Nudging to reduce the perceived threat of Coronavirus and stockpiling intention

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ABSTRACT

Prior research in behavioral economics has examined the effects of nudging and the diverse aspects of choice on individuals' decisions and behavior. Based on this premise, the current research offers a novel and timely view by examining how communication messages in public service advertisements (PSAs) can alter the perception of threat under uncertain situations such as the coronavirus (COVID-19) pandemic. This paper investigates the role of additional relative statistical information on the perception of threat and stockpiling intention. First, we examine whether there is a reduction in the perceived threat of the coronavirus if information about the potential severity of an alternative threat (car accidents) is activated, when compared to offering only COVID-19 statistics. Furthermore, we established the mediating role of a perceived threat in consumers' decisions and behavior in times of severe crisis. This suggests that organizations and policymakers can influence individuals by increasing or decreasing their perceived level of threat depending on the desired outcomes (e.g., respecting authorities' recommendations or avoiding stockpiling). This research offers a deeper understanding of how consumers can be "nudged" towards desired behavior in the context of public health and safety.

INTRODUCTION

The coronavirus (hereafter COVID-19) is a serious problem for all humanity as the virus continues to spread around the world (World Health Organization, 2020). COVID-19 represents a global threat and the way individuals respond to it will determine its severity. According to the World Health Organization (WHO), "Most people infected with the COVID-19 virus will experience mild to moderate respiratory illness and recover without requiring special treatment." However, the fear of this unknown and deadly virus has led to extreme psychological effects and reactions of stress, including inaccurate judgment (e.g., overestimated threat perception) and unnecessary behavior (e.g., stockpiling). The speed at which COVID-19 is spreading, the lack of a vaccine or prevention, and the unclear understanding of the impact of the virus on people's health has created a high level of uncertainty.

In situations surrounded by uncertainty individuals tend to make judgments based on perceived threats, rather than the actual disaster itself (Slovic, Fischhoff, and Lichtenstein, 1980). Limited knowledge and strong emotions can easily lead to fearful attitudes and a flawed assessment of risk. Uncertainty or unpredictability create a feeling of a lack of control, leading to stronger emotional and behavioral reactions in response to threats (Hogg and Mullin, 1999; Van den Bos, 2001). Thus, a perceived threat can lead to overreaction and irrational behavior. In the case of COVID-19, examples of stockpiling including acquiring many months' worth of toilet paper, canned food, and medical supplies have been observed worldwide. The same phenomenon of consumer panic buying has been observed during other disruptive events (e.g., snowstorms, tornados), where people have bought uncommonly large amounts of supplies in fear of potential future shortage (Yoon, Narasimhan, and Kim, 2018). Thus, when facing a natural crisis or during troubling times, consumers often try to regain

control of the situation by purchasing large volumes of items they expect to become scarce. In this research we aim to address the gap in understanding how communication messages in public service advertisements (PSAs) can influence perceived threat in uncertain situations such as during the COVID-19 pandemic. PSAs are primarily designed to inform and educate rather than to sell a product or service. They aim to change public opinion and raise awareness on important issues (e.g., drunken driving, smoking, drug addiction, and safe sex) while disseminating information quickly and efficiently. In this research we investigate the practical role of '*nudging*' in the issue described above. Behavioral economists have previously explored the way in which various aspects of choice can modify and influence people's decisions and behavior (Thaler and Sunstein, 2008). This topic is becoming more prevalent as governments and policy makers increase those nudging techniques. For example, the National Institute of Health in the United States has emphasized the importance of the "science of behavior change," while the UK, France and Denmark have set up labs to study nudging techniques (Blumenthal-Barby and Burroughs, 2012; Trettel et al., 2017).

In this paper we attempt to develop optimal strategies for organizations and policymakers dealing with disruptive events potentially presenting significant challenges when dealing with people's heightened sense of threat. Previous studies in health or risk communication have demonstrated how framing messages can result in different behavioral consequences; however, these have tested only a few dimensions of message framing, such as visual versus verbal information, or words versus numbers (Spiegelhalter et al., 2011). Consistent with prior research, we expect that the way anticipated health consequences of a threat are described will affect individuals' affective and cognitive reactions. In investigating this issue, we focus mainly on the information to be used in PSAs and ways to provide key statistics to the public. This study examines the impact of comparative statistics on the level of perceived threat and stockpiling intentions. We argue that the perceived threat will be

lower when the statistics are presented to the public with supplementary comparative statistics, leading to lower stockpiling intent. Furthermore, we investigate two boundary conditions to this relationship (i.e., preciseness of information and comparison standard).

This paper is expected to contribute to theoretical and practical knowledge in several ways. Firstly, while prior work has demonstrated that nudging can influence individual choice and behavior in areas such as health (Li and Chapman, 2013; Thaler and Sunstein, 2008), this study extends our understanding of nudging on the perception of threat and examines the role of additional relative statistical information. Past literature suggests that people's frequency judgment can be biased and that they seek additional outside evidence to put things into perspective (Griffin & Tversky, 1992; Kahneman & Tversky, 1996; Tversky & Kahneman, 1973, 1983). This research demonstrates that one way to decrease uncertainty related to a risky situation is the addition of comparative statistics (in this case car accidents and flu statistics). Indeed, providing additional concrete information about other relative aspects leads to a positive assimilation of those comparative statistics, contributing to a lower perception of threat. Secondly, we advance perceived threat as a crucial construct for understanding people's irrational behavior in times of crisis. We show that messages used in PSAs influence the perception of threat and that this perceived threat can impact choice and decision-making, such as stockpiling and panic buying of supplies. Lastly, this paper extends the literature on heuristics by showing how presentation can influence the processing of information, with a significant impact on an individual's judgment and decision-making.

The results of this research have substantive implications. Although people have rapid and constant access to information concerning disruptive events and natural disasters, consumer psychology research and health promotion have not focused on the best way of communicating with individuals in times of uncertainty. This paper contributes to our understanding of key information use in PSAs during a severe crisis. The findings lead to

suggestions for governments and health-related organizations regarding successful health campaigns. Based on the specific situation (e.g., preventing overreaction vs. promoting strict action such as self-isolation), these institutions will use different nudges to achieve their goals. Indeed, health organizations (e.g., WHO), governments, and public health associations could implement a distinct nudge based on the prevailing situation to reduce or increase the perceived threat.

THEORETICAL DEVELOPMENT

Public Service Advertising (PSA)

Public service advertisements or announcements can be defined as promotional materials that address problems assumed to be of general concern to public. PSAs attempt to increase public awareness of a problem and a solution if available, aiming to influence public beliefs, attitudes, and behavior concerning the problem (O'Keefe and Reid 1990). PSAs are mostly initiated by non-profit organizations or government agencies and exposed to the public through broadcast or print media.

