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**Effectiveness of message framing in changing COVID-19 vaccination intentions:
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Abstract

This research examines the effectiveness of message framing, message appeal and information content in changing respondents' COVID-19 vaccination intentions through influencing their vaccine risk perceptions. Furthermore, the moderating effect of travel desire on the relationship between vaccine risk perceptions and changing vaccination intentions is examined. In doing so, two rounds of data were collected from the same respondents. The first survey recorded respondents' vaccination intentions, travel desire and socio demographics. A follow up survey tested cause-and-effect relationships on the proposed relationships using a 2 (message frame: gain, loss) x 2 (message appeal: rational, emotional) x 2 (information content: subjective, objective) between-subjects online experimental design. Findings suggest that loss-framed messages are more effective than gain-framed and emotional-rational messages in reducing risk perceptions and, thus, changing vaccination intentions. Travel desire is found to moderate the effect of vaccine risk perception on vaccination intentions by weakening the negative effect of vaccine risk perception on vaccination intention. Findings show the importance of travel desire along with message framing and message appeal on changing individuals' COVID-19 vaccination intentions in public health communications.

Keywords: message frame, message appeal, COVID-19 vaccination intention, perceived vaccine risk, travel desire

1. Introduction

The COVID-19 pandemic has wreaked havoc on the world economy as well as the hospitality and tourism industry, due to unprecedented shutdowns, stay home orders and border closures (Gursoy & Chi, 2020). Even after the easing of restrictions, a large number of individuals have decided to postpone their travel plans due to fear of becoming infected with the COVID-19 virus. Since a large body of scientific literature indicates that COVID-19 vaccines are effective against the COVID-19 virus (Lopez Bernal et al., 2021), increasing vaccination rates can have significant impacts on willingness to travel and the recovery of the hospitality and tourism industry (Gursoy et al., 2021).

While a number of factors can influence vaccination intentions, travel desire can play a critical role in deciding whether to be vaccinated against the COVID-19 virus (Hasan et al., 2021). Since most hospitality and tourism activities are co-created, delivered and consumed in social settings, where other people are also present (Chen et al., 2021), individuals who wish to travel are likely to be more open to being vaccinated (Gursoy & Chi, 2021). Furthermore, utilization of vaccine certificates for international travel is rapidly becoming a general policy (Atadil & Lu, 2021). Some countries are welcoming fully vaccinated travelers. For example, the European Union has introduced the EU digital COVID certificate for travelers (Europe Commission, 2021).

However, a significant portion of the population, (i.e. 25 to 35 per cent), remains skeptical about the safety of the COVID-19 vaccines (Malik et al., 2020). This skepticism about the safety of COVID-19 vaccines appears to be triggering a complex risk assessment of the COVID-19 vaccines, and subsequently influencing willingness to accept vaccination. Also, individuals' level of knowledge about COVID-19 vaccines can have significant impacts on their assessment of COVID-19 vaccine risks and benefits. As suggested by the protection motivation theory (PMT) and secondary risk theory (SRT), individuals will only get

vaccinated if they believe that the combined benefit of the vaccine and disease threat, are greater than the secondary threat resulting from the vaccine risk. If the perceived threat of the secondary risk from the COVID-19 vaccines, side-effects and complications due to the vaccine itself are sufficiently high, they can alter the protection motivation and subsequent vaccination behaviors of individuals. While the lack of knowledge regarding the effectiveness of COVID-19 vaccines can increase risk perceptions, and thus, vaccine hesitancy, simply increasing knowledge levels may not necessarily lower risk perceptions. Thus, decreasing individuals' risk perceptions and improving their willingness to get COVID-19 vaccines requires further investigation. It is important to investigate not only the availability of information, but also how the message is framed. If a vaccine message is presented to mitigate the perceived severity of the vaccine side-effects or the appraisal of the positive aspects of the vaccine, it is likely to influence perceived risk of the vaccine and vaccine intention. (Cheng, Woon, & Lynes, 2011).

Message framing is considered to be an effective communication approach for influencing people's attitudes and behaviors (Cheng et al., 2011; Kim & Kim, 2014; Zhang et al., 2018). The way a message is framed can have significant impacts on the message persuasiveness (Smith & Petty, 1996). For example, loss-framed messages have been reported to be more effective in decreasing behaviors with risky outcomes, while gain-framed messages are found to be more effective in increasing behaviors that are considered safe (Cheng et al., 2011; Kim & Kim, 2014). Studies suggest that individuals tend to be more sensitive to losses than benefits or rewards (e.g., O'Keefe & Jensen, 2008). Since the COVID-19 virus poses significant risks, loss-framed messages should be more effective than gain-framed messages in motivating individuals to get vaccinated.

In addition to the framing of the message, the content of the message can also influence message persuasiveness (Chi, Denton, & Gursoy, 2021). Studies suggest that individuals who

receive objective and rational information are more likely to utilize a more systematic approach to process the message as compared to individuals who receive subjective and emotional information (Chi et al., 2021). Since knowledge about the effectiveness of COVID-19 vaccines is an important determinant of individuals' willingness to get vaccinated, it is important to investigate the effects of information content and message type (emotional or rational, objective or subjective) on perceived vaccine risks and vaccination intentions.

Thus, this study aims to examine the effectiveness of framed messages (loss vs gain, emotional vs rational, and objective vs subjective) on perceived vaccine risk and the influence of perceived vaccine risk in changing vaccination intentions. This study further examines the moderating role of travel desire on the relationship between perceived vaccine risk and vaccination intentions. In doing so, a longitudinal research design is used to provide empirical evidence about the causal effects of message framing on perceived risk of COVID-19 vaccines and the moderating effects of travel desire on the relationship between perceived vaccine risk and the vaccination intentions. Furthermore, this study explores the interaction effects of message framing and the type of vaccine information (objective/subjective) on the perceived risk of COVID-19 vaccines.

