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Combating COVID-19 fake news on social media through fact checking: Antecedents and consequences

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Combating COVID-19 fake news on social media through fact checking: Antecedents and consequences

The onset of the COVID-19 pandemic was accompanied with a pandemic of fake news spreading over social media (SM). Fact checking might help combat fake news and a plethora of fact-checking platforms exist, yet few people actually use them. Moreover, whether fact checking is effective in preventing citizens from falling for fake news, particularly COVID-19 related, is unclear. Against this backdrop, we (a) examine potential antecedents to fact checking that can be a target for interventions and (b) establish that fact checking is actually effective for preventing the public from falling for harmful COVID-19 fake news. To do so, we use a representative U.S. sample collected in April of 2020. We find that awareness of fake news and patterns of active SM use (e.g., commenting on content on SM instead of just reading it) increases the fact checking of COVID-19 fake news, whereas SM homophily reduces fact checking and the effects of SM use as users are trapped in "echo chambers." We also find that fact checking helps users identify and follow accurate information on how to protect themselves against COVID-19 instead of false and often harmful claims propagated on SM. These findings highlight the importance of fact checking for combating COVID-19 fake news and help identify potential interventions.

Keywords: fake news, social media, fact checking, awareness, active use, passive use, homophily, COVID-19, echo chamber.

Introduction

Fake news, referring to intentionally and verifiably false news (Allcott & Gentzkow, 2017), is a troubling trend of the 21st century. During the onset of the COVID-19 pandemic, its danger became apparent when misinformation was so pronounced that the United Nations warned people not only about the consequences of the virus, but also of the "infodemic" surrounding it.[1] The World Health Organization (WHO) actively campaigned against many of the false claims such as COVID-19 being just like the flu and the pathogen being spread by 5G networks (WHO, 2020). Although the onset of the pandemic has passed, the influence of fake news on COVID-related information, particularly the availability and safety of an eventual vaccine, will continue to affect our ability to defeat the pathogen, especially as, at the time of completion of this manuscript, the virus had spread to nearly every continent and, in many countries, numbers continued to soar and set new record heights (Pettersson et al., 2020).

Particularly dangerous is fake news that is propelled by social media (SM), which is the focus of this study. In the contemporary climate of eroding trust in the traditional news media, fake news finds large audiences among many who now turn to SM as their primary source of news (Shearer, 2019). Trusting online information leads to the sharing of fake news (Laato et al., 2020). Thus, on SM, passing from person to person, fake news spreads faster and farther than the truth (Vosoughi et al., 2018), sometimes with disastrous consequences. For example, people who use SM more are more likely to believe false and dangerous anti-vaccination claims (Stecula et al., 2020). Fake news on SM has been suggested as having played a role in swaying the 2016 U.S. presidential election (Allcott & Gentzkow, 2017), in fuelling a civil war in south Sudan (Patinkin, 2017), and in stimulating hate crimes against

[1] https://www.un.org/en/un-coronavirus-communications-team/un-tackling-'infodemic'-misinformation-and-cybercrime-covid-19

Asian-Americans with the onset of the COVID-19 pandemic (Kelley, 2020). Clearly, fake news on SM is dangerous and combating it is of critical relevance to protect citizens from harmful misinformation.

One way to combat fake news is to empower citizens to detect and contest fake news, as recently suggested in a *Science* article by Lazer et al. (2018). To that end, several solutions have emerged. These range from fake news flags that are supposed to raise SM users' suspicions regarding the veracity of an article or presented information to fact-checking platforms that make it easy and convenient for people to *fact check*, i.e., making assessments about the truthfulness of a claim (Colliander, 2019). However, evidence of their effectiveness is lacking. Flags have been shown to be ineffective in making users less susceptible to believing fake news (Colliander, 2019; Moravec et al., 2019) and despite the hundreds of fact-checking platforms available, it has been reported that 9 out of 10 Americans do not fact check the news they read on SM (Zignal Labs, 2017). It is also currently unclear whether fact checking actually prevents users from believing fake news, which is particularly important to discover in the context of the COVID-19 pandemic and an upcoming COVID-19 vaccine. Users might simply distrust the information provided by fact-checking platforms (Brandtzaeg & Folstad, 2017) or may have encountered fact-checking platforms that repeat false claims, thus making them more likely to remember false claims that may even lead to counterproductive results (Lazer et al., 2018). As a result of the nascent state of the literature and absence of effective interventions against fake news, Lazer et al. (2018) called for future research, particularly on fact checking and interventions that can help combat fake news.

