

How do information overload and message fatigue reduce information processing in the era of COVID-19? An ability–motivation approach

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Abstract

The global outbreak of COVID-19 in 2020 has led to the dominance of COVID-19 prevention information on all media channels. Drawing on the ability–motivation model of information processing, this study examined how such an information overabundance hampered individuals' ability and motivation to process in the era of COVID-19. With a survey conducted from 493 participants, we found that less message elaboration of COVID-19 prevention information was predicted by greater message fatigue, a state of low motivation due to information overabundance. In addition, greater message fatigue was accompanied by greater information overload, a state of low ability due to information overabundance. Moreover, certain motivation-related (i.e. health status, trait reactance and frequency of information seeking) and ability–related factors (i.e. health literacy, health status, trait anxiety and information quality) were found to be associated with message fatigue and information overload, respectively. The theoretical and practical implications are discussed.

Keywords

Ability–motivation model of information processing; COVID-19; information overabundance; information overload; message fatigue

Starting from the end of 2019, COVID-19 has infected 510 million people, caused more than 6.22 million deaths and affected dozens of economies, as of 25 April 2022 [1]. Because of its significant impacts on individual lives, COVID-19 has resulted in public and media attention. A large amount of relevant information is disseminated through various media channels. On the one hand, providing COVID-19 health information is critical in helping people understand the disease and make informed decisions on how to protect their health [2,3]. On the other hand, there is evidence showing that the overabundance of information would lead to a reduction in message elaboration, which is featured with 'careful and thoughtful consideration of the true merits of the information presented in support of an advocacy' [4–6]. Less elaboration has been found to be linked to an increased likelihood of sharing fake news, ineffective learning of new knowledge and decreased adherence to preventive rules and guidance [4,5].

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According to research on information processing, message elaboration requires a large amount of cognitive effort, the extent of which is primarily determined by the ability or motivation to process [7]. A lower level of ability or motivation to process is associated with less message elaboration [4]. In light of this perspective, our study focuses on the factors that would hamper individuals' ability and motivation to process COVID-19-related information. Our study seeks to extend previous studies in three ways. First, we offer a theoretical explanation for how message elaboration is impacted by the information overabundance. Specifically, we propose that information overabundance can result in information overload, which is linked to a reduction in the ability to process information [8]. Meanwhile, repetition of similar information can cause message fatigue, which is linked to decreased motivation to process [9]. Both information overload and message fatigue further reduce message elaboration [6,10].

Second, we investigate who is less capable and less motivated to process when a large amount of information about COVID-19 is repeatedly offered. We also seek to understand what types of messages tend to decrease information-processing ability and motivation. Although the amount of health information is the predominant predictor, certain personal and message characteristics associated with cognitive capacities determine the extent to which a person suffers from information overload [11,12]. Some individual and message characteristics associated with the motivational state of information processing would also inform one's experience of message fatigue [10]. As such, the present study examines the impacts of these individual and message factors in the context of processing COVID-19 prevention information.

Finally, we aim to advance the current literature on information overabundance by modelling the interaction between information overload and message fatigue. Extant research shows that both information overload and message fatigue may explain why information overabundance decreased information processing, whereas information overload and message fatigue operate in different ways. Considering that some studies discovered connections between information overload and message fatigue [13,14], we employ the ability–motivation model of information processing, in attempts to examine how information overload and message fatigue would interact to influence information processing.

1. Information overabundance and the ability–motivation model of information processing

The model we proposed in this article draws from persuasion research, which describes the shape and change of attitudes through information processing [4,15,16]. Specifically, it is believed that the amount of cognitive effort assigned to information processing determines attitude changes [4,15]. The greater the cognitive effort, the greater the message elaboration, which involves careful and thoughtful consideration of the information. Conversely, little cognitive effort leads to greater reliance on simple cues available in persuasion settings and inattention to the messages. Whereas there exist debates about how the effortful and less effortful processing impact persuasive outcomes, respectively, a core assumption shared by researchers is that although both processing routes can jointly influence persuasion, the effortful processing predicts higher effectiveness [4,7,15–17]. Consistently, empirical evidence shows that more message elaboration is related to longer memory of information [18,19], a more comprehensive understanding of health risks [20–22], greater attitude certainty [18,19,23,24] and more informed health decision-making [20,22].

Given the relationship between cognitive effort and message elaboration, the impact of information overabundance on message elaboration can be explained by its impact on cognitive effort assigned to information processing. In specific, processing effort is determined by individuals' cognitive capacity and motivation to process [4,7]. Information overabundance, on the contrary, impedes ability and motivation. Regarding the ability, a large body of literature indicates that humans have limited cognitive capacity processors and may struggle with processing large amounts of information [25–31]. When the amount of information is beyond their information-processing capacity, people will feel overloaded, which is featured with a state of being overwhelmed and confused to process the information properly and effectively [8,32,33].

Information overload has been found in many health contexts. Cancer patients, for example, are frequently overloaded by the abundance, uncertainty and complexity of cancer information [12,34,35]. In the same vein, as we learn more about the novel coronavirus and its consequences, the information on how to protect ourselves from COVID-19 is not only increasing but also changing constantly [36]. As a result, greater cognitive efforts are required to keep up with the constant information influx on COVID-19, putting people at risk of information overload [37–39]. In response, people tend to seek simple but mostly unhelpful information, rely their decisions on simple cues, neglect details, and in some cases, avoid information processing totally [6,37,40,41]. In light of this evidence, we pose the following hypothesis:

Hypothesis 1 (H1): Information overload is negatively related to message elaboration of COVID-19 prevention information.

Aside from ability, a growing body of literature warns that large amounts of information can lead to message fatigue and a decreased motivation to allocate processing efforts [9,10,42,43]. Message fatigue is a result of excessive exposure to messages pertaining to a common persuasive target [10]. Cognitively, message fatigue is described as (1) perceived over-exposure, which refers to the frequency of exposure to a particular class of messages has exceeded the desired level, and (2) perceived redundancy, which refers to the perception that incoming messages are repetitive and overlapping [10]. At the experiential level, message fatigue is associated with (1) emotional exhaustion, a feeling of exhaustion and burn-out, and (2) emotional tedium, a feeling of boredom [10]. As a factor that closely relates to one's motivational state, message fatigue energises disengagement with information processing in a variety of health contexts (e.g. unprotected sex, obesity and smoking) [9,10,44]. In the case of COVID-19 prevention information, scholars have forewarned the potential of message fatigue after hearing constant and repetitive reminders of the importance of social distancing practices, sanitisation, masks and quarantines [45]. Naturally, a person would avoid elaboration of any message related to COVID-19 if they have been wearying of hearing these messages [46].

