

How Emotions, Pronoun Use, and Message Values Shape Public Understanding and Support for Wastewater Monitoring: Experimental Study

Moonsun Jeon, Youllee Kim

Submitted to: JMIR Formative Research
on: August 27, 2025

Disclaimer: © The authors. All rights reserved. This is a privileged document currently under peer-review/community review. Authors have provided JMIR Publications with an exclusive license to publish this preprint on its website for review purposes only. While the final peer-reviewed paper may be licensed under a CC BY license on publication, at this stage authors and publisher expressly prohibit redistribution of this draft paper other than for review purposes.

Table of Contents

Original Manuscript.....	4
---------------------------------	----------

Preprint
JMIR Publications

How Emotions, Pronoun Use, and Message Values Shape Public Understanding and Support for Wastewater Monitoring: Experimental Study

Moonsun Jeon¹ MA; Youllee Kim² PhD

¹ Michigan State University East Lansing US

² University of Denver Denver US

Corresponding Author:

Youllee Kim PhD

University of Denver

2000 E. Asbury Ave., 298 Sturm Hall

Denver

US

Abstract

Background: Although wastewater monitoring is an effective, non-intrusive public health strategy for tracking community-level COVID-19 prevalence, there has been limited research on public perceptions of this novel surveillance method. A significant gap exists in understanding how to design effective communication campaigns to gain public support for wastewater monitoring and persuade individuals to take preventive actions based on the data.

Objective: This study examines the impact of emotional appeals (fear vs. hope) and pronoun use (we vs. you) on public support for COVID-19 wastewater monitoring, intentions to discuss the intervention, and intentions to engage in preventive behaviors.

Methods: An online 2 (emotional appeal: fear vs hope) × 2 (pronoun use: you-language vs we-language) between-subjects experiment with a control condition was conducted. A total of 603 US residents were recruited via Prolific in July 2023. Participants were randomly assigned to view one of five message stimuli and then completed a survey measuring emotional responses, message judgments (fatigue and shocking value), and the primary outcome variables.

Results: Fear appeals led to greater support and stronger intentions to engage in preventive behaviors than hope appeals, while pronoun use had no significant effect. Additionally, message fatigue and shock value mediated the relationship between the message-evoked emotions and the outcome variables, whereby message fatigue was negatively associated with the outcome variables, and message shock value was positively correlated with policy support and communication intention.

Conclusions: The findings suggest that while fear-based messages are effective, communication strategies should also aim to mitigate message fatigue to sustain public engagement and support for long-term public health initiatives.

(JMIR Preprints 27/08/2025:83060)

DOI: <https://doi.org/10.2196/preprints.83060>

Preprint Settings

1) Would you like to publish your submitted manuscript as preprint?

✓ **Please make my preprint PDF available to anyone at any time (recommended).**

Please make my preprint PDF available only to logged-in users; I understand that my title and abstract will remain visible to all users.

Only make the preprint title and abstract visible.

No, I do not wish to publish my submitted manuscript as a preprint.

2) If accepted for publication in a JMIR journal, would you like the PDF to be visible to the public?

✓ **Yes, please make my accepted manuscript PDF available to anyone at any time (Recommended).**

Yes, but please make my accepted manuscript PDF available only to logged-in users; I understand that the title and abstract will remain visible to all users.

Yes, but only make the title and abstract visible (see Important note, above). I understand that if I later pay to participate in [a JMIR journal](#), I will be able to make the full manuscript available to all users.

No. Please do not make my accepted manuscript PDF available to anyone. I understand that if I later pay to participate in [a JMIR journal](#), I will be able to make the full manuscript available to all users.

Original Manuscript

Abstract

Background: Although wastewater monitoring is an effective, non-intrusive public health strategy for tracking community-level COVID-19 prevalence, there has been limited research on public perceptions of this novel surveillance method. A significant gap exists in understanding how to design effective communication campaigns to gain public support for wastewater monitoring and persuade individuals to take preventive actions based on the data.

Objective: This study examines the impact of emotional appeals (fear vs. hope) and pronoun use (we vs. you) on public support for COVID-19 wastewater monitoring, intentions to discuss the intervention, and intentions to engage in preventive behaviors.

Methods: An online 2 (emotional appeal: fear vs hope) $\times$ 2 (pronoun use: you-language vs we-language) between-subjects experiment with a control condition was conducted. A total of 603 US residents were recruited via Prolific in July 2023. Participants were randomly assigned to view one of five message stimuli and then completed a survey measuring emotional responses, message judgments (fatigue and shocking value), and the primary outcome variables.

Results: Fear appeals led to greater support and stronger intentions to engage in preventive behaviors than hope appeals, while pronoun use had no significant effect. Additionally, message fatigue and shock value mediated the relationship between the message-evoked emotions and the outcome variables, whereby message fatigue was negatively associated with the outcome variables, and message shock value was positively correlated with policy support and communication intention.

Conclusions: The findings suggest that while fear-based messages are effective, communication strategies should also aim to mitigate message fatigue to sustain public engagement and support for long-term public health initiatives.

Keywords: Emotional appeals, we-vs. you-language, COVID-19 preventive behaviors, message fatigue, message shocking value

How Emotions, Pronoun Use, and Message Values Shape Public Understanding and Support for Wastewater Monitoring: Experimental Study

Since the outbreak of COVID-19, various measures have been implemented to get up-to-date

information on the prevalence of infection in order to take necessary steps for the patients and to prevent the spread of the disease among community members [1,2]. One effective, non-intrusive way to track the infection is through wastewater monitoring (i.e., wastewater surveillance; [3,4]). Although interest in the use of wastewater for public health surveillance has grown exponentially during the COVID-19 pandemic [5], there has been limited research on the actual perceptions and understanding of the community members regarding the novel strategy [6], including how to gain the public's support toward this surveillance intervention and persuade them to take necessary actions based on the wastewater monitoring data.

To begin filling this gap for the campaign design, this study examines the effects of emotional appeals (fear vs. hope appeal) and type of pronouns (we-language vs. you-language) on support for COVID-19 wastewater monitoring, interpersonal communication about COVID-19 wastewater monitoring, and intentions for COVID-19 preventive behavior upon viewing the wastewater monitoring data. We begin by reviewing the roles of fear and hope in the context of COVID-19, examining how the variations of the pronouns in fear and hope appeals may lead to different persuasive outcomes. Next, we investigate the two message judgments (i.e., message fatigue and message shocking value) as mechanisms for how fear and hope appeals lead to persuasive outcomes. Finally, we report on and discuss a study that tests our predictions about the message effects on persuasive outcomes.

Communicating COVID-19 Wastewater Monitoring to the Public

Wastewater surveillance involves analyzing sewage water to detect and monitor the presence and concentration of pathogens, such as viruses, shed by a community [5]. Centers for Disease Control and Prevention (CDC) launched the National Wastewater Surveillance System (NWSS) in September 2020 in response to the COVID-19 pandemic [7]. NWSS coordinates with communities in the United States to detect the presence of SARS-Cov-2, which is the primary virus that causes COVID-19. Wastewater monitoring is an effective tool that can inform timely public health

responses to prevent further spread of COVID-19, providing quick and efficient community-level data for early detection and warning [8]. Unlike other types of COVID-19 surveillance, wastewater monitoring is independent of healthcare access or testing availability, with the potential to detect various infectious disease threats in the future [9,10]. That is, it retains clear relevance as a long-term public health strategy as the infrastructure and analytic capacity developed during the pandemic can be leveraged to monitor a range of emerging and re-emerging infectious diseases, including influenza, RSV, and potential future pathogens of concern [11].