2. Conceptual Background and Research Hypotheses

2.1 Secondary Risk Theory

This study utilizes the secondary risk theory of protection motivation as the conceptual framework (Cummings, Rosenthal, & Kong, 2021). Secondary risk theory is an extension of the protection motivation theory that explores how an individual's response to threats is influenced by the severity and the likelihood of a threat (threat appraisal), the perceived self-efficacy and the response efficacy (coping appraisal) (Rogers, 1975; Cummings et al., 2021).

The health industry has been utilizing the protection motivation theory and message framing to minimize threats to individuals' health, and to encourage desirable health behaviors for a number of years (Cismaru et al., 2010; Lwin, Stanaland, & Chan, 2010; Prentice-Dunn, Floyd, & Flournoy, 2001). Assuming that the threat appraisal and coping appraisals are sufficiently high, individuals are motivated to protect themselves by participating in the recommended protective behavior. However, protection motivation theory falls short of examining the full sequence of rational reasoning necessary when deciding whether or not to take a vaccine.

Secondary risk theory expands upon the protection motivation theory in order to account for the secondary threat which may be inherent in the recommended solution or response to the primary threat (Cummings et al., 2021). For example, vaccination is a widely accepted response to the risk of a viral disease (primary risk), but vaccinations themselves can also present a risk (secondary risk) such as side effects and long-term effects (Verger & Dube, 2020). While most people have little concern over the safety of traditional vaccines, there has been a certain amount of skepticism about COVID-19 vaccines safety due to the new vaccine development technology (Messenger RNA (MRNA) vs traditional vaccines) and the short time-period in which the COVID-19 vaccines were developed. A number of individuals are concerned and asking, "is the COVID-19 treatment worse than the disease?" These individuals who believe that the COVID-19 vaccine presents a risk are likely to decide whether to take the vaccine after assessing its effectiveness in responding to the primary threat, COVID-19 infection, and the secondary threat posed by the vaccine side effects. Karlsson et al. (2021) found that willingness to take a possible COVID-19 vaccine (vaccine was not yet available at the time the study was conducted) was strongly predicted by the individuals trust in the safety of the vaccine. Verger and Dube (2020) found that in general trust in vaccines was influenced by the components utilized in the vaccine, whether it was

new or old technology, and based on individuals' exposure to previous vaccine controversies. The COVID-19 vaccines available in early 2021 were all new and utilized new technology (i.e. MRNA), indicating that the trust in them was already going to be low based on the findings of Verger and Dube (2020). Accordingly, COVID-19 vaccine uptake is dependent upon mitigating the perceived threat posed by the COVID-19 vaccine side effects.

Cummings et al. (2021) argue that high primary threat appraisal (i.e. disease), high coping appraisal (i.e. vaccine), and high secondary threat appraisal (vaccine side-effects) will lead to low protection motivation and low vaccination intentions. Conversely, high primary threat appraisal (disease), high coping appraisal (vaccine), and low secondary threat appraisal (vaccine side-effects) will lead to high protection motivation and vaccination intentions. Therefore, secondary risk appraisals for vaccines can negatively influence vaccine intentions when the perceived severity of the secondary threat is high. As suggested by Karlsson et al. (2021), trust in COVID-19 vaccines is a critical determinant of COVID-19 vaccine intentions, even more so than the increase in the perceived risk of COVID-19 disease. Secondary risk assessments (e.g. perceived side-effects) can account for a significant variance in willingness to be vaccinated, up to 30% more than the protection motivation theory model alone (Cummings et al., 2021). Due to the prevalent nature of COVID-19 infection, the incidence of death, and the severity of illness in cases not resulting in death, we posit that the primary risk factor, COVID-19 infection, is sufficiently high so as to trigger a protection motivation in the general population. As such, it stands to reason that the perceived secondary risk of a new and novel vaccine, developed in a relatively short period of time, is creating such a large secondary risk assessment as to drastically increase vaccine hesitancy in the population. Additionally, after a year of a global pandemic, individuals' risk assessment of COVID-19 has already been completed, making it difficult to influence their perceived risk of COVID-19. Thus, it is critical to investigate the factors that can influence and mitigate the perceived

secondary vaccine risks, which may still be open to outside influence. Since previous studies suggest that the message framing can influence perceived risk, this study examines the effects of different COVID-19 messages on individuals' COVID-19 vaccine risk perceptions.

2.2 Message Framing

Message framing is presenting information in a specific way to influence or change the recipient's behavior (Chi et al., 2021; Kapuściński & Richards, 2016; Tversky & Kahneman, 1981). Message framing originates from the framing theory proposed by Goffman (1974) and Tversky and Kahneman (1981) who found that people's interpretation of information and their subsequent actions could be manipulated by the presentation of the message (Zhang et al., 2018).

Message framing has been explored in relation to a number of public health issues including vaccinations (Chen et al., 2021; Huang & Li, 2021; Kim, Kim, & Murphy, 2020). Vaccination is a multi-faceted issue which includes benefits and risks to individuals and public. Vaccine hesitancy refers to reluctance or refusal to be vaccinated; which is currently classified as one of the top 10 threats to public health, worldwide (World Health Organization, 2019). Even though more than half of the population has already been inoculated with a COVID-19 vaccine in developed countries (Gursoy & Chi, 2021), a large group of individuals are still vaccine hesitant which raise serious concerns about the recovery of the overall economy, the hospitality and tourism industry, and the possibility of a new surge of COVID-19 infections. Most of these vaccine hesitant individuals are concerned that COVID-19 vaccines present an inherent risk, whether that be an immediate side effect or a long-term adverse effect. Since reaching the herd immunity against the COVID-19 virus depends on the population's vaccination rate being sufficiently high (for polio this number is 80% and for measles's it is 95%, indicating that coronavirus may fall somewhere in this range

(WHO, 2020) it is critical to minimize vaccine hesitancy through strategic communication using messages that are specifically framed to reduce vaccine hesitancy.