In the early 1970s about half of PSAs dealt with health or safety related topics such as alcohol, drug abuse, preventive health care, traffic safety, and nutrition (Hanneman, et al., 1973). More recent studies also show a similar trend. For example, in an anti-smoking campaign, PSAs delivered with an explicit message (directly with concrete statements) were more effective than those with an implicit message (indirectly via metaphor) (Shadel et al., 2010). In an evaluation of PSAs in an anti-drinking campaign, realism and themes were important factors in increasing the salience and persuasiveness of the PSAs. However, realistic logic-based PSAs were less effective than unrealistic but enjoyable advertisements in respondents' free-recall (Adnsager et al., 2001). Paek et al. (2011) tested the influence of the message producer on PSA effectiveness in the context of child abuse prevention videos. They

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found that PSA videos produced by peers were more effective than those produced by an expert. The effects of peer producer on issue importance was even higher among less involved viewers than among highly involved viewers. Chew and Eysenbach (2010) conducted a content analysis of tweets during the 2009 pandemic of the H1N1 outbreak. Their results indicated H1N1 related tweets were used primarily to disseminate information from credible sources but were also a source of opinions and experiences. The study illustrates the potential of using social media to conduct PSA campaigns. It also indicated that resource-related tweets were most commonly shared (52.6%) and 4.5% of cases were identified as misinformation. News websites were the most popular sources (23.2%), while government and health agencies were linked only 1.5% of the time (Chew and Eysenbach 2010). This research indicates that the effectiveness of PSAs is primarily influenced by message types and message sources.

In this paper we focus on how communication messages in PSAs can alter the perception of threat and stockpile intention during the COVID-19 pandemic.

Nudging in Communicating Health Information

In this section we will review the current understanding of the role of nudging in PSAs to promote health information. Whereas traditional economists indicate that decision-makers mostly make rational choices to maximize utility, behavioral economists suggest that people's judgment and decision-making are often biased in predictable ways (Baron, 2004; Blumenthal-Barby and Burroughs, 2012). Importing experimental methods from psychology, behavioral economists show that individual decision-making is rather less rational than economists have commonly assumed (Sugden, 2009). Researchers and policymakers are increasingly interested in exploring how principles from behavioral economics affect human lives and behavior, and facilitate people's choices in areas such as health-related behavior,

lifestyle and habit (Blumenthal-Barby and Burroughs, 2012; Li and Chapman, 2013; Thaler and Sunstein, 2008). Most notably, Thaler and Sunstein (2008) referred to such an intervention as a "nudge" and defined it as follows:

> "A nudge, as we will use the term, is any aspect of the choice architecture that alters people's behavior in a predictable way without forbidding any options or significantly changing their economic incentives." (Thaler and Sunstein, 2008, p. 6)

Government policymakers, companies, and health care providers have increasingly adopted nudging in their practices (e.g., the National Institutes of Health in the United States, the Institute for Government, and the Cabinet Office in the UK; Blumenthal-Barby and Burroughs, 2012). Behavioral economics offer a grounding as to how different principles (e.g., framing effect, emotional appeals, and default and position effects) have an impact on individuals' choices and decisions when related to health and safety (see Li and Chapman, 2013 for a systematic review).

Firstly, health messages can be framed either in terms of potential gains (i.e., advantages or benefits) or in terms of losses (i.e., risk of not performing the behavior). That is, gain-framed health messages (e.g., a 2/3 chance nobody will be saved) can encourage risk-averse choice; whereas loss-framed health messages (e.g., a 1/3 chance nobody will die) can promote risk-seeking choice (Rothman and Salovey, 1997). Furthermore, understanding the nature of health behavior—prevention (e.g., a healthy diet reduces heart attack risk) and detection (e.g., breast screening in diagnosing cancer)—is essential in designing health messages tailored to induce desired behavior (Rothman and Salovey, 1997).

It has been argued that gain and loss message framing is crucial in health behavior intentions in various contexts, such as breast self-examination (Meyerowitz and Chaiken, 1987), sunscreen use (Olson et al., 2008), healthy eating (Gerend and Maner, 2011), and child-directed health messages (Wyllie, Baxter, and Kulcznski, 2015). Research demonstrates

that gain-framed messages are more effective in stimulating prevention behavior to help individuals maintain good health and reduce illness (Gallagher and Updegraff, 2012), while loss-framed messages are more successful in stimulating detection behavior to discover the presence of illness (Gallagher et al., 2011).

Secondly, public health campaigns can reach people with emotional appeals, such as those using fear and humor (Turner, 2011). Fear is one of the most frequently used emotional appeals in prevention-related health messages (Witte and Allen, 2000), aiming to frighten people into adopting healthier behavior by emphasizing the harmful effect on health when message recommendations are not implemented (Nabi, 1999). For example, preventing people from being infected by COVID-19 requires health messages to be loaded with a discrete emotion that evokes avoidance behavior (e.g., social distancing). Once fear is evoked, the receiver becomes motivated to engage with the message recommendations and to respond with the desired action. The most recent fear appeal theory, the Extended Parallel Process Model (EPPM) attempts to explain the processing of fear appeals and provides reasoning for their successes and failures (Witte, 1992). Specifically, it suggests that when fear appeals work, people try to avert the danger (danger control) when appraising the threat; however when fear appeals fail, people reduce their fear by perceiving the threat as being less severe (fear control). Danger control results in engagement with the message's recommended behavior, whereas fear control leads to discounting the risk and the subsequent non-engagement with the recommended behavior.

Thirdly, in relation to the default effect, people tend to stick with the default option— the option that takes effect without a person making an explicit choice. For example, in countries using a donor default strategy (e.g., France and Poland use a default model that presumes consent for organ donation), people are much more likely to be registered donors (90~100%) compared with those not using a default donor strategy (5~30%; Blumenthal-

Barby and Burroughs, 2012; Johnson and Goldstein, 2003). Also, using the principle of position effects, placing healthier foods in easy to reach or prominent locations has prompted people to adopt a healthier diet (Downs, Loewenstein, and Wiscom, 2009; Rozin et al., 2011).

In sum, various nudging strategies have been investigated in the domain of health, especially in the perceived persuasiveness of messages and behavioral intentions. In the next section we develop the main predictions based on nudging methods less frequently investigated in existing literature. These nudging methods are expected to have substantial practical communication implications regarding the virus.