We focus on (a) antecedent factors that could be potential targets of interventions that can stimulate fact checking of COVID-19 fake news on SM as well as (b) consequences of fact checking so as to assess whether fact checking actually protects users' from believing the often dangerous information spread by fake news. We draw from prior work to motivate

potential antecedents that could be targets for effective and efficient interventions. As consequences, we examine users' adaptive and maladaptive responses to the COVID-19 pandemic.

Model Development

The first purpose of this inquiry is to examine the antecedents of fact checking so as to shed light on factors that might be targets of interventions. Although many different type of intervention techniques exist (cf. Abraham & Michie, 2008), we consider three different antecedents for interventions.

The first is awareness. In public health contexts, awareness is often targeted through awareness campaigns, which is perhaps the least resource intensive to carry out and might be especially effective when awareness is low in the general population (Jacobsen & Jacobsen, 2011). The second factor that we consider relates to how SM is used. Many interventions in public health contexts aim at engendering behavioural change related to how things (e.g., alcohol, condoms) are used or consumed (cf. Boyd & Wandersman, 1991). Following that logic, we consider how SM should be consumed (actively or passively) but note that behavioural change may be more difficult to promote than disseminating information through awareness campaigns and that their effect might depend on the SM environment. Given that any SM platform could function as an echo chamber (Allcott & Gentzkow, 2017; Flaxman et al., 2016; Garrett, 2009), we specifically consider the effect of homophily of SM ties as an environmental factor and how it affects fact checking as well as the relationship between SM use patterns and fact checking. Finally, given that much prior research has reported substantial effects of cognitive biases on people's responses to fake news (Kim et al., 2019; Moravec et al., 2019), we consider mindfulness as a potential debiasing intervention that can be promoted through mindfulness interventions (e.g., Jensen et al., 2017). However, we note

that this intervention might be the most resource intensive. Figure 1 shows our research model.

-- Figure 1 about here --

Antecedents of fact checking

Homophily of social media ties

The extent to which people engage in fact checking is likely to be influenced by their social ties on SM. The social ties that users develop and sustain on SM have deep, abiding influence on behaviour (Althoff et al., 2017). A powerful factor in social ties is the concept of *homophily*—the tendency of people to seek out and interact with others like themselves (McPherson et al., 2001). Homophily can be at the *surface*- or *deep*-level (Lazarsfeld & Merton, 1954 used the terms ascribed and acquired). Surface-level attributes are those that are readily discerned such as race/ethnicity, gender, and age, whereas deep-level attributes are those that are based on attitudes, beliefs, and values such as religious or political alignment (Lambert & Bell, 2013). Although surface- and deep-level attributes constitute two different dimensions of homophily, we expect them to have similar effects.

Higher levels of homophily are likely to reduce users' fact checking. Research has shown that homophily in social interactions decreases uncertainties while increasing feelings of safety and general ease in communication (Prisbell & Andersen, 1980). Thus, on SM, greater homophily allows for faster transmission of information but limits the diversity of that information (Halberstam & Knight, 2016). A plausible explanation can be that because of decreased uncertainty and increased comfort with other SM users, wherein users are more willing to trust and thus accept and share fake news (Laato et al., 2020). Thus, we hypothesize:

H1: SM tie homophily will be negatively associated with fact checking.

Awareness

An antecedent that could serve as a target for interventions is awareness. *Awareness* in the context of this work refers to an user's cognizance of the presence of fake news on their SM (adapted from Torres et al., 2018). Some research has suggested that people's knowledge of misinformation tactics may make them resistant to persuasion, as their general awareness of persuasion tactics increases their ability to recognize such attempts (Fransen et al., 2015). Thus, aware users might be able to recognize fake news as such, or at least become suspicious once they recognize cues and tactics (e.g., fear mongering). Further, with the proliferation of fake news on the Internet and social media, as well as the eroding trust in news in general (Allcott & Gentzkow, 2017), we expect users who are aware of fake news being propagated on SM will engage in more fact checking. Thus, we hypothesize:

H2: Awareness will be positively associated with fact checking.