Although wastewater monitoring proves to be a promising tool in tracking community-level viral spread, the public health communication challenge lies in engaging and educating the public about the relevance and necessity of this surveillance method. A nationwide survey indicated that survey respondents had limited knowledge of the basic functions of wastewater monitoring [12]. Findings from another survey revealed a similar gap in understanding, with 49% of respondents reporting that they did not know COVID-19 can be detected in municipal sewer systems [6]. Moreover, some participants expressed skepticism and mistrust toward the method due to a lack of familiarity in the same survey. Although more recent survey data suggest overall public support for wastewater monitoring, researchers continue to call for expanded public education, as concerns regarding privacy and anonymity persist [11]. Successfully addressing these challenges involves not only gaining public support and sustaining their interest in wastewater monitoring but also encouraging individuals to take preventive measures in response to wastewater data. To this end, we investigate the message features and underlying mechanisms that influence support toward COVID-19 wastewater monitoring, interpersonal communication about the COVID-19 wastewater monitoring, and intention to take preventive measures in response to wastewater monitoring data.

Emotional Appeals Using Different Types of Pronouns (i.e., We- vs. You-language)

The COVID-19 pandemic stirred widespread feelings of fear within the public, a negatively-valenced emotion instigated by an emerging threat or perceived danger [13,14]. Fear has been

recognized as a significant driving force behind preventive health behaviors against COVID-19, including social distancing, frequent hand washing, and mask-wearing [15,16]. Messages that evoke fear (i.e., fear appeals) effectively induce high perceived severity and susceptibility, motivating individuals to adopt risk preventive measures [17]. During the pandemic, health messages often utilized fear appeals to promote public health behaviors [18]. Meanwhile, increasing attention has been drawn to the use of positively-valenced emotions such as hope in persuasive communication (e.g., [19]). Especially in the context of COVID-19, several researchers have called for a need to counterbalance prevalent negative emotions with positive emotional appeals to reduce undesired consequences, such as message avoidance and reactance [20,21]. For instance, hope plays a crucial role in aiding individuals to cope and persevere, particularly under stressful and challenging circumstances [22]. Hope appeals have been noted as a powerful motivator for behaviors that enable oneself to obtain future rewards and avoid punishment [23].

In addition to evoking emotional responses such as fear and hope, COVID-19 has triggered a sense of both individualistic and collectivistic perspectives to address the public health issue. Individually, people were confronted with risks of infection and pain from short- and long-term post-symptoms even after recovery, such as a change in smell or taste, shortness of breath, chronic chest pain, depression, and changes in menstrual cycles [24]. COVID-19 was a life-threatening problem to some individuals in the most extreme cases, as more than one million Americans have lost their lives due to COVID-19 [25]. Simultaneously, the pandemic necessitated a communal approach, with fundamental prevention measures like masking and quarantine relying on individuals being socially aware that their actions impact not just themselves, but others in their community who might be more vulnerable [26].

Noting the dual nature of COVID-19, researchers examined the pronoun usage (i.e., we vs. you) to understand effective message design for combating COVID-19 [27,28]. Previous research generally showed that we-language is effective in inducing a collective self-concept, enhancing

communal coping perceptions, attitudes, and social connectedness [29,30]. In the COVID-19 context, Jordan et al [27] conducted experimental studies with messages that emphasized personal, public, or their combined benefits of prevention behaviors, showing the importance of highlighting the public benefits of COVID-19 prevention behaviors.

Pronoun usage has often been investigated along with emotions as they yield some interactive influences on communicative, relational, and behavioral outcomes [31,32]. In this study, we examine the interactive effects of pronoun usage with two message-induced emotions, fear and hope, on attitudinal, communicative, and behavioral intentions related to COVID-19 wastewater surveillance. Therefore, we pose the following research questions:

RQ1. Will the type of pronouns (we-language vs. you-language) used in the message moderate the influence of fear appeal on (a) support for wastewater surveillance, (b) interpersonal communication about wastewater surveillance, and (c) intention to perform COVID-19 preventive behavior?

RQ2. Will the type of pronouns (we-language vs. you-language) used in the message moderate the influence of hope appeal on (a) support for wastewater surveillance, (b) interpersonal communication about wastewater surveillance, and (c) intention to perform COVID-19 preventive behavior?

Message Fatigue and Message Shocking Value as Mediators

To understand the mechanisms of how fear and hope appeals influence the public's support for and understanding of wastewater monitoring against COVID-19, we considered two message judgments as mediators in the relationship: message fatigue and message shocking value. Message fatigue refers to an aversive motivational state caused by overexposure to campaign messages or information perceived to be similar and redundant over an extended period of time [33,34]. Message fatigue is associated with adverse cognitive, affective, and behavioral outcomes of persuasive messages, including message avoidance, annoyance, desensitization, counterargument, and less

message elaboration [34].

Research suggests that emotional responses can shape the degree of message fatigue audiences experience. For instance, COVID-19 message fatigue was positively correlated with negative emotions including fear and sadness, while hope acted as a buffer against the aforementioned negative consequences [33]. We may infer that fear heightens perceived threat salience [35,36] and makes repeated exposure more taxing, thereby exacerbating message fatigue. In contrast, hope fosters a sense of efficacy and solution-oriented thinking [23], functioning as a buffer against the aversive effects of repeated exposure. Drawing on these insights, we hypothesize that COVID-19–related fear will be positively associated with message fatigue, whereas COVID-19–related hope will be negatively associated with message fatigue.

In various health contexts including COVID-19, message fatigue has been associated with reactance, yielding undesirable health outcomes such as less favorable attitude and behavioral intentions toward positive health behaviors [37,38]. Feeling fatigued with messages has also reduced the likelihood one will share the message content with others [39]. Despite the relatively novel aspects of wastewater monitoring, we expected to observe negative effects of message fatigue in the current study due to the general fatigue that the public is experiencing regarding COVID-19 [40]. Drawing from the previous empirical findings, we posit the following hypotheses about the antecedents and consequences of COVID-19 message fatigue.

H1: Message fatigue is (a) positively associated with fear but (b) negatively associated with hope.

H2: Message fatigue is negatively associated with (a) support for COVID-19 monitoring in wastewater, (b) intentions to talk about the monitoring with others, and (c) intentions to engage in COVID-19 safety behaviors.

We posed message shocking value as a mediator between the two discrete emotions and the proposed message outcomes. Defined as a combination of surprise and extremity regarding a

message, message shocking value was positively associated with the specific emotional appraisals (e.g., feeling dangerous) of threat messages [41,42]. Fear, as a primary appraisal of threat [43], may heighten sensitivity to novel or extreme elements in a message [44], thereby increasing its perceived shocking value. Hope is often considered as a core element of secondary appraisals of fear that provides people with abilities and motives to take appropriate actions to escape from the current negative state [16]. In the context of wastewater monitoring, which is a relatively novel public health strategy, hope may lead individuals to interpret the message's innovative aspects as surprising and promising, thus elevating shocking value. From the above theoretical assumptions, we expect that both fear and hope would be positively correlated with message shock value.

Shocking health messages are more likely to attract attention, be talked about, and be shared among people [45,46]. In line with previous findings, we expect that message shocking value will be associated with greater intentions to talk about the message topic. In the context of COVID-19, there is a lack of empirical investigation on how message shocking value would be correlated with some behavioral outcomes such as wastewater surveillance policy support or implementing preventive actions. Guided by the prior theoretical assumptions and observations, the following hypotheses and a research question were raised:

H3: Perceived message shocking value is positively associated with (a) fear and (b) hope.

