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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 behaviors. 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 SARS-CoV-2 coronavirus pandemic. This article 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 statistics on the disease caused by SARS-CoV-2, which is known as COVID-19. 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" toward desired behavior in the context of public health and safety.

Introduction

The novel coronavirus SARS-CoV-2, which causes the disease known as COVID-19, is a serious problem for all of humanity as the virus continues to spread around the world (World Health Organization [WHO] 2020). COVID-19 represents a global threat, and the way that individuals respond to it will determine its severity. According to the 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 the virus is spreading, the lack of a vaccine or any known 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 and 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

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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, tornadoes), 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 disaster 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., drunk 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. Behavioral economists have previously explored the way in which various aspects of choice can modify and influence people's decisions and behaviors (Thaler and Sunstein 2008). This topic is becoming more prevalent as governments and policymakers increase those nudging techniques. For example, the National Institutes of Health (NIH) in the United States has emphasized the importance of the "science of behavior change," while the United Kingdom, France, and Denmark have set up labs to study nudging techniques (Blumenthal-Barby and Burroughs 2012; Trettel et al. 2017).

In this article 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 and risk communication have demonstrated how framing messages can result in different behavioral consequences; however, these studies have tested only a few dimensions of message framing, such as visual versus verbal information, or words versus numbers (Spiegelhalter, Pearson, and Short 2011). Consistent with prior research, we expect that the ways 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 article is expected to contribute to theoretical and practical knowledge in several ways. First, 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 and Tversky 1992; Kahneman and Tversky 1996; Tversky and 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. Second, 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. Finally, this article 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 article contributes to our understanding of key information use in PSAs during a serious 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 versus 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

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 nonprofit 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 abuse, drug abuse, preventive health care, traffic safety, and nutrition (Hanneman, McEwen, and Coyne 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, Fryer, and Tharp-Taylor 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, Austin, and Pinkleton 2001). Paek et al. (2011) tested the influence of the message producer on PSA effectiveness in the context of child abuse prevention videos. They found that PSA videos produced by peers were more effective than those produced by experts. 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 swine flu pandemic that occurred due to an outbreak of the H1N1 flu virus. Their results indicated that 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 article 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 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., NIH in the United States; Institute for Government and Cabinet Office in the United Kingdom; 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 (for a systematic review, see Li and Chapman 2013).

First, 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—including 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 Kulczynski 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).

Second, 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 the novel coronavirus SARS-CoV-2 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 nonengagement with the recommended behavior.

Third, 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 an organ 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% to 100%) compared with those countries not using a default donor strategy (5% to 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 Wisdom 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 novel coronavirus.

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

Even though researchers have shown that frequency judgments are relatively accurate (e.g., Alba et al. 1980; Hasher and Zacks 1984), people tend toward 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 (versus later) case. In addition, familiarity (e.g., Hintzman 1988), concreteness of information (e.g., Betsch et al. 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

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 1. Stimuli for Study 1.

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). To put this a different way, 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 (versus absolute) frequency information (Harries and Harvey 2000; also see evaluability hypothesis in Hsee 1996). For example, sound quality (e.g., total harmonic distortion, or THD) 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 cases, number of 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: Exposure to other frequency information will influence the perceived threat. Perceived threat of COVID-19 will be lower when key information is provided with (versus without) other statistics.

H2: Exposure to other frequency information will influence stockpiling intention. Stockpiling intention due to COVID-19 will be lower when key information is provided with (versus 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 through 3). The studies were conducted mid-March 2020 (Study 1) and May 2020 (Studies 2 and 3). Participants were limited to one country (the United States) to control for the specific disease situation in different countries.

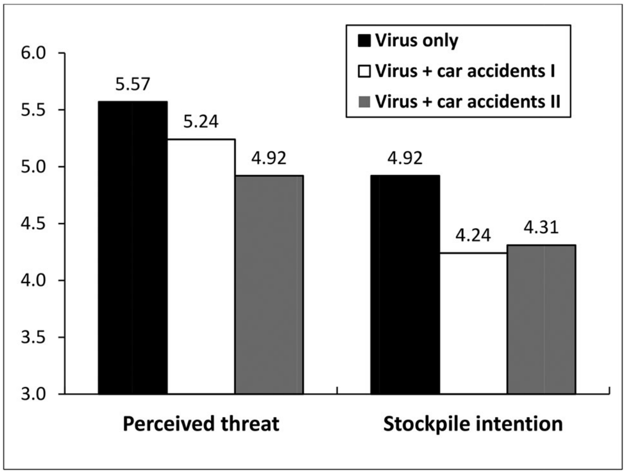

Figure 2. Results of Study 1.