Hypothesis 2 (H2): Message fatigue is negatively related to message elaboration of COVID-19 prevention information.

1.1. Individual and message differences in ability and motivation to process

While information overabundance, in general, leads to a decrease in processing ability (due to information overload) and motivation (due to message fatigue), not everyone will experience the same extent of information overload and message fatigue. In other words, when surrounded by a wealth of health information, some people tend to go through higher levels of information overload and message fatigue due to individual characteristics and types of messages they received. Thus, the second goal of our study is to examine the impacts of these individual and message factors.

Since the nature of information overload is explained by people's limited cognitive capacities, literature has supported the negative relationship between individual cognitive ability and information overload. In specific, people who have health literacy [47,48] and are with high trait anxiety [11] are considered as the population with a lower level of cognitive ability. Consequently, they are more likely to suffer from information overload [6,11]. Moreover, certain message characteristics would promote or hinder individuals' information-processing abilities. To elaborate, high-quality information increases the efficiency with which information is used to meet people's needs and goals. On the contrary, when low-quality information is received, extra cognitive resources are required to discern the correct information from a plethora of irrelevant and useless information [49]. People could feel overloaded as a result of such a tedious process [49].

Hypothesis 3 (H3): Trait anxiety is positively related to information overload about COVID-19 prevention information.

Hypothesis 4 (H4): Health literacy (a) and information quality (b) are negatively related to information overload about COVID-19 prevention information.

Message fatigue represents a low motivational state of information processing. Individual differences in motivation to know more are expected to relate to it. For instance, the use of active media channels (i.e. printed media and the Internet) and frequent information seeking already reflect the audience's greater health orientation, which refers to the extent to which individuals are motivated towards health issues [12,50]. On the contrary, the use of passive media channels and infrequent information seeking indicates that the audience is less health-oriented because they are exposed to health information passively [12,50]. Thus, we can anticipate that COVID-19 information use from active media channels and frequent information seeking will be inversely associated with message fatigue.

Hypothesis 5 (H5): The uses of active media (a) and the frequency of COVID-19 information seeking (b) are negatively associated with message fatigue about COVID-19 prevention information.

Furthermore, based on the relationship between individual motivation and message fatigue, we also pose research questions about the role of health status and trait reactance in message fatigue. In terms of health status, some studies find that poor health is positively correlated with motivation to obtain health knowledge because people who believe they are in poor health (e.g. cancer patients) want to learn more about how to protect themselves from health risks. In view of this, high-risk COVID-19 populations [51,52] are less susceptible to message fatigue. Other studies have found

that because they are the primary target of health-promoting messages, people of poor health status tend to receive much more health information than those in good health [9,44]. As a result, even though they are motivated to protect themselves, the amount of incoming information could have exceeded the desired frequency [10]. If this is the case, it is also possible that high-risk populations of COVID-19 will report greater message fatigue.

Research Question 1a (RQ1a): How is health status associated with message fatigue about COVID-19 prevention information?

In terms of trait reactance, previous research has found that message fatigue caused psychological reactance [53]. However, it is still unclear if message fatigue increases when an individual is internally more probably to experience psychological reactance. After all, high trait-reactant individuals have a strong desire for independence and autonomy, thereby being less motivated to process persuasive messages, including COVID-19 prevention information, than their low trait-reactant counterparts [54–57]. Therefore, message fatigue may occur when high trait-reactant individuals are constantly and repetitively exposed to messages they have been avoiding.

Research Question 2 (RQ2): How is trait reactance associated with message fatigue about COVID-19 prevention information?

Finally, we anticipate that certain message characteristics can reduce message fatigue by raising people's motivation to process information. For example, previous studies have investigated how the valence of message frames could influence message fatigue [10,44]. Health promotion messages are presented in either a positive or a negative frame, with the former emphasising the benefits of compliance and the latter emphasising the costs of non-compliance [58]. There has yet to reach a consensus on the effectiveness of negatively framed and positively framed health promotion messages [59]. However, evidence shows that negative frames could elicit a desire for knowledge on how to prevent negative health effects [60,61]. In other words, when people receive negatively framed health messages, they are more motivated to elaborate, which reduces the likelihood of message fatigue. In light of this evidence, we propose the following hypothesis:

Hypothesis 6 (H6): COVID-19 messages that are framed negatively are associated with less message fatigue than COVID-19 messages that are framed positively.

1.2. The relationship between information-processing ability and motivation

In the last two sections, we have proposed an ability–motivation model of information processing when information is overabundant. Another major issue of this model is how the ability path and the motivation path interact. To address this research question, first, we examine the relationship between information overload, which represents a lack of processing ability, and message fatigue, which represents a lack of processing motivation. Second, we focus on whether and how the individual and message factors related to cognitive capacities may influence message fatigue. Similarly, we also investigate whether and how the individual and message factors related to motivation may influence information overload.

Only a few studies have examined how feelings of overload impacted feelings of fatigue in the use of social media. For example, Lee et al. [13] and Hwang et al. [14] found that an overload of SNS messages would cause a loss of attention, which was accompanied by feelings of fatigue after a session of SNS uses. Fu and Li [62] and Whelan et al. [63] found that overloads of both information overflow on social media platforms and the platforms' communication demands made social media usage an exhausting task, leading to strong feelings of social media fatigue. To date, few studies have empirically investigated the impacts of information overload on message fatigue in general. In addition, it is still unknown whether feelings of fatigue would amplify the feelings of overload.

Research Question 3 (RQ3): What is the relationship between information overload and message fatigue about COVID-19 prevention information?