Main Prediction: The Role of Proving Other Statistics on Threat Perception

Even though researchers have shown that our frequency judgments are relatively accurate (e.g., Alba, Chromiak, Hasher, and Attig, 1980; Hasher and Zacks, 1984), people tend to a systemic bias when estimating the probability of an event or case. This bias could result in inaccurate frequency judgment rather than objective frequency. Several factors are related to this phenomenon. One typical example is the availability heuristic of Tversky and Kahneman (1973), suggesting that frequency judgment could be significantly influenced by ease of retrieving the event from memory. For example, people overestimate the frequency of words with the letter K in the first position and underestimate the frequency of words with the letter K in the third position due to the ease of thinking in the former [vs. later] case. In addition, familiarity (e.g., Hintzman, 1988), concreteness of information (e.g., Betsch, Siebler, Marz, Hormuth, and Dickenberger, 1999), or salience of category (Greene, 1989; Hanson and Hirst, 1988) influence this bias as well. Furthermore, people tend to overestimate scarce cases in frequency judgment (e.g., Biggs, Adamo, and Mitroff, 2014; Tversky and Kahneman, 1973).

Related to the previous argument, when people make frequency judgments (e.g., Griffin and Tversky, 1992; Kahneman and Tversky, 1996; Tversky and Kahneman, 1983) they consider outside perspectives to "activate and bring to mind evidence that is relative to a broader distribution of cases that makes this evidence easier to apply and may also activate rules of reasoning that are relevant to statistically based properties of set inclusion" (Griffin and Buehler, 1999, p. 49). Put differently, our frequency judgment could be significantly influenced by other information available at the time of judgment. One way to reduce this systematic bias in frequency judgment is to emphasize relative (vs. absolute) frequency information (Harries and Harvey, 2000; also see Hsee (1996)'s evaluability hypothesis). For example, sound quality (i.e., THD [total harmonic distortion]) based on a probability of .003% is relatively difficult to estimate or to influence judgment in the single evaluation mode. However, if the likelihood of THD = .003% is accompanied by another probability of THD = .01% in the joint evaluation mode, probability information can be used more meaningfully in judgment and decision-making.

Following this logic, we can expect frequency judgment based on information of unfamiliar or rare events to be improved when combined with information of familiar or common events. For example, if people are provided with frequency information concerning COVID-19 (e.g., number of patients and deaths) together with data of accessible, easier to understand and higher frequency incidents (e.g., annual car accident deaths), individuals may perceive the threat to be less severe.

> **H1**: *The exposure to other frequency information will influence the perceived threat. The perceived threat of COVID-19 will be lower when key information is provided with (vs. without) other statistics.*

> **H2**: *The exposure to other frequency information will influence stockpiling intention. The stockpiling intention due to COVID-19 will be lower when key information is provided with (vs. without) other statistics.*

H3: *The perceived threat of COVID-19 will mediate the impact of exposure to other frequency information on stockpiling intention.*

In the next section, we present a series of three empirical studies that contribute to an understanding of perceived threat and stockpiling intention (Studies 1-3). The studies were conducted mid-March 2020 (study 1) and May 2020 (studies 2-3). Participants were limited to one country (USA) in order to control for the specific disease situation in different countries.

STUDY 1: SHOWING THE EFFECT OF COMPARATIVE STATISTICS

Study 1 examines the main prediction regarding the perceived threat based on statistical information (H1-3). We predict that the perceived threat of COVID-19 will be lower when the statistics of the virus are presented with other easy-to-compare statistics such as annual car accident deaths. We also measure stockpiling intention to investigate the effect of statistical information on key behavioral outcomes during a crisis such as the COVID-19 pandemic.

Method

The study involved 207 US adults (51.2% female, average age = 37.62, SD = 12.66) from an online panel (Amazon MTurk) who participated in exchange for monetary payment. Participants were randomly assigned to one of three experimental conditions (Coronavirus information only vs. Coronavirus + car accident information I vs. Coronavirus + car accident information II) in a between-subjects design.

All participants were first asked to read the information about COVID-19. In the Coronavirus information only condition, participants were given worldwide cases and deaths at the time of the survey. In the Coronavirus + car accident information I and II conditions, participants were given worldwide cases and deaths at the time of the survey as well as information on global car crash deaths, as shown in Figure 1. Indeed, participants in the car accident information I & II conditions were provided with exactly the same information about the virus and the car accidents, but participants in the car accident information I condition were asked to report their perceived threat of car accidents before providing their perceived threat of COVID-19 on a 7-point scale (1 = not at all serious/ not at all life-threatening; 7 = very serious/very life-threatening; Cronbach α = .814 for n = 71). Participants in the car accident information II condition did not report the perceived threat of car accidents; they only reported their perceived threat of the virus after reviewing the provided information. At the end of the survey, all participants were asked to rate their perceived threat of the two items, based on Böhm and Pfister (2005) and Kim (2020), using the same scale: "In your opinion, is coronavirus a serious threat?" and "In your opinion, how life-threatening is coronavirus?" (Cronbach α = .828). Finally, participants were also asked to indicate their stockpiling intentions: "Do you think it is necessary to stockpile food due to coronavirus?" and "Do you think it is necessary to stockpile hygienic products (e.g., hand sanitizers) due to coronavirus?") on a 7-point scale (1 = not at all necessary; 7 = very necessary; Cronbach α = .869).

[Insert Figure 1 about here]

Results and Discussion

First, participants in the virus + car accident information II condition generated a higher perceived threat for the car accidents ($M = 5.61$, $SD = 1.32$) than for the virus ($M = 4.92$, $SD = 1.78$, $t(70) = 3.14$, $p = .002$).

Second, regarding the perceived threat of the virus, the overall results of a 3 (Coronavirus information only vs. Coronavirus + car accident information I vs. Coronavirus + car accident information II) ANOVA (Analysis of Variance) were also significant ($F(2, 204) = 3.13$, $p = .046$, $\eta^2 = .030$) as shown in Figure 2. Planned contrast analysis indicated that participants in the virus information only condition ($M = 5.60$, $SD = 1.17$) generated a higher perceived threat than those in the virus + car accident information II condition ($M = 4.92$, $SD = 1.78$, $F(1, 204) = 6.25$, $p = .013$, $\eta^2 = .030$). However, there was no difference between the virus information only condition and the virus + car accident information I condition ($M = 5.24$, $SD = 1.54$, $F(1, 204) = 1.65$, $p = .200$, $\eta^2 = .008$), but the results showed a direction. These results support H1. In addition, the above effect was still significant ($F(2, 199) = 3.90$, $p = .022$, $\eta^2 = .038$) considering various covariates (e.g., whether participants exercise regularly, whether they take medicine, or health supplements, age, and gender).