H4: Perceived message shocking value is positively associated with the intention to talk about COVID-19 monitoring in wastewater.

RQ3: Does perceived message shocking value have a significant association with (a) support for COVID-19 monitoring in wastewater and (b) intentions to engage in COVID-19 safety behaviors?

Additionally, as we only focused on two mediators in this experimental study, we hoped to explore other factors that might influence individuals' support for waste monitoring for COVID-19 prevention. Therefore, we posed the following research question and examined the participants'

open-ended responses to the question:

RQ4: Why do people decide to support (or not support) COVID-19 monitoring in wastewater?

Method

Study Design and Message Stimuli

The study was a 2 (emotional appeal: fear appeal vs. hope appeal) × 2 (types of pronouns: you-language vs. we-language) between-subjects design with one control condition (i.e., informational message only). All participants read an informative message about COVID-19 monitoring in wastewater, followed by five different message stimuli (See Appendix for the messages).

Participants

Upon receiving approval from the university's institutional review board, participants were recruited using Prolific and restricted to US residents who are 18 years or older. Of the total 609 participants, 5 participants who failed the attention check question and 1 participant who took less than 5 minutes to complete the survey were eliminated from the following analyses. The final sample included 603 participants (54.7% female) who, on average, were 39.59 years old (*SD* 12.94, *Med* 37, *Min* 18, *Max* 81). *Table 1* presents demographic information of the participants.

Ethics Approval

This study received approval from the Institutional Review Board at the University of Denver. All participants provided informed consent for their participation and for the publication of their anonymized data. The survey collected sociodemographic data (age, gender, education, race, employment, and income) but no personal identifiable information. Participants received monetary compensation for completing the survey.

Procedures

The survey was conducted between July 18 and July 19, 2023. After giving consent,

participants were asked to select the wastewater utility service area that matches their residential area or the one that they think is the closest to where they live. All participants then read an informative message about COVID-19 monitoring in wastewater. Participants in all five conditions read additional message stimuli, which were followed by questions about their emotional responses, message judgments, and attitudinal, communicative, and behavioral outcomes regarding wastewater monitoring for COVID-19.

Measures

We used multi-item scales to assess fear, hope, perceived message shocking value, message fatigue, support for COVID-19 monitoring in wastewater, interpersonal communication about COVID-19 monitoring in wastewater, and preventive behaviors against COVID-19. All variables were based on 5-point scales from 1 (*strongly disagree*) to 5 (*strongly agree*) and averaged, otherwise stated. Across items, there were a total of 17 missing observations. The missing data were replaced with mean scores for non-missing observations for the given scale [47]. A confirmatory factor analysis was conducted in AMOS version 26 to test the measurement properties of these scales. We used the following criteria to evaluate the overall model fit: $\chi^2/df < 3.00$, CFI $> .90$, and RMSEA $< .08$ [48,49]. The measurement model included all items for each latent construct, and latent constructs were allowed to covary. The fit for the initial measurement model showed room for improvement, $\chi^2/df = 4.51$, CFI = .91, and RMSEA = .09, 90% CI .081-.089. Based on the modification indices, we allowed the error terms of three pairs of items for message fatigue and three pairs of items for COVID-19 preventive behaviors to covary. The adjusted measurement model showed a good fit to the data, $\chi^2/df = 2.55$, CFI = .96, and RMSEA = .06, 90% CI .053-.061.

Message Informativeness. To ensure the experimental conditions do not differ in informational content, message informativeness was measured with three items including “I learned something from reading the message,” and “The message provided me with meaningful information” (mean 3.90, SD 0.88; $\alpha = .87$).

Fear. Fear was measured by asking participants how much of the following three emotions – fear, scared, and afraid – they felt after reading the message. Responses, marked on the 5-point scales from 1 (*none of this emotion*) to 5 (*a great deal of this emotion*), were averaged into one score, with higher scores indicating greater fear (mean 1.52, SD 0.82; $\alpha=.96$).

Hope. Hope was measured by asking participants how much of the following three emotions – hope, inspired, and encouraged – they felt after reading the message. Responses, marked on the 5-point scales from 1 (*none of this emotion*) to 5 (*a great deal of this emotion*), were averaged into one score, with higher scores suggesting stronger hope (mean 1.96, SD 1.14; $\alpha=.93$).

Message Fatigue. Adapted from So et al [34], message fatigue was assessed with eight items including “Messages about COVID-19 are all beginning to sound the same to me,” and “I’m tired of hearing about the importance of COVID-19 preventive behaviors” (mean 2.95, SD 1.23; $\alpha=.96$).

Message Shocking Value. Adapted from Smith et al [41], message shocking value was assessed with three items that measured the degree to which participants judged the message to be surprising, shocking, and alarming (mean 1.72, SD 0.79; $\alpha=.87$).

Support for COVID-19 Monitoring in Wastewater. Support for COVID-19 monitoring in wastewater was assessed with four items including “I’m supportive of COVID-19 monitoring in wastewater” and “I think COVID-19 monitoring in wastewater is helpful” (mean 4.04, SD 1.06, $\alpha=.98$).

Interpersonal Communication about COVID-19 Monitoring in Wastewater. Interpersonal communication about COVID-19 monitoring in wastewater was assessed with five items such as “I will tell others about COVID-19 monitoring in wastewater,” “I will talk about COVID-19 monitoring in wastewater with my family” (mean 2.81, SD 1.20; $\alpha=.96$).

Intention for Preventive Behavior against COVID-19. Intention for preventive behaviors against COVID-19 was assessed with six items including “I will wear a mask in indoor spaces,” and “I will try to avoid crowded locations and mass gatherings” (mean 4.14, SD 0.93; $\alpha=.89$).

COVID-19 Involvement. COVID-19 involvement was assessed with three items: “Preventing COVID-19 is important to me,” “Preventing COVID-19 is relevant to me,” and “Preventing COVID-19 is meaningful to me.” (mean 4.32, SD 0.94; $\alpha=.95$).

Political Ideology. Political ideology was measured by asking participants to indicate their political ideology on a 5-point scale from 1 (*extremely liberal*) to 5 (*extremely conservative*); mean 2.36, SD 1.15.

Results

Manipulation Checks

We first assessed whether (a) the fear appeal was the most fear-inducing, (b) the hope appeal was the most hope-inducing, and (c) the five messages were comparable in levels of informativeness. The ANOVA results showed that participants reported greater fear in response to the fear appeal (mean 1.73, SD .91; 95% CI 1.62-1.85) than the hope appeal (mean 1.40, SD 0.72; 95% CI 1.31-1.49) or informational appeal (mean 1.36, SD 0.72; 95% CI 1.23-1.49); $F_{2,600}=13.59$; $P<.001$; $\eta^2=.04$. The ANOVA results showed that participants reported greater hope in response to the hope appeal (mean 2.10, SD 1.24; 95% CI 1.95-2.26) than the fear appeal (mean 1.84, SD 1.08; 95% CI 1.70-1.98), but there was no statistically significant difference with the informational appeal (mean 1.93, SD 1.03; 95% CI 1.75-2.12); $F_{2,600}=3.27$; $P<.05$, $\eta^2=.04$. The ANOVA results showed that perceived informativeness did not vary by message condition, $F_{4,598}=1.98$; $P=.095$; $\eta^2=.01$. The confidence intervals for the message conditions overlapped, indicating that the difference between the conditions were not statistically significant: informational appeal (mean 4.06, SD 0.67; 95% CI 3.94-4.18), fear appeal in we-language (mean 4.03, SD 0.88; 95% CI 3.87-4.18), hope appeal in we-language (mean 3.95, SD 0.80; 95% CI 3.81-4.10), fear appeal in you-language (mean 3.85, SD 0.91; 95% CI 3.69-4.01), hope appeal in you-language (mean 3.81, SD 0.93; 95% CI 3.65-3.98). In the subsequent analyses, we included a total of 482 participants in the fear appeal and hope appeal conditions.

