

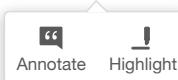
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Alyssa H. Sinclair, Morgan K. Taylor, Audra Davidson, Joshua S. Weitz, Stephen J. Beckett, and Gregory R. Samanez-Larkin
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EMPIRICAL ARTICLE

Scenario-Based Messages on Social Media Motivate COVID-19 Information Seeking

Alyssa H. Sinclair¹, Morgan K. Taylor¹, Audra Davidson², Joshua S. Weitz^{2, 3, 4},
Stephen J. Beckett², and Gregory R. Samanez-Larkin¹¹ Department of Psychology and Neuroscience, Duke University, United States² School of Biological Sciences, Georgia Institute of Technology, United States³ School of Physics, Georgia Institute of Technology, United States⁴ Institut d'Biologie, École Normale Supérieure, France

Communicating information about health risks empowers individuals to make informed decisions. To identify effective communication strategies, we manipulated the specificity, self-relevance, and emotional framing of messages designed to motivate information seeking about COVID-19 exposure risk. In Study 1 ($N = 221,829$), we conducted a large-scale social media field study. Using Facebook advertisements, we targeted users by age and political attitudes. Episodic specificity drove engagement: Advertisements that contextualized risk in specific scenarios produced the highest click-through rates, across all demographic groups. In Study 2, we replicated and extended our findings in an online experiment ($N = 4,233$). Message specificity (but not self-relevance or emotional valence) drove interest in learning about COVID-19 risks. Across both studies, we found that older adults and liberals were more interested in learning about COVID-19 risks. However, message specificity increased engagement across demographic groups. Overall, evoking specific scenarios motivated information seeking about COVID-19, facilitating risk communication to a broad audience.

General Audience Summary

Throughout the COVID-19 pandemic, individuals have weighed risks and benefits when making choices about everyday activities. Learning about the current local risk of COVID-19 exposure is important for making informed decisions. Social media can be a platform for rapidly disseminating health information, but it can also contribute to misinformation and confirmation bias. Here, we tested strategies for risk communication on social media, targeting users by age and political attitudes. In Study 1, we used Facebook advertisements to motivate users to learn about COVID-19 exposure risk. Users who clicked on an ad were directed to interactive risk assessment tools on a public website. We varied the *specificity* of the advertisements by describing national ("in the United States"), local ("in your area"), or scenario ("at your favorite restaurant") risks. We also manipulated emotional valence by using positive ("stay safe and healthy") or negative ("avoid danger and illness") language. Specificity drove engagement: In all demographic groups, users were the most likely to click on scenario ads. In Study 2, we replicated and extended our findings in a sample of paid participants. In addition to varying the specificity and valence of the ads, we manipulated self-relevance (e.g., "a restaurant" vs. "your favorite restaurant") and tested an alternative scenario (grocery store instead of restaurant). Consistent with Study 1, specificity (but not valence or self-relevance) drove interest in learning about COVID-19 risk. In both studies, we also found that older adults and liberals were more interested in COVID-19 information, whereas conservatives were less engaged and more likely to feel angry or disgusted. However, scenario ads reliably increased engagement across demographic groups. Overall, we found that evoking specific scenarios motivated information seeking about COVID-19 risks. Health messages with improved specificity can be readily disseminated on social media, reaching a broad audience to support public health goals.

Keywords: COVID-19, social media, risk communication, episodic specificity, information seeking

Supplemental materials: <https://doi.org/10.1037/mac0000114.supp>

Alyssa H. Sinclair  <https://orcid.org/0000-0003-0447-3959>
Morgan K. Taylor  <https://orcid.org/0000-0003-0628-2945>
Audra Davidson  <https://orcid.org/0000-0002-9749-0039>
Joshua S. Weitz  <https://orcid.org/0000-0002-3433-8312>

Stephen J. Beckett  <https://orcid.org/0000-0002-4410-2960>
Gregory R. Samanez-Larkin  <https://orcid.org/0000-0001-7846-3804>
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continued

The COVID-19 pandemic has presented unique challenges and opportunities for public health messaging. Communicating information about exposure risk empowers individuals to make informed decisions about everyday activities. Social media can stimulate community action and allow experts to rapidly disseminate information, but it can also impede science-driven communication because individuals can share misinformation or avoid information that contradicts their established beliefs (Malecki et al., 2021; Nickerson, 1998). Communicating COVID-19 risk information to older adults, who are at greater risk of severe disease (Chen et al., 2021), and conservatives, who are less likely to engage in preventative health behaviors (Ruisch et al., 2021), is particularly important. Improving public health communication requires motivating individuals to seek information and identifying messaging strategies that engage broad audiences to facilitate belief and behavior change.

What factors predict the efficacy of COVID-related persuasive messages? Messages that emphasize narrative scenarios, personal risk and recklessness, or community protection have proved more effective at increasing perceived risk and motivating health behaviors (e.g., social distancing, mask wearing, and vaccination; Bokemper et al., 2022; Cakanlar et al., 2022; Sinclair, Hakimi, et al., 2021). Particularly in the United States (Pennycook et al., 2022), political partisanship has influenced pandemic-related beliefs, attitudes, information consumption, public policy, and health behaviors (Barrios & Hochberg, 2020; Bruine de Bruin et al., 2020; Grossman et al., 2020; Havey, 2020; Kerr et al., 2021; Rau et al., 2021; Ruisch et al., 2021; Weisel, 2021; Ye, 2021). Liberals tend to be more concerned, perceive greater risk, and show greater support for preventative actions intended to reduce the spread of COVID-19. However, tailoring messages to specific audiences using market segmentation can help influence beliefs and motivate action (Beane & Ennis, 1987), especially for politically polarized issues (e.g., climate change; Bölsen & Shapiro, 2017). For instance, conservatives and older adults are particularly responsive to specific, self-relevant messages about COVID-19 risks (Cakanlar et al., 2022; Sinclair, Stanley, et al., 2021). Overall, results from these recent COVID-19 studies align with three key variables identified in existing theoretical frameworks: episodic specificity, self-relevance, and emotion.