2.3 Research Hypotheses

Gain vs Loss-Framed Messages on Perceived Vaccine Risk

Vaccinations present benefits to individuals in the form of decreased probability of infection and subsequent illness. These benefits are countered by the inherent risk of the vaccine development process or the possible vaccine side effects. Perceived vaccination risk triggers a secondary threat assessment, which can result in an appraisal of the vaccine safety rather than the initial disease threat, as discussed in the secondary risk theory model (Cummings et al., 2021). Thus, perceived risk of COVID-19 vaccines can greatly influence vaccine uptake.

Studies that examined the effects of message-framing models on health-related behaviors report that individuals are more likely to avoid risky treatments when they are asked to exhibit behaviors that will generate positive outcomes. Meanwhile they are more likely to approve risky treatments when they are exposed to the possibility of negative outcomes (Detweiler et al., 1999). Studies investigating the impacts of gain-framed messages on preventative health behaviors reported positive effects (Latimer, Salovey, & Rothman, 2007). This effect was most significant for dental hygiene treatment which had a lower perceived risk than other health preventative treatments, such as vaccination (Latimer et al., 2007). In fact, gain-framed messages were found to increase uncertainty in the effectiveness of a vaccine, compared to loss-framed messaging for influenza vaccination (Latimer et al, 2007). Ferguson and Gallagher (2007) suggest that message framing can influence perceived vaccination risk and thus vaccination decisions. Another study, examining the uptake of West Nile virus

vaccination found that if the effectiveness was uncertain, loss-framing has greater positive outcomes than gain-framing (Bartels, et al., 2010).

The preceding discussion suggest that the loss-framed messaging is likely to be more effective in changing people's behavior in situations where individuals perceive high secondary risks (i.e., vaccine side effects) by emphasizing what they would lose if they do not participate in the recommended protective behavior (Kim & Kim, 2014, Cheng et al., 2011). Since a large portion of the population is concerned about the safety of COVID-19 vaccines, loss-framed messaging is likely to be more effective in lowering perceived vaccine risk compared to gain-framed messaging. Thus, we propose that:

H1. Individuals who receive loss-framed messages will perceive lower vaccine risk compared to individuals who receive gain-framed messages.

Rational vs Emotional Framed Messages on Perceived Vaccine Risk

Messages can be framed either rationally or emotionally in addition to being loss or gain-framed. Messages with emotional appeal, aim to generate positive or negative emotions depending on the message context. Rational messages focus on the rationality of the receiver by presenting information in an objective manner.

Studies that examined the impact of external motivators on vaccination uptake found that emotionally framed messages such as, 'others in the community could not or would not get vaccinated due to pre-existing health conditions' result in emotions that motivate individuals to get vaccinated compared to individuals who receive rational messages (Böhm et al., 2019). The reason behind this is that receivers of emotional messages are more likely to process the information heuristically and focus on the outcome of their behavior rather than the actual risk associated with the behavior as they appeal to receivers' emotions (McKay-Nesbitt et al.,

2011, Yoo & MacInnis, 2005). On the other hand, individuals who receive rational messages are more likely to process the information systematically to determine credibility of the message since rational messages appeal to receivers' cognitions (McKay-Nesbitt et al., 2011, Yoo & MacInnis, 2005). Thus, respondents are more likely to focus on the level of risk associated with their behavior rather than the outcome. Based on the preceding discussion, we propose that:

H2. Individuals who receive emotional appeal messages will perceive lower vaccine risk compared to individuals who receive rational appeal messages.

Effects of Objective and Subjective Message Framing

The manner in which a message is framed can greatly influence the persuasive power of the message (Smith & Petty, 1996). In addition to message framing, messages deliver factual, or subjective information about the topic. Research has shown that objective messages result in generally more positive attitudes towards the message compared to subjective messages (Holbrook, 1978). This aligns with the heuristic-systemic processing model (HSM), which asserts that individuals who receive objective information are more likely to engage in systematic information processing compared to those that receive subjective information (Chaiken, 1980; Denton et al., 2020). Park (2018) found that when individuals were presented with gain-framed subjective information about the yearly influenza vaccines, they exhibited significantly higher perceived vaccine risk than those who were presented with gain framed objective messages. Hence, we propose an interaction effect between information type (objective/subjective) and gain framed and loss framed messages.

H3. Gain-framed messages that include subjective information about vaccines will result in greater perceived vaccine risk than gain or loss-framed messages containing objective information about vaccine.

Additionally, we expect that an interaction will exist between rational framed messages and objective/ subjective messaging.

H4. Rational-framed messages that include subjective information about the vaccine will result in greater perceived vaccine risk than rational or emotional framed messages containing objective information about vaccine.

Mediating Effects of Perceived Vaccination Risk

As previously discussed, the secondary risk theory model suggests that when there is a perceived risk in the recommended treatment or solution to an initial threat (disease), individuals will conduct a secondary threat appraisal before taking protective measures (Cummings et al., 2021). In the case of vaccines, if the secondary threat (i.e. perceived risk) is high, it is possible that the effect of protection motivation on vaccination intentions will be mediated by perceived risk. Following this logic, we propose the following:

H5. Perceived vaccine risk mediates the effectiveness of message frames and message appeals in changing vaccination intention.

Moderating Effects of Travel Desire

Desire is a higher-level state of mind that represents individuals' wishes, cravings and their natural longings for things that excites them. Travel desire refers to individual yearning for

travel. Travel desire is different from travel intention because travel desire is a feeling while travel intention is an idea that individuals plan to carry out in the future (Prestwich et al., 2008). Planning and forethought are critical components of behavioral intentions. Strong desires can magnify the positive relationship between intention and actual behavior (Prestwich et al, 2008). For example, in travel and tourism context, strong desires of escaping from one's everyday environment can motivate an individual to travel to a destination and participate in activities and experiences that are significantly different from their everyday life activities.