Preliminary Analyses

To inspect overall patterns in the data, we examined Table 2, which includes the means and standard deviations of all variables and the correlations among them. One notable feature of the data was relatively low mean values for fear and hope. We also note the relatively high levels of support for COVID-19 monitoring in wastewater and intentions to engage in COVID-19 safety behaviors. Because COVID-19 involvement and political ideology showed significant associations with substantive variables, we conducted our main analyses with these variables as covariates, following the procedure by Tabachnick and Fidell [50].

Hypotheses and RQs

To explore RQ1 and RQ2, we ran a series of 2 (emotional appeal: hope vs. fear appeals) $\times$ 2 (pronouns: we vs. you language) analysis of covariance (ANCOVA) to examine message effects on support for COVID-19 wastewater monitoring, interpersonal communication about COVID-19 wastewater monitoring, and COVID-19 preventive behavior intention, controlling for involvement with COVID-19 and political ideology. Results of a two-way ANCOVA found that fear appeal (mean 4.11, SD 1.00) led to significantly higher support for COVID-19 wastewater monitoring than hope appeal (mean 3.91, SD 1.16) $F_{1, 476}=5.15$; $P<.05$; partial $\eta^2=.011$. Pronouns used in the message ($F_{1, 476}=1.57$; $P=.21$; partial $\eta^2=.003$) or interaction between emotional appeal and pronouns ($F_{1, 476}=1.83$; $P=.18$; partial $\eta^2=.004$) did not influence higher support for COVID-19 wastewater monitoring. Neither the main effects of emotional appeal ($F_{1, 476}=.53$; $P=.47$; partial $\eta^2=.001$.) and pronouns ($F_{1, 476}=.03$; $P=.86$; partial $\eta^2=.001$) nor the interaction effects of the two ($F_{1, 476}=.75$; $P=.39$; partial $\eta^2=.002$) were significant for interpersonal communication about COVID-19 wastewater monitoring. Fear appeal (mean 4.18, SD .87) led to significantly higher intentions for COVID-19 preventive behavior than hope appeal (mean 4.02, SD 1.03) $F_{1, 476}=4.67$; $P<.05$; partial $\eta^2=.01$. Pronouns used in the message $F_{1, 476}=1.30$; $P=.26$; partial $\eta^2=.003$) or interaction between emotional appeal and pronouns ($F_{1, 476}=.03$; $P=.86$; partial $\eta^2=.000$) did not influence higher intentions for COVID-19 preventive behavior.

Hypotheses H1 – H4 and RQ3 were tested using structural equation modeling. The initial model included two exogenous variables (i.e., fear and hope). Perceived message shocking value and message fatigue were treated as mediating variables, and support for COVID-19 monitoring in wastewater, interpersonal communication about COVID-19 monitoring in wastewater, and preventive behaviors against COVID-19 were the outcome variables. The initial model included all possible paths from the exogenous variables to the mediating variable, all possible paths from the mediating variable to the outcome variables, and no direct paths from the exogenous variables to the outcome variables. COVID-19 involvement and political ideology were added as covariates to the model. The estimated model indicated good fit to the data: $\chi^2/df = 2.70$, CFI=.95, and RMSEA=.06, 90% CI .056-.063. *Figure 1* presents the significant pathways between the exogenous and endogenous variables.

H1 predicted (a) a positive relationship between fear and message fatigue while proposing (b) a negative relationship between hope and message fatigue. Both fear ($\beta = -.21$; $P < .001$) and hope ($\beta = -.32$; $P < .001$) were negatively associated with message fatigue, partially supporting H1.

H2 proposed a negative association between message fatigue and three proposed outcomes. Supporting H2, message fatigue was negatively associated with (a) support for COVID-19 monitoring in wastewater ($\beta = -.53$; $P < .001$), (b) intentions to talk about the monitoring with others ($\beta = -.41$; $P < .001$), and (c) intentions to engage in COVID-19 safety behaviors ($\beta = -.37$; $P < .001$).

H3 proposed a positive relationship (a) between the message shocking value and fear, and (b) between the message shocking value and hope. Supporting H3, both fear ($\beta = .61$; $P < .001$) and hope ($\beta = .08$; $P < .01$) was positively associated with perceived message shocking value ($\beta = .61$; $P < .001$).

H4 and RQ3 were proposed to examine the relationship between perceived message shocking value and three proposed outcomes. Supporting H4, message shocking value was positively associated with intentions to talk about COVID-19 wastewater monitoring with others ($\beta = .34$; $P < .001$). Regarding RQ3, the results showed that perceived message shocking value was positively

associated with support for COVID-19 monitoring in wastewater ($\beta=.13$; $P<.01$) but had a non-significant relationship with intentions to engage in COVID-19 safety behaviors ($\beta=.07$; $P=.15$).

Respondents' open-ended responses were collected for an in-depth understanding of the reasons behind their support (or non-support) toward wastewater monitoring (RQ4). The codebook was developed after the initial review of the entire open-ended responses. Regarding the attitude toward the policy, the responses were categorized into support, conditional support, no support, and neutral. The reasoning category for policy support included informative value, effectiveness, novelty, non-intrusiveness, community protection, etc. The reasoning category for not supporting the policy included waste of money, government mistrust, not enough information, low perceived threat toward COVID-19, and privacy concerns. These categories were non-exclusive. The unit of analysis was a complete answer about participants' opinions with or without specific reasons. Based on the codebook, the authors coded 20% of the open-ended responses and resolved a few disagreements through discussion. The two coders independently coded the rest of the data. Inter-coder reliabilities ranged from .94 to 1.00. The coding categories and examples are presented in Table 3.

Most respondents ($n=425$; 74.2%) indicated they supported COVID-19 monitoring in wastewater, whereas 62 (10.8%) did not support the policy and 61 (10.6%) answered as neutral. For reasons to support wastewater monitoring, most of the respondents claimed that they support the intervention considering its effectiveness and informative value, followed by offering protection to the community. The leading reason for not supporting the intervention was due to financial concerns, followed by a low-risk perception of COVID-19 and government mistrust. A total of 19 respondents who were neutral about the intervention stated that they would need more information before forming an opinion, while others did not specify reasons for their neutral stance.

Discussion

The current study investigated the impact of emotional appeals (i.e., fear and hope appeals) and pronoun use (you-language vs we-language) on the attitudinal, communicative, and behavioral

outcomes related to wastewater monitoring for COVID-19. Although the main effect of pronoun use was not significant, we observed that the fear appeal led to greater support for the policy and intentions to engage in COVID-19 preventive behaviors compared to the hope appeal. Additionally, significant mediating mechanisms, involving message fatigue and shock value were observed between message-evoked emotions (i.e., fear and hope) and the proposed outcomes.