Third, regarding stockpiling intention, the overall results of a 3 (Coronavirus information only vs. Coronavirus + car accident information I vs. Coronavirus + car accident information II) ANOVA were also significant ($F(2, 204) = 3.24$, $p = .041$, $\eta^2 = .031$) as shown in Figure 2. Planned contrast analysis indicated that participants in the virus information only condition ($M = 4.92$, $SD = 1.62$) generated a higher stockpiling intention than those in the virus + car accident information I condition ($M = 4.24$, $SD = 1.74$, $F(1, 204) = 5.31$, $p = .022$, $\eta^2 = .025$) as well as those in the virus + car accident information II condition ($M = 4.31$, $SD = 1.76$, $F(1, 204) = 4.40$, $p = .037$, $\eta^2 = .021$). However, there was no difference between the two "virus + car accident information" conditions ($p = .817$). In addition, the effect above was still significant ($F(2, 199) = 3.32$, $p = .038$, $\eta^2 = .032$) even

with various covariates in the analysis (e.g., whether participants exercise regularly, whether they take medicine, or health supplements, age, and gender). In sum, H2 was supported.

Finally, we conducted a mediation analysis (IV→ perceived threat → stockpiling intention) after combining one virus + car accident information condition from two experimental conditions (virus + car accident information I & II) since the two conditions generated similar results for stockpiling intentions. The results of Hayes (2017) #4 indicated a significant indirect effect (effect = -.288, 95% Confidence Interval: [-.540, -.055]), whereas the direct effect was insignificant (effect = -.355, 95% Confidence Interval: [-.786, .077]), supporting H3. We also conducted the reverse mediation analysis (IV→ stockpiling intention → perceived threat). The indirect effect was also significant (effect = -.300, 95% Confidence Interval: [-.577, -.068]). The significant results of the reverse mediation could be driven by the measurement order (Kim et al., 2018). Specifically, participants in this study were asked to answer first the mediator (perceived threat), then the DV (i.e., stockpiling intention). To control this order effect, we measured the stockpiling intention first in study 2.

[Insert Figure 2 about here]

STUDY 2: SHOWING THE EFFECT OF INFORMATION PRECISENESS

Study 2 replicates study 1 with a few modifications. As described earlier, we changed the measurement order of our two key variables by asking participants to respond to the stockpiling intention first, and then the perceived threat. Also, the current presentation format of COVID-19 differs amongst websites, with some providing the exact number (e.g., 1,212,000 cases from CDC.gov, worldometers.info, or cnn.com), whereas others provide the simple number (1.21M cases from google.com). The preciseness of the information could influence the processing. Specifically, the precise (vs. imprecise) number can increase the

credibility of the information, resulting in an increase in confidence (e.g., Jerez-Fernandez, Angulo, and Oppenheimer, 2014; Xie and Kronrod, 2012; Zhang and Schwarz, 2013). For example, people were more likely to use precise (vs. imprecise) product information (e.g., 24.78% vs. 25%) in the product evaluation (Kim et al., 2020; Xie and Kronrod, 2012). This stream of research suggested that the impact of other information could be strong when the information was precise (vs. imprecise). On the other hand, the imprecise (vs. precise) information could increase the fluency of the information, resulting in its increased importance in judgment (e.g., King and Janiszewski, 2011; Wadhwa and Zhang, 2015). For example, Coulter and Roggeveen (2014) suggested that the importance of processing fluency is due to the fact that people can more easily compare imprecise (vs. precise) price information (e.g., \$50 -\$30 vs. \$29.97 - \$29.96; see also Thomas and Morwitz, 2009). This could result in the stronger impact of other information when the key information was imprecise (vs. precise). Since two different streams of research suggested the opposite pattern, we empirically test the effect in this study. Specifically, we compare three different levels of preciseness (e.g., 1,187,302 vs. 1,190,000 vs. 1.19M). Furthermore, general health consciousness could significantly influence people's perceived threat and stockpiling intention (e.g., Hayes and Ross, 1987; Kraft and Goodell, 1993). Therefore, we control this factor by measuring it and considering it as a covariate in the analysis.

Method

The study involved 305 US adults (51.8% female, average age = 38.05, SD = 12.97) from an online panel (Amazon MTurk) who participated in exchange for monetary payment. Participants were randomly assigned to one of 2 (information: Coronavirus information only vs. Coronavirus + flu information) X 3 (preciseness of number: precise vs. imprecise I vs. imprecise II) experimental conditions in a between-subjects design.

All participants were first asked to read the information about COVID-19 (or flu in 2019). In the Coronavirus information only condition, participants were given US cases and deaths at the time of the survey. In the Coronavirus + flu information conditions, participants were given US cases and deaths at the time of the survey as well as information on US flu in 2019, as shown in Figure 3. All flu data were from the US Centers for Disease Control and Prevention (CDC.gov).

We further manipulated the preciseness of information in that participants in the precise condition were given the specific numbers (e.g., 1,187,302 or 68,569), whereas participants in the imprecise I condition (e.g., 1,190,000 or 69,000) and imprecise II condition (e.g., 1.19M or 69K) were not given precise numbers.

All participants were asked to indicate their stockpiling intention using the same scale as study 1 (Cronbach α = .867). They were also asked to rate the perceived threat of two items as in study 1 (Cronbach α = .840). Participants were also asked to indicate their general health consciousness on a 7-point scale (1 = not at all concerned; 7 = very concerned).

[Insert Figure 3 about here]

Results and Discussion

First, regarding the perceived threat of the virus, we conducted a 2 (information: Coronavirus information only vs. Coronavirus + flu information) X 3 (preciseness of number: precise vs. imprecise I vs. imprecise II) ANCOVA (e.g., health consciousness as a covariate). The covariate was significant (F (1, 298) = 88.68, $p < .001$, $\eta^2 = .229$). The main effect of the information was significant in that the participants in the virus information only condition ($M = 5.54$, $SD = 1.36$) generated a higher perceived threat than those in the virus + flu information condition ($M = 5.31$, $SD = 1.47$; F (1, 298) = 3.85, $p = .051$, $\eta^2 = .013$), supporting H1. In addition, the interaction effect of the two experimental variables was also

significant (F (1, 298) = 2.44, p = .089, η^2 = .016), as shown in Figure 4. Planned contrast showed that for participants in the precise information condition, the perceived threat was similar to the virus only (M = 5.14, SD = 1.55) and the virus + flu information condition (M = 5.34, SD = 1.63; F (1, 298) = .44, p = .506, η^2 = .001). However, participants in the imprecise I condition generated a higher perceived threat than in the virus only condition (M = 5.82, SD = 1.26) and the virus + flu information condition (M = 5.27, SD = 1.29; F (1, 298) = 4.67, p = .032, η^2 = .015). A similar pattern was found for participants in the imprecise II condition in that the perceived threat was higher in the virus only condition (M = 5.67, SD = 1.19) and the virus + flu information condition (M = 5.31, SD = 1.51; F (1, 298) = 3.71, p = .055, η^2 = .012). Therefore, this result suggested that the impreciseness of the information could increase the processing fluency, resulting in a threat reduction effect from the additional flu information.