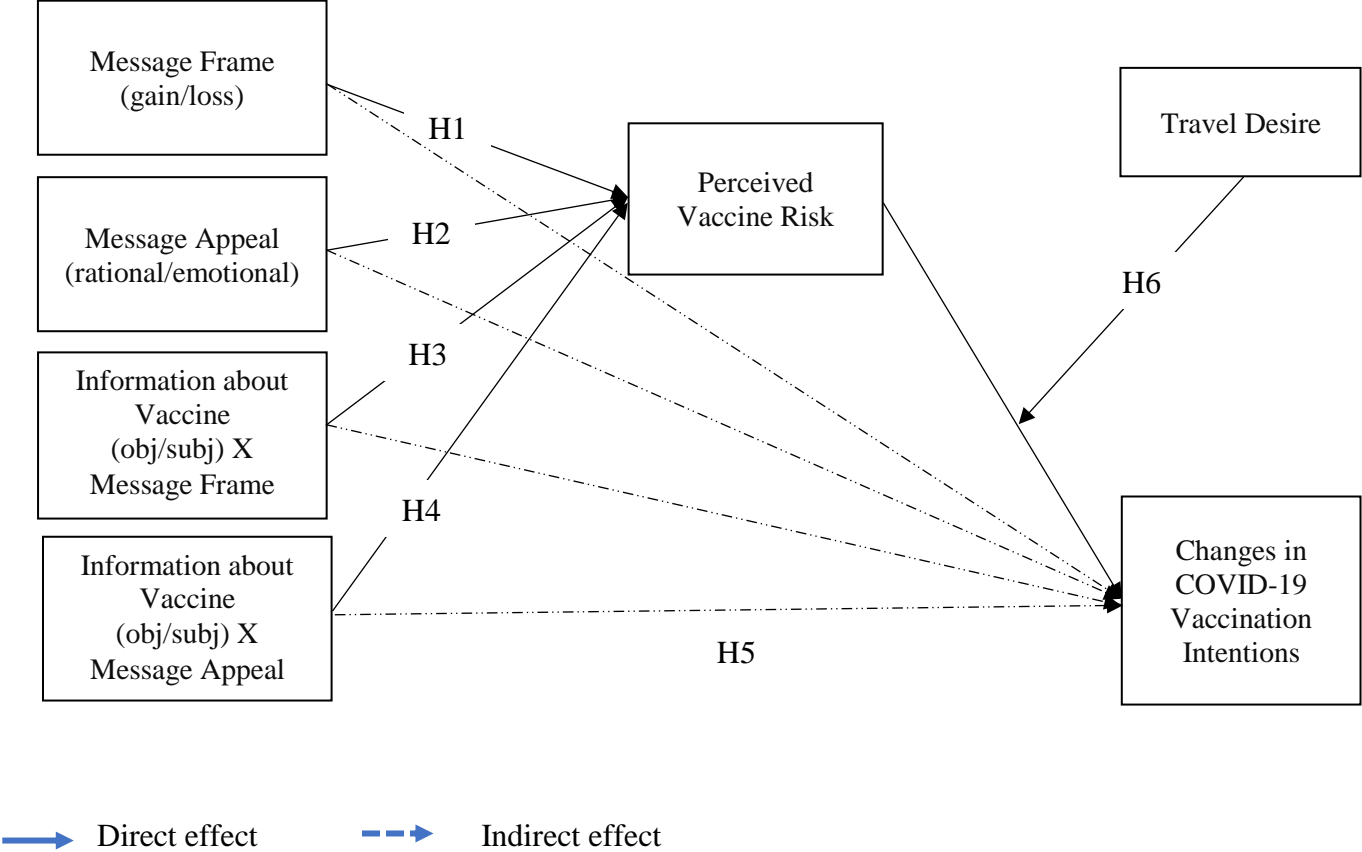
Adongo et al., (2021) argue that travelers may have distinct attitudes towards vaccination from ordinary people. Since travelling is an indispensable component of some people's lifestyle, travel desire can moderate the effects of perceived vaccine risks on COVID-19 vaccination intention. Those individuals who wish to travel may perform a cost benefits analysis by comparing the benefits of traveling on their wellbeing and possible vaccine risks. Individuals with strong travel desire are likely to view travel as an important contributor to their overall wellbeing, thus, they may be willing to get vaccinated even if they think that COVID-19 vaccines pose some risks. Travel desire also presents a benefit tangential to other benefit analysis, which individuals may have conducted. Traditionally, benefit analysis for vaccine examines the efficacy and disease prevention benefits of the vaccine. Previous studies suggest that if a vaccine efficacy is high, travelers are more likely to get vaccinated before travelling (Crockett & Keystone, 2008). Additionally, new international COVID-19 travel regulations (i.e. PCR testing, vaccine passports and quarantine rules) can further motivate individuals with strong travel desire to become vaccinated (Wang et al., 2021). These travel regulations may present a benefit independent of vaccine efficacy. An individual can perceive the vaccine as having low efficacy, thus not presenting a sufficiently high benefit to motivate vaccination, but then choose to get it as the regulations for travel require it. However, this additional benefit analysis will only be effective if the secondary risk is not extraordinarily high. Thus, we expect

that travel desire will weaken the negative effect of vaccine risk perception on vaccination intentions. Hence, we hypothesize the following:

H6. The relationship between perceived vaccine risk and changes in COVID-19 vaccine intention is moderated by travel desire.

Accordingly, Figure 1 illustrates the proposed model. As can be seen from the research model, perceived vaccine risk is directly influenced by gain-loss-framed messages (H1), rational-emotional message frames (H2) and their interactions with objective – subjective information (H2 & H4). Perceived vaccine risk mediates the effects of message framing on changes in COVID-19 vaccine intentions (H5). Finally travel desire moderates the relationship between perceived vaccine risk and COVID-19 vaccination intentions (H6).