Patterns of social media use

Another factor that can trigger users' fact checking is related to the actions and interactions in which people engage on SM. Users can use SM both passively and actively. *Passive social media use (PSMU),* sometimes referred to as "lurking", involves a pattern of use wherein there is perusal of posts and comments on those posts left by other users but without any active engagement beyond reading such information (Trifiro & Gerson, 2019). Users who passively read posts, articles in the posts and also associated comments, often use the comments as a means of judging the accuracy of the information being presented (Jiang & Wilson, 2018). Passively reading others' critical comments can thus not only reduce the likelihood of sharing fake news, but also, as prior work has shown (Colliander, 2019), serve as cues that trigger users to engage in fact checking. Thus, we hypothesize:

H3a: Passive SM use will be positively associated with fact checking.

Active social media use (ASMU) involves a pattern of use with direct exchanges among users such as commenting on, reacting to and sharing of others' posts on an SM platform (Verduyn et al., 2017). Such actions are often motivated by users' needs for self-presentation. Self-presentation might either be protective, meaning avoiding social disapproval and unfavourable impression formation, or acquisitive, referring to the pursuit of social approval and favourable impression formation (Leary & Allen, 2011). These self-presentation processes are relevant to fact checking in that (unknowingly) posting fake news might elicit negative responses that are damaging to one's public image and can lead to social disapproval. Consequently, in order to avoid "looking stupid," users who actively use SM are likely more motivated to fact check information before commenting on, liking, posting, or sharing fake news earnestly. Thus, we hypothesize:

H4a: Active SM use will be positively associated with fact checking.

SM use and homophily

Social media ties influence what content users can either passively read or actively respond to on SM. When one's SM ties are homogeneous, critical comments are less likely to be encountered, as homophily suggests like-minded users posting information that reinforces their own beliefs. This creates an echo chamber wherein PSMU is likely to result in a deluge of messaging that reinforces one's own beliefs (Flaxman et al., 2016). For ASMU, we expect the same to be true. As users also engage in ASMU satisfy their need for self-presentation and belonging (Nadkarni & Hofmann, 2012), in highly homophilious networks, users are likely less concerned with the truth and more concerned with matching the public opinion of their ties in their posts and replies. Thus, SM use in echo chambers can reduce fact checking. Thus, we hypothesize:

H3b: Under conditions of high SM tie homophily, passive SM use will be negatively associated with fact checking.

H4b: Under conditions of high SM tie homophily, active SM use will be negatively associated with fact checking.

SM mindfulness

The role of an users' information processing style has received much attention in the literature on fake news. *SM mindfulness,* in this context, refers to users' conscious thought and attention to the present moment when using SM (based on Creswell, 2017). The believability of fake news seems to be strongly influenced by cognitive biases (Moravec et al., 2019). As mindfulness is generally argued to contrast the automated and heuristic processing that gives biases the opportunity to manifest (Creswell, 2017), mindfulness has been shown to reduce the influence of biases (e.g., Kiken & Shook, 2011). For example, mindfulness training has been shown to reduce people's susceptibility to deceptive phishing attacks (Jensen et al., 2017). SM mindfulness could, therefore, help users overcome biases that inhibit their critical processing of suspicious news items. Thus, we hypothesize:

H5: SM mindfulness will be positively associated with fact checking.

Outcomes of fact checking

To understand the outcomes of fact checking, we examine the role of fact checking in people's adaptive and maladaptive responses to the COVID-19 pandemic. People cope by expending effort to deal with the problem or situation that causes the stress (Folkman et al., 1986). Such coping responses can be broadly categorized into those that are useful and those that are not useful in dealing with a threat (Liang et al., 2019). Useful behavioural responses are generally referred to as being adaptive, where *adaptive responses* relate to desirable behaviours that objectively help with dealing with a situation. In contrast, *maladaptive responses* relate to undesirable behaviours that are objectively ineffective in dealing with a situation (Lazarus & Folkman, 1984).

We argue that fact checking influences the likelihood of adaptive and maladaptive responses. As fake news intentionally spreads verifiable misinformation, belief in the misinformation causes maladaptive responses in that they relate to objectively wrong behaviours. However, without fact checking, such misinformation remains uncontested. Therefore, users who do not fact check are more likely to be misguided by misinformation and ultimately, more likely to perform maladaptive responses. In contrast, people who fact check are more likely to contest misinformation and discover accurate information that leads to adaptive responses. Thus, we hypothesize:

H6a: Fact checking will be positively associated with adaptive responses.

H6b: Fact checking will be negatively associated with maladaptive responses.