Second, regarding the stockpiling intention, the covariate was significant (F (1, 298) = 58.86, p < .001, η^2 = .165). Compared to the results of the perceived threat, the interaction effect was not significant (F (1, 298) = .23, p = .794, η^2 = .002); however, the main effect of the information was significant (F (1, 298) = 3.33, p = .069, η^2 = .011). Specifically, the stockpiling intention was higher for participants in the virus information only condition (M = 4.28, SD = 1.69) than for those in the virus + flu information condition (M = 4.00, SD = 1.81). Therefore, the results supported H2.

Finally, we conducted a mediation analysis (i.e., IV→ perceived threat → stockpiling intention) after combining two imprecise conditions into one condition. The results of Hayes (2017) #4 indicated a significant indirect effect (effect = -.074, 95% Confidence Interval: [-.171, -.001]), whereas the direct effect was insignificant (effect = -259, 95% Confidence Interval: [-.616, .097]). We also conducted the reverse mediation analysis (i.e., IV→ stockpiling intention → perceived threat). The indirect effect was not significant (effect =

-.053, 95% Confidence Interval: [-.121, .001]). Therefore, the results of the mediation analysis clearly supported H3 in study 2.

[Insert Figure 4 about here]

In sum, we found that additional information about the flu could significantly reduce the perceived threat and stockpiling intention. We further demonstrated that the effect was moderated by the preciseness of the information, especially for the perceived threat, and that too much detailed information could eliminate this reduction.

STUDY 3: SHOWING THE EFFECT OF COMPARISON STANDARD

So far, we have shown the positive effect of the reduction of additional information such as traffic car accidents or abundant flu information. In this study we investigate a boundary condition to this effect. We investigate the comparative standard with other statistics. Specifically, when the additional information suggested a higher frequency of COVID-19 compared with another disease (e.g., 1 M cases for COVID-19 vs. 35 M cases for flu), we replicate the previous study so that the additional information can reduce the perceived threat and stockpiling intention. On the other hand, when the additional information suggested a lower frequency of COVID-19 (e.g., 70,000 deaths for COVID-19 vs. 35,000 deaths for flu), the effect of the reduction will be eliminated or reversed. Study 3 tests this possibility. In terms of information acquisition, people are normally exposed to the updated information repeatedly across different times, so to extend the external validity, we used the repeated method as well.

Method

The study involved 131 US adults (51.1% female, average age = 38.39, SD = 12.81) from an online panel (Amazon MTurk) who participated in exchange for monetary payment.

Participants were randomly assigned to one of 2 (information: Coronavirus information only vs. Coronavirus + flu information) X 2 (type of flu information: flu cases vs. flu death numbers) in a mixed-experimental design. The information factor was a repeated factor.

The procedure of this study was similar to that of study 2, with a few modifications. In stage 1, all participants were first asked to read the information about COVID-19 (cases and deaths at the time of the survey). Then all participants were asked to indicate their stockpiling intention (Cronbach α = .903) and the perceived threat (Cronbach α = .880) using the same scale as Study 1.

In stage 2 participants were informed that additional information about the flu outbreak last year would be provided and were asked to answer questions based on this additional information. Participants were asked to consider this as a new survey and that their responses could change. Having received the above instruction, participants in the flu cases condition were given flu cases of the year 2019 (i.e., 35,500,000), whereas participants in the flu deaths condition were given US flu deaths of the year 2019 (i.e., 34,000), as shown in Figure 5. Subsequently all participants were asked to indicate their stockpiling intention (Cronbach α = .907) and the perceived threat (Cronbach α = .913) again using the same scale as in the previous task.

Finally, in order to check the manipulation for the different information, participants were asked to answer their relative perception regarding exposure to COVID-19 and the flu along a 7-point scale (1 = definitely Coronavirus, 7 = definitely the flu).

Results and Discussion

First, the manipulation was successful in that participants evaluated a higher risk of exposure to the flu in the flu cases condition ($M = 4.35$, $SD = 2.07$) and the flu deaths condition ($M = 3.11$, $SD = 1.73$; $F(1, 129) = 14.02$, $p < .001$, $\eta^2 = .098$). Regarding the

perceived threat of the virus only from stage 1, we assumed there would be no difference between the two types of flu information. The results confirmed this prediction in that stockpiling intention was similar in the flu cases condition ($M = 4.28$, $SD = 1.79$) and the flu deaths condition ($M = 4.08$, $SD = 1.88$; $F(1, 129) = .42$, $p = .516$, $\eta^2 = .003$). The perceived threat was also similar in the flu cases condition ($M = 5.45$, $SD = 1.50$) and the flu deaths condition ($M = 5.48$, $SD = 1.57$; $F(1, 129) = .01$, $p = .913$, $\eta^2 = .001$).

Second, in comparing the two different stages we conducted a 2 (information: Coronavirus information only vs. Coronavirus + flu information) X 2 (type of flu information: flu cases vs. flu death numbers) repeated ANOVA. Regarding the perceived threat, the interaction effect was significant ($F(1, 129) = 3.74$, $p = .055$, $\eta^2 = .028$) as shown in Figure 6. Planned contrast showed that for participants in the flu cases information condition we replicated study 2, as the perceived threat in stage 1 ($M = 5.45$, $SD = 1.50$) was reduced with the additional flu cases information in stage 2 ($M = 5.20$, $SD = 1.65$; $F(1, 129) = 6.99$, $p = .009$, $\eta^2 = .051$), supporting H1. On the other hand, the perceived threat in stage 1 ($M = 5.48$, $SD = 1.57$) was not reduced with the additional flu deaths information in stage 2 ($M = 5.48$, $SD = 1.66$; $F(1, 129) = .01$, $p = .937$, $\eta^2 = .001$).