While empirical data reveals the impact of pronoun use on people's emotions and judgments, we did not observe the main effect of pronoun use on our proposed outcomes. We speculate that testing the psycholinguistic features (specifically 'we' versus 'you') alongside emotional appeals may have confounded the effects. 'You' language is often associated with negative feelings such as fear, especially when the source of a problem is being investigated. This attributive nature in 'you' language facilitates denigrating, or accusing a person of wrongdoing (e.g., you should have behaved this way to prevent COVID-19; [51]). Conversely, 'we' language obscures the singular source of the problem, making it less explicit. Thus, using 'you' language in messages can effectively induce fear, whereas, fear appeals in 'we' language are more prone to trigger cognitive dissonance by conveying contradictory perceptions. Future research should delve into the distinct emotional valence associated with each pronoun.

We found intriguing mediating mechanisms between discrete emotions and COVID-19-related preventive measures using message fatigue and message shocking value as mediators. Both fear and hope were negatively correlated with message fatigue, with hope acting as a buffer, aligning with previous research [52]. The unexpected negative relationship between fear and message fatigue may be related to fear's novelty-inducing nature [53]. Given the prevalent message fatigue around COVID-19, experiencing any emotion might reduce fatigue. Participants with lower message fatigue were more likely to support COVID-19 wastewater monitoring, engage in discussions, and adopt preventive behaviors drawn from wastewater data. This suggests that emotional appeals may be particularly effective when addressing issues with high message fatigue.

As predicted, both fear and hope were positively associated with message shocking value, supporting the notion that messages that evoke discrete emotions are likely to be perceived as shocking [54]. The results highlight the importance of message shocking value as the mediating mechanism, as shocking messages promote support toward the novel health intervention and encourage intentions for discussions. Meanwhile, message shocking value did not have a significant influence on preventive actions against COVID-19, as message shocking value was mostly driven by the description of the novel health intervention in the message, rather than the information about COVID-19 preventive actions that were also presented in the message. Future research should explore ways to translate public interest in novel health interventions into adherence to recommended health behaviors.

Practically, we believe that the use of emotions and different pronouns in message design can be applied to other contexts and is worth investigating further as they can generate unique psycholinguistic features in the messages. Although we did not find an interaction effect between the two message features, we believe that this is one of the crucial areas of message design that can be applicable to various contexts in need of more attention. More importantly, our results regarding the effectiveness of emotional appeals as a remedy for message fatigue demonstrate that well-designed messages can counteract fatigue in topics that typically suffer from audience disengagement, such as COVID-19 or climate change, thereby sustaining attention and support for diverse public health and environmental issues. This potential to alleviate message fatigue represents a central contribution of the present study.

Furthermore, this was one of the first studies to investigate effective message strategies to increase public support and understanding of COVID-19 wastewater monitoring. Analysis of the open-ended responses revealed that support for this intervention is highly affected by the perceived effectiveness and informative value. To garner public support, emphasizing the unique advantages and efficiency of COVID-19 wastewater monitoring compared to other interventions is crucial.

Moreover, concerns about wasting resources and government mistrust drew people away from favoring the policy. While establishing trust in government requires long-term sustained efforts, public health campaigns can effectively focus on alleviating concerns related to resource wastage. Health messages to increase public support toward wastewater monitoring of COVID-19 could, for instance, highlight the cost-effective aspect of this intervention. Considering several participants who were neutral about the intervention due to their desire for more information before forming an opinion, it seems especially pertinent to underscore in the health messages not only the necessity of COVID-19 wastewater monitoring but also its functionality in enhancing public health.

This study is not without limitations. First, this study was cross-sectional in design, which makes it difficult to draw causal inferences. Second, the context of our study can be referred to as being paradoxical, in which the situational setting of message topic was concerned with feelings of fatigue and boredom (i.e., overwhelming messages about COVID-19 prevention) and feelings of novelty (i.e., wastewater monitoring as a novel health intervention) simultaneously. While this setting provided us with an interesting context to test the predictions, we wondered if such context had any influence on the message effects. This remains speculative due to the lack of empirical data in the current study, leaving room for future investigation.

In conclusion, this study investigated the effects of emotional appeals and pronoun use on the communicative, attitudinal, and behavioral consequences of messages regarding wastewater monitoring for COVID-19. The current study sheds light on understanding the influence of message-evoked emotions in the unique context of promoting the public's support and understanding of wastewater monitoring for COVID-19 and the underlying mediating mechanisms that add to its explanatory power. By showing that lower message fatigue was associated with greater policy support, discussion intentions, and preventive behavior intentions, our findings highlight the potential for well-designed emotional appeals to counteract fatigue on high-exposure issues. This capacity to mitigate message fatigue, which is relevant not only to COVID-19 but also to other

sustained public health and environmental challenges such as climate change, represents a meaningful contribution to both theory and practice.



References

1. Deepa N, Parveen A, Khurshid A, Ramachandran M, Sathiyaraj C, Vimala C. A study on issues and preventive measures taken to control COVID-19. In: 2022:020226. doi:10.1063/5.0075078
2. Güner R, Hasanoğlu İ, Aktaş F. COVID-19: Prevention and control measures in community. *Turk J Med Sci*. 2020;50(SI-1):571-577. doi:10.3906/sag-2004-146
3. National Center for Immunization and Respiratory Diseases (U.S.). Division of Viral Diseases. *Science Brief: Indicators for Monitoring COVID-19 Community Levels and Making Public Health Recommendations*.; 2022. Accessed August 13, 2025. <https://stacks.cdc.gov/view/cdc/120247>
4. Haraguchi M, Klaassen F, Cohen T, Salomon JA, Menzies NA. Statistical relationship between wastewater data and case notifications for COVID-19 surveillance in the United States from 2020 to 2023: Bayesian hierarchical modeling approach. *JMIR Public Health Surveill*. 2025;11(1):e68213. doi:10.2196/68213
5. World Health Organization. *Environmental Surveillance for SARS-CoV-2 to Complement Public Health Surveillance: Interim Guidance, 14 April 2022*.; 2022.
6. Holm RH, Brick JM, Amraotkar AR, et al. Public awareness of and support for the use of wastewater for SARS-CoV-2 monitoring: a community survey in Louisville, Kentucky. *ACS EST Water*. 2022;2(11):1891-1898. doi:10.1021/acsestwater.1c00405
7. Centers for Chronic Disease Control and Prevention. Surveillance and data analytics. COVID-19. April 10, 2025. Accessed August 13, 2025. <https://www.cdc.gov/covid/php/surveillance/index.html>
8. Kumar M, Joshi M, Patel AK, Joshi CG. Unravelling the early warning capability of wastewater surveillance for COVID-19: a temporal study on SARS-CoV-2 RNA detection and need for the escalation. *Environ Res*. 2021;196:110946. doi:10.1016/j.envres.2021.110946
9. Liu P, Ibaraki M, VanTassell J, et al. A sensitive, simple, and low-cost method for COVID-19 wastewater surveillance at an institutional level. *Sci Total Environ*. 2022;807:151047. doi:10.1016/j.scitotenv.2021.151047
10. Smith T, Holm RH, Yeager R, et al. Combining community wastewater genomic surveillance with state clinical surveillance: a framework for SARS-CoV-2 public health practice. *Food Environ Virol*. 2022;14(4):410-416. doi:10.1007/s12560-022-09531-2
11. Holm RH, Anderson LB, Ness HD, LaJoie AS, Smith T. Towards the outbreak tail, what is the public opinion about wastewater surveillance in the United States? *J Water Health*. 2024;22(8):1409-1418. doi:10.2166/wh.2024.074
12. LaJoie AS, Holm RH, Anderson LB, Ness HD, Smith T. Nationwide public perceptions regarding the acceptance of using wastewater for community health monitoring in the United States. *PLOS ONE*. 2022;17(10):e0275075. doi:10.1371/journal.pone.0275075
13. Lwin MO, Lu J, Sheldenkar A, et al. Global sentiments surrounding the COVID-19 pandemic on Twitter: analysis of Twitter trends. *JMIR Public Health Surveill*. 2020;6(2):e19447.