Regarding the roles of individual and message factors, the literature suggests that processing motivation may influence information overload. Chae et al. [11] argue that greater motivation to know more predicts greater efforts in message elaboration. Greater message elaboration then facilitates effective learning, thereby attenuating the feelings of overload [64,65]. In this vein, both poor health status (e.g. family cancer history) and health information use from active media channels indicate high motivation to know more and thus would be negatively associated with more information overload

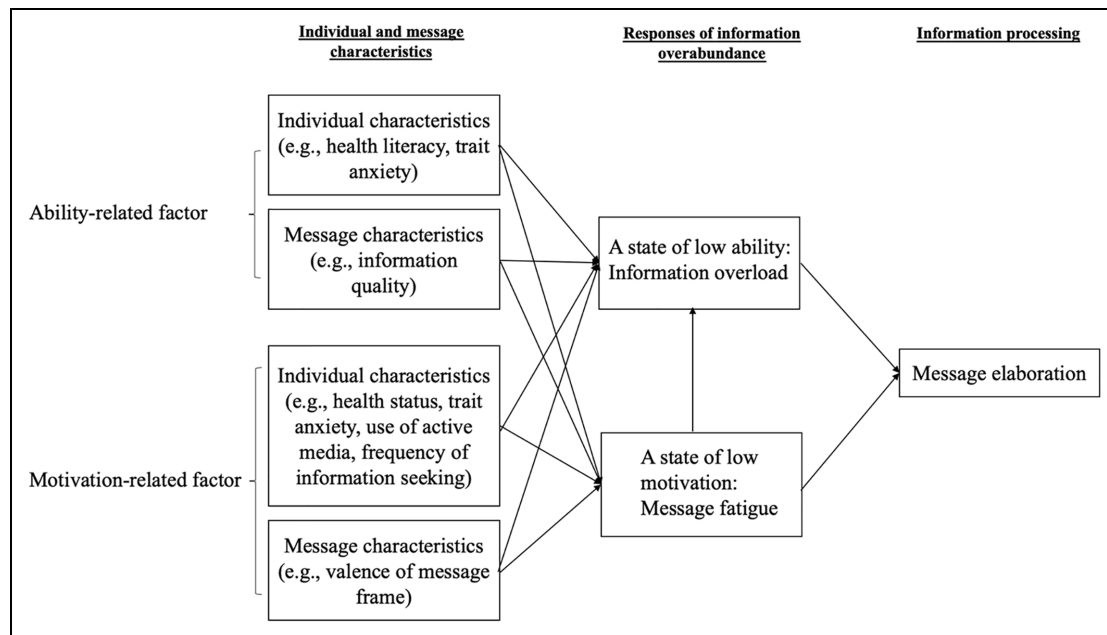


Figure 1. Conceptual model.

[11]. The relationship between individual/message differences in ability and message fatigue is less clear. So et al. [10] suggest that people will be tired of excessive exposure to health messages, regardless of their ability to obtain, process, understand and communicate health information. In line with this viewpoint, health literacy was found to be unrelated to message fatigue [10]. However, there is evidence that other ability-related factors, such as education levels, predict message fatigue. Taken together, we pose the following hypotheses and research questions:

Hypothesis 7 (H7): Populations with poor health status experience lower levels of information overload about COVID-19 prevention information than those with excellent health status.

Hypothesis 8a (H8a): Trait reactance is positively associated with information overload about COVID-19 prevention information.

Hypothesis 8b–8c (H8b–8c): The use of active media (a), the frequency of COVID-19 information seeking (b) and message frame (c) are negatively associated with information overload about COVID-19 prevention information.

Research Question 4 (RQ4): How are trait (a) anxiety, (b) health literacy and (c) information quality associated with message fatigue about COVID-19 prevention information.

Based on the hypotheses and research questions, a conceptual model of this study is visually displayed in Figure 1.

2. Method

2.1. Participants

We recruited participants from Amazon Mechanical Turk (MTurk). The final sample consisted of 493 participants ranging from 18 to 75 years old ($M = 35.77$ and $SD = 12.17$). The majority of participants (40.8%) were females ($n = 201$), and 61.1% of them were identified as White ($n = 301$). The majority of participants (74.8%) obtained at least an undergraduate degree, and 32.9% had a household income equal to or more than US\$70,000. Each participant was paid US\$0.30 for completing our questionnaire.

2.2. Procedure and measures

Before the questions, participants were given the consent form. After they gave their consent to participate in the study, they were directed to the online questionnaire. They first answered demographic questions about their age, gender, race,

education level and income. Second, they were asked to report their health status. Participants with certain medical conditions [66] were coded as people with poor health status.

Third, health literacy was assessed on a seven-item scale [67] (e.g. ‘how easy would you say it is to find information on treatments of illnesses that concern you’; $\alpha = 0.90$, $M = 3.83$ and $SD = 0.61$). Fourth, participants were also asked about their trait anxiety level [11] (e.g. ‘how often you have been bothered by little interest or pleasure in doing things’; four items; $\alpha = 0.89$, $M = 2.50$ and $SD = 1.07$) and their trait reactance level [56] (e.g. ‘I became frustrated when I am unable to make free and independent decisions’; eleven items; $\alpha = 0.90$, $M = 3.03$ and $SD = 0.89$).

Then, regarding the use of media channels, participants reported the frequency of their health information use from nine sources: newspapers, magazines or newsletters (printed media; $M = 2.68$ and $SD = 1.32$); television news, television health programmes (television media; $M = 3.10$ and $SD = 1.31$); online newspapers, professional health-related websites, social networking sites or online communities (the Internet; $M = 3.32$ and $SD = 1.18$); and family and friends, and healthcare professionals (interpersonal communication; $M = 3.20$ and $SD = 1.22$). They were also asked to indicate the valence of the health information they received [68] (costs of not conducting COVID-19 prevention strategies – benefits of conducting COVID-19 prevention strategies; $M = 3.93$ and $SD = 1.13$), the quality of the information (e.g. ‘The COVID-19 prevention messages I received were credible’; five items, $\alpha = 0.89$, $M = 4.00$ and $SD = 0.78$) and the frequency of their COVID-19 information seeking [12] ($M = 2.66$ and $SD = 1.14$).

Furthermore, information overload was measured using 13 items adapted from Jensen et al. [69]. The scale has been used in several studies, specifically to assess information overload in the health field [70,71]. Sample items included ‘It seems like there are new COVID-19 preventive recommendations every day’. The reliability measured by Cronbach’s alpha was 0.94 ($M = 2.94$ and $SD = 0.96$).

We measured message fatigue with a 17-item scale adapted from So et al. [10]. The scale measures message fatigue, which includes perceived over-exposure, perceived redundancy, perceived exhaustion and perceived tedium. The measurement has been used in different health contexts, including safe sex, anti-obesity [10] and COVID-19 prevention information [72]. Sample items include ‘There are simply too many health messages about COVID-19 preventive measures nowadays’. For the current sample, the reliability measured by Cronbach’s alpha was 0.95 ($M = 3.31$ and $SD = 0.96$).

We measured message elaboration [73] on a three-item scale. Sample item includes ‘I try to think thoroughly to better understand the information about COVID-19 preventive measures’ ($\alpha = 0.74$). All aforementioned measures were assessed on a 1–5 Likert-type scale.

3. Results

The data were analysed using the Statistical Package for Social Sciences (SPSS 26.0) [74] for descriptive analysis and the *Mplus* (version 7.4) [75] for structural equation modelling (SEM) [76]. We presented the correlations between all the variables in Table 1.