Study 1: Showing the Effect of Comparative Statistics

Study 1 examines the main prediction regarding the perceived threat based on statistical information (hypotheses 1 through 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 U.S. adults (51.2% female, average age = 37.62, $SD = 12.66$) from an online panel (Amazon.com's Mechanical Turk [MTurk]) who participated in exchange for monetary payment. Participants were randomly assigned to one of three experimental conditions (coronavirus information only versus coronavirus + car accident information I versus Coronavirus + car accident information II) in a between-subjects design.

All participants were first asked to read 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 and 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's α = .814 for $n = 71$). Participants in the car accident information II condition did not report the perceived threat of car accidents; they reported only 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's 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's α = .869).

Results and Discussion

First, participants in the virus + car accident information II condition generated a higher perceived threat for 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 perceived threat of the virus, the overall results of a 3 (coronavirus information only versus coronavirus + car accident information I versus coronavirus + car accident information II) analysis of variance (ANOVA) were also significant (F (2, 204) = 3.13, p = .046, η^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, η^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, η^2 = .008), but the results showed a direction. These results support hypothesis 1. In addition, this effect was still significant (F (2, 199) = 3.90, p = .022, η^2 = .038) considering various covariates (e.g., whether participants exercise regularly, whether they take medicine or health supplements, age, gender).

Third, regarding stockpiling intention, the overall results of a 3 (coronavirus information only versus coronavirus + car accident information I versus coronavirus + car accident information II) ANOVA were also significant (F (2, 204) = 3.24, p = .041, η^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, η^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, η^2 = .021). However, there was no difference between the two virus + car accident information conditions (p = .817). In addition, this effect was still significant (F (2, 199) = 3.32, p = .038, η^2 = .032) even with various covariates in the analysis (e.g., whether participants exercise regularly, whether they take medicine or health supplements, age, gender). In sum, hypothesis 2 was supported.

Finally, we conducted a mediation analysis (independent variable → perceived threat → stockpiling intention) after combining one virus + car accident information condition from two experimental conditions (virus + car accident information I and II) because the two conditions generated similar results for stockpiling intention. The results of Hayes (2017) #4 indicated a significant indirect effect (effect = −.288, 95% confidence interval [CI]: [−.540, −.055]), whereas the direct effect was insignificant (effect = −.355, 95% CI: [−.786, .077]), supporting hypothesis 3. We also conducted reverse mediation analysis (independent variable → stockpiling intention → perceived threat). The indirect effect was also significant (effect = −.300, 95% CI: [−.577, −.068]). The significant results of the reverse mediation could be driven by measurement order (Kim et al. 2018). Specifically, participants in this study were asked to answer first the mediator (perceived threat), then the dependent variable (i.e., stockpiling intention). To control this order effect, we measured stockpiling intention first in Study 2.

Study 2: Showing the Effect of Information Preciseness

Study 2 replicates Study 1 with a few modifications. As described, we changed the measurement order of our two key variables by asking participants to respond to stockpiling intention first and perceived threat second. Also, the current presentation format of COVID-19 differs among 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 (1.21 M [million] cases from google.com). The preciseness of the information could influence processing. Specifically, a precise (versus imprecise) number can increase 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 2012). For example, people were more likely to use precise (versus imprecise) product information (e.g., 24.78% versus 25%) in the product evaluation (Kim et al. 2020; Xie and Kronrod 2012). This stream of research suggests that the impact of other information could be strong when the information is precise (versus imprecise). On the other hand, imprecise (versus 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 (versus precise) price information (e.g., \$50 to \$30 vs. \$29.97 to \$29.96; see also Thomas and Morwitz 2009). This could result in the stronger impact of other information when the key information was imprecise (versus precise). Because two different streams of research suggest the opposite pattern, we empirically test the effect in this study. Specifically, we compare three different levels of preciseness (e.g., 1,187,302 versus 1,190,000 versus 1.19 M). 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 U.S. adults (51.8% female, average age = 38.05, SD = 12.97) from an online panel (MTurk) who participated in exchange for monetary payment. Participants were randomly assigned to one of 2 (information: coronavirus information only versus coronavirus + flu information) × 3 (preciseness of number: precise versus imprecise I versus 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 U.S. cases and deaths at the time of the

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 3. Stimuli for Study 2.

survey. In the coronavirus + flu information conditions, participants were given U.S. cases and deaths at the time of the survey, as well as information on U.S. flu in 2019, as shown in Figure 3. All flu data were from the U.S. Centers for Disease Control and Prevention.