A diverse body of literature has emphasized the importance of *specificity* in learning and decision-making. Engaging episodic memory systems, such as by imagining scenarios, can enhance learning about risk, future-oriented decision-making, and prosocial intentions (Gaesser & Schacter, 2014; Peters & Büchel, 2010; Sinclair, Hakimi, et al., 2021). Narratives can also enhance persuasion, particularly when encouraging preventative behaviors for health risks (Allen et al., 2000; Shen et al., 2015). Previously, we

showed that imagining a COVID-19-related scenario—regardless of whether or not the scenario was self-relevant—improved subsequent learning about exposure risk, correcting risk misestimation, and decreasing willingness to take risks (Sinclair, Hakimi, et al., 2021). We then applied elements of this intervention to interactive risk assessment tools on our COVID-19 Event Risk website (<https://covid19risk.biosci.gatech.edu/>), demonstrating the benefits of this large-scale risk communication strategy (Chande et al., 2020; Sinclair et al., 2022). On the basis of these past studies, we predicted that messages describing specific scenarios would be more persuasive than less-specific messages.

A separate literature on persuasion and health communication has emphasized the importance of self-relevance. The *elaboration likelihood model* predicts that messages that are self-relevant, vivid, or actionable are more persuasive (Hung & Wyer, 2014; Petty & Cacioppo, 1986; Stapel & Velthuijsen, 1996), perhaps because these characteristics increase perceived self-efficacy (Bandura, 1977; Strecher et al., 1986). Self-relevant persuasive messages are more likely to increase perceived risk and motivate health behavior change (Gregory et al., 1982; Hung & Wyer, 2014; Stapel & Velthuijsen, 1996; Strecher et al., 1986). Self-relevant examples may be particularly effective when they clearly convey *gist*, a qualitative representation of detailed information. According to fuzzy-trace theory, gist is a crucial component of risky decision-making (Reyna, 2021; Reyna et al., 2021). For example, an individual might read statistics and an anecdote about smoking and lung cancer. The individual may forget the statistical details but extract and remember the gist of the passage (e.g., "Smoking is bad for me"), thus influencing risk perception and health behaviors.

Last, emotional appeals also contribute to persuasion and motivation (Petty & Brifol, 2015; Yan et al., 2012). For instance, the *attention allocation hypothesis*, which draws on the elaboration likelihood model, predicts that mild or moderate levels of fear arousal facilitate systematic processing of threat-relevant information, thus supporting risk communication (Meijnders et al., 2001). Individual differences in *regulatory focus* may also govern persuasion: Prevention-focused individuals are motivated to avoid negative outcomes, whereas promotion-focused individuals are motivated to achieve positive outcomes (Higgins, 1998; Yan et al., 2012). Conservatives are more likely to be prevention-oriented, whereas liberals are more likely to be promotion-oriented (Cornwell & Higgins, 2013). However, other recent work suggests that threat sensitivity does not differ between conservatives and liberals (Bakker et al., 2020). Overall, these prior studies predict that negative messages that emphasize risk prevention may be more persuasive, especially for conservatives.

their contributions to the website design and interactive tools for risk communication. The authors have no conflicts of interest to declare.

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All data and code necessary to reproduce results and figures are publicly available in a permanent repository hosted by the Open Science Framework (<https://doi.org/10.17605/OSF.IO/MBH9W>; Sinclair, 2022).

Alyssa H. Sinclair played lead role in conceptualization, formal analysis, investigation, methodology, visualization, writing-original draft, and writing-

review and editing. Morgan K. Taylor played supporting role in conceptualization, investigation, methodology, writing-original draft, and writing-review and editing. Audra Davidson played supporting role in conceptualization and methodology. Joshua S. Weitz played supporting role in conceptualization and writing-review and editing. Stephen J. Beckett played supporting role in conceptualization and writing-review and editing. Gregory R. Samanez-Larkin played supporting role in conceptualization, investigation, methodology, writing-original draft, and writing-review and editing.

Correspondence concerning this article should be addressed to Alyssa H. Sinclair, Department of Psychology and Neuroscience, Duke University, 308 Research Drive, Room B353, Durham, NC 27710, United States. Email: sinclair.allie@gmail.com

Which message features motivate learning about COVID-19 risks? Do different communication strategies appeal to different demographic groups? To investigate these questions, we manipulated three message variables: specificity, self-relevance, and valence. In Study 1, we conducted a large-scale field experiment on social media, disseminating different advertisements (ads) to politically liberal and conservative users across the adult life span. Our primary measure of user engagement was clicks on the ads. Users who clicked on an ad were redirected to our risk assessment tools on the COVID-19 Event Risk website. In additional exploratory analyses, we tracked subsequent website activity. In Study 2, we conducted an online experiment with paid participants to replicate our findings and identify cognitive mechanisms. Study 1 revealed that messages describing specific scenarios were the most effective at motivating information seeking across all demographic groups. Users who subsequently engaged with our interactive risk assessment tools became less willing to take risks. Study 2 replicated findings from Study 1, demonstrating that specificity (rather than emotional valence or self-relevance) drove interest in learning about COVID-19 risks. Overall, we propose that messages that evoke specific scenarios motivate information seeking and support health behavior change.

Study 1: Method

Participants

Participants were active Facebook users (currently residing in the United States) who viewed the ads while using the social media platform (mobile or desktop). We used audience targeting to stratify users by *age group* (young adults ages 18–35, middle-aged adults ages 36–59, and older adults ages 60+) and *political leaning* (liberal vs. conservative). Political leaning was classified by Facebook, depending on each user's prior engagement with U.S. political content on the social media platform. A prior study validated Facebook's political classifications (Vogels et al., 2021); 73% of survey respondents reported that Facebook's classification of their political affiliation was "very accurate" or "somewhat accurate." The majority of users who viewed (81%) and clicked on the ads (88%) were women, likely reflecting baseline gender differences in social media usage. Gender proportions for each condition are provided in Supplemental Table 6. Data on race and ethnicity were not available.

In total, Facebook displayed our ads 350,204 times to 221,829 unique users (1.58 exposures per user). A subset of the users who viewed an ad voluntarily clicked on the ad to visit the COVID-19 Event Risk website. Participants were not paid or otherwise incentivized for their engagement with the ads. The study was approved by Duke University's institutional review board (Protocol No. 2022-0010) and the Georgia Institute of Technology's institutional review board (Protocol No. H21292). Sample sizes for all analyses (stratified by ad condition, demographic group, and website usage) are provided in Supplemental Table 1.

Due to the constraints of the advertising platform, our sample size was not predetermined. We allocated a budget of \$100 to each of the 30 conditions (5 ad versions targeted to 6 demographic groups) and ensured that the full budget amount for each ad condition was spent at a consistent rate over the course of the 2-week ad campaign. Ad expenditure determines the number of

times the ad is displayed on the platform. However, because the number of active Facebook users differed across our target demographic groups, our sample sizes differed across conditions. We disabled all automatic audience targeting features to ensure that ads would be delivered to our intended demographic groups, and the targeting strategy would not change during the campaign.