Method

To test our hypotheses, we collected data using a survey investigating the antecedents and consequences of fact checking in the context of the COVID-19 pandemic. During the onset of the pandemic, fake news ranged from ineffective (e.g., taking hot baths, eating garlic) to outright dangerous behaviours (e.g., taking antibiotics, gargling with bleach).[2] Thus, in the context of this pandemic, the validity of the more egregious of these claims (such as gargling with bleach) is reasonably verifiable. The pandemic hence presents a context in which one can assess the consequences of fact checking by examining to what extent people who engage in fact checking act upon information and misinformation.

Participants

We recruited a sample of 461 responses through a survey panel provider. The data collection was initiated and completed in April 2020 by which time the COVID-19 pandemic had a

[2] The WHO offers an overview of these "myths" here: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public/myth-busters

substantial volume of fake news, especially on SM. As purposefully stratified by the panel provider, the sample characteristics closely resemble the characteristics of the U.S. population (see Appendix A).

Measurement

We mostly built on established measurements for the constructs in our model (Appendix B reports our full measurement instrument). We measured adaptive and maladaptive responses using an index measure (Diamantopoulos & Winklhofer, 2001). To identify behaviours that would classify as adaptive or maladaptive, we used the COVID-19 advice and myths curated by the WHO (2020) in March 2020. Specifically, we asked to what extent participants practiced six behaviours that the WHO recommended (e.g., "I wash my hands frequently") or six behaviours that the WHO advised against (e.g., "I spray alcohol and chlorine on my body to kill the virus"). Control variables included age, education, and SM use (minutes per day), participants' self-reported confirmation, political orientation. To alleviate the threat of common method bias to some extent, the measures of IVs and DVs were temporally separated by two weeks.

Analysis & Results

We assessed the reliability and validity of our scales through Cronbach's alpha values (Table 1) and the square roots of AVEs (Table 2). Cronbach's alpha values were all above the 0.7 threshold and square root of AVEs were greater than the construct correlations, thus indicating discriminant validity.

-- Table 1 and 2 here --

Analysis of antecedents to fact checking

Table 3 reports a hierarchical regression analysis. Model 4 explained the highest variance

with an R^2 of .38. There was a direct effect of deep-level homophily on fact checking, significant at $p < 0.10$, thus indicating marginal support for H1. Further, we found significant positive effects for awareness and PSMU, thus supporting H2 and H3a. We did not find evidence of a significant main effect of ASMU on fact checking, thus not supporting H4a. The effect of SM mindfulness was nonsignificant, thus not supporting H5.

-- Table 3 here --

We also found significant interaction effects between PSMU and homophily as well as ASMU and homophily. However, the results showed that the interaction between PSMU and surface-level homophily was negative, whereas the interaction between ASMU and deep-level homophily was positive. To better understand the interactions, we plotted them (Figure 2). The interaction effect between surface-level homophily and PSMU was such that, in conditions of high homophily, high PSMU led to less fact checking, thus supporting H3b. In contrast, the interaction effect between deep-level homophily and ASMU was such that, in conditions of high homophily, high ASMU led to more fact checking, thus being opposite to the hypothesized direction in H4b.

-- Figure 2 here --

Analysis of consequences of fact checking

To understand the effect of fact checking on adaptive and maladaptive responses, we fitted two multiple regressions. Here, we included fact checking as a predictor and added its antecedents and other control variables. The results (Table 4) showed that fact checking had a positive direct effect on adaptive responses but not on maladaptive responses, thus supporting H6a but not H6b.

-- Table 4 here --

Post-hoc mediation analysis

Finally, we performed a post-hoc mediation analysis to examine whether fact checking behaviour mediated any of the effects of its antecedents on adaptive and maladaptive responses. To that end, we fitted a structural equation model using R. The use of SEM is appropriate here as it allows for a holistic test of our model that is needed for a mediation analysis. We introduced direct effects from all antecedents to outcomes so as to understand the mediation role of fact checking. The estimated model yielded a CFI of .951, a TLI of .943, a RMSEA of .046, and a SRMR of .060. These scores are in line with established validity criteria (i.e., CFI, TLI of .90 or higher, RMSEA below .06, SRMR below .08) and thus indicate acceptable model fit.

Table 5 shows the results of the fitted model. The findings from this SEM analysis were identical to our findings from the hierarchical regression analysis. Specifically, the results showed significant direct effects of awareness as well as passive and active SM use. Further, the results indicate that fact checking only affected adaptive responses but not maladaptive responses.