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., 1.19 M or 69 K) were not given precise numbers.

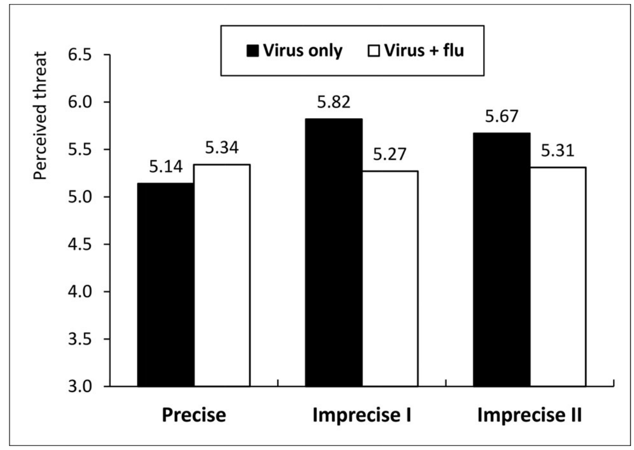

Figure 4. Results of Study 2.

All participants were asked to indicate their stockpiling intentions using the same scale as used in Study 1 (Cronbach's α = .867). They were also asked to rate the perceived threat of two items as in Study 1 (Cronbach's 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*).

Results and Discussion

First, regarding the perceived threat of the virus, we conducted a 2 (information: coronavirus information only versus coronavirus + flu information) × 3 (preciseness of number: precise versus imprecise I versus imprecise II) analysis of covariance (ANCOVA) (e.g., health consciousness as a covariate). The covariate was significant (F (1, 298) = 88.68, $p < .001$, η^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, η^2 = .013), supporting hypothesis 1. In addition, the interaction effect of the two experimental variables was also significant (F (1, 298) = 2.44, p = .089, $\boldsymbol{\eta^2}$ = .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

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 5. Stimuli for Study 3.

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 suggests the impreciseness of the information could increase processing fluency, resulting in a threat-reduction effect from the additional flu information.

Second, regarding 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, 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 hypothesis 2.

Finally, we conducted a mediation analysis (i.e., independent variable → 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% CI: [−.171, −.001]), whereas the direct effect was insignificant (effect = −259, 95% CI: [−.616, .097]). We also conducted the reverse mediation analysis (i.e., independent variable → stockpiling intention → perceived threat). The indirect effect was not significant (effect = −.053, 95% CI: [−.121, .001]). Therefore, the results of the mediation analysis clearly supported hypothesis 3 in Study 2.

In sum, we found that additional information about the flu could significantly reduce 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 suggests a higher frequency of COVID-19 compared with another disease (e.g., 1 M cases for COVID-19 versus 35 M cases for flu), we replicate the previous study so that additional information can reduce perceived threat and stockpiling intention. On the other hand, when the additional information suggests a lower frequency of COVID-19 (e.g., 70,000 deaths for COVID-19 versus 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 updated information repeatedly across different times, so to extend the external validity we used the repeated method as well.

Method

The study involved 131 U.S. adults (51.1% female, average age = 38.39, $SD = 12.81$) from an online panel (MTurk) who participated in exchange for monetary payment. Participants were randomly assigned to one of 2 (information: coronavirus information only versus coronavirus + flu information) × 2 (type of flu information: flu cases versus flu death numbers) in a mixed experimental design. The information factor was a repeated factor.

The procedure for 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). All participants were then asked to indicate

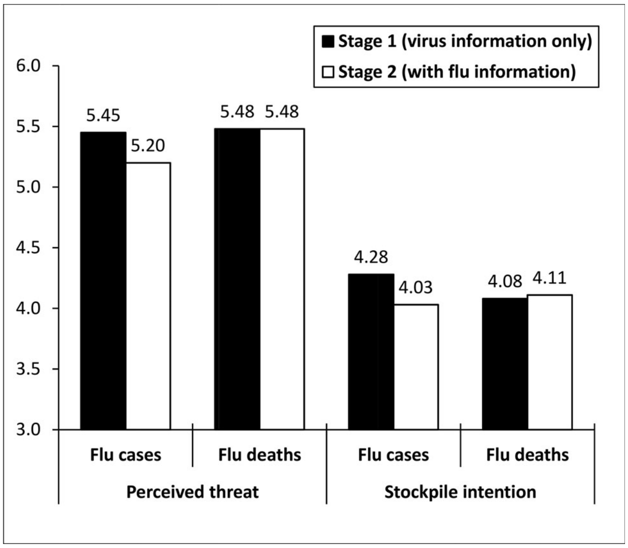

Figure 6. Results of Study 3.

their stockpiling intention (Cronbach's $\alpha = .903$) and perceived threat (Cronbach's $\alpha = .880$) using the same scale as used in Study 1.