doi:10.2196/19447

14. Luo F, Ghanei Gheshlagh R, Dalvand S, Saedmoucheshi S, Li Q. Systematic review and meta-analysis of fear of COVID-19. *Front Psychol.* 2021;12:661078. doi:10.3389/fpsyg.2021.661078
15. Harper CA, Satchell LP, Fido D, Latzman RD. Functional fear predicts public health compliance in the COVID-19 pandemic. *Int J Ment Health Addict.* 2021;19(5):1875-1888. doi:10.1007/s11469-020-00281-5
16. Lazarus RS. *Emotion and Adaptation*. Oxford University Press; 1991. ISBN: 9780197735275
17. Witte K, Allen M. A meta-analysis of fear appeals: implications for effective public health campaigns. *Health Educ Behav.* 2000;27(5):591-615. doi:10.1177/109019810002700506
18. Stolow JA, Moses LM, Lederer AM, Carter R. How fear appeal approaches in COVID-19 health communication may be harming the global community. *Health Educ Behav.* 2020;47(4):531-535.
19. Nabi RL, Myrick JG. Uplifting fear appeals: considering the role of hope in fear-based persuasive messages. *Health Commun.* 2019;34(4):463-474. doi:10.1080/10410236.2017.1422847
20. Chou WYS, Budenz A. Considering emotion in COVID-19 vaccine communication: addressing vaccine hesitancy and fostering vaccine confidence. *Health Commun.* 2020;35(14):1718-1722. doi:10.1080/10410236.2020.1838096
21. Heffner J, Vives ML, FeldmanHall O. Emotional responses to prosocial messages increase willingness to self-isolate during the COVID-19 pandemic. *Pers Individ Dif.* 2021;170:110420. doi:10.1016/j.paid.2020.110420
22. Lazarus RS. Hope: An emotion and a vital coping resource against despair. *Soc Res.* 1999;66(2):653-678.
23. Chadwick AE. Toward a Theory of Persuasive Hope: Effects of Cognitive Appraisals, Hope Appeals, and Hope in the Context of Climate Change. *Health Commun.* 2015;30(6):598-611. doi:10.1080/10410236.2014.916777
24. National Center for Immunization and Respiratory Diseases (U.S.). Division of Viral Diseases. Long COVID or post-COVID conditions. July 20, 2023. Accessed August 13, 2025. <https://stacks.cdc.gov/view/cdc/133106>
25. Varkila MRJ, Montez-Rath ME, Salomon JA, et al. Use of wastewater metrics to track COVID-19 in the US. *JAMA Netw Open.* 2023;6(7):e2325591. doi:10.1001/jamanetworkopen.2023.25591
26. Scharnetzki E, Waterston L, Scherer AM, Thorpe A, Fagerlin A, Han PKJ. Effects of Prosocial and hope-promoting communication strategies on COVID-19 worry and intentions for risk-reducing behaviors and vaccination: experimental study. *JMIR Form Res.* 2023;7(1):e41959. doi:10.2196/41959
27. Jordan J, Yoeli E, Rand DG. Don't get it or don't spread it: comparing self-interested versus prosocial motivations for COVID-19 prevention behaviors. *Sci Rep.* 2021;11(1):20222.

doi:10.1038/s41598-021-97617-5

28. Tian X, Kim Y, Solomon DH. The effects of type of pronouns and hope appeals in supportive messages about COVID-19. *J Lang Soc Psychol.* 2021;40(5-6):589-601. doi:10.1177/0261927X211044721
29. Brewer MB, Gardner W. Who is this “we”? levels of collective identity and self representations. *J Pers Soc Psychol.* 1996;71(1):83-93. doi:10.1037/0022-3514.71.1.83
30. Simmons RA, Gordon PC, Chambless DL. Pronouns in marital interaction: what do “you” and “I” say about marital health? *Psychol Sci.* 2005;16(12):932-936. doi:10.1111/j.1467-9280.2005.01639.x
31. Chung CK, Pennebaker JW. The psychological functions of function words. In: Fiske ST, Gilbert DT, Lindzey G, eds. *Handbook of Social Psychology*. Vol 1. 5th ed. John Wiley & Sons Inc; 2010:522-540.
32. Karan A, Wright RC, Robbins ML. Everyday emotion word and personal pronoun use reflects dyadic adjustment among couples coping with breast cancer. *Pers Relatsh.* 2017;24(1):36-48. doi:10.1111/pere.12165
33. Shen L, Price Dillard J, Tian X, Cruz S, Smith RA. The Role of fatigue in a campus COVID-19 safety behaviors campaign. *Am Behav Sci.* Published online September 29, 2022:000276422211246. doi:10.1177/00027642221124668
34. So J, Kim S, Cohen H. Message fatigue: conceptual definition, operationalization, and correlates. *Commun Monogr.* 2017;84(1):5-29. doi:10.1080/03637751.2016.1250429
35. Cauberghe V, De Pelsmacker P, Janssens W, Dens N. Fear, threat and efficacy in threat appeals: message involvement as a key mediator to message acceptance. *Accid Anal Prev.* 2009;41(2):276-285. doi:10.1016/j.aap.2008.11.006
36. Keller PA, Block LG. Increasing the persuasiveness of fear appeals: the effect of arousal and elaboration. *J Consum Res.* 1995;22(4):448-459. doi:10.1086/209461
37. Okuhara T, Okada H, Kiuchi T. Addressing message fatigue for encouraging COVID-19 vaccination. *J Commun Healthc.* 2023;16(3):298-303. doi:10.1080/17538068.2023.2207246
38. So J. Counterproductive effects of overfamiliar antitobacco messages on smoking cessation intentions via message fatigue and resistance to persuasion. *Psychol Addict Behav.* 2022;36(8):931-941. doi:10.1037/adb0000776
39. Sun J, Lee SK. Flooded with too many messages? predictors and consequences of instant messaging fatigue. *Inf Technol People.* 2022;35(7):2026-2042. doi:10.1108/ITP-03-2021-0239
40. Guan M, Li Y, Scoles JD, Zhu Y. COVID-19 Message fatigue: how does it predict preventive behavioral intentions and what types of information are people tired of hearing about? *Health Commun.* 2023;38(8):1631-1640. doi:10.1080/10410236.2021.2023385
41. Smith RA, Zhu X, Fink EL. Understanding the effects of stigma messages: danger appraisal and message judgments. *Health Commun.* 2019;34(4):424-436.