Procedure

Facebook Advertisements

The social media advertising campaign took place on Facebook between January 24, 2022, and February 7, 2022. All ad versions were variations on a static image template, similar in style and format (Figure 1). Across ad versions, we varied the *specificity* of the context by inviting users to learn about risk levels in the United States (national), in their area (local), or at their favorite restaurant (scenario). Additionally, we varied the emotional *valence* of the messages by stating that users could check risk levels to "avoid danger and illness" (negative) or "stay safe and healthy" (positive). In sum, we tested five ad conditions: national context with no valence message (*Control*, Figure 1A), local context with negative valence (*Local-*, Figure 1B), local context with positive valence (*Local+*, Figure 1C), scenario context with negative valence (*Scenario-*, Figure 1D), and scenario context with positive valence (*Scenario+*, Figure 1E). As described above (see Participants section), we used audience targeting to test the efficacy of our ads across demographic groups. We tested each of the five ad versions across six demographic groups, stratified by age group (younger, middle-aged, or older adult) and political leaning (liberal or conservative).

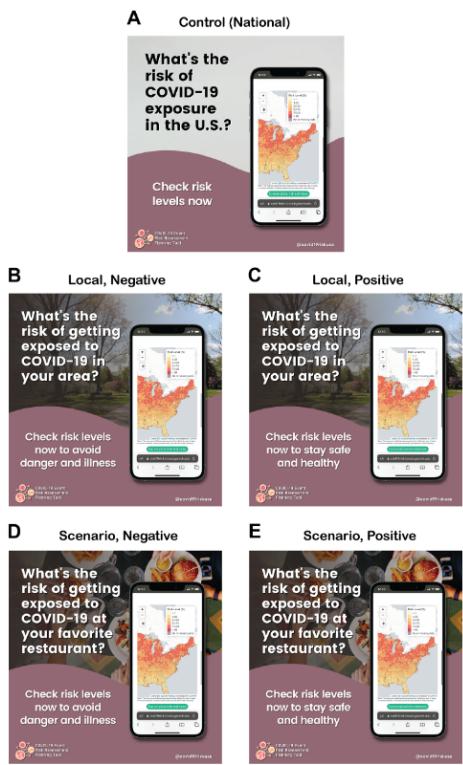
COVID-19 Event Risk Website

Users who clicked on an ad were redirected to our online interactive risk assessment dashboard, the COVID-19 Event Risk website (<https://covid19risk.biosci.gatech.edu/>). We tracked subsequent user activity on the website and used URL parameters (embedded within ad redirect links) to associate website activity with specific ad versions and demographic groups. Using a modal dialogue box, we prompted users to assert that they were at least 18 years of age, currently residing in the United States, and consented to share their data for research purposes. Website data were only saved for users who agreed to these conditions and provided responses to the interactive tools.

The COVID-19 Event Risk website featured several interactive tools for real-time assessment of local, national, and global COVID-19 exposure risk. The homepage of the website displayed a county-level map of the United States depicting the estimated risk of attending an event, given the event location and size. We calculated prevalence-based exposure risk as the estimated probability (ranging from <1% to >99%) that at least one individual at an event of a given size is infected with SARS-CoV-2. Additional information about risk calculation, website development, and the interactive tools are described in prior reports (Chande et al., 2020; Sinclair et al., 2022).

Participants were able to interact with the map by selecting various event sizes (ranging from 10 people to 5,000 people) and hovering over counties to view relevant statistics. Next to the risk

Figure 1
Social Media Ad Experiment Conditions



Note. Clicking on any ad version redirected users from Facebook to the COVID-19 Event Risk website. Specificity ranged from national (A) to local (B, C) and scenario (D, E) contexts. We also manipulated the emotional valence of the ads by varying the subheadings (negative: B, C; positive: D, E). See the online article for the color version of this figure.

map, we included a “risk context” panel that illustrated the selected event size with real-world examples (e.g., “You’re viewing risk levels for an event with 50 people, which is like a supermarket or a restaurant.”). The risk context panel was intended to evoke specific scenarios (similar to the scenario ads) because we previously found that imagining scenarios enhanced learning about risk statistics (Sinclair, Hakimi, et al., 2021). Below the risk map was a rating scale that prompted participants to report whether they were more or less willing to participate in an event of the specified size ($-2 = \text{much less willing} \dots 0 = \text{no change} \dots 2 = \text{much more willing}$). Due to feasibility and user experience constraints, we only obtained a single measure of “change in willingness” (as opposed to separate baseline and postintervention measures of absolute willingness).

On a separate page of the website was an interactive risk quiz that allowed participants to test their knowledge of local risk levels and receive feedback. After selecting their location, participants used a sliding scale (0%–100%) to guess the probability of SARS-CoV-2 exposure for four different event sizes (20, 50, 100, and 1,000 people). Each event size was associated with an example scenario (coffee shop, grocery store, movie theater, and graduation ceremony, respectively). Participants then received feedback about their risk estimation accuracy. Below the feedback table was a 5-point rating scale ($-2 = \text{much less willing} \dots 0 = \text{no change} \dots 2 = \text{much more willing}$) that prompted participants to rate whether they were more or less willing to participate in events such as those described in the risk quiz.

Statistical Analysis

All analyses were conducted in R (v.4.1.1) with RStudio (v.2021.09.0). See Supplemental Material (*R Package Versions*), for additional information. Statistical significance was evaluated with two-sided tests and a threshold of $p < .05$.

Data and Code Availability

All data and code necessary to reproduce results and figures are publicly available in a permanent repository hosted by the Open Science Framework (<https://doi.org/10.17605/OSF.IO/MBH9W>). To protect the privacy of our participants, some identifiers have been removed from the website data (the last two digits of IP addresses). The study was not preregistered.