In stage 2, participants were informed that additional information about the 2019 flu outbreak 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 these instructions, participants in the flu cases condition were given the number of flu cases in the year 2019 (i.e., 35,500,000), whereas participants in the flu deaths condition were given U.S. 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's $\alpha = .907$) and perceived threat (Cronbach's $\alpha = .913$), again using the same scale as in the previous task.

Finally, 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) $= .42$, $p = .516$, $\eta^2 = .003$). 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 versus coronavirus + flu information) × 2 (type of flu information: flu cases versus flu death numbers) repeated ANOVA. Regarding 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 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 hypothesis 1. On the other hand, 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 hypothesis 2. 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., independent variable → perceived threat → stockpiling intention) after calculating the difference between stage 1 and stage 2 for perceived threat and stockpiling intention. The results of Hayes (2017) #4 indicated a significant indirect effect (effect = −.101, 95% CI: [−.214, −.001]), whereas the direct effect was insignificant (effect = −.183, 95% CI: [−.446, .080]), supporting hypothesis 3.

General Discussion

During health crises and disruptive events, such as the current global COVID-19 crisis, governments and policymakers aim to find the best communication messages and PSA strategies to enhance public understanding of the problem and to stimulate desired behavior. In fact, PSA 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 can also lead to irrational behavior, such as stockpiling that jeopardizes the well-being of the economy and society. This article 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 level of perceived threat and stockpiling intention. 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 demonstrates that the preciseness of the information moderates the effect. In addition, the Study 3 provides evidence of another boundary condition to this relationship. The comparison standard (higher versus 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 (versus lower) frequency (e.g., flu cases versus 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 perceived threat during a global crisis. One may question whether the term *nudge* is applicable in describing key effects on judgment and intentions, as nudges often involve choice behavior. However, past research has shown that aspects of choice architecture can also influence nonbehavior elements such as implementation intentions (Milkman et al. 2011), nonaction (Johnson and Goldstein 2003), and evaluation (Li et al. 2010). Thus, the term *nudge* is used broadly to refer any element of context in which people make decisions, judgments, and evaluations, and form intentions.

Related to this point, policymakers and governments implement nudges in PSAs to communicate effectively with the population, and this article 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 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 perceived threat related to the disruptive event (e.g., COVID-19). This article strengthens our knowledge about how additional comparative information impacts perception in PSAs.

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 PSAs 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 article has several practical implications. Nudging people toward 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 (i.e., 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 detrimental health effects, and persuade people to take action to avoid or reduce related health risks (Atkin 2001). As of August 2020, Brazil and India, experiencing rapid growth of COVID-19 infections, are the two most affected countries in the world after the United States, which has slowed the growth momentarily. Interestingly, some TV commercials have adopted an indirect messaging strategy, highlighting that, in many cases, severe consequences of COVID-19 are generally linked to preexisting 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 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 article clearly shows that the nudging method of controlling information can increase or decrease perceived threat and hoarding behavior. The relevant agencies, including government and health organizations, could use this method to provide the best social control under pandemic conditions.

Because the information provided to individuals is crucial in affecting their judgment, governments and policymakers 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, policymakers may utilize our findings to encourage people to follow protective measures, such as wearing a mask or washing their hands frequently. Specifically, policymakers 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. First, 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. Second, 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, Neville, and Whitwell 2010, 2014); investigating whether such a gap exists in severe crises such as the COVID-19 pandemic, as well as exploring the underlying mechanisms, would be fruitful avenues for future studies.

Third, we have focused mainly on one nudging strategy in this article. Various other nudging strategies could also influence response and behavioral intention regarding the coronavirus. 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 PSAs. 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. In particular, 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 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 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 behavior specifically linked to COVID-19. Future studies could explore general stockpiling intentions.

Final Remarks

This research demonstrates the main effect of additional information on perceived threat and stockpiling intention during times of crisis, such as the present COVID-19 pandemic. 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 perceived threat (hypothesis 1) and stockpiling intention (hypothesis 2). However, Study 2 indicated that the preciseness of the information moderates this effect. Indeed, precise information can eliminate this reduction, especially for perceived threat. In addition, the main effect of other frequency information on perceived threat was significant only when the additional information suggested a higher (versus lower) frequency (e.g., flu cases versus flu deaths) compared to the current health situation. This finding 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 (hypothesis 3).

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