-- Table 5 here --

Following the guidelines of Zhao et al. (2010), we compared the direct paths and indirect paths to understand the type of mediation (Zhao et al., 2010). We found evidence of an indirect effect of awareness on adaptive responses through fact checking. As the direct effect of awareness on adaptive responses remained nonsignificant (Table 6), it suggests that fact checking fully mediated the effect of awareness on adaptive responses. Further, we found evidence of an indirect effect of ASMU on adaptive responses. As the direct effect was significant, this suggests a partial mediation. The path between fact checking and maladaptive responses remained nonsignificant.

-- Table 6 here --

Discussion

Scientific contributions

First, our findings revealed new antecedents of fact checking in the context of COVID-19, thus adding to our understanding of the phenomenon beyond the previously examined demographics and ideologies as antecedents (Robertson et al., 2020). Specifically, we found evidence that SM homophily was an inhibitor of fact checking (H1) and that awareness was a strong driver of fact checking (H2), reinforcing the importance of raising awareness about fake news among SM users. Further, we found that SM use patterns affected fact checking. Here, our studies supported that PSMU (H3a) led to more fact checking, particularly under conditions of low homophily (H3b). Interestingly, we found that ASMU only led to more fact checking when homophily was high (H4b). Overall, these findings show that with the onset of the COVID-19 pandemic, in which uncertainty about information was high, users were more careful by fact checking COVID-19 related news on SM when they were in less homophilious SM environments and generally aware of the circulation of COVID-19 fake news on SM. Also, SM use influenced users' fact checking of potential COVID-19 fake news. Here, PSMU seems to encourage fact checking more when SM users were outside homophilious networks—so called echo cambers in the context of SM—and ASMU when users were within so called echo chambers. This reveals potential avenues for interventions that could stimulate fact checking under conditions marked by high uncertainty such as the evolving COVID-19 pandemic.

Second, we add to the body of research on the outcomes of fact checking (Colliander, 2019; Lazer et al., 2018; Margolin et al., 2018). Although previous research has shown that fact checking may stimulate rebuttals of misinformation and reduce users' likelihood to share misinformation (Colliander, 2019; Margolin et al., 2018), scant research has examined the direct consequences of fact checking on the user. As fact checking leads to repeated exposure

to false claims, Lazer et al. (2018) speculated on whether fact checking could be counterproductive. Our study alleviates this concern by finding a significant positive effect of fact checking on adaptive responses in the context of the COVID-19 pandemic (H6a). Here, our results showed that more fact checking led to more behaviours that were desirable for protecting against the pathogen (e.g., frequently washing hands). Further, our mediation analysis showed that fact-checking fully mediated the effects of awareness on adaptive responses. This suggests that awareness of fake news is not enough to discern correct information. Rather, fact checking helped users discover truthful information that led to desirable behavioural adaptations that were essential for self-protection against contracting COVID-19. Further, the mediation analysis showed that the effects of ASMU were partially mediated by fact checking, thereby further highlighting the importance of fact checking in leading to positive outcomes.

Interestingly, we did not find evidence that fact checking significantly reduced maladaptive responses (H6b) that do not help protecting against COVID-19. This suggests that fact checking did not necessarily lead users to refute COVID-19 misinformation. One explanation for this finding aligns with prior evidence that users are often unwilling to update their beliefs even when confronted with facts (De Keersmaecker & Roets, 2017), as users may distrust fact-checking websites. Indeed, in line with prior research (e.g., Robertson et al., 2020), we found that a Republican political orientation reduced an users' likelihood to engage in fact checking and also increased maladaptive responses. Thus, distrust in fact checking websites, fuelled by political weaponization of these services, as has been the case during the COVID-19 pandemic, particularly in the U.S. where we sampled from, might have potentially disastrous consequences for people's health.

Importantly, our mediation analysis revealed that PSMU should not be promoted through interventions. Although our findings suggested that it might help increase fact

checking, our mediation analysis also revealed significant direct effects on adaptive and maladaptive responses. These direct effects are overall undesirable, as they show that PSMU was associated with less adaptive responses and with more maladaptive responses. Thus, arguments that users passively reading other users' comments is beneficial should be interpreted with caution (Colliander, 2019). The effect of PSMU here presents a contrast to the effects of awareness and ASMU that yield desirable effects. In light of alternative approaches, such as fake news flags (Moravec et al., 2019) and media literacy interventions (Jones-Jang et al., 2019), being ineffective, these two factors add new avenues that hold much promise for combating fake news.