Third, regarding stockpiling intention, the interaction effect was also significant ($F(1, 129) = 4.09$, $p = .045$, $\eta^2 = .031$) as shown in Figure 6. Planned contrast showed that for participants in the flu cases information condition, stockpiling intention in stage 1 ($M = 4.28$, $SD = 1.79$) was reduced with the additional flu cases information in stage 2 ($M = 4.03$, $SD = 1.84$; $F(1, 129) = 6.47$, $p = .012$, $\eta^2 = .048$), supporting H2. On the other hand, stockpiling intention in stage 1 ($M = 4.08$, $SD = 1.88$) was not reduced with the additional flu deaths information in stage 2 ($M = 4.11$, $SD = 1.89$; $F(1, 129) = .09$, $p = .760$, $\eta^2 = .001$).

Finally, we conducted a mediation analysis (i.e., IV→ perceived threat → stockpiling intention) after calculating the difference between stage 1 and stage 2 for the perceived threat

and stockpiling intention. The results of Hayes (2017) #4 indicated a significant indirect effect (effect = -.101, 95% Confidence Interval: [-.214, -.001]), whereas the direct effect was insignificant (effect = -.183, 95% Confidence Interval: [-.446, .080]), supporting H3.

GENERAL DISCUSSION

Summary of Paper

During health crises and disruptive events such as the actual global COVID-19 crisis, governments and policy makers aim to find the best communication messages and public service announcement strategies to enhance public understanding of the problem and to stimulate desired behavior. In fact, public service announcement strategies can arguably create a heightened perceived threat among individuals. This perceived threat can lead to desirable behavior such as action to avoid risk, but also to irrational behavior such as stockpiling that jeopardizes the well-being of the economy and society. This paper uses three studies to offer a timely understanding of how nudging (i.e., communication message framing) can influence the perceived threat of COVID-19 and other possible disruptive events. The results of the three experiments contribute to better knowledge of the role of additional relative statistical information on the perception of threat and stockpiling intention. We demonstrate that other frequency information influences the level of threat. Indeed, the presence of additional comparative statistics along with key information reduces the level of perceived threat and stockpiling intentions. We also show that perceived threat mediates the relationship between communicating statistics about the virus alone and easy-to-compare information as predictors of stockpiling intention. This research demonstrated that the preciseness of the information moderated the effect. In addition, the third study provides evidence of another boundary condition to this relationship. The comparison standard (higher

vs. lower standard) influenced the impact of additional comparative statistics. The effect of additional information on the perceived threat was only significant when the additional information suggested a higher (vs. lower) frequency (e.g., flu cases vs. flu deaths) for the current issue. This result indicates the importance of the type of additional information in health communications.

Theoretical Implications

This research makes several significant contributions. It extends the literature on information processing by showing the link between nudging and the perceived threat during a global crisis. One may question whether the term 'nudge' is applicable in describing key effects on judgement and intentions as nudges often involve choice behavior. However, past research has shown that aspects of choice architecture can also influence non-behavior elements such as implementation intentions (Milkman et al., 2011), non-action (Johnson and Goldstein, 2003), and evaluation (Li, Vietri, Galvani, and Chapman, 2010). Thus, the term nudge is used broadly to refer any element of context in which people make decisions, judgments, evaluations, and form intentions.

Related to the above point, policy makers and governments implement nudges in public service announcements to communicate effectively with the population, and this paper extends our knowledge of additional comparative statistics in the health communication domain. Prior work suggests that people's frequency judgment can be biased and that they seek additional evidence to put things into perspective (e.g., Griffin and Tversky, 1992; Kahneman and Tversky, 1996; Tversky and Kahneman, 1973, 1983). Our results demonstrate that the simple addition of comparative statistics (i.e., car accidents or flu information) to coronavirus statistics, leads to a reduction in the perceived threat. Looking beyond the inclusion of comparative statistics, emphasizing the potential threat of other events (i.e., car accidents and flu) has the desired effect of reducing the perceived threat related to the

disruptive event (e.g., COVID-19). This paper strengthens our knowledge about how additional comparative information impacts on perception in public service announcements.

Also, this study further extends the theory related to information processing in the judgment of health crises and disruptive events. Our research demonstrates that preciseness of information influences the processing of additional comparative information. Specifically, we add to this research by showing that precise information increases the level of credibility of the information, resulting in a positive influence of this information in affective and behavioral outcomes. This finding offers empirical support for arguments on how preciseness of information leads to more processing fluency.

This research also extends the literature on heuristics by showing that nudges used in public service announcements can be used as an anchor in people's judgment and decision-making process. Additional information is used by consumers to estimate the likelihood of an event and this results in an augmented or decreased perception of threat. The results of the different studies show that additional comparative information can influence behavioral intentions, such as stockpiling, through the level of perceived threat.

Practical Implications

This paper has several practical implications. Nudging people towards more optimal health decisions is not only a cost-effective intervention but also an effective way to promote healthy behavior (Li and Chapman, 2013). Although health education programs may entail high costs and take a long time (Thomas, 2006), nudging (e.g., message framing) requires little effort beyond constructing the wording of a health message. Effective public health promotions should raise awareness about health issues, educate target audiences about any detrimental health effects, and persuade people to take action to avoid or reduce related health risks (Atkin, 2001). For instance Italy, the United States, and Spain are experiencing

rapid growth in terms of COVID-19 infection and fatalities and interestingly, some TV commercials have adopted an indirect messaging strategy, highlighting that in many cases, severe consequences of COVID-19 are generally linked to pre-existing health conditions. As shown in our study, additional comparative statistics lead to a reduced perceived threat, potentially reducing negative behavior such as stockpiling.

The results of this research suggest that precise comparative statistics can also diminish the perceived threat. Hence, if government or health organizations want to decrease the perceived severity of COVID-19, it would be better to use precise comparative information in their communications. In contrast, in countries experiencing cases where lockdown and social distancing are crucial, but the population is not fully adhering to these recommendations, we recommend authorities use COVID-19 information without comparative statistics or imprecise information, based on the findings of this study. Such measures should increase the perceived threat and thus motivate people to stay in their homes. To summarize, this paper clearly showed that the nudging method of controlling information could increase or decrease the perceived threat and hoarding behavior. The relevant agencies, including the government and health organizations, could use this method to provide the best social control under pandemic conditions.

Since the information provided to individuals is crucial in affecting their judgment, governments and policy makers need to have valid and accurate strategies to develop the desired information. Therefore, nudge planning should integrate the correct elements to be effective in impacting individuals' judgment and behavior. In this research we have focused on a specific disease to explain a temporarily important phenomenon of stockpiling behavior. Nevertheless, we believe our research offers implications for health-protective practices and for other types of crises. For example, policy makers may utilize our findings to encourage people to follow protective measures such as wearing a mask or frequent handwashing.