doi:10.1080/10410236.2017.1405487

42. Ledford V, Lim JR, Namkoong K, Chen J, Qin Y. The influence of stigmatizing messages on danger appraisal: Examining the model of stigma communication for opioid-related stigma, policy support, and related outcomes. *Health Commun.* 2022;37(14):1765-1777. doi:10.1080/10410236.2021.1920710
43. King KW, Reid LN. Fear arousing anti-drinking and driving PSAs: Do physical injury threats influence young adults? *Curr Issues Res Advert.* 1990;12(1-2):155-175. doi:10.1080/01633392.1990.10504950
44. Ruiter RAC, Verplanken B, De Cremer D, Kok G. Danger and fear control in response to fear appeals: the role of need for cognition. *Basic Appl Soc Psychol.* 2004;26(1):13-24. doi:10.1207/s15324834basp2601_2
45. Braun J, Gillespie T. Hosting the public discourse, hosting the public: when online news and social media converge. *Journal Pract.* 2011;5(4):383-398. doi:10.1080/17512786.2011.557560
46. Kim HS. Attracting Views and Going Viral: How message features and news-sharing channels affect health news diffusion: attracting views and going viral. *J Commun.* 2015;65(3):512-534. doi:10.1111/jcom.12160
47. Anderson AB, Basilevsky A, Hum DP. Measurement: theory and techniques. In: *Handbook of Survey Research.* Elsevier; 1983:231-287.
48. Browne MW, Cudeck R. Alternative ways of assessing model fit. *Sociol Methods Res.* 1992;21(2):230-258. doi:10.1177/0049124192021002005
49. Kline RB. *Principles and practice of structural equation modeling.* Guilford publications; 2023. ISBN: 9781462551910
50. Tabachnick BG, Fidell LS. Using Multivariate statistics Needham Heights. MA Allyn Bacon. Published online 2001. ISBN: 9780673994141
51. Black, M. P., Georgiou, P. G., Katsamanis, A., Baucom, B. R., Narayanan, S. "You made me do it": Classification of blame in married couples' interactions by fusing automatically derived speech and language information. 12th Annual Conference of the International Speech Communication Association (INTERSPEECH 2011); 2011 August 27-31; Florence, Italy.
52. Lu H, Yuan S. Exploring the sequencing effects of fear-hope appeals on promoting MMR vaccination. *Health Commun.* 2023;38(10):2132-2140. doi:10.1080/10410236.2022.2054229
53. Adolphs R. The biology of fear. *Curr Biol.* 2013;23(2):R79-R93. doi:10.1016/j.cub.2012.11.055
54. Berger J. Word of mouth and interpersonal communication: a review and directions for future research. *J Consum Psychol.* 2014;24(4):586-607. doi:10.1016/j.jcps.2014.05.002

Preprint
JMIR Publications

Table 1. Respondent demographics

	Frequency (N)	Percent (%)
Gender		
Female	330	54.7
Male	261	43.3
Transgender	5	0.8
Prefer not to answer	7	1.2
Education		
Attended high school	10	1.7
Graduated from high school	209	34.7
Graduated from college with an associate's degree (AA, AS, etc.)	70	11.6
Graduated from college with a bachelor's degree (BA, BS, etc.)	233	38.7
Graduated with a graduate degree (MA, JD, MD, PhD, etc.)	80	13.3
Race		
White	441	73.1
Black or African American	91	15.1
Hispanic, Latino, or Spanish origin	59	9.8
Asian	53	8.8
American Indian or Alaska Native	16	2.7
Native Hawaiian or other Pacific Islander	4	0.7
Some other race, ethnicity, or origin	5	0.8
Income (US\$)		
< \$20,000	91	15.1
\$20,000 – \$34,999	95	15.8
\$35,000 – \$44,999	117	19.5
\$50,000 – \$74,999	122	20.3
\$75,000 - \$ 99,999	74	12.3
≥ \$100,000	101	16.8
Employment		
Employed by a company that you do not own	334	55.4
Self-employed	95	15.8
Full-time student	36	6.0
Unemployed	97	16.1
Retired	41	6.8

Note. Participants were allowed to respond to multiple options for race/ethnicity.

25

COMMUNICATING WASTEWATER MONITORING

Table 2. Correlation matrix for all variables (N = 603)

	1	2	3	4	5	6	7	8	9
1. fear	1								
2. hope	.06	1							
3. msgfatig	-.18**	-.32**	1						
4. msgshock	.53**	.12**	-.12**	1					
5. support	.10*	.35**	-.51**	.13**	1				
6. comm	.26**	.34**	-.42**	.29**	.45**	1			
7. intention	.11**	.21**	-.49**	.10*	.63**	.37**	1		
8. involve	.17**	.24**	-.51**	.14**	.59**	.38**	.67**	1	
9. political	-.04	-.05	.37**	.04	-.37**	-.16**	-.36**	-.30**	1

Note. Msgfatig refers to message fatigue, msgshock refers to message shocking value, support

refers to support for wastewater surveillance, comm refers to interpersonal communication about wastewater surveillance, intention refers to intention to perform COVID-19 preventive behavior, involve refers to involvement with COVID-19, and political refers to political ideology (i.e., higher score refers to stronger conservative political ideology).

* $P < .05$, ** $P < .01$

26

COMMUNICATING WASTEWATER MONITORING

Table 3. Examples, frequency, and intercoder reliability of the reasons for supporting and not supporting COVID-19 wastewater monitoring policy

Coding category	Examples	<i>n</i>	<i>k</i>
<i>Reasons for supporting COVID-19 wastewater monitoring</i>			
Informative value	"I support any means to keep track of the outbreaks."	138	1.00
Effectiveness	"I do support it. It is another tool we can use to stop infections."	157	0.94
Novelty	"I would support it because it's an effective, new technique that can beneficially help communities know about outbreaks quickly."	2	1.00
Non-intrusiveness	"Sure, because it's a non-invasive way to track Covid spread."	37	1.00
Increase awareness	public "I think we should because it's a potential public health hazard regardless."	13	1.00
For population	vulnerable "I would support it because I think it's important to know if there is a spike of COVID in a community, especially for those who are at risk."	1	1.00
Protect community	"I support any effort done to monitor and minimize COVID-19 in the community."	96	0.96
Importance of COVID-19	"Yes I support it. If it helps eradicate covid; I'm all for it."	36	0.96
No downside	"I don't see any reason to not support it."	29	1.00
<i>Reasons for not supporting COVID-19 wastewater monitoring</i>			
Waste of resources	"I wouldn't support it. It's a waste of money and resources."	19	1.00
Government mistrust	"Not a big deal. Gov makes big deal out of nothing to control and gain power."	10	1.00
Not enough information	"I would not support the COVID-19 monitoring in wastewater until I knew it was	5	0.96

27

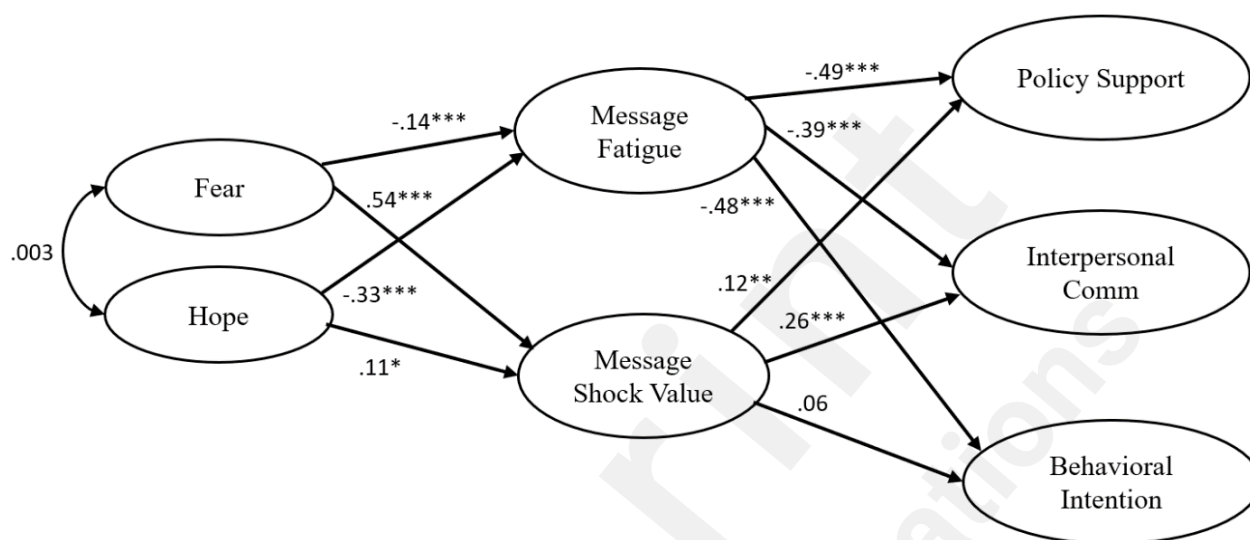
COMMUNICATING WASTEWATER MONITORING

Low perceived threat	real.” “COVID has a low fatality rate and is no longer important.”	12	0.96
Privacy concerns	“I do not support monitoring wastewater because I believe it is an invasion of citizen's privacy.”	5	1.00