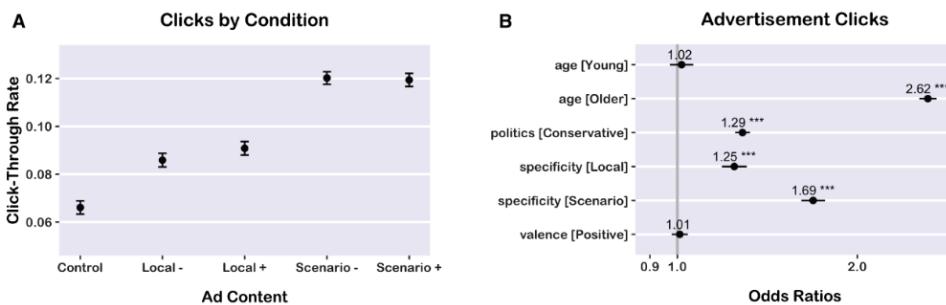
Study 1: Results

Advertisement Clicks

First, we compared the efficacy of the five ad conditions (Figure 1), collapsing across demographic groups. Using logistic regression, we predicted *ad clicks*, a binary dependent variable (whether a given user did or did not click on the ad). The click-through rate differed among the five ad conditions, $\chi^2(4, N = 221,824) = 1116.8, p < .0001$ (Figure 2A). As predicted, local and scenario ads all performed better than the control ads (Figure 2A). The local ads generated more clicks than the control ads (Cohen’s $d = 0.08$), and the scenario ads generated more clicks than both the control ads ($d = 0.18$) and the local ads ($d = 0.11$). There was no significant difference in click-through rate between the local– and local+ conditions nor between the scenario– and scenario+ conditions. All other pairwise contrasts were significant ($p < .0001$) after correcting for multiple comparisons (Supplemental Table 2).

Next, we tested a model that predicted ad clicks from the variables *specificity* (local, scenario, or national), *valence* (positive or negative), *age* (young adult, middle-aged, or older adult), and *political leaning* (conservative or liberal; Figure 2B). As described above, there was a significant effect of specificity, $\chi^2(2, N = 221,824) = 367.1, p < .0001$; scenario ads generated the most clicks (12.0%), local ads generated fewer clicks (8.8%), and national ads generated the fewest clicks (6.6%). The effect of emotional valence was not significant, $\chi^2(1, N = 221,824) = 0.4, p = .5538$. We also found differences across demographic groups. There was a significant effect of age, $\chi^2(2, N = 221,824) = 4344.5,$

Figure 2
Advertisement Clicks



Note. (A) Average click-through rate (unique link clicks/unique users shown the ad) for the five ad conditions. (B) Parameter estimates from a logistic regression model predicting the likelihood of a user clicking on an ad after viewing it. Odds ratios are calculated relative to the following reference groups: middle-aged (age), liberal (politics), national (specificity), and negative (valence). Error bars indicate 95% confidence intervals. See the online article for the color version of this figure.

*** $p < .001$.

$p < .0001$, such that older adults clicked on the ads more (15.1%) than young adults (6.3%) and middle-aged adults (6.6%). There was also a significant effect of political leaning, such that conservatives clicked on the ads more (10.9%) than liberals (8.5%), $\chi^2(1, N = 221,824) = 294.6, p < .0001$. All parameter estimates and pairwise contrasts are reported in Supplemental Table 3.

Last, we tested a model with all ad-by-demographic interactions (Supplemental Table 4). Overall, the effect of specificity (scenario > local > national) was robust and consistent across demographic groups. There was no interaction between valence and political leaning, contradicting the prediction that prevention-oriented ads may be more persuasive for conservative individuals (Supplemental Table 4 and Figure 1). However, there were higher order interactions that depended on valence, age, politics, and specificity (Supplemental Table 4 and Figures 2–4). For instance, conservative young adults were more likely to click on positive ads than negative ads (Supplemental Figure 2). For liberal older adults, valence interacted with specificity: positive ads were more effective for the local context (emphasizing community well-being), but negative ads were more effective for the scenario context (emphasizing personal risk; Supplemental Figure 4).

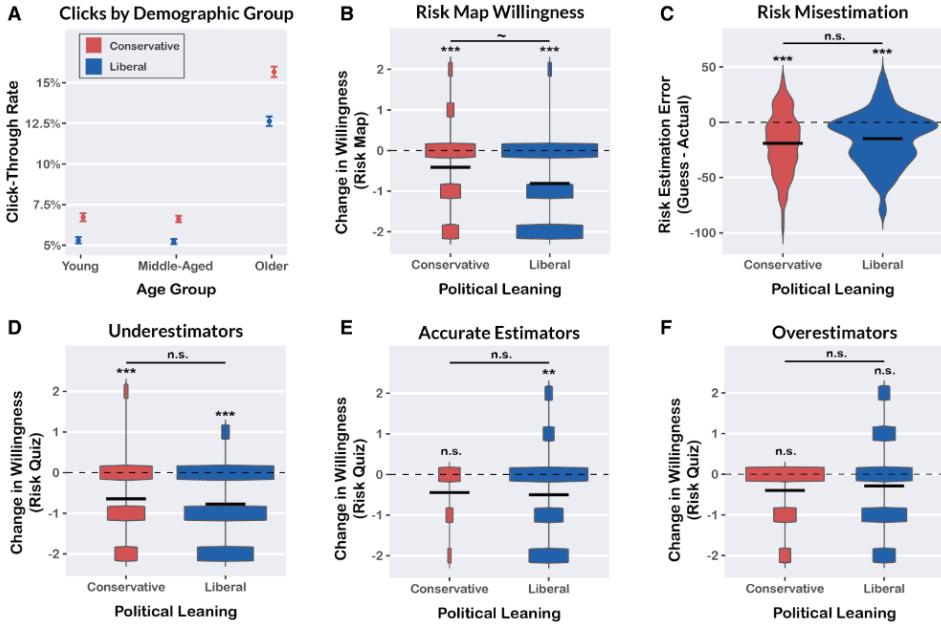
Exploratory Analyses: Website Interactions

Not all users who clicked on the ads interacted with the website, used the tools to learn about risk, or consented to sharing their data. There are likely baseline differences in social media habits, privacy concerns, and link-clicking tendencies across demographic groups (regardless of ad content). Furthermore, clicking on an ad may not always indicate that an individual is receptive to learning about COVID risks; clicks may be motivated by curiosity, surprise, or anger. Therefore, we also tracked and compared website activity from liberal and conservative Facebook users who clicked on the advertisements.

Among the subset of Facebook users who clicked on an advertisement, we calculated the proportion of liberal and conservative users who used the interactive risk assessment tools and consented to sharing their responses for research purposes. Although few users subsequently used the tools and shared their data (refer to Supplemental Table 1 for sample sizes for all data sources), we observed political differences. Despite a high number of conservatives clicking on the ads (Figure 3A), a significantly smaller proportion of conservatives who clicked on the ads completed the risk quiz (136/12194, 1.1%) relative to liberals (293/9410, 3.1%), $\chi^2(1, N = 21,604) = 108.98, p < .0001$. However, among the subset of users who completed a risk quiz, the difference in proportion of users who submitted a postquiz willingness rating was not statistically significant when comparing liberals (136/293, 46.4%) and conservatives (50/136, 36.8%), $\chi^2(1, N = 429) = 0.57, p = .500$. On the risk map page, fewer conservatives submitted a willingness rating after viewing the map (29/12,194; 0.24%), relative to liberals (65/9,410; 0.69%), $\chi^2(1, N = 21,604) = 25.15, p < .0001$. Overall, we found that although conservatives were more likely than liberals to click on the ads, they were less likely to use the interactive tools on the website (and/or consent to sharing their responses).