Prior to the path analysis, we conducted a confirmatory factor analysis (CFA) on all latent variables to verify the measurement model. According to Hu and Bentler’s [77] two-index presentation strategy recommendations, a good-fit model should satisfy one of the following combinations: (1) comparative fit index (CFI)/Tucker–Lewis index (TLI) ≥ 0.95 , standardised root mean square residual (SRMR) ≤ 0.09 , or (2) root mean square error of approximation (RMSEA) ≤ 0.06 , SRMR ≤ 0.09 . Our measurement model achieved an acceptable fit ($\chi^2(2459) = 5897.34$, $p < 0.05$, RMSEA = 0.05 (90% CI = (0.05, 0.06)), CFI = 0.85, TLI = 0.84, SRMR = 0.08).

To test the research questions and hypotheses, we specified our model with 14 exogenous variables. Because two of these exogenous variables (i.e. race and health status) are dichotomous variables, they were contrast coded (white = 1 and non-white = -1; low in health risk = 1 and high in health risk = -1). The initial process model demonstrated poor fit: $\chi^2(11) = 242.2$, $p < 0.001$, RMSEA = 0.21 (90% CI = (0.19, 0.23)), CFI = 0.79, TLI = 0.33, SRMR = 0.13.

The modification indices suggested allowing information quality and health literacy to predict message elaboration. With these modifications, the model fit improved substantially ($\chi^2(9) = 24.13$, $p = 0.04$, RMSEA = 0.06 (90% CI = (0.03, 0.09)), CFI = 0.99, TLI = 0.95, SRMR = 0.03). The final model is presented in Figure 2, and the coefficient of every path was summarised in Table 2.

The H1–H2 predicted the impacts of information overload and message fatigue on message elaboration of COVID-19 prevention information. As shown in Table 1, we found that message fatigue was negatively associated with message elaboration ($b = -0.22$, $SE = 0.05$, $t = -4.32$, $p < 0.001$, 95% CI (-0.45, -0.29)). H2 was supported. On the contrary, information overload was positively associated with message elaboration ($b = 0.20$, $SE = 0.05$, $t = 4.01$, $p < 0.001$, 95% CI (0.10, 0.29)). H1 was not supported.

H3–H4 focused on the impacts of ability-related factors on information overload. A significant and positive relationship between trait anxiety and information overload was found ($b = 0.08$, $SE = 0.04$, $t = 2.20$, $p = 0.03$, 95% CI (0.01,

Table 1. Correlation matrix.

	M	SD	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Information overload	2.94	0.61	1.00												
2. Message fatigue	3.31	1.07	0.77**	1.00											
3. Message elaboration	3.85	0.80	-0.20**	-0.30**	1.00										
4. Health literacy	3.83	0.61	-0.21**	-0.11*	0.36*	1.00									
5. Trait anxiety	2.50	1.07	0.49**	0.38**	0.01	-0.14**	1.00								
6. Information quality	4.00	0.78	-0.38**	-0.40**	0.60**	0.34**	-0.08	1.00							
7. Trait reactance	3.03	0.89	0.63**	0.54**	-0.06	-0.08	0.60**	-0.15**	1.00						
8. Valence of message frame	-0.26	20.35	0.02	0.01	0.03	-0.06	0.08	-0.03	0.10**	1.00					
9. Use of print media	2.68	1.32	0.37**	0.18**	0.20**	0.07	0.42**	0.10*	0.35**	0.05	1.00				
10. Use of television media	3.10	1.31	0.14**	0.02	0.28**	0.17**	0.22**	0.27**	0.18**	0.02	0.47**	1.00			
11. Use of the Internet	3.32	1.18	0.04	-0.02	0.25**	0.14**	0.19**	0.25**	0.04	0.02	0.31**	0.41**	1.00		
12. Interpersonal communication	3.2	1.22	0.13**	0.06	0.25**	0.25**	0.28**	0.21**	0.21**	0.02	0.41**	0.44**	0.40**	1.00	
13. Frequency of information seeking	2.66	1.14	0.12**	-0.10*	0.33**	0.10	0.22**	0.25**	0.14**	0.05	0.45**	0.44**	0.33*	0.31**	1.00

**Correlation is significant at the 0.01 level (two-tailed).

*Correlation is significant at the 0.05 level (two-tailed).

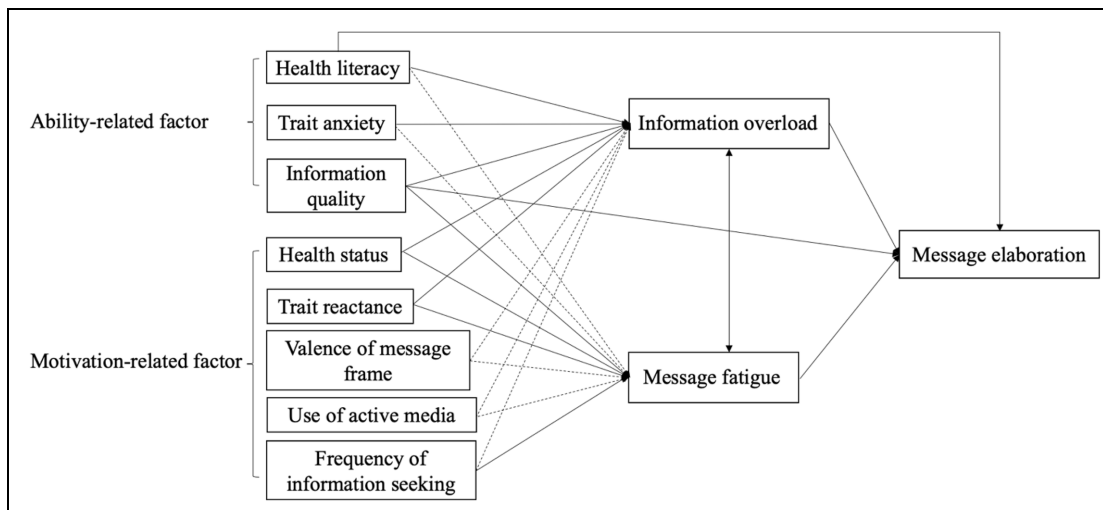


Figure 2. Final model. Dashed lines are insignificant paths.

Table 2. Coefficient of every path in the final model.

