3, the effect of self-efficacy on behavioral intentions is a function of vulnerability because the change in the protective-behavior intentions when self-efficacy is increased is not the same at the two vulnerability levels. Average intentions increase if self-efficacy increases, but only if the vulnerability is low (solid line). If the vulnerability is high (dashed line), self-efficacy improvement decreases behavioral intentions, revealing an antagonist effect. The larger averages in the protective-behavior intentions correspond to the combinations (low vulnerability, high self-efficacy) or (high vulnerability, low self-efficacy). Therefore, the most suitable combination is (low vulnerability, high self-efficacy) to agree with the recommendation established after the previous interaction analysis.

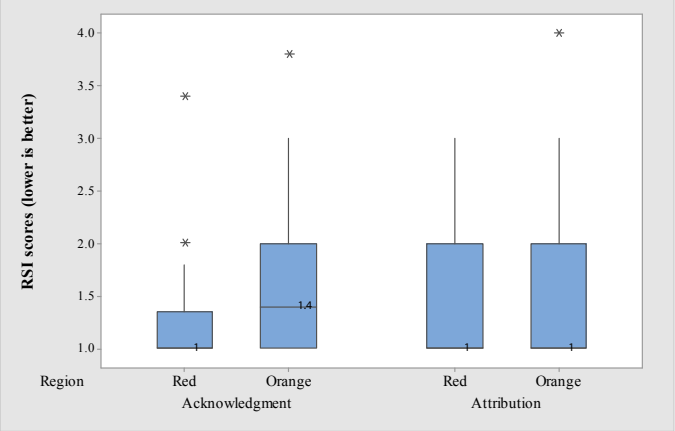
Extant research suggests that if vulnerability and self-efficacy are high, the individual is more prone to adopt protective behaviors, thus suggesting a synergistic effect (Cismaru & Lavack, 2007). However, this study's results indicate that the upgrading of self-efficacy would motivate the reinforcement of COVID-19 protective behaviors only if vulnerability perceptions are bearable. In other words, if the risk of contagion is not judged so extreme (low vulnerability), then self-efficacy is the dominant factor that drives health-protective behaviors. McKinley and Ruppert (2014) report a similar vulnerability and self-efficacy interaction in the case of the use and trust of online mental health resources. They found that vulnerability perceptions toward mental health problems were only associated with favorable web services judgments at low self-efficacy levels. No explanation for this unexpected result is provided; the authors only remark more research is required to understand better how the threat (vulnerability) and coping (self-efficacy) factors of the PMT interact. The explanation we suggest is that one element of the message dominates the attention and drives the individual's decision. If the vulnerability is emphasized, then intentions are driven by this factor, but if the vulnerability is mild (low condition in the communication message), then self-efficacy perceptions drive behavioral intention. This finding goes in line with the Extended Parallel Process Model (EPPM) that proposes a sequential information process: threat information is processed first, and depending on its level, self-efficacy information is appraised.

Cismaru et al. (2008) integrated the EPPM with the Transtheoretical Model (TTM) to suggest a social marketing strategy that proposes different PMT elements need to be highlighted at each stage of the TTM. This proposal fits with our results. At the maintenance stage of the COVID-19 pandemic, social messages must sustain the high severity of the threat, advocate a tolerable vulnerability level (low), and contain large amounts of self-efficacy to prevent relapse in previous stage.

Finally, according to the ANOVA results, the two dimensions of ISR and the respondent's medical condition do not have a significant effect on the probability of strengthening or maintaining the highest level of COVID-19 protective behaviors. Consequently, hypotheses H7 and H8 were unsupported. An explanation for these findings is that the level of ISR is considerably high in both regions. Figure 4 descri-

bes graphically the distribution of the scores of the two ISR dimensions, namely acknowledgment of own responsibility for social protection and individual attribution of protective practices. The median values reported in the middle of the box-plots indicate that about 50% of the respondents scored 1.0 (the upmost value in the scale) in both dimensions. All box plots indicate that ISR scores have relatively low dispersion and skewness, and only a few respondents (identified with *) are indifferent to their social responsibility. Additionally, the number of individuals with a medical condition (chronic or immuno-depressive diseases) is very low in both regions. Only 25% of the respondents (8 persons) in each region reported at least one medical condition.

Figure 4
Individual social responsibility scores per con tagion risk region



The way communication messages are framed can persuade individuals to adopt protective behaviors or discourage them from performing unhealthy practices. Negative communication messages that plead to fear appeals have been used in social marketing. However, these communication messages should be adapted to the target, the severity and stage of the health emergency, and the social context's characteristics. The analysis of what features of a communication message is more influential to Mexicans provides relevant insights to revise and design communication strategies to promote the reinforcement and maintenance of protective behaviors to mitigate the COVID-19 pandemic.