Note that the overall percentage of users who submitted responses on the website is low, likely because not all users consent to sharing their data and the interactive tools were less prominent on mobile view relative to desktop view (97.5% of users were redirected from the mobile Facebook application). However, the proportions observed were comparable to the proportion of website visitors who used the interactive tools during the 4-month period prior to the ad campaign, as described in a prior report (Sinclair et al., 2022). Thus, it seems that the users directed to the website by this particular set of ads showed similar engagement rates as users who self-directed to the website seeking information about COVID-19.

Figure 3
Comparing User Engagement and Intervention Efficacy Across Political Groups



Note. Error bars indicate 95% confidence intervals, black dotted lines mark zero, and black horizontal bars indicate means. Violin plots depict data distributions (blocked for integer variables, smoothed for continuous variables). (A) Average click-through rate by demographic group. Conservatives and older adults were more likely to click on the ads. (B) Liberals and conservatives both reported significant decreases in willingness to take risks after viewing the risk map. Negative values on the y-axis indicate being less willing to participate in events that could spread COVID-19. (C) Liberals and conservatives both significantly underestimated risk in the risk quiz. Risk estimation error is the average discrepancy between user-estimated exposure risk ("guess") and prevalence-based exposure risk estimates ("actual risk"). Negative values on the y-axis indicate risk underestimation; positive values indicate risk overestimation, and the dotted line at zero indicates accurate estimation. (D) Liberals and conservatives who had been underestimating risk (defined as risk estimation error scores < -10, continuous variable binned for visualization only) reported decreases in willingness after viewing their risk quiz feedback. (E) Liberals who were relatively accurate at estimating risk (defined as risk estimation error scores between -10 and +10) still showed a decrease in willingness after receiving feedback, whereas this shift was not significant for conservatives. (F) Neither liberals nor conservatives who had been overestimating risk (defined as risk estimation error scores > +10) showed a significant change in willingness after receiving feedback. *n.s.* = not significant. See the online article for the color version of this figure.

~ $p < .10$. ** $p < .01$. *** $p < .001$.

Exploratory Analyses: Impact of Website Tools

We also conducted exploratory analyses to compare how liberals and conservatives responded to our interactive risk assessment tools. After viewing the risk map, both liberals, $t(124) = -7.07$, $p < .0001$, $d = -0.63$, 95% CI [-0.83, -0.44], and conservatives, $t(49) = -4.73$, $p < .0001$, $d = -0.67$, 95% CI [-0.98, -0.36], reported significant decreases in willingness to take risks; there was no significant difference between groups, $t(91) = 1.87$, $p = .065$, $d = 0.42$, 95% CI [-0.03, 0.86]. Overall, viewing the risk map decreased willingness to take risks for both liberals and conservatives (Figure 3B).

Using responses from the risk quiz, we calculated the average *risk estimation error* for each user, defined as the discrepancy (averaged across the four event sizes in the quiz) between the user's risk estimate and our prevalence-based risk estimate. Negative risk estimation error scores indicate *underestimation* of risk, a score of zero indicates perfectly accurate estimation, and positive scores indicate *overestimation* of risk. Both liberals, $t(292) = -10.65$, $p < .0001$, $d = -0.62$, 95% CI [-0.75, -0.50], and conservatives, $t(135) = -8.21$, $p < .0001$, $d = -0.70$, 95% CI [-0.89, -0.52], significantly underestimated risk (Figure 3C); there was no significant difference between groups, $t(427) = -1.68$,

$p = .094$, $d = -0.17$, 95% CI [-0.38, 0.03]. We also compared risk estimation across event sizes and found that the pattern of risk miscalibration was consistent across demographic groups (Supplemental Figures 5–6).

After completing the risk quiz and viewing their accuracy feedback, both liberals, $t(124) = -7.07$, $p < .0001$, $d = -0.63$, 95% CI [-0.83, -0.44], and conservatives, $t(49) = -4.73$, $p < .0001$, $d = -0.67$, 95% CI [-0.98, -0.36], reported significant decreases in willingness to take risks. Once again, the confidence intervals around the effect sizes were highly overlapping, reflecting no difference between liberals and conservatives, $t(173) = 0.36$, $p = .721$, $d = 0.06$, 95% CI [-0.27, 0.39]. For both liberals and conservatives, the postquiz decrease in willingness was primarily driven by participants who had been underestimating risk prior to viewing feedback (Figure 3D–F; continuous measure of risk estimation error binned for data visualization only). Overall, although conservatives were less likely to use the website tools, the subset of conservatives who did engage with the website responded positively. Our interactive risk assessment tools benefited both liberals and conservatives.

Study 2: Method

We conducted a follow-up study with several aims: (a) replicate results from our field study in a more controlled setting, (b) dissociate cognitive mechanisms that may drive interest, and (c) gain insight into the affective responses elicited by the ad messages.

Stimuli

In Study 2, we created additional ads to test different message features. We manipulated three variables: *specificity*, *self-relevance*, and *valence*. As in Study 1, we tested three levels of specificity: *national* (United States), *local* (your area), and *scenario* (restaurant). In addition, we tested two levels of self-relevance: low (e.g., “a restaurant in your area”) and high (e.g., “your favorite restaurant”). Last, as in Study 1, we tested three levels of affective valence: positive (“Check risk levels now to stay safe and healthy”), neutral (“Check risk levels now”), and negative (“Check risk levels now to avoid danger and illness”). We tested all possible combinations of these variables, yielding a set of 18 ads. In addition, we tested a set of six ads with an alternative scenario: a grocery store. We aimed to compare the grocery store ads to the restaurant ads to test whether interest differed across scenarios. If interest in the grocery store ads is similar to interest in the restaurant ads, this would support the idea that specificity drives interest regardless of the specific scenario provided. These 24 ad messages (primary set of 18 ads + 6 grocery store scenario ads) are listed in Supplemental Table 8. All ad images are provided in the Supplemental Material. Stimuli were presented in a Qualtrics survey.