Paths	Standard beta	SE	t value	95% CI
Information overload				
Health literacy	-0.15	0.06	-2.68	[-0.26, -0.04]
Trait anxiety	0.08	0.04	2.20	[0.01, 0.16]
Information quality	-0.37	0.04	-8.60	[-0.45, -0.28]
Health status	-0.10	0.03	-3.03	[-0.16, -0.03]
Trait reactance	0.47	0.04	11.06	[0.39, 0.55]
Valence of message frame	0.03	0.03	1.09	[-0.02, 0.08]
Use of print media	0.06	0.03	1.92	[-0.001, 0.11]
Use of television media	0.04	0.03	1.21	[-0.02, 0.09]
Use of the Internet	0.03	0.03	1.00	[-0.03, 0.08]
Interpersonal communication	-0.01	0.03	-0.09	[-0.06, 0.06]
Frequency of information seeking	0.03	0.03	1.00	[-0.03, 0.09]
Message fatigue				
Health status	-0.10	0.03	-2.91	[-0.17, -0.03]
Trait reactance	0.44	0.05	9.83	[0.36, 0.53]
Valence of message frame	0.05	0.03	1.69	[-0.01, 0.10]
Use of print media	0.04	0.03	1.40	[-0.02, 0.10]
Use of television media	0.02	0.03	0.73	[-0.04, 0.08]
Use of the Internet	0.04	0.03	1.18	[-0.03, 0.10]
Interpersonal communication	-0.02	0.03	-0.65	[-0.08, 0.04]
Frequency of information seeking	-0.12	0.03	-3.74	[-0.19, -0.06]
Health literacy	0.02	0.06	0.36	[-0.10, 0.14]
Trait anxiety	0.05	0.04	1.21	[-0.03, 0.13]
Information quality	-0.39	0.05	-8.47	[-0.48, -0.30]
Message elaboration				
Information overload	0.20	0.05	4.01	[0.10, 0.29]
Message fatigue	-0.22	0.05	-4.32	[-0.31, -0.12]
Information quality	0.54	0.04	13.23	[0.46, 0.62]
Health literacy	0.30	0.05	5.79	[0.20, 0.40]
Information overload <-> Message fatigue	0.27	0.02	11.54	[0.23, 0.32]

Bold lines are significant paths.

0.16)). In addition, we found that health literacy ($b = -0.15$, $SE = 0.06$, $t = -2.68$, $p = 0.01$, 95% CI $(-0.26, -0.04)$) and information quality ($b = -0.37$, $SE = 0.04$, $t = -8.60$, $p < 0.001$, 95% CI $(-0.45, -0.28)$) were negatively associated with information overload. H3b and H4b–H4c were supported.

H5–H6 and RQ1–RQ2 focused on the impacts of motivation-related factors on message fatigue. First, we found that message fatigue was significantly influenced by individuals' health status ($b = -0.10$, $SE = 0.03$, $t = -2.91$, $p = 0.004$, 95% CI $(-0.17, -0.03)$). The populations of poor health status ($M = 3.68$ and $SD = 0.76$) experienced higher levels of message fatigue than healthy populations ($M = 3.16$ and $SD = 0.95$). Second, we found a significant relationship between trait reactance and message fatigue. People of higher trait reactance were more probably to experience message fatigue than those of low trait reactance ($b = 0.44$, $SE = 0.05$, $t = 9.83$, $p < 0.001$, 95% CI $(0.36, 0.53)$). Furthermore, in line with H5b, a negative relationship between the frequency of information seeking and message fatigue was found ($b = -0.12$, $SE = 0.03$, $t = -3.73$, $p < 0.001$, 95% CI $(-0.19, -0.06)$). No evidence showed that the use of active media channels and negative message frames were significantly related to message fatigue. H5a and H6 were not supported.

RQ3 asked about the interaction between information overload and message fatigue about COVID-19 prevention information. The result showed that information overload and message fatigue were positively interrelated ($b = 0.27$, $SE = 0.02$, $t = 11.54$, $p < 0.001$, 95% CI $(0.23, 0.32)$). H7–H8 and RQ4 focused on the impacts of ability-related factors on message fatigue and of motivation-related factors on information overload. Information quality, as an ability-related factor, was found to be negatively related to message fatigue ($b = -0.39$, $SE = 0.05$, $t = -8.47$, $p < 0.001$, 95% CI $(-0.48, -0.30)$). In the meanwhile, as motivation-related factors, trait reactance and health status are significantly related to information overload. Supporting H8a, trait reactance is positively related to information overload ($b = 0.47$, $SE = 0.04$, $t = 11.06$, $p < 0.001$, 95% CI $(0.39, 0.55)$). However, contradictory to H7b, populations of poor health status ($M = 3.34$ and $SD = 0.83$) experienced higher levels of information overload than populations of excellent health status ($M = 2.75$, $SD = 0.93$; $b = -0.10$, $SE = 0.03$, $t = -3.03$, $p = 0.002$, 95% CI $(-0.16, -0.03)$). We did not find that other ability-related factors, including trait anxiety (RQ4a) and health literacy (RQ4b) related to message fatigue. We also did not find the significant influences of other motivation-related factors, including the use of active media channels (H8b), the frequency of COVID-19 information seeking (H8c) and the message frame (H8d) on information overload.

4. Discussion

Drawing on the ability–motivation model of information processing, we investigated how information overabundance hampered individuals' ability and motivation to process COVID-19 prevention information. As predicted, less message elaboration of COVID-19 prevention information was associated with greater message fatigue, a state of low motivation due to information overabundance. On the contrary, more message elaboration was associated with greater information overload, a state of low ability due to information overabundance, inconsistent with our proposal. In addition, the results supported our predictions that the state of ability and the state of motivation were interrelated when processing overabundant information.

Theoretically, our results add to the body of research on how people process information when there is so much of it. Previous research has established a variety of internal and external factors that may play a role in processing overabundant information [10–12,44]. We theorised the relationship between those factors and information processing in this study, focusing on motivation and ability. Specifically, we found that an increase in message fatigue about COVID-19 prevention information was associated with a decreased likelihood of message elaboration. In summary, these findings support our proposal that the reduced message elaboration would be linked to a lack of motivation to process due to an overabundance of COVID-19 prevention information.

Regarding the ability path, in line with previous studies, as a state of low ability to process, greater information overload about COVID-19 prevention information was associated with low individual cognitive capacities (e.g. trait anxiety and low health literacy) and message factors that would increase processing difficulties (e.g. low information quality) [11,12]. However, contrary to our prediction, greater information overload led to more message elaboration. Despite the fact that information overload represents a low processing ability, only a few studies have empirically examined and reported inconsistent relationships between information overload and actual message elaboration [6]. Our finding is consistent with Cheng et al.'s [78], which found a positive relationship between information overload and message elaboration. This finding also paved the way for future research to consider the interaction between the motivation path and the ability path. Information overload leads to confusion and anxiety among health consumers [48]. As a result, rather than assuming its direct and negative impact on message elaboration due to a state of low ability [6,12,69,79], it is possible that for those highly motivated, even though they are overloaded and feel difficult to process a large amount of information, the feelings of confusion and anxiety make them elaborate more for further clarification and better comprehension

[64,65,78]. On the contrary, when one's motivational state is unconstrained, information overload may function indirectly by reducing motivation to process.