28

COMMUNICATING WASTEWATER MONITORING

Figure 1. SEM diagram presenting the effects of discrete emotions on the three outcome variables mediated by message fatigue and perceived message shocking value



Note. The model presents standardized regression weights. Covariate and error terms were included in the analysis and are omitted from the figure for the sake of parsimony.

COMMUNICATING WASTEWATER MONITORING

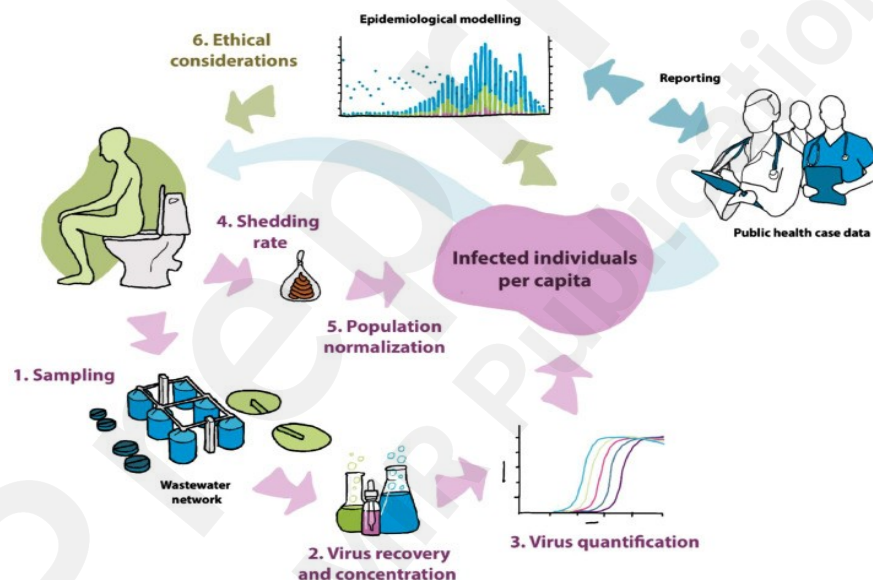
Appendix

Message Stimuli

The following infographic about the background and general description of wastewater monitoring policy was presented to all conditions prior to the main message.

People infected with SARS-CoV-2 can shed the virus in their feces, even if they don't have symptoms. The virus can then be detected in wastewater, enabling wastewater monitoring to capture the presence of SARS-CoV-2 shed by people with and without symptoms. This allows wastewater monitoring to serve as an early warning that COVID-19 is spreading in a community.

A graphic description of the wastewater monitoring process is as follows:



1. Information only condition

Keep up with COVID-19 preventive behaviors!

Higher levels of coronavirus in wastewater can indicate a rise in COVID-19 cases. If the community's monitoring data shows high levels of COVID-19 virus particles, remember to keep up with COVID-19 preventive behaviors.

Preventive measures against COVID-19 include basic health and hygiene behaviors, wearing a mask in indoor spaces, and avoiding crowded locations. It is also important to monitor for symptoms and get tested for COVID-19 if needed.

30

COMMUNICATING WASTEWATER MONITORING

2. Fear × we condition

Do not forget the threats of COVID-19 to us!

Know that we are facing a dire situation. We should be aware that COVID-19 is a highly severe and infectious disease. New variants of SARS-CoV-2, the virus that causes COVID-19, continue to occur, and our chances of developing the severe disease are real.

Higher levels of coronavirus in wastewater can indicate a rise in COVID-19 cases, which may lead to dangerous outcomes. If wastewater monitoring data for our community shows high levels of COVID-19 virus particles, we should be worried and keep up with COVID-19 preventive behaviors.

We still have a good chance of catching and suffering from COVID-19. To avoid a devastating future, we should keep up with basic health and hygiene behaviors, wear a mask in indoor spaces, and avoid crowded locations. We should also monitor ourselves for symptoms and get tested for COVID-19 if needed.

We can reduce fear of the COVID-19 pandemic by playing our parts.

3. Fear × you condition

Do not forget the threats of COVID-19 to you!

Know that you are facing a dire situation. You should be aware that COVID-19 is a highly severe and infectious disease. New variants of SARS-CoV-2, the virus that causes COVID-19, continue to occur, and your chances of developing the severe disease are real.

Higher levels of coronavirus in wastewater may indicate a rise in COVID-19 cases, which can lead to dangerous outcomes. If wastewater monitoring data for your community shows high levels of COVID-19 virus particles, you should be worried and keep up with COVID-19 preventive behaviors.

You still have a good chance of catching and suffering from COVID-19. To avoid a devastating future, you should keep up with basic health and hygiene behaviors, wear a mask in indoor spaces, and avoid crowded locations. You should also monitor yourself for symptoms and get tested for COVID-19 if needed.

You can reduce fear of the COVID-19 pandemic by playing your part.

4. Hope × we condition

Imagine a better future for us!

31

COMMUNICATING WASTEWATER MONITORING

Know that a bright future is coming toward us. We should be aware that there are many things that we can do to stay safe from COVID-19. Even though new variants of SARS-CoV-2, the virus that causes COVID-19, continue to occur, we can protect ourselves to bring about a better future for us.

Higher levels of coronavirus in wastewater may indicate a rise in COVID-19 cases. Even if wastewater monitoring data for our community shows high levels of COVID-19 virus particles, we should hold on to hope and keep up with COVID-19 preventive behaviors.

We can move forward from COVID-19. To achieve a better future, we should keep up with basic health and hygiene behaviors, wear a mask in indoor spaces, and avoid crowded locations. We should also monitor ourselves for symptoms and get tested for COVID-19 if needed.

We can increase hope for ending the COVID-19 pandemic by playing our parts.

5. Hope × you condition

Imagine a better future for yourself!

Know that a bright future is coming toward you. You should be aware that there are many things that you can do to stay safe from COVID-19. Even though new variants of SARS-CoV-2, the virus that causes COVID-19 continue to occur, you can protect yourself to bring about a better future for you.

Higher levels of coronavirus in wastewater may indicate a rise in COVID-19 cases. Even if wastewater monitoring data of your community shows high levels of COVID-19 virus particles, you should hold on to hope and keep up with COVID-19 preventive behaviors.

You can move forward from COVID-19. To achieve a better future, you should keep up with basic health and hygiene behaviors, wear a mask in indoor spaces, and avoid crowded locations. You should also monitor yourself for symptoms and get tested for COVID-19 if needed.

You can increase hope for ending the COVID-19 pandemic by playing your part.