Participants

We recruited participants from Prolific, an online platform for paid study participants. Participants were paid \$0.25 for completing a brief survey that took approximately 1 min to complete (a rate of \$15/hr). The study was approved by the Duke Health’s institutional review board (Pro00101720). Data collection took place between September 27, 2022, and November 14, 2022.

Using prescreening options from Prolific, we recruited individuals who were U.S. residents and had self-identified as either Democrats or Republicans on a prior Prolific demographics survey. We aimed to test 100 Democrats and 100 Republicans per ad condition (4,800 subjects in total). However, the Prolific user base is biased toward Democrats; we ended data collection after 6 weeks because of difficulty recruiting additional Republicans. In total, 4,233 participants completed the study: 2,324 participants identified as Democrats, 1,700 participants identified as Republicans, and 254 participants identified as independent/other party/no affiliation. Notably, some participants reported different political affiliations on our demographics survey (e.g., switching from Democrat to independent), suggesting that their affiliation or views had changed since the prior Prolific screening was conducted. Therefore, in all analyses, we used a continuous measure of political attitudes (liberal to conservative) collected at the time of the study.

Participants’ ages ranged from 18 to 86 years ($M = 37.6$, $SD = 13.5$). The gender distribution was balanced (52.1% female, 46.5% male, 1% nonbinary/third-gender, 0.4% prefer not to say). The racial distribution was as follows: 80% White/Caucasian, 9.1% Asian, 6.7% Black/African American, 1.4% Native American/Alaskan, 2.6% mixed/other.

Procedure

Each participant was randomly assigned to view one of the 24 ads (Supplemental Table 8). Below the ad image, participants used a 4-point Likert-style scale to respond to the question, “After viewing the message above, how much do you want to learn about COVID risk?” (1 = *not at all* … 4 = *a lot*). We then prompted participants to describe their current emotional state by using a sliding valence scale (0 = *very negative* … 100 = *very positive*) and selecting check boxes for a set of emotion words (curious, anxious, angry, excited, happy, sad, afraid, disgusted, and surprised).

On the next page of the survey, participants responded to several demographics questions about their age, gender, and race. In addition, participants reported whether they identified with any political groups in the United States (Democratic, Republican, other party [write-in], independent) and rated their political attitudes on a 5-point scale (1 = *very liberal*, 5 = *very conservative*). In our analyses, we used the continuous measure of political attitudes.

Exclusions

During the early phase of data collection, we identified a technical error that prevented some users from checking multiple options on the questions pertaining to categorical emotions and race. Therefore, we excluded responses to these questions provided before the error was resolved (177 participants, 4.5% of the sample).

Data and Code Availability

All data and code necessary to reproduce results and figures are publicly available in a permanent repository hosted by the Open Science Framework (<https://doi.org/10.17605/OSF.IO/MBH9W>; Sinclair, 2022). The study was not preregistered.

Study 2: Results

Predicting Interest From Message Features

First, we analyzed the primary set of ads (Supplemental Table 8, Ads 1–18), excluding the grocery store scenario. Using linear regression, we predicted *interest ratings* (interest in learning about COVID-19 risks) from the variables *specificity* (national, local, or scenario), *valence* (positive, neutral, or negative), and *self-relevance* (high or low). The model included covariates for *political leaning* (continuous measure ranging from 1 = *very liberal* to 5 = *very conservative*) and *age* (in years).

Replicating results from Study 1, there was a significant main effect of specificity, $F(2, 3179) = 4.6, p = .010$. Numerically, results were consistent with Study 1: interest levels were highest for scenario ads, intermediate for local ads, and lowest for national ads (Figure 4). Post hoc pairwise comparisons indicated that this effect was driven by the contrast between national and scenario ads (national > scenario: $\beta = -0.09, 95\% \text{ CI } [-0.17, -0.001], t = -1.99, p = .047$; national > local: $\beta = -0.05, 95\% \text{ CI } [-0.14, 0.03], t = -1.22, p = .223$; local > scenario: $\beta = -0.03, 95\% \text{ CI } [-0.12, 0.05], t = -0.77, p = .442$). Neither valence nor self-relevance predicted interest. There were significant main effects of political leaning ($\beta = -0.39, 95\% \text{ CI } [-0.42, -0.36], t = -23.77, p < .0001$) and age ($\beta = 0.13, 95\% \text{ CI } [0.09, 0.16], t = 7.77, p < .0001$), such that liberals and older adults were more interested in learning about COVID-19 risks. There were no significant interactions. Additional statistics are provided in Supplemental Table 9.

Next, we tested whether the grocery store scenario differed from the restaurant scenario. Notably, the main effect of specificity was still evident if we included all 24 ads (including the restaurant and grocery store scenarios) in the model described above, $F(2, 4239) = 3.92, p = .020$; Supplemental Table 10. In a separate

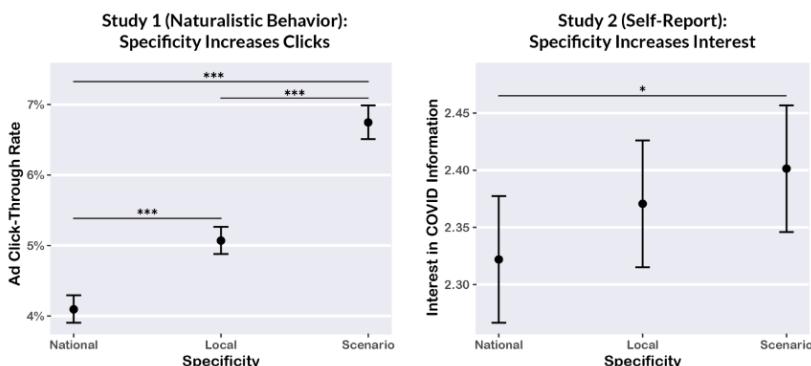
model, we directly compared interest ratings between the two scenarios; there was no significant difference between the restaurant and grocery store scenarios ($\beta = -0.03, 95\% \text{ CI } [-0.07, -0.01], t = -1.22, p = .223$) nor any significant interactions with other variables. Further information is provided in Supplemental Table 11. Overall, the restaurant and grocery store scenarios appeared to elicit similar responses, suggesting that the effect of specificity driving interest was not limited to the restaurant example.