Specifically, they may limit information about COVID-19 or provide precise information so as not to dilute the perceived threat and to encourage protective behavior. The validity and efficiency of those strategies will determine the future adoption of health recommendations and could strongly influence future decisions related to global health crises and disruptive events.

Limitations and Future Directions

As in all research, the limitations of this project offer opportunities for future work. Firstly, the results of this study could be significantly influenced by the timing of the data collection, with results changing as the COVID-19 pandemic evolves. Further examination at different stages of the crisis could be necessary before generalizing conclusions. Secondly, we measured only the perceived threat and behavioral intention of stockpiling in this study; future research could investigate the role of nudging in actual behavior change. Also in some circumstances, there could be an intent-behavior gap (e.g., Carrington et al., 2010, 2014); investigating if such a gap exists in severe crises such as the COVID-19 pandemic, as well as exploring the underlying mechanisms would be a fruitful avenue for future studies.

Thirdly, we have focused mainly on one nudging strategy in this paper. Various other nudging strategies could also influence response and behavioral intention regarding the virus. Indeed, other nudging factors could influence how additional information is processed in the case of health crises and disruptive events. Addressing these questions would enhance our understanding of nudging in public service announcements. Further research would also be required to examine the different types of additional information and their roles in various kinds of crises. In addition, in addressing unique but temporarily pervasive psychological and behavioral responses, this research has focused on COVID-19. However, given the significance of the disease and the importance of individuals' health-protective behavior in

the future, there should be further research. Particularly to provide accurate implications in different contexts, future research should test the impact of various forms of information presentation on a broad range of behavior.

Finally, there were some limitations in our empirical investigation. In all of our experiments, participants were given the basic information about COVID-19 (e.g., cases or deaths), and we did not include a control condition in which participants did not receive any statistical information regarding COVID-19. Future studies could investigate the influence of the perceived threat on stockpiling intention with a control condition in which participants did not receive any statistical information about COVID-19. Study 2 used health consciousness as a covariate in analysis. Future studies need to extend the factors influencing our key measurements. The measurement of stockpiling intention in the current study focused on behaviour specifically linked to COVID-19. Future studies could explore general stockpiling intentions.

Final Remarks

In summary, this research demonstrates the main effect of additional information on the perceived threat and stockpiling intentions during times of crisis, such as the present COVID-19 health crisis. Three studies provided empirical evidence that the addition of easy-to-compare statistics about annual car death accidents or flu information can lead to a reduction of the perceived threat (H1) and stockpiling intentions (H2). However, study 2 indicated that the preciseness of the information moderates this effect. Indeed, precise information can eliminate this reduction, especially for the perceived threat. In addition, the main effect of other frequency information on perceived threat was only significant when the additional information suggested a higher (vs. lower) frequency (e.g., flu cases vs. flu deaths) compared to the current health situation. This shows the importance of comparative statistics

in the evaluation of perceived threat. Finally, the experiments demonstrate that the perceived

threat mediates the impact of exposure to other frequency information on stockpiling

intentions (H3).

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FIGURE 1

Stimuli for Study 1

The Virus Information Only Condition

Coronavirus Information

Please read the following information about Coronavirus

Worldwide Coronavirus Cases (up to 10:00 GMT on March 19 2020): **220,877**
Worldwide Deaths (up to 10:00 GMT on March 19 2020): **8,988**

The Virus + Car Accident Information I & II Condition

Coronavirus Information

Please read the following information about Coronavirus and car accidents:

Worldwide Coronavirus Cases (up to 10:00 GMT on March 19 2020): **220,877**
Worldwide Deaths (up to 10:00 GMT on March 19 2020): **8,988**

Worldwide Car Crash Deaths (from January 1 to March 19 2020): **260,875**
(Therefore, the probability of being killed in a car accident is **30 times** higher than dying from a coronavirus infection!)
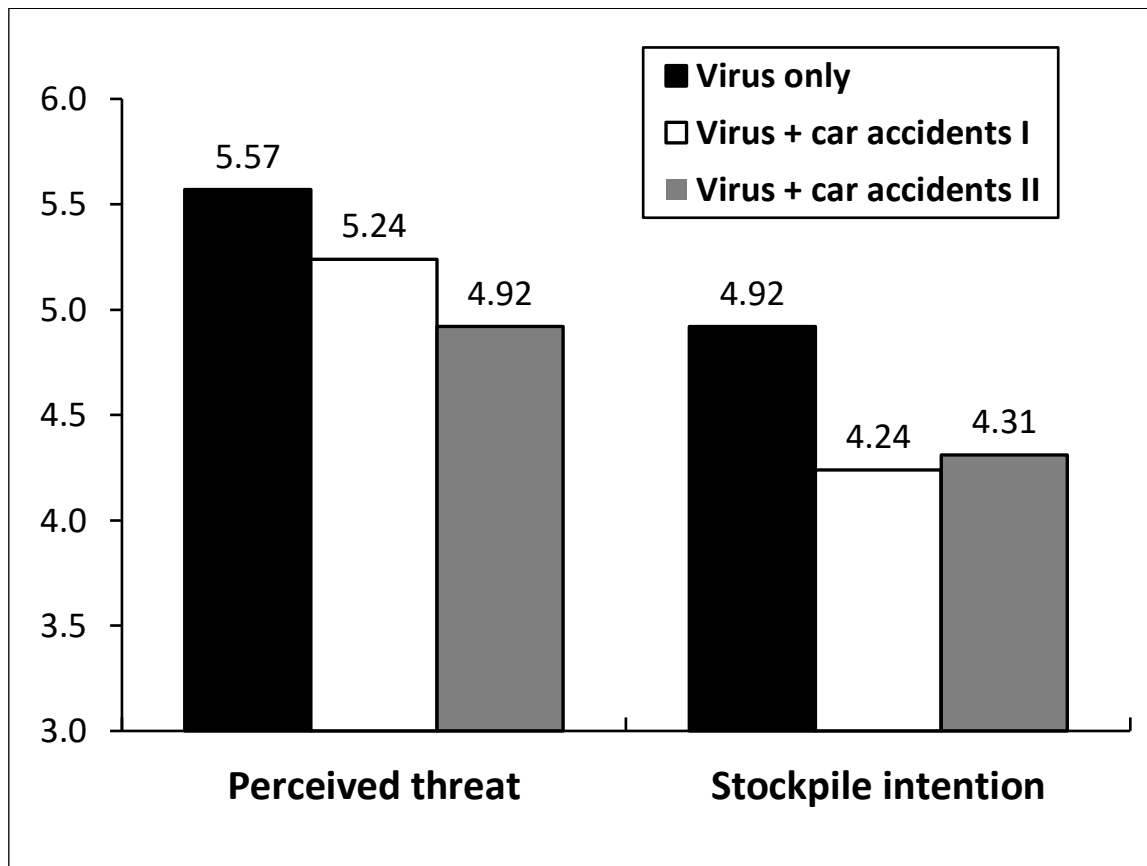
FIGURE 2