Based on PMT proposals, different communication messages were framed by underlying (or not) threat appeals to prompt perceived health risk, inform of the efficacy of preventive measures, and reassuring individuals they have the skills to modify their current behavior. This experimental study indicates that emphasizing both vulnerability and severity may trigger strong fear emotions that lead to negative reactions. Increasing the vulnerability perceptions related to COVID-19 disease positively affects behavior only if the severity is tolerable. Similarly, the enhancement of self-efficacy beliefs positively influences the intentions to strengthen protective practices provided vulnerability is low. Therefore, communications that couple messages at the cutoff value of severity and point out the high risk of transmission of the virus (high vulnerability) and the need to develop the abilities to meet the challenges and cost to sustain the protective behaviors can be more effective to persuade Mexicans to adopt COVID-19 preemptive practices.

This study's findings enhance the understanding of how the PMT variables (i.e., vulnerability, severity, efficacy, and self-efficacy) interact with each other. Additionally, the effect of the individual (age, medical condition, and individual social responsibility) and contextual factors (the prevailing contagion risk) was considered. Although these variables were declared non-significant, they are theoretically relevant and deserve further study. A secondary contribution of this research is using a full factorial design confounded in blocks of size eight. Although 2^k designs are screening experiments with good efficiency and low cost, they have been mainly applied in engineering and natural sciences (biology, chemistry, and physics), while their advantages have not been entirely recognized in the social sciences.

This study is not without limitations. The non-random selection of respondents, particularly the selection-history threat (workers and managers of industries in the red region, and university employees in the orange region) to internal validity, is the main drawback. Performing a randomized experiment is, therefore, a recommended extension of this research. Replication of the study in other regions, controlling not only by the regional contagion risk but also by other sociodemographic variables that may increase the vulnerability of individuals (e.g., income) is another meaningful extension of this research because profiling the individuals who are more or less likely to react to communication messages is relevant to propose direct persuasion strategies.

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APPENDIX I. Example of a questionnaire for a particular combination of PMT constructs.

Several research projects are being conducted by universities worldwide to better understand the dynamics and consequences of the coronavirus pandemic and to developing effective measures to overcome it. The Tecnologi-co de Monterrey and the Universidad de Guanajuato are developing projects covering different topics. One of the-se studies deals with individual's behaviors and reactions toward protective measures (e.g. social distancing, home office, etc.) in the context of the Covid-19 pandemic.

We are asking you to participate in this study by res-ponding to a survey that will take approximately 15 minutes to complete. The information collected will be strictly anon-ymous and confidential, and the study has received ethics approval by both universities. The information you provide will help to make informed decisions about how to promote health-protective behaviors.

First, please let us know the extent to which you are currently following the protective measures to prevent the Covid-19 infection. Please mark the option that better des-cribes your current practices:

1 = I continue with my regular activities as usual. I only have limited those activities restricted by the authorities, for example going to the gym. I do not use face masks unless some authority demands me their use (e.g. my work supervisor).

2 =I have reduced my social activities, but I still participate in family reunions and only use face masks if I need to go to places where their use is compulsory.

3 =I only go outside home if necessary, for example, to buy food or go to work, and always maintain social distancing from people and use face masks. I only visit my relatives and friends in their homes, or they come to my home. I also wash my hands regularly and follow my usual personal and home hygiene practices.

4= I only go outside home if necessary, for example, to buy food or go to work, and always maintain social distancing from people and use face masks. I only visit (or receive) relatives and friends at their homes but we only meet in groups of up to two households and keep social distancing. I also wash my hands regularly and have increased my personal and home hygiene practices according to the recommendations of the Mexican Ministry of Health.

5 = I have self-isolated at home with my family. If it is necessary to go out, for example, to buy food I use high protection face masks (KN97) and an additional acrylic mask. When returning home, I take a bath and wash my clothes. I do not visit relatives or friends or receive them at my home. We also follow strict hygiene practices at home and disinfect everything we buy or are delivered at my home.

INSTRUCTIONS: Please read carefully the following informative note. All information in the note was compiled from reports and websites of reliable international health organizations such as the World Health Organization (WHO), the Pan-American Organization of Health (OPS), and the Health Ministries of countries such as Spain and the United Kingdom. Please underlie the most salient sentences of each paragraph. After you finish reading, reflect on the information provided and then answer the questions at the end of the note.