Affective Responses to Messages

We also compared the emotions elicited by different messages. We collected both continuous and categorical measures of each participant's emotional state after viewing an ad. First, we used linear regression to predict *emotional valence* ratings (continuous variable, ranging from 0 = *very negative* ... 100 = *very positive*) from message *valence*, *specificity*, *self-relevance*, and all interactions. The model also included covariates for *political leaning* and *age*. There was a main effect of message valence on emotion ratings, such that participants reported feeling more negative affect after negative ads, $F(2, 3196) = 3.20, p = .041$, relative to neutral ads ($\beta = -0.09, 95\% \text{ CI } [-0.18, -0.01], t = -2.21, p = .027$) and positive ads ($\beta = -0.09, 95\% \text{ CI } [-0.18, -0.01], t = -2.17, p = .030$). There were no significant effects of specificity or self-relevance on emotion ratings nor any significant interactions. There were main effects of political leaning ($\beta = -0.1, 95\% \text{ CI } [-0.13, -0.06], t = -5.33, p < .0001$) and age ($\beta = 0.11, 95\% \text{ CI } [0.08, 0.15], t = 6.42, p < .0001$) predicting emotion ratings, such that liberals and older adults reported more positive affect. Further information is provided in Supplemental Table 12.

Last, we tested whether categorical emotional responses differed depending on political attitudes. Using linear regression, we

Figure 4
Specificity Increased Engagement With COVID-19 Risk Information



Note. *Left:* In Study 1 (observed naturalistic behavior), participants were substantially more likely to click on more specific ads. *Right:* In Study 2 (self-reported interest, ranging from 1 to 5), participants reported greater interest in learning about COVID-19 risks after viewing more specific ads. Note that variance was greater and effect sizes were smaller in Study 2, likely due to the smaller sample, different dependent measure, and changing COVID-19 zeitgeist. Error bars depict 95% confidence intervals. See the online article for the color version of this figure.

* $p < .05$. *** $p < .001$.

predicted *political leaning* (ranging from 1 = *very liberal* ... 5 = *very conservative*) from binary variables indicating yes/no reporting of various emotions (curiosity, anxiety, anger, excitement, happiness, sadness, fear, disgust, and surprise). Liberal participants were more likely to report feeling curious ($\beta = -0.16$, 95% CI [-0.19, -0.12], $t = -9.67$, $p < .0001$), anxious ($\beta = -0.13$, 95% CI [-0.16, -0.09], $t = -7.77$, $p < .0001$), sad ($\beta = -0.04$, 95% CI [-0.07, -0.01], $t = -2.67$, $p = .008$), or afraid ($\beta = -0.03$, 95% CI [-0.07, -0.00], $t = -2.20$, $p = .028$). Conservative participants were more likely to report feeling angry ($\beta = 0.04$, 95% CI [0.01, 0.08], $t = 2.72$, $p = .007$), disgusted ($\beta = 0.18$, 95% CI [0.15, 0.22], $t = 10.94$, $p < .0001$), or happy ($\beta = 0.07$, 95% CI [0.04, 0.10], $t = 4.25$, $p < .0001$). Excitement ($\beta = 0.00$, 95% CI [-0.02, 0.04], $t = 0.61$, $p = .543$) and surprise ($\beta = 0.02$, 95% CI [-0.01, 0.05], $t = 1.23$, $p = .218$) were not associated with political attitudes.

We previously showed that message specificity drove interest. One possibility is that specific scenarios increase curiosity, which in turn drives engagement. To investigate this, we used logistic regression to predict *curiosity* (yes/no report) from the variables *specificity*, *valence*, and *self-relevance*. Curiosity did not differ across ad conditions; there were no significant effects of specificity, valence, or self-relevance (Supplemental Table 13). In other words, although curiosity likely facilitates engagement, the effect of specificity driving interest was not explained by curiosity alone.

Discussion

In a large-scale online field experiment and a follow-up study, we tested strategies for motivating information seeking about COVID-19 exposure risk. In Study 1 (January 2022), we manipulated the episodic specificity and emotional valence of advertisements disseminated on Facebook. We compared efficacy (ad clicks) across demographic groups (stratified by age group and political leaning). Ads that invited users to learn about exposure risk in specific, self-relevant scenarios produced the highest levels of engagement across all demographic groups. In Study 2 (October 2022), we replicated this key finding in a sample of paid participants and dissociated specificity and self-relevance. We demonstrated that specificity (but not message valence or self-relevance) drove interest in learning about COVID-19 risks. We conclude that evoking specific scenarios is an effective strategy to motivate information seeking about health risks.

Specific Scenarios Motivate Information Seeking

In Study 1, we tested five different advertisements that systematically varied the specificity (national, local, or scenario context) and emotional valence (positive or negative framing) of the messages. Across all demographic groups, we found that specificity drove user engagement. Ads that described a specific scenario ("What's the risk of getting exposed to COVID-19 at your favorite restaurant?") generated significantly more clicks than local ads ("... in your area?") or national ads ("... in the United States?"). Local ads were more effective than national ads.

In Study 2, we expanded the stimulus set to include 24 ads; these additional conditions allowed us to dissociate specificity from self-relevance and test whether results would generalize to a different scenario (grocery store instead of restaurant). Crucially, we replicated results from Study 1; specificity, but not valence or

self-relevance, predicted interest in learning about COVID-19 risks. However, the effect of specificity was larger and more robust in Study 1 than in Study 2. The difference between studies is likely due to several factors: (a) viral transmission and public concern were much higher during Study 1 (January–February 2022) than during Study 2 (September–November 2022); (b) Study 1 measured naturalistic behavior, whereas Study 2 relied on explicit self-report; and (c) Study 1 included a larger sample size. Overall, across distinct samples and time periods, we demonstrated that specificity drove engagement with COVID-19 information.

Several theoretical frameworks have emphasized the importance of narratives and self-relevant information in persuasive messaging (Allen et al., 2000; Hung & Wyer, 2014; Petty & Cacioppo, 1986; Shen et al., 2015; Stapel & Velthuijsen, 1996). Crucially, our findings extend and refine these theories by demonstrating that *specificity* increases the efficacy of messages. Here, we found no effect of self-relevance driving interest or engagement—this finding is consistent with our previous COVID-19 intervention study (Sinclair, Hakimi, et al., 2021), in which we showed that imagining a specific COVID-19-related scenario enhanced subsequent learning about exposure risk, regardless of whether or not the scenario was self-relevant. Our approach was inspired by prior research on episodic specificity, which has shown that engaging episodic memory systems influences learning about risk, future-oriented decision-making, and prosocial intentions (Benoit et al., 2019; Gaesser & Schacter, 2014; Schacter et al., 2008; Sinclair, Hakimi, et al., 2021). Here, we unified these separate literatures, applying episodic specificity to persuasion and information seeking. We propose that specificity (not only self-relevance) is an important factor for motivating information seeking and improving risk communication.