Third, our findings also add to research on echo chambers (Allcott & Gentzkow, 2017; Flaxman et al., 2016; Garrett, 2009). Related work has shown that consuming news through SM increases the diversity of users' news consumption, whereas seemingly paradoxically, also increases their ideological segregation (Flaxman et al., 2016). Here, our study adds evidence that this might be because users in echo chambers are less likely to fact check COVID-19 related news, as we found evidence of significant negative effects of deep-level homophily on fact checking (H1). Thus, echo chambers do not only function through the presentation of news and content selected by algorithms (Flaxman et al., 2016), but also due to the homophily of users' SM environments. This finding explains that, during the onset of the COVID-19 pandemic, one reason for why COVID-19 fake news spread fast and far was because it remained unchecked in such echo chambers.

Fourth, we did not find evidence substantiating the idea that SM mindfulness influenced fact checking (H5). However, that does not mean that mindfulness interventions are irrelevant for combating fake news. To the contrary, we found evidence that SM mindfulness was positively related to adaptive responses, suggesting that, although mindfulness interventions might not affect fact checking, it does influence what information

users believe and act upon. This points to the importance of believability, as studied in prior research (Colliander, 2019; Kim & Dennis, 2019; Kim et al., 2019; Moravec et al., 2019). Mindfulness was thus a virtue in dealing with the high uncertainty and abundance of misinformation that marked the onset of the COVID-19 pandemic and protected users from falling for fake news.

Limitations and future research

The focus of our study was on fake news in the context of SM and COVID-19. In reality, citizens encounter fake news not just on SM, but also when watching TV, interacting with friends, family, and coworkers. Thus, future research could investigate triggers of fact checking outside the SM context. A further limitation relates to the role of SM. We conceptualized SM use to be the source of fake news and conceptualized fact checking to be a second, independent activity. However, SM may also be used as a fact-checking platform, as it allows for news to be discussed and rebutted on the SM platform itself. Thus, future research could examine the mechanisms by which SM itself can serve as a fact-checking tool. Further, we did not investigate the specific influence of the SM platform but rather studied fake news on SM holistically. However, as SM platforms (i.e., Facebook, Twitter, YouTube) not only suffer from fake news to different degrees, but also share different approaches to combating it, it is possible that the effects of fake news and the role of fact checking may depend on the specific SM platform. Also, we treated fake news as an exogeneous variable and did not incorporate the features of fake news that lead to fact checking. Although this was appropriate for understanding the general factors that influence fact checking, future research could incorporate specific fake news features.

Another limitation of our work pertains to the time at which our data were collected. Our first wave was collected immediately after the onset of the COVID-19 pandemic and our

second wave was two weeks later. At that time, much information and misinformation circulated on SM and distilling fake from accurate news and information might have been especially difficult. This might have led to the strong effects of fact checking that we observed. Over time, as more was learned about the pathogen, it might have become easier for SM users to identify fake news even without fact checking. Although this does not invalidate the importance of fact checking, it suggests that our findings are contextual to the onset of a situation (here, something that turned into a crisis) that is characterized by a fair degree of uncertainty. Further research should investigate the role of fact checking in later parts of a developing crisis. The conceptualization and incorporation of time in theorizing, especially for such a dynamically evolving phenomenon, is vital (see Venkatesh et al., 2006). Finally, to enhance the generalizability of our findings, we call on future research to test our fact checking model in the contexts of other crises and to examine SM users' fact checking in general.

Practical implications

Our work provided evidence on the effectiveness of fact checking in driving users to objectively desirable outcomes. Specifically, we showed that fact checking increased one's likelihood to engage in adaptive responses that help protect them against COVID-19 fake news. These findings underscore the importance of deploying interventions that stimulate fact checking, particularly in the onset of a global crisis in which uncertainty is high, and may also convince sceptics about the benefits of fact checking.

Our work also suggested three ways by which fake news can be combated. First, our work underscores the promise of awareness campaigns, an approach that has not been formally investigated. Not only did our results provide empirical support that awareness is linked to fact checking, but also established that awareness affects users' likelihood to engage

in adaptive and maladaptive responses. With the onset of the COVID-19 pandemic, based on our findings, the U.S. population would have needed *more* public service announcement—disseminated on SM platforms—that inform the public about which recommendations were misinformation. Second, our work suggests that ASMU should be promoted, as it increased fact checking and is further linked to adaptive responses. Thus, the more people actively engage with content of SM, the better off they may be. Finally, adding to that point, our results suggest that users' PSMU should be kept in check.