Consistently, we found the interrelationship between information overload and message fatigue. Greater information overload was accompanied by greater message fatigue. Furthermore, it was found that individual differences in motivation (i.e. trait reactance) play a significant role in the occurrence of information overload, a state of low processing ability. In a similar vein, message factors that influence cognitive capabilities (i.e. information quality) were related to the likelihood of message fatigue, a state of low motivation to process. Along with these findings, we can conclude that decreased message elaboration on COVID-19 prevention information is the product of an interplay between low ability and low motivation to process due to information overabundance.

Not surprisingly, there are also other findings that were inconsistent with our predictions. First, because poor health status is an indicator of low motivation, as a factor that often suggests high motivation to know more, poor health status was found to be positively associated with message fatigue and information overload. This finding supports So and Popova [9] and So and Alam's [44] claim that in the case of information overabundance. In addition, some scholars point out that poor health status may also relate to a low ability to process, given that people with a poor health status have a higher level of risk perception, which is positively related to worry and anxiety [11,12,80–82]. As a result, as an indicator of low motivation and low ability, it is possible that poor health status has led to greater message fatigue and more information overload about COVID-19 prevention information, as shown in our study.

Second, we did not find associations between the valence of message frames and the use of active channels with message fatigue and information overload. These null findings highlighted the distinct nature of COVID-19, a global pandemic, in comparison with other public health issues. For example, in light of other health topics, the audience is disposed towards an active information-seeking orientation when using active media channels [12,50]. However, the unprecedented media and public attention on COVID-19 has led to continuous updates and intensive repetitions of related information on every media channel [45]. People may passively receive it even though they are using active media for other purposes. Consequently, the use of active media channels may no longer represent greater motivation for COVID-19 prevention information. Finally, in line with previous studies [44,53], the negative message frames did not increase people's motivation to process, which in turn did not attenuate message fatigue. Future studies should explore other message characteristics that have the potential to facilitate information-processing motivation when people are suffering from excessive exposure [10].

Practically, the findings of our study call for constant attention and efforts to understand the potential negative impacts of information overabundance. Especially in the response to a global pandemic, a tremendous amount of messages were sent out to persuade people to adopt prevention measures such as social distancing, sanitisation, wearing masks and quarantines. As shown in our study, receiving such a large amount of information in a short time would make people feel overloaded and fatigued, which consequently dampened their abilities and motivations for message elaboration. Moreover, given that both information overload and message fatigue are related to certain individual and message characteristics, our study provides tactics that can be used to attenuate the negative effects of information overabundance. For example, tailored and interactive tools, such as AI-chatbots, can be used to offer personalised information and address individual concerns about COVID-19 [83,84]. In addition, the quality of information needs to be improved to promote people's ability and motivation to process large amounts of information [38].

5. Limitations and future research

Several limitations associated with our study need to be addressed. First, our sample is relatively skewed in terms of education, with 74.8% of participants having at least an undergraduate degree. In the future, researchers should use quota sampling as the sampling method to make the sample represent the target population. Second, although the cross-sectional nature of our study reflected participants' real-life experiences of COVID-19, it was impossible to infer causality from the current data. Future research should empirically manipulate the message factors (e.g. information quality and valence of message frame) and excessive exposures to a group of messages (i.e. information overload and message fatigue) to test their influences through the ability and the motivation paths. Moreover, our study focused on the decreased information processing about an epidemic: COVID-19. More work on other public health topics is needed to the generalisability of the ability–motivation model.

Author's Note

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References

- [1] World Health Organization. WHO coronavirus (COVID-19) dashboard, <https://covid19.who.int/> (2021, accessed 10 May 2021).
- [2] Heffner J, Vives ML and FeldmanHall O. Emotional responses to prosocial messages increase willingness to self-isolate during the COVID-19 pandemic. *Pers Individ Dif* 2021; 170: 110420.
- [3] Su Z, Wen J, McDonnell D et al. Vaccines are not yet a silver bullet: the imperative of continued communication about the importance of COVID-19 safety measures. *Brain Behav Immun Health* 2021; 12: 100204.
- [4] Petty RE and Cacioppo JT. The elaboration likelihood model of persuasion. In: Berkowitz L (ed.) *Advances in experimental social psychology*. New York: Academic Press, 1986, pp. 123–205.
- [5] Bernes A. Information overload and fake news sharing: a transactional stress perspective exploring the mitigating role of consumers' resilience during COVID-19. *J Retail Consum Serv* 2021; 61: 102555.
- [6] Hong H and Kim HJ. Antecedents and consequences of information overload in the COVID-19 pandemic. *Int J Environ Res Public Health* 2020; 17: 9305.
- [7] Petty RE, Barden J and Wheeler SC. The elaboration likelihood model of persuasion: developing health promotions for sustained behavioral change. In: Diclemente RJ, Crosby RA and Kegler MC (eds) *Emerging theories in health promotion practice and research*. San Francisco, CA: Jossey-Bass, 2009, pp. 185–214.
- [8] Eppler MJ and Mengis J. The concept of information overload: a review of literature from organization science, accounting, marketing, MIS, and related disciplines. *Inform Soc* 2004; 20: 325–344.
- [9] So J and Popova L. A profile of individuals with anti-tobacco message fatigue. *Am J Health Behav* 2018; 42: 109–118.
- [10] So J, Kim S and Cohen H. Message fatigue: conceptual definition, operationalization, and correlates. *Commun Monogr* 2017; 84: 5–29.
- [11] Chae J, Lee CJ and Jensen JD. Correlates of cancer information overload: focusing on individual ability and motivation. *Health Commun* 2016; 31: 626–634.
- [12] Kim K, Lustria MLA, Burke D et al. Predictors of cancer information overload: findings from a national survey. *Inform Res* 2007; 12: 12–14.
- [13] Lee AR, Son SM and Kim KK. Information and communication technology overload and social networking service fatigue: a stress perspective. *Comput Hum Behav* 2016; 55: 51–61.
- [14] Hwang MY, Hong JC, Tai KH et al. The relationship between the online social anxiety, perceived information overload and fatigue, and job engagement of civil servant LINE users. *Govern Inform Quart* 2020; 37: 101423.
- [15] Chaiken S, Liberman A and Eagly AH. Heuristic and systematic information processing within and beyond the persuasion context. In: Uleman JS and Bargh JA (eds) *Unintended thought*. New York: Guilford Press, 1989, pp. 212–252.
- [16] Chen S and Chaiken S. The heuristic-systematic model in its broader context. In: Chaiken S and Trope Y (eds) *Dual-process theories in social psychology*. New York: Guilford Press, 1999, pp. 73–96.
- [17] Kruglanski AW and Thompson EP. Persuasion by a single route: a view from the unimodel. *Psychol Inq* 1999; 10: 83–109.
- [18] Petty RE and Wegener DT. The elaboration likelihood model: current status and controversies. In: Chaiken S and Trope Y (eds) *Dual-process theories in social psychology*. New York: Guilford Press, 1999, pp. 41–72.
- [19] Petty RE and Cacioppo JT. Issue involvement can increase or decrease persuasion by enhancing message-relevant cognitive responses. *J Pers Soc Psychol* 1979; 37: 1915–1926.
- [20] Goh D and Chi J. Central or peripheral? Information elaboration cues on childhood vaccination in an online parenting forum. *Comput Hum Behav* 2017; 69: 181–188.
- [21] Trumbo CW. Information processing and risk perception: an adaptation of the heuristic-systematic model. *J Commun* 2002; 52: 367–382.
- [22] Greene K, Krcmar M and Rubin DL. Elaboration in processing adolescent health messages: the impact of egocentrism and sensation seeking on message processing. *J Commun* 2002; 52: 812–831.
- [23] Barden J and Petty RE. The mere perception of elaboration creates attitude certainty: exploring the thoughtfulness heuristic. *J Pers Soc Psychol* 2008; 95: 489–509.