According to information published by the Pan-American Organization of Health, a high percentage (80%) of the persons infected by COVID-19 only experienced mild discomfort like when you catch a cold. Of those who became seriously ill, only 5% were required to go to a hospital and IUC and only 2.3 died. But most of them were elderly people with bad health condition. Although the number of tests performed in Latin-America countries is limited, the number of deaths due to the coronavirus is still below the number of deaths due to cardiovascular diseases, non-transferable chronic diseases such as diabetes, and cancer.

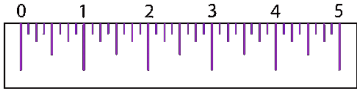
There is no vaccine or effective treatment for COVID-19, therefore, following the protective measures recommended by international health organizations such as the OMS is essential to prevent the infection. There are no other options to eliminate the risk of becoming diseased and infect the people with whom you live. The COVID-19 spreads very easily from person to person. If you are in contact with people who do not show symptoms or with objects they have touched, you can be infected and nobody knows how sick you are going to be even if you are a healthy person.

The virus is transmitted through the droplets produced by infected people when they cough, sneeze or speak. Thus, washing your hands frequently, cleaning regularly the surfaces you touch most, using face masks when is necessary to go out of your home, and keeping social distancing with others are the most effective protection practices. The effectiveness of these measures is evident in the case of Asian countries such as China, Hong Kong, Taiwan, and Singapore that make these practices compulsory and even imposed homestay on their citizens. In the case of countries such as Spain and Italy, the strengthening in the application of the preventive measures and the prohibition of the unnecessary movement of people contributed to flattening the contagion curve. Although many people question the effectiveness of protection practices, what is clear is that what has zero effectiveness is not following them.

But the adaptation to the "new normality" is challenging. Staying home, not visiting relatives, friends, boy- and girlfriends is hard. Stop traveling and going to shopping centers and restaurants, not going to school and working at home, especially for a long time, requires a relentless effort. Moreover, social distancing is difficult and makes me feel alone, and without any control over the situation. Constantly washing hands and disinfecting everything one

buys or receives sometimes seems so costly and burdensome, while the use of face mask is uncomfortable. Thus, is understandable why one feels unconfident in practicing all these preventive actions for an indefinite time.

1. After reading the informative note, how likely is that you increase the level with which you are following the protective practices described at the beginning of the survey or sustain the highest level of protection if you already do so.

No chance I will reinforce  Surely I will increase the my current practices

2. Please read carefully each of the following statements and express your level of agreement with each one on the scale. Select (1) only if you unquestionably agree with the statement and (5) if you entirely disagree. Otherwise use the values in the middle of the scale.

2.1.Following the recommendations of the health authorities to prevent the COVID-19 disease must be considered a civic responsibility.

Totally agree	Agree	Indecisive	Disagree	Totally disagree
1	2	3	4	5

2.2.I do not have to go out of my home only if it is necessary, for example to go to my work and to buy food and medicines, each one knows what to do.

Totally agree	Agree	Indecisive	Disagree	Totally disagree
1	2	3	4	5

2.3.It is a personal decision to follow the protective measures (social distancing, use of face masks, staying at home, etc.) related to the COVID-19 pandemic.

Totally agree	Agree	Indecisive	Disagree	Totally disagree
1	2	3	4	5

2.4.Following the protective measures recommended by the health authorities to prevent the COVID-19 is everybody's responsibility.

Totally agree	Agree	Indecisive	Disagree	Totally disagree
1	2	3	4	5

2.5.I do all I can to protect myself, my family, and my community.

Totally agree	Agree	Indecisive	Disagree	Totally disagree
1	2	3	4	5

2.6.I am irritated that people do not follow the protective measures, they set us all at risk.

Totally agree	Agree	Indecisive	Disagree	Totally disagree
1	2	3	4	5

2.7.I do not need to strictly follow all the recommended protection measures to prevent the COVID-19 disease, only risk groups (people with chronic diseases, elderly people, and health personnel) are the only ones that need to practice them.

Totally agree	Agree	Indecisive	Disagree	Totally disagree
1	2	3	4	5

3. Please check all the diseases you currently have ___ Diabetes
___ Heart diseases
___ Pulmonary/respiratory diseases
___ Kidney diseases
___ Hypertension
___ Overweight and obesity
___ Diseases that decrease your resistance to infections, such as lupus, VIH, cancer, atherosclerosis

4. Please select your age group 18 up to 29
30 up to 39
40 up to 54
More than 55

5. Please mark your gender ____ Male _____ Female

APPENDIX II. Sources revised to elaborate the stimuli.

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