Figure 1. The Research Model



3. Methodology

The goal of the study was to examine whether message framing affects perceived vaccine risk and subsequently change the COVID-19 vaccination intention through a scenario-based experiment and a longitudinal research design. In doing so, two rounds of data that were collected from the same respondents. A 2 (message frame: gain, loss) x 2 (message appeal: rational, emotional) x 2 (information content: subjective, objective) between-subjects online experimental design was used to test cause-and-effect relationships on the proposed hypotheses (Viglia & Dolnicar, 2020) (See Appendix). The first online survey recorded respondents' vaccination intentions and socio demographics. A follow up survey was conducted to record the participants' responses to framed messages, perceived risk, travel desire and COVID-19 vaccination intentions. The use of before and after message framing captured changes in COVID-19 vaccination intentions.

Gain-framed message emphasized the benefits of taking a protective action (i.e., if you choose to get the COVID-19 vaccine, you will be helping to reduce the spread of the COVID-19 virus), whereas loss-framed message highlighted the cost of not taking a protective action (i.e. if you choose NOT to get the COVID-19 vaccine, you will be helping spread of the COVID-19 virus). Rational message text was "Be responsible. Get the COVID-19 vaccine to protect personal and public health.", while emotional appeal included a message that stated, "please get the COVID-19 vaccine to show how much you care about your loved ones". Objective information included the following statement: "Based on evidence from clinical trials, COVID-19 vaccines that were approved in the United States are at least 86.7 percent effective against the COVID-19 virus", whereas subjective information stated that "all COVID-19 vaccines currently available in the United States have been shown to be safe and highly effective at preventing COVID-19 virus". Perceived vaccine risk was measured with three items (Cronbach's $\alpha=.91$) that were developed by Cummings et al. (2021). Participants

were asked to indicate the strength of their agreement or disagreement with statements, (a) “The COVID-19 vaccine causes serious illness”; (b) “Health effects of the COVID-19 vaccine are severe”; and (c) “The COVID-19 vaccine has considerable negative consequences”. Intention to get vaccinated for COVID-19 virus was measured with the 4 statements (Cronbach’s $\alpha=.94$), adopted from Chen et al. (2021): “How likely you will (a) get the vaccine, (b) recommend getting vaccinated to someone who seeks your advice, (c) encourage your friends and relatives to get vaccinated?” and (d) “say positive things about getting vaccinated?”. Travel desire was measured using scales adopted from Lee et al. (2012): (a) “I want to travel...”, (b) “I wish to travel different places...”, (c) “I am eager to go on vacation...” and (d) “I wish to visit places in different states” in the next 12 months. All items were measured on a 5-point Likert-type scale, ranging from 1 (*strongly disagree*) to 5 (*strongly agree*).

A pilot study was conducted with a total of 94 college students from a public university in the U.S. to test the message manipulations. Respondents were asked to indicate whether the message was gain- or loss-framed, having emotional or rational appeal and the information content was objective or subjective on a 7-point Likert bipolar scale (e.g., 1: loss framed, 7: gain framed). Participants also rated credibility and understandability of each message. Wording of some of the scenarios were slightly modified based on the findings of the pilot test.

In the first study, data were collected from 1,021 individuals in the United States, using MTurk which can be considered as a convenient tool to deliver a survey or experiment for a high-quality data (Hunt & Scheetz, 2019). After two weeks of Study 1, 393 respondents who stated that they were not willing to get vaccinated were invited to participate in Study 2. Of these, 266 agreed to participate in the second study. They were randomly assigned to one of the eight experimental conditions, ranging from 32 to 35 subjects per experimental condition.

This satisfied the minimum sample size requirement of 20 respondents per cell (Simmons, Nelson, & Simonsohn, 2011). Changes in vaccination intentions were calculated by deducting participant's vaccination intention scores in Study 1 from the updated scores in Study 2, as shown below.

$$\Delta VI = VI_{study2} - VI_{study1}$$

Proposed hypotheses were tested utilizing independent sample t test, a one-way ANOVA with Post-Hoc test (Tukey test), and PROCESS Macro (Model 14) for the mediation and moderation analyses.

4. Results

4.1 Manipulation Checks

A pilot study was conducted to assess the effectiveness of manipulations, and credibility and understandability of the messages. Independent t-test results indicated that the gain framed message (Mean=5.95) was perceived to be significantly more gain focused ($t_{(366)}=14.462$, $p<.001$) than the loss framed message (Mean=3.46). The message with rational appeal (Mean =4.78) was perceived to be more rational ($t_{(366)}=4.366$, $p<.001$) than the one with emotional appeal (Mean =3.95). Objectively framed COVID-19 information (Mean=4.46) was perceived to be more objective ($t_{(350)}=2.399$, $p=.017$) than the subjectively framed COVID-19 information (Mean =4.05). No significant differences were observed among experimental conditions in perceived message credibility ($t_{(350)} = 0.99$, $p = .92$) and understandability ($t_{(350)}=.955$, $p = .21$). These findings provided empirical evidence that the scenarios are appropriately designed.

4.2 Respondents Profile

In study 1, the majority of participants were female (49.7%), aged between 26 and 35 (32.8%), single (44.6%), having income level of \$20,000-39,999 (20.5%), and management, professional or related jobs (26.2%). Most participants in the second study were female (59.4%), aged between 26 and 35 (32.3%), and married (42.5%). A large portion of them earned a four-year bachelor's degree (33.1%). While 24.4% of them were unemployed, 23.7% occupied management or professional related jobs. In addition, the majority of respondents had annual income of \$80,000 or more (20.7%) (See Table 1).