Results of Study 1

FIGURE 3

Stimuli for Study 2

The Precise Virus Information Only Condition

Please read the following information about Coronavirus (now) in the U.S.:

U.S. Coronavirus - Cases:	**1,187,302**
U.S. Coronavirus - Deaths:	**68,569**

The Precise Virus + Flu Information Condition

Please read the following information about Coronavirus (now) and the flu (2019) in the U.S.:

U.S. Coronavirus - Cases:	**1,187,302**
U.S. Coronavirus - Deaths:	**68,569**
U.S. Flu (2019) - Cases:	**35,476,450**
U.S. Flu (2019) - Hospitalization:	**490,650**

The Imprecise I - Virus Information Only Condition

Please read the following information about Coronavirus (now) in the U.S.:

U.S. Coronavirus - Cases:	**1,190,000**
U.S. Coronavirus - Deaths:	**69,000**

The Imprecise I - Virus + Flu Information Condition

Please read the following information about Coronavirus (now) and the flu (2019) in the U.S.:

U.S. Coronavirus - Cases:	**1,190,000**
U.S. Coronavirus - Deaths:	**69,000**
U.S. Flu (2019) - Cases:	**35,500,000**
U.S. Flu (2019) - Hospitalization:	**490,000**

The Imprecise II Virus Information Only Condition

Please read the following information about Coronavirus (now) in the U.S.:

U.S. Coronavirus - Cases:	**1.19M**
U.S. Coronavirus - Deaths:	**69K**

The Imprecise II Virus + Flu Information Condition

Please read the following information about Coronavirus (now) and the flu (2019) in the U.S.:

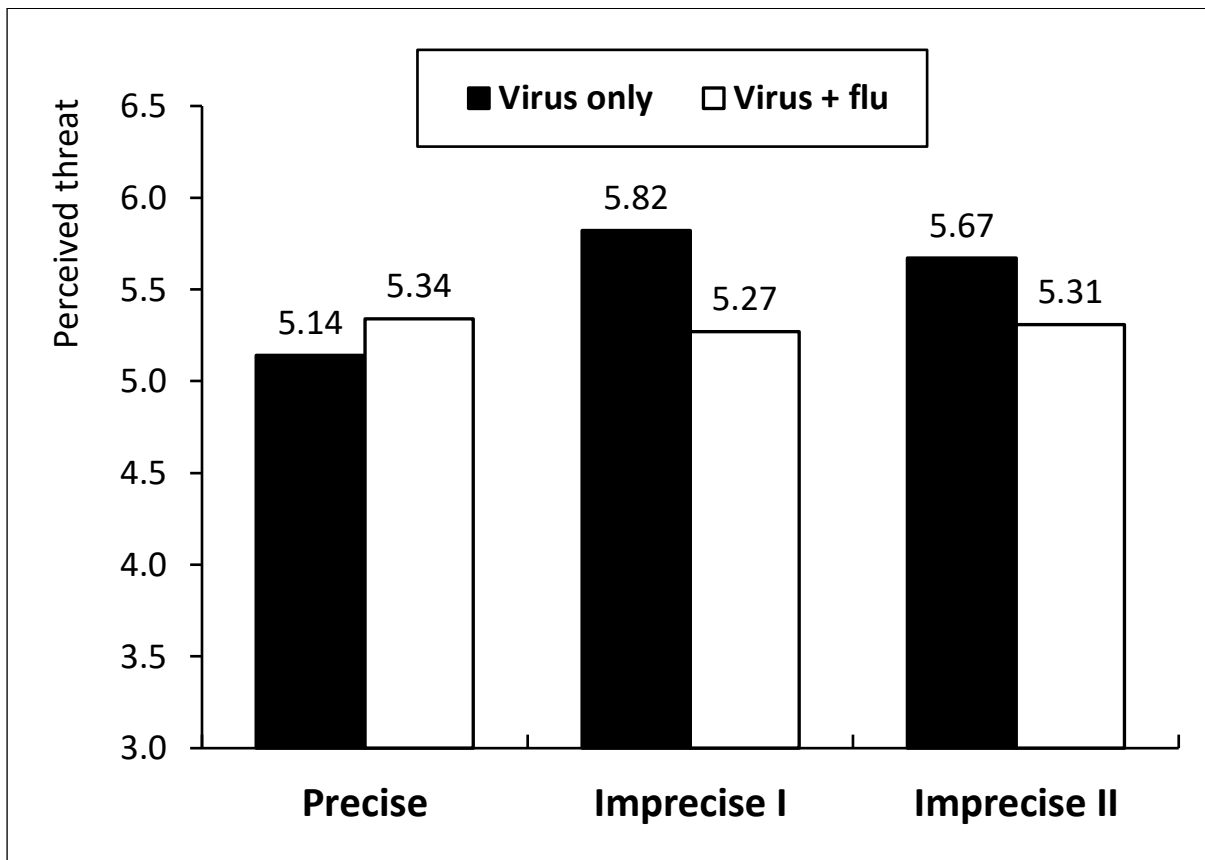|	
U.S. Coronavirus - Cases:	**1.19M**
U.S. Coronavirus - Deaths:	**69K**
U.S. Flu (2019) - Cases:	**35.50M**
U.S. Flu (2019) - Hospitalization:	**490K**

FIGURE 4

Results of Study 2

FIGURE 5

Stimuli for Study 3

Stage 1: All participants

Please read the following information about Coronavirus (now) in the U.S.:

U.S. Coronavirus - Cases:	**1,201,000**
U.S. Coronavirus - Deaths:	**69,000**

Stage 2: Additional Flu Cases Information Condition

Please read the following information about Coronavirus (now) and the flu (2019) in the U.S.:

U.S. Coronavirus - Cases:	**1,201,000**
U.S. Coronavirus - Deaths:	**69,000**
U.S. Flu (2019) - Cases:	**35,500,000**

Stage 2: Additional Flu Deaths Information Condition

Please read the following information about Coronavirus (now) and the flu (2019) in the U.S.:

U.S. Coronavirus - Cases:	**1,201,000**
U.S. Coronavirus - Deaths:	**69,000**
U.S. Flu (2019) - Deaths:	**34,000**

FIGURE 6

Results of Study 3