Our study also offers insights into which interventions should be tried out first. When comparing the results of the antecedents on fact checking, among the antecedents that increased adaptive responses, awareness had the largest magnitude. When considering the pragmatism surrounding deploying interventions, such as the efforts and costs involved, awareness will arguably be least expensive to target. Thus, our findings suggest that awareness is the low-hanging fruit when it comes to interventions that aim to empower citizens to combat fake news. Based on this finding, any government administration should be advised that combating COVID-19 related fake news is best addressed through awareness campaigns. This finding might also apply when a vaccine becomes within reach, as is currently the case in the U.S. and U.K., among others. As misinformation about its safety might hamper public acceptance, governments should act early to inoculate the public about vaccine-related fake news.

Given the negative effects of PSMU on adaptive responses and large positive effects on maladaptive responses, another area to focus is to keep PSMU in check, particularly in homophilous networks. This is perhaps an avenue in which changes in the algorithms of SM platforms could help so that users receive more varied content with different information, which could further prompt fact checking. Finally, approaches to stimulate ASMU should be

considered—e.g., using gamification to encourage commenting regarding the lack of veracity on fake news posts (e.g., badges for fact checkers).

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Tables

Table 1. Descriptive Statistics and Reliabilities

Construct	Mean	SD	CA[a]
SM Use (Minutes per day)	47.64	49.68	na
Bias	4.20	1.13	0.93
Homophily (Surface)	4.35	1.09	0.90
Homophily (Deep)	3.17	1.14	0.87
Awareness	5.21	1.35	0.87
Passive SM Use	2.89	1.66	0.92
Active SM Use	4.13	1.53	0.90
SM Mindfulness	4.66	1.30	0.82
Fact Checking	4.40	1.79	0.97
Adaptive Responses	41.6	5.34	na
Maladaptive Responses	11.88	6.17	na

CA = Cronbach's alpha; [a] Not available for constructs that were measured with one-item scales or calculated using index measures.

Table 2. Correlations and AVEs

Construct	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
1: Age	NA													
2: Gender	-.04*	NA												
3: Education	.09+	.03	NA											
4: Political Orientation	-.15**	-.01*	-.03*	NA										
5: Bias	.01*	-.09*	.08+	-.07*	**.91**									
6: SM Use (Minutes per day)	-.26***	.05	-.10*	.02	.03	NA								
7: Homophily (Surface)	-.05*	.01*	-.05*	.11*	-.12*	.05	**.84**							
8: Homophily (Deep)	-.08*	.08+	-.02*	.09+	-.29***	.01*	.09*	**.81**						
9: Awareness	-.08*	-.07*	.04	-.05*	.02	.11*	.10*	-.07*	**.87**					
10: PSMU	-.03*	-.10*	-.10*	-.02*	.16***	.11*	.03	-.10**	.23***	**.92**				
11: ASMU	-.17***	-.09*	-.09*	.04	.17***	.11*	.06	-.15***	.24***	.67***	**.83**			
12: SM Mindfulness	.26***	.04	-.12**	-.02*	-.06*	-.09*	.03	-.05*	-.02*	07+	.06	**.78**		
13: Fact Checking	.01*	-.06*	.01*	.05	.03	.12*	.13*	-.12**	.42***	.10*	.41***	.44***	**.95**	
14: Adaptive Responses	.18***	-.13**	.09+	-.06*	.09*	-.05*	-.06**	-.19***	.22***	.11*	.11*	.18***	.20***	NA
15: Maladaptive responses	-.08*	.01*	-.05*	-.06*	.01*	.12*	-.08**	.10*	-.03*	-.03*	.28***	.19***	.06	.06

†p < .1, *p < .05, **p < .01, ***p < .001, bold numbers running down the diagonal represent the square-root of AVE. NA = AVE not applicable for single-item measures and index measures.