Table 1. Demographic information of participants

Demographic		Study 1 (n = 1021) %	Study 2 (n = 266) %
Gender	Male	48.7	40.2
	Female	49.7	59.4
	Other	1.7	.4
Marital status	Cohabiting	10.2	10.9
	Divorced/ Separated/ Widowed	7.6	10.5
	Married	37.6	42.5
	Single	44.6	36.1
Age	18-25	22.5	12.0
	26-35	32.8	32.3
	36-45	22.7	30.8
	46-55	12.3	15.4
	Over 55	9.6	9.4
Education	High school graduate (high school diploma or equivalent including GED) or less	12.3	15.0
	Some college but no degree	20.1	26.7
	Associate degree in college (2-year)	10.3	10.5
	Bachelor's degree in college (4-year)	36.8	33.1
	Master's / Doctoral / Professional (JD, MD) degree	20.5	14.7
Annual income	Unemployed	11.9	11.7
	Less than \$ 19,999	18.8	19.9
	\$20,000-39,999	20.5	20.3
	\$40,000-59,999	16.4	18.0
	\$60,000-79,999	13.5	9.4
	\$80,000 or more	19.0	20.7

Occupation	Construction, extraction, maintenance, farming, fishing, and forestry	3.5	3.4
	Frontline essential workers	2.4	3.4
	Government	4.7	1.9
	Healthcare professional	5.8	3.0
	Management, professional, and related	26.2	23.7
	Production, transportation, and material moving	4.0	3.8
	Retired	2.8	3.0
	Sales and office	14.0	19.9
	Service	13.4	13.5
	Unemployed	23.0	24.4

4.3 Effects of Message Framing and Message Appeal on Perceived Vaccine Risk

We conducted an independent sample t-test to assess the main effects of message framing and message appeal on perceived vaccine risk. Results indicated that loss-framed messages (Mean = 3.16, SD = 1.19) produced lower perceived vaccine risk than gain-framed messages (Mean = 3.54, SD = .83) ($t_{(264)} = 2.964, p = .003$). With regards to message appeal, messages emotional appeal (Mean = 3.20, SD = 1.11) messages produced lower perceived vaccine risk than rational appeal (Mean = 3.50, SD = .93), ($t_{(264)} = 2.391, p = .018$). These results provided support for both H1 and H2.

4.4 Impact of Interaction Effect on Perceived Vaccine Risk

We performed one-way ANOVA with Tukey test to investigate the effects of different message frames and appeals along with information type on perceived vaccine risk. The results suggested that different message frames and appeals lead to significantly different levels of perceived vaccine risk. The post-hoc analysis suggested that a gain-framed message with subjective information about COVID-19 vaccines (Mean = 3.71, SD = .75) leads to significantly greater perceived vaccine risk than other messages ($p < .05$) except for gain-framed messages with objective information (Mean = 3.37, SD = .34, $p = .19$ n.s) (See Table 2). These results provide partial support for H3.

Table 2. Results for Post-Hoc (Tukey) Tests for Perceived Vaccine Risk

	Mean	Mean Difference	<i>p</i>
Gain Subjective	3.71		
Gain Objective	3.37	.34	.19
Loss Subjective	3.23	.48	.03*
Loss Objective	3.10	.61	.00*
Rational Subjective	3.52		
Rational Objective	3.50	.02	.99
Emotional Subjective	3.43	.09	.95
Emotional Objective	2.99	.53	.01*

* $p < .05$

There were significant differences between rational-appeal message with subjective information about COVID-19 vaccine (Mean = 3.52, SD = 1.05) and other messages. The post-hoc analysis suggested that a rational-appeal message with subjective information (Mean = 3.71, SD = .75) lead to significantly higher perceived vaccine risk than an emotional-appeal message with objective information (M = 2.99, SD = .53). However, there were no statistically significant differences for any other combination of rational or emotional appeal messages containing objective/ subjective information about the vaccine ($p > .05$). These results provide partial support for H4.

4.5 Mediating Effects of Perceived Vaccine Risk and Moderator Effect of Travel Desire

We utilized PROCESS Macro for SPSS with the bootstrap method (Moderated mediation model 14) to examine the mediating role of vaccine risk and moderator role of travel desire for changes in COVID-19 vaccination intention (Hayes, 2018). Table 3 summarizes the results of the analysis.

Table 3. Model Coefficients for the Conditional Process Model

Antecedents	Outcomes					
	Perceived vaccine risk (M)			Changes (Δ VI) in COVID-19 vaccination intention (Y)		
	Coeff.	S.E.	<i>p</i>	Coeff.	S.E.	<i>p</i>

Model 1: Message frame (gain/loss)								
R ² = .39, F(4,261) = 42.490, p < .001								
Gain vs loss framed messages	A	-.37	.12	.003	c'	-.05	.09	.55
Perceived vaccine risk (Mediator)		-	-	-	b ₁	-.27	.11	.014
Travel desire (Moderator)		-	-	-	b ₂	.38	.10	<.001
Perceived vaccine risk x Travel desire		-	-	-	b ₃	-.07	.03	.012
Constant	iM	3.91	.19	<.001	iY	.94	.43	.032
Model 2: Message appeal (rational / emotional)								
R ² = .39, F(4,261) = 42.459, p < .001								
Rational vs emotional message appeal	A	-.30	.12	.017	c'	-.05	.09	.59
Perceived vaccine risk		-	-	-	b ₁	-.27	.11	.014
Travel desire		-	-	-	b ₂	.37	.10	<.001
Perceived vaccine risk x Travel desire		-	-	-	b ₃	-.07	.03	.013
Constant	iM	3.81	.20	<.001	iY	.93	.44	.034
Model 3: Information about vaccine (obj/subj) x Message frame (gain/loss)								
R ² = .39, F(4,261) = 42.343, p < .001								
Information type x Message frame	A	-.19	.05	<.001	c'	-.00	.04	.99
Perceived vaccine risk		-	-	-	b ₁	-.27	.11	.015
Travel desire		-	-	-	b ₂	.37	.10	<.001
Perceived vaccine risk x Travel desire		-	-	-	b ₃	-.07	.02	.014
Constant	iM	3.84	.15	<.001	iY	.85	.42	.048
Model 4: Information about vaccine (obj/subj) x Message appeal (ratio/emot)								
R ² = .39, F(4,261) = 42.344, p < .001								
Information type x Message appeal	A	-.16	.05	.003	c'	.00	.04	.96
Perceived vaccine risk		-	-	-	b ₁	-.27	.11	.015
Travel desire		-	-	-	b ₂	.37	.10	<.001
Vaccine risk x Travel desire		-	-	-	b ₃	-.07	.03	.013
Constant	iM	3.77	.15	<.001	iY	.84	.43	.04