- [24] Rucker DD and Petty RE. Increasing the effectiveness of communications to consumers: recommendations based on elaboration likelihood and attitude certainty perspectives. *J Publ Pol Market* 2006; 25: 39–52.
- [25] Klingberg T. *The overflowing brain: information overload and the limits of working memory*. New York: Oxford University Press, 2009.
- [26] Klausegger C, Sinkovics RR and Zou H. Information overload: a cross-national investigation of influence factors and effects. *Market Intell Plan* 2007; 25: 691–718.
- [27] Miller GA. The magical number seven, plus or minus two: some limits on our capacity for processing information. *Psychol Rev* 1956; 63: 81–97.
- [28] Shiffrin RM and Schneider W. Controlled and automatic human information processing: II. Perceptual learning, automatic attending and a general theory. *Psychol Rev* 1977; 84: 127–190.
- [29] Miller N, Maruyama G, Beaver RJ et al. Speed of speech and persuasion. *J Pers Soc Psychol* 1976; 34: 615–624.
- [30] Rodriguez MG, Gummadi K and Schoelkopf B. Quantifying information overload in social media and its impact on social contagions. In: *Proceedings of the eighth international AAAI conference on weblogs and social media*, <https://www.aaai.org/ocs/index.php/ICWSM/ICWSM14/paper/viewPaper/8108> (2014, accessed 14 May 2022).
- [31] Iselin ER. The effects of the information and data properties of financial ratios and statements on managerial decision quality. *J Bus Finan Account* 1993; 20: 249–266.
- [32] Bawden D and Robinson L. The dark side of information: overload, anxiety and other paradoxes and pathologies. *J Inform Sci* 2009; 35: 180–191.
- [33] Almeida TA, Silva TP, Santos I et al. Text normalization and semantic indexing to enhance instant messaging and SMS spam filtering. *Knowl Based Syst* 2016; 108: 25–32.
- [34] Jensen JD, Carcioppolo N, King AJ et al. The cancer information overload (CIO) scale: establishing predictive and discriminant validity. *Pat Educ Couns* 2014; 94: 90–96.
- [35] Hall A and Walton G. Information overload within the health care system: a literature review. *Health Inform Libr J* 2004; 21: 102–108.
- [36] Poonia SK and Rajasekaran K. Information overload: a method to share updates among frontline staff during the COVID-19 pandemic. *Otolaryn Head Neck Surg* 2020; 163: 60–62.
- [37] Mohammed M, Sha'aban A, Jatau AI et al. Assessment of COVID-19 information overload among the general public. *J Rac Ethn Health Dispar* 2022; 9: 184–192.
- [38] Cuan-Baltazar JY, Muñoz-Perez MJ, Robledo-Vega C et al. Misinformation of COVID-19 on the internet: infodemiology study. *JMIR Public Health Surveill* 2020; 6: e18444.
- [39] Gupta L, Gasparyan AY, Misra DP et al. Information and misinformation on COVID-19: a cross-sectional survey study. *J Korean Med Sci* 2020; 35: e256.
- [40] Song S, Yao X and Wen N. What motivates Chinese consumers to avoid information about the COVID-19 pandemic? The perspective of the stimulus-organism-response model. *Inf Process Manag* 2021; 58: 102407.
- [41] Taylor SE. The interface of cognitive and social psychology. *Cognit Soc Behav Environ* 1981; 1: 189–211.
- [42] Bright LF, Kleiser SB and Grau SL. Too much Facebook? An exploratory examination of social media fatigue. *Comput Hum Behav* 2015; 44: 148–155.
- [43] Kim S and So J. How message fatigue toward health messages leads to ineffective persuasive outcomes: examining the mediating roles of reactance and inattention. *J Health Commun* 2018; 23: 109–116.
- [44] So J and Alam N. Predictors and effects of anti-obesity message fatigue: a thought-listing analysis. *Health Commun* 2019; 34: 755–763.
- [45] Koh PKK, Chan LL and Tan EK. Messaging fatigue and desensitisation to information during pandemic. *Arch Med Res* 2020; 51: 716–717.
- [46] Guan M, Li Y, Scoles JD et al. COVID-19 message fatigue: how does it predict preventive behavioral intentions and what types of information are people tired of hearing about? *Health Commun*. Epub ahead of print 5 January 2022. DOI: 10.1080/10410236.2021.2023385.
- [47] Crook B, Stephens KK, Pastorek AE et al. Sharing health information and influencing behavioral intentions: the role of health literacy, information overload, and the internet in the diffusion of healthy heart information. *Health Commun* 2016; 31: 60–71.
- [48] Khaleel I, Wimmer BC, Peterson GM et al. Health information overload among health consumers: a scoping review. *Pat Educ Couns* 2020; 103: 15–32.
- [49] Jackson TW and Farzaneh P. Theory-based model of factors affecting information overload. *Int J Inf Manage* 2012; 32: 523–532.
- [50] Dutta-Bergman MJ. Complementarity in consumption of news types across traditional and new media. *J Broad Electron Med* 2004; 48: 41–60.
- [51] Yancy CW. COVID-19 and African Americans. *JAMA* 2020; 323: 1891–1892.
- [52] Garg S, Kim L, Whitaker M et al. Hospitalization rates and characteristics of patients hospitalized with laboratory-confirmed coronavirus disease 2019 – COVID-NET, 14 states, March 1–30, 2020. *MMWR Morb Mortal Wkly Rep* 2020; 69: 458–464.
- [53] Reynolds-Tylus T, Lukacena KM and Truban O. Message fatigue to bystander intervention messages: examining pathways of resistance among college men. *Health Commun* 2021; 36: 1759–1767.