Negative Messages Worsen Affect Without Increasing Engagement

Some theories of persuasion and motivation (e.g., the attention allocation hypothesis, regulatory focus theory) predicted that negatively valenced messages that emphasize risk prevention would be more persuasive (Meijnders et al., 2001; Petty & Briñol, 2015), especially for conservatives who are more likely to be prevention-focused than liberals (Cornwell & Higgins, 2013). However, in Studies 1 and 2, we did not observe any effects of valence on engagement or interest nor any interactions between valence and political leaning (Supplemental Figure 1). In Study 2, we found that negative messages (prevention-framing) elicited negative affective responses but did not increase interest. Our findings align with a recent meta-analysis, which found that loss-framing in COVID-19 messaging increased anxiety without impacting policy attitudes, behavioral intentions, or information seeking (Dorison et al., 2022). However, it is possible that positive messages were weakened by other negative concepts (e.g., the word "risk"), or positive and negative messages appeal to different individuals but yield no net effect on average.

Engagement and Emotions Across Demographic Groups

In Study 1, we found that older adults were more likely to click on the ads than younger and middle-aged adults. Older adults may be more likely to click on ads in general; prior research has

shown that older adults are the most responsive to online advertising (Lewis & Reiley, 2014). COVID-19-related information may also be more salient to older adults than younger adults (Kim & Crimmins, 2020) because age is associated with greater risk of severe disease and death (Chen et al., 2021). However, COVID-19 information does not necessarily cause distress in older adults; in Study 2, we found that older adults were more likely to report positive affect after viewing an ad, consistent with prior evidence on positivity biases. Overall, we show that older adults were responsive to messaging about COVID-19 risks. Encouraging COVID-19-related information seeking in older adults is particularly important because older adults are at greater risk of severe disease and more likely to avoid seeking information about negative outcomes (Hertwig et al., 2021).

In Study 1, we found that conservative users were more likely to click on the ads than liberal users. Despite higher rates of clicking on the ads, conservative users were less likely to use the interactive tools (and/or consent to sharing their data) after being redirected to the website. Study 2 revealed that conservatives were more likely to report feeling anger or disgust after viewing an ad message, whereas liberals were more likely to report feeling curiosity, anxiety, fear, and sadness. Therefore, conservative link clicks in Study 1 may have been driven by these negative emotions rather than curiosity. Additionally, there are likely baseline differences across political groups in social media usage. Conservative users and pages drive substantially more interactions (e.g., likes, comments, and shares) on Facebook than liberal users and pages (Heilweil, 2020; Roose, 2020), despite relatively equal numbers of liberal and conservative users (Vogels et al., 2021).

Limitations and Future Directions

Although online field studies allow large-scale data collection and broader impacts, there are some limitations of this approach. In Study 1, we targeted specific demographic groups via Facebook's advertising platform. Political affiliation was inferred from users' prior engagement with political content on Facebook. Although political labels may not always align with self-reported affiliations, the labels are reasonably accurate: A 2019 Pew Research Center survey (Vogels et al., 2021) found that 73% of respondents reported that Facebook's classification of their political affiliation was "very accurate" or "somewhat accurate." In Study 2, we asked all users to report political attitudes at the time of the study, thereby avoiding this issue.

In Study 1, it is possible that some users shared the ads with other users, such as in groups or private messages. For example, one user viewed an ad, copied the link, and shared the link (without the accompanying ad image) in a Facebook group. However, this particular repost received very little attention (one "like" and two shares), suggesting that it could not have substantially influenced our results. To our knowledge, there were no other instances of an ad link being shared without the accompanying ad image. We also investigated Facebook reactions (emojis indicating like, love, care, laugh, wow, sad, and angry) and comments across ad versions but found that there were too few observations to draw meaningful statistical inferences (Supplemental Table 7).

In both studies, we were limited in our ability to recruit a diverse sample that is representative of the U.S. population. In Study 1, we were not able to acquire detailed demographic information from

our participants, due to the nature of the field study and the limitations of Facebook's ad platform. In Study 2, our participants were primarily White/Caucasian, reflecting the makeup of the Prolific user base. Overall, although we recruited large samples that covered a broad age range, we were not able to compare the efficacy of messages across racial or ethnic groups. Prior research has demonstrated race/ethnicity differences in COVID-19 attitudes and behaviors (Baker et al., 2022); a key goal for future research is to test public health messaging in diverse populations, across platforms (e.g., phone outreach, flyers/posters), and in messages other than English.

Last, the COVID-19 Event Risk website currently focuses on exposure risk that depends on disease prevalence and event size. We chose to focus on these key variables because prevalence and event size are the foundation of exposure risk; all other variables (some of which may not be known ahead of time) modify this baseline risk level. However, prevalence estimates are influenced by population immunity, testing availability, and the frequency and accuracy of case reporting. Additionally, the risk of exposure is distinct from the risk of infection. As described on the COVID-19 Event Risk website, other factors influence the risk of infection. Receiving vaccinations (including boosters), wearing a mask, improving ventilation, decreasing crowd density, and holding gatherings outdoors all decrease the risk of infection, even if a COVID-19-positive individual is present at the event. In future research, we aim to develop tools that aid individuals in assessing personal risk (in addition to exposure risk) and motivate actions that can be taken to reduce risk levels. Incorporating specific scenarios may increase the impact of risk information and the efficacy of calls to action.

Conclusion

In the present study, we tested the efficacy of messages intended to motivate information seeking about COVID-19. We found that inviting users to consider risk levels for a specific scenario in their local community was the most effective way to motivate information seeking. In Study 1, scenario ads generated click-through rates nearly twice as high as the national-level control ads. In Study 2, we replicated and extended this key finding, demonstrating that specificity (rather than self-relevance) drove interest in learning about COVID-19 risks. Furthermore, we demonstrated that political partisanship substantially influences COVID-19 attitudes and information seeking. Relative to liberals, conservatives were less interested in learning about COVID-19 risks, more likely to feel disgust and anger in response to an ad, and less likely to use our interactive risk assessment tools. However, scenario ads increased engagement across demographic groups, and our risk assessment tools benefited both liberals and conservatives who engaged with our website. Overall, we propose that evoking specific scenarios motivates information seeking to improve risk communication. Even small effect sizes can have substantial cumulative impact when applied to a large-scale, cost-effective advertising campaign: On average, for every dollar we spent on scenario ads, nine Facebook users sought information about COVID-19 risks. Our results bear broader implications for science communication in other domains that involve risk assessment and behavior change, such as vaccination or climate change.

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