Y: Outcome variable; M: Mediator; a: Effect of X on M; b₁: Effect of M on Y; c': Direct effect of X on Y; b₂: Effect of W on Y; b₃: Moderated mediation effect of W on the relationship of M and Y. iM, iY=Coefficients for the constant.

The results show that the conditional indirect effects of message frame and message appeal on changes in COVID-19 vaccination intention, through perceived vaccine risk were statistically significant in all four models. These results provided support for H5. The findings also confirm that perceived vaccination risk fully mediates the effect of message framing on changes in COVID-19 vaccination intention because the direct effects of message framing on vaccination intention were not statistically significant across four models ($p > .05$).

Meanwhile, travel desire moderated the effect of perceived vaccine risk on changes in COVID-19 vaccination intention only in Model 1 [Effect: .03, 95% CI: .0004, .0666] and Model 2 [Effect: .01, 95% CI: .0001, .0335], but not in Model 3 [Effect: .02, 95% CI: -.0006, .0605] and Model 4 [Effect: .01, 95% CI: -.0006, .0321]. These results supported H6, such that, the higher travel desire, the higher impact of message frame (gain vs loss) and message appeal (gain subjective vs gain objective and loss objective/subjective information about vaccine) on perceived vaccine risk and changes in COVID-19 vaccine intention. Also, the results indicate that travel desire has a direct strong positive effect ($\beta = .37$, $p < .05$) on changes in COVID-19 vaccination intention.

5. General Discussion

We utilized a longitudinal dataset to examine the effects of message frames and message appeals on vaccine risk and subsequent changes in COVID-19 vaccination intention. Through the lens of secondary risk theory (Cummings et al., 2021), we examined the impacts of framed messaging on the perceived COVID-19 vaccination risk, or secondary risk, on vaccination intentions. This study provides fruitful insights into the potential usage of framed health messages to promote COVID-19 vaccination. This information will be invaluable in the ongoing global COVID-19 vaccination efforts.

The literature on message framing and vaccination intention has been conflicted for some time. Due to the current COVID-19 pandemic, unprecedented levels of disease risk, and the implementation of new and novel vaccines is a perfect opportunity to re-examine the effects of message framing on perceived vaccine risk. Vaccine risk is an accepted secondary risk in the secondary risk theory framework, with disease risk being the primary risk (Cummings et al., 2021). In this regard, this study confirms the application of secondary risk theory into COVID-19 prevention behavior. That is, high vaccine risk led to low protection motivation and low vaccination intentions. Secondary risk appraisals for COVID-19 vaccines negatively influence individuals' vaccine intentions when the perceived COVID-19 vaccine risk is high.

This study further demonstrated that participants in the gain-framed condition reported higher perceived vaccine risk than those in the loss-framed one. This contrasts previous studies which found no significant differences between gain- and loss-framed groups in regard to vaccinations (Hayles et al., 2015; Kasting et al., 2019). Abhyankar, O'Connor, and Lawton (2008) demonstrated that exposure to loss-framed messaging is more effective than gain-framed messages in increasing vaccination intentions. Latimer et al. (2007) found that loss-framed messaging was more effective in increasing the uptake of the yearly Influenza vaccine, as gain-framed messages increased vaccine risk perceptions. These two studies align with the findings of this paper. However, the current study distinguishes from these studies as it examines the effects of message framing directly on perceived vaccine risk and indirectly on changes in COVID-19 vaccination intention through vaccine risk. This relationship illustrates how mitigating the perception of the secondary risk of COVID-19 vaccination, can influence the willingness to be vaccinated via protection motivation and secondary risk theory.

Furthermore, our study found that rational appeal messages led to higher vaccine risk perceptions than emotional appeal messages. Rational / emotional message appeal has

frequently been used in the tourism and hospitality research context (Byrd et al., 2021; Yoon et al., 2019; Wang, Kim, & Agrusa, 2018; Wang et al., 2020). However, this is the first study that investigates the effect of rational / emotional message appeals on attitudes and behaviors in the context of novel COVID-19 pandemic (Koinig, 2021) and travel and tourism context. Our study demonstrates the effectiveness of emotional appeal messages in reducing the perceived vaccine risk as compared to rational appeal messages. This finding is in line with the findings of Koinig (2021), which suggests a higher degree of message empowerment for emotional appeal messages.

The current research demonstrated that gain-framed messages with subjective information about vaccines led to greater perceived vaccine risk than loss-framed messages with both subjective and objective information. However, no differences were evident between the gain-framed message with subjective information and the one with objective information, in terms of vaccine risk perceptions. Moreover, this study found that exposure to an emotional appeal message with objective information resulted in lower vaccine risk perceptions compared to exposure to a rational message appeal with subjective information about a vaccine. These findings contradict the findings of Lanciano et al. (2020) as they did not find any significant effect of perceived knowledge about the COVID-19 on risk perception.