- [54] Quick BL, Scott AM and Ledbetter AM. A close examination of trait reactance and issue involvement as moderators of psychological reactance theory. *J Health Commun* 2011; 16: 660–679.
- [55] Shen L and Dillard JP. Psychometric properties of the Hong psychological reactance scale. *J Pers Assess* 2005; 85: 74–81.
- [56] Hong SM and Faedda S. Refinement of the Hong psychological reactance scale. *Educ Psychol Meas* 1996; 56: 173–182.
- [57] Koch T and Zerback T. Helpful or harmful? How frequent repetition affects perceived statement credibility. *J Commun* 2013; 63: 993–1010.
- [58] Kahneman D and Tversky A. Prospect theory: an analysis of decision under risk. In: Maclean LC and Ziemba WT (eds) *Handbook of the fundamentals of financial decision making*. Singapore: World Scientific, 2012, pp. 99–127.
- [59] O’Keefe DJ and Jensen JD. The relative persuasiveness of gain-framed and loss-framed messages for encouraging disease prevention behaviors: a meta-analytic review. *J Health Commun* 2007; 12: 623–644.
- [60] Petty RE and Briñol P. Emotion and persuasion: cognitive and meta-cognitive processes impact attitudes. *Cogn Emot* 2015; 29: 1–26.
- [61] Stavraki M, Lamprinakos G, Briñol P et al. The influence of emotions on information processing and persuasion: a differential appraisals perspective. *J Exp Soc Psychol* 2021; 93: 104085.
- [62] Fu S and Li H. Understanding social media discontinuance from social cognitive perspective: evidence from Facebook users. *J Inf Sci Eng* 2022; 48: 544–560.
- [63] Whelan E, Najmul Islam AK and Brooks S. Is boredom proneness related to social media overload and fatigue? A stress–strain–outcome approach. *Intern Res* 2020; 30: 869–887.
- [64] Eveland WP. The cognitive mediation model of learning from the news: evidence from nonelection, off-year election, and presidential election contexts. *Commun Res* 2001; 28: 571–601.
- [65] Eveland WP, Shah DV and Kwak N. Assessing causality in the cognitive mediation model. *Commun Res* 2003; 30: 359–386.
- [66] Centers for Disease Control and Prevention (CDC). People with certain medical conditions, <https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/people-with-medical-conditions.html> (2020, accessed 24 May 2021).
- [67] Rouquette A, Nadot T, Labitrie P et al. Validity and measurement invariance across sex, age, and education level of the French short versions of the European Health Literacy Survey Questionnaire. *PLoS ONE* 2018; 13: e0208091.
- [68] Shen L. Antecedents to psychological reactance: the impact of threat, message frame, and choice. *Health Commun* 2015; 30: 975–985.
- [69] Jensen JD, Pokharel M, Carcioppolo N et al. Cancer information overload: discriminant validity and relationship to sun safe behaviors. *Pat Educ Couns* 2020; 103: 309–314.
- [70] Obamiro K and Lee K. Information overload in patients with atrial fibrillation: can the cancer information overload (CIO) scale be used? *Pat Educ Couns* 2019; 102: 550–554.
- [71] Ramondt S and Ramírez AS. Assessing the impact of the public nutrition information environment: adapting the cancer information overload scale to measure diet information overload. *Pat Educ Couns* 2019; 102: 37–42.
- [72] Ball H and Wozniak TR. Why do some Americans resist COVID-19 prevention behavior? An analysis of issue importance, message fatigue, and reactance regarding COVID-19 messaging. *Health Commun*. Epub ahead of print 3 May 2021. DOI: 10.1080/10410236.2021.1920717.
- [73] Yang ZJ, Aloe AM and Feeley TH. Risk information seeking and processing model: a meta-analysis. *J Commun* 2014; 64: 20–41.
- [74] IBM Corporation. *IBM SPSS statistics for Windows*. New York: IBM Corporation, 2019.
- [75] Muthén LK and Muthén BO. *Mplus user’s guide: statistical analysis with latent variables: user’s guide*. Los Angeles, CA: Muthén & Muthén, 2004.
- [76] Kline RB. *Principles and practice of structural equation modeling*. 4th ed. New York: Guilford Press, 2015.
- [77] Hu L and Bentler PM. Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. *Struct Equ Model* 1999; 6: 1–55.
- [78] Cheng P, Ouyang Z and Liu Y. The effect of information overload on the intention of consumers to adopt electric vehicles. *Transportation* 2020; 47: 2067–2086.
- [79] Hwang MI and Lin JW. Information dimension, information overload and decision quality. *J Inf Sci Eng* 1999; 25: 213–218.
- [80] Chen CJ and Huang JW. How organizational climate and structure affect knowledge management – the social interaction perspective. *Int J Inf Manage* 2007; 27: 104–118.
- [81] DiLorenzo TA, Schnur J, Montgomery GH et al. A model of disease-specific worry in heritable disease: the influence of family history, perceived risk and worry about other illnesses. *J Behav Med* 2006; 29: 37–49.
- [82] Katapodi MC, Lee KA, Facione NC et al. Predictors of perceived breast cancer risk and the relation between perceived risk and breast cancer screening: a meta-analytic review. *Prev Med* 2004; 38: 388–402.
- [83] Miner AS, Laranjo L and Kocaballi AB. Chatbots in the fight against the COVID-19 pandemic. *NPJ Digit Med* 2020; 3: 65.
- [84] Herriman M, Meer E, Rosin R et al. Asked and answered: building a chatbot to address Covid-19-related concerns, NEJM Catalyst Innovations in Care Delivery, 2020, <https://catalyst.nejm.org/doi/abs/10.1056/cat.20.0230>.