Table 3. Predicting Fact Checking

Variables	**Model 1: Controls only[1]**	**Model 2: Homophily[1]**	**Model 3: Homophily + Interventions[1]**	**Model 4: Full Model[1]**
Age	.01 (.01)	.01 (.01)	.01 (.00) †	.01 (.00) †
Gender	-.24 (.16)	-.23 (.16)	-.04 (.13)	-.04 (.13)
Education	.03 (.08)	.04 (.08)	.08 (.07)	.07 (.07)
Political Orientation (Republican)	-.48 (.20)*	-.40 (.20)*	-.34 (.17)*	-.37 (.17)*
SM Use (Minutes per day)	.01 (.00)**	.01 (.00)**	.01 (.00)+	.01 (.00)
Bias	.02 (.07)	-.01 (.07)	-.07 (.06)	-.08 (.06)
Homophily (Surface)		.22 (.07)***	.13 (.06)*	.21 (.16)
Homophily (Deep)		-.2 (.07)**	-.09 (.06)	-.30 (.16)+
Awareness			.40 (.05)***	.37 (.05)***
Passive SM Use			.14 (.05)**	.55 (.27)*
Active SM Use			.32 (.06)***	-.13 (.25)
SM Mindfulness			.07 (.05)	.07 (.05)
Homophily (Surface) X Passive SM Use				-.11 (.03)*
Homophily (Deep) X Passive SM Use				-.02 (.05)
Homophily (Surface) X Active SM Use				.04 (.05)
Homophily (Deep) X Active SM Use				.14 (.01)**
R^2 (ΔR^2)	.03	.07 (.04*)	.34 (.27***)	.38 (.04*)

[1]Unstandardized coefficients (standard errors in parentheses). † $p \leq .1$, * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$

Table 4. Predicting Adaptive and Maladaptive Responses

Variables	Adaptive Responses[1]	Maladaptive Responses[1]
Homophily (Surface)	-.13 (.24)	-.26 (.28)
Homophily (Deep)	-.22 (.23)	.90 (.28)***
Awareness	.31 (.21)	-.73 (.25)***
Passive SM Use	-.33 (.20)†	.95 (.24)***
Active SM Use	.45 (.23)*	.30 (.27)
SM Mindfulness	.55 (.20)**	-.17 (.24)
Fact Checking	.35 (.17)*	.11 (.20)
Age	.06 (.02)***	-.01 (.02)
Gender	-.87 (.50)†	.06 (.59)
Education	.51 (.25)*	.02 (.30)
Political Orientation (Republican)	-.12 (.60)	2.30 (.71)***
SM Use (Minutes per day)	.01 (.01)	.01 (.01)
Bias	.06 (.24)	-.20 (.28)
RSq	.14	.18

[1]Unstandardized coefficients (standard errors in parentheses). † $p \leq .1$, * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$

Table 5. Structural Equation Estimation of the Full Research Model

	FC[1]	AR[1]	MR[1]
Homophily (Surface)	.08 (.08)	-.24 (.24)	-.44 (.29)
Homophily (Deep)	-.11 (.07)	-.21 (.22)	.97 (.26)***
Awareness	.65 (.10)***	.42 (.31)	-1.10 (.36)***
Passive SM Use	.17 (.06)**	-.35 (.21)†	1.22 (.25)***
Active SM Use	.30 (.07)***	.65 (.25)**	.03 (.3)
SM Mindfulness	.07 (.06)	.47 (.21)*	-.30 (.25)
Fact Checking		.33 (.16)*	.10 (.19)
Age		.07 (.02)***	-.01 (.02)
Gender		-.85 (.45)†	.12 (.52)
Education		.38 (.22)†	-.09 (.26)
Political Orientation (Republican)		.22 (.56)	2.23 (.66)***
SM Use (Minutes per day)		.00 (.01)	.01 (.01)†
Bias		.02 (.19)	.05 (.23)
RSq	.33	.14	.20

[1]Unstandardized coefficients (standard errors in parentheses). † $p \leq .1$, * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$
FC = Fact checking, AR = Adaptive responses, MR = Maladaptive responses.

Table 6. Mediation Analysis

Indirect Path	Effect Estimate	Standard Error	p-Value
Homophily (Surface) → FC → AR	.03	.03	.37
Homophily (Deep) → FC → AR	-.04	.03	.21
Awareness → FC → AR	.21	.11	.05*
PSMU → FC → AR	.06	.04	.11
ASMU → FC → AR	.10	.05	.06†
Mindfulness → FC → AR	.02	.02	.30

Note: † $p \leq .1$, * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$
FC = Fact checking, AR = Adaptive responses., PSMU = Passive SM use, ASMU = Active SM use

Figures