Finally, the results indicated that travel desire moderates the effect of perceived vaccine risk on changes in COVID-19 vaccination intention in two message frame and message appeal conditions. Risk perception associated with the COVID-19 pandemic is a central issue for travelers (Meng et al., 2021). There is little known about how individuals' travel desire can influence the effect of COVID-19 vaccine risk on vaccination intention. This study finds that higher travel desire lowers the negative effect of vaccine risk perceptions on individuals' vaccination intention if loss frame messaging, and/or loss framed messages with both objective and subjective information about vaccines are used. This expands beyond the

secondary risk theory which examines only primary and secondary risk. The addition of travel desire into the model introduced an external non-risk-based motivator. Based on the ability of desire to travel to moderate the relationship between perceived vaccination risk and willingness to be vaccinated, this may be a natural future expansion of protection motivation theory and secondary risk theory; the influence of external positive motivators to mitigate risk assessments and subsequent behaviors. As the study found direct effect of travel desire on changes in COVID-19 vaccination intention, the findings support Wang et al. (2021) who propose that people with strong travel desire are more willing to receive the COVID-19 vaccine for international travel.

5.1 Limitations and Further Research

While the sample size of individuals who did not want to get the COVID-19 vaccine was adequate for the study purpose, a higher sample size for each experimental condition could have provided relatively more powerful results. However, since this study aimed to identify the effects of framed messages on changes in perceived vaccine risk and vaccination intentions, the second round of data was collected from individuals who indicated that they would not get the COVID-19 vaccine during the first round of data collection, which limited sample selection process.

This study examined the effects of message framing and message appeal on perceptions of vaccine risk and role of travel desire. It does not examine the effects of these messages on perceived disease risk. Hence, this study focused on the secondary risk of the COVID-19 vaccine through the lens of secondary risk theory, rather than the primary risk of COVID-19 disease. If this study was to be extended, it may be worthwhile to examine the role of primary risk through the lens of protective motivation theory.

Additionally, the findings of this study may help the hospitality and tourism industries frame their own messaging about vaccine requirements. With moderate tweaks, industry could use similar messages when conveying vaccination requirements to guests. If messages are framed in an appropriate manner, it may be possible to mitigate negative feedback from guests. This is one avenue worthy of further investigation.

6. Conclusion

How the public receive messages has been shown to be instrumental in shaping the public's vaccination intentions (Mheidly & Fares, 2020). This study expanded upon these findings by illustrating how a variety of message frames influence the perception of COVID-19 vaccine risks and subsequent vaccination intention. It also illustrates the moderating effect that individuals' desire to travel can have on changes in vaccination intention. In the ongoing worldwide COVID-19 vaccination campaign, the importance of these findings cannot be understated. The messages in this study can be utilized by health professionals around the world to mitigate the perception of COVID-19 vaccination risk. These findings will hopefully be implemented to increase vaccination uptake, thus allowing the hospitality and tourism industries to reopen and recover in the near future.

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Appendix: Stimuli

Suppose the COVID-19 vaccine is available to you. The health officials use the message shown below to remind you about the importance of getting the COVID-19 vaccine, please read the message and respond to the questions afterwards.

Group 1 message (gain frame + rational appeal + subjective info)

All COVID-19 vaccines currently available in the United States have been shown to be safe and highly effective at preventing COVID-19 virus.

If you choose to get the COVID-19 vaccine, you will be helping to reduce the spread of the COVID-19 virus.

Be responsible. Get the COVID-19 vaccine to protect personal and public health.

Group 2 message (gain frame + emotional appeal + subjective info)

All COVID-19 vaccines currently available in the United States have been shown to be safe and highly effective at preventing COVID-19 virus.

If you choose to get the COVID-19 vaccine, you will be helping to reduce the spread of the COVID-19 virus.

Please get the COVID-19 vaccine to show how much you care your about loved ones.

Group 3 message (loss frame + rational appeal + subjective info)

All COVID-19 vaccines currently available in the United States have been shown to be safe and highly effective at preventing COVID-19 virus.

If you choose NOT to get the COVID-19 vaccine, you will be helping to spread of the COVID-19 virus.

Be responsible. Get the COVID-19 vaccine to protect personal and public health.

Group 4 message (loss frame + emotional appeal + subjective info)

All COVID-19 vaccines currently available in the United States have been shown to be safe and highly effective at preventing COVID-19 virus.

If you choose NOT to get the COVID-19 vaccine, you will be helping to spread of the COVID-19 virus.

Please get the COVID-19 vaccine to show how much you care about your loved ones.

Group 5 message (gain frame + rational appeal + objective info)

Based on evidence from clinical trials, COVID-19 vaccines that were approved in the United States are at least 86.7 percent effective against the COVID-19 virus.

If you choose to get the COVID-19 vaccine, you will be helping to reduce the spread of the COVID-19 virus.

Be responsible. Get the COVID-19 vaccine to protect personal and public health.

Group 6 message (loss frame + rational appeal + objective info)

Based on evidence from clinical trials, COVID-19 vaccines that were approved in the United States are at least 86.7 percent effective against the COVID-19 virus.

If you choose NOT to get the COVID-19 vaccine, you will be helping to spread of the COVID-19 virus.

Be responsible. Get the COVID-19 vaccine to protect personal and public health.

Group 7 message (gain frame + emotional appeal + objective info)

Based on evidence from clinical trials, COVID-19 vaccines that were approved in the United States are at least 86.7 percent effective against the COVID-19 virus.

If you choose to get the COVID-19 vaccine, you will be helping to reduce the spread of the COVID-19 virus.

Please get the COVID-19 vaccine to show how much you care about your loved ones.

Group 8 message (loss frame + emotional appeal + objective info)

Based on evidence from clinical trials, COVID-19 vaccines that were approved in the United States are at least 86.7 percent effective against the COVID-19 virus.

If you choose NOT to get the COVID-19 vaccine, you will be helping to spread of the COVID-19 virus.

Please get the COVID-19 vaccine to show how much you care about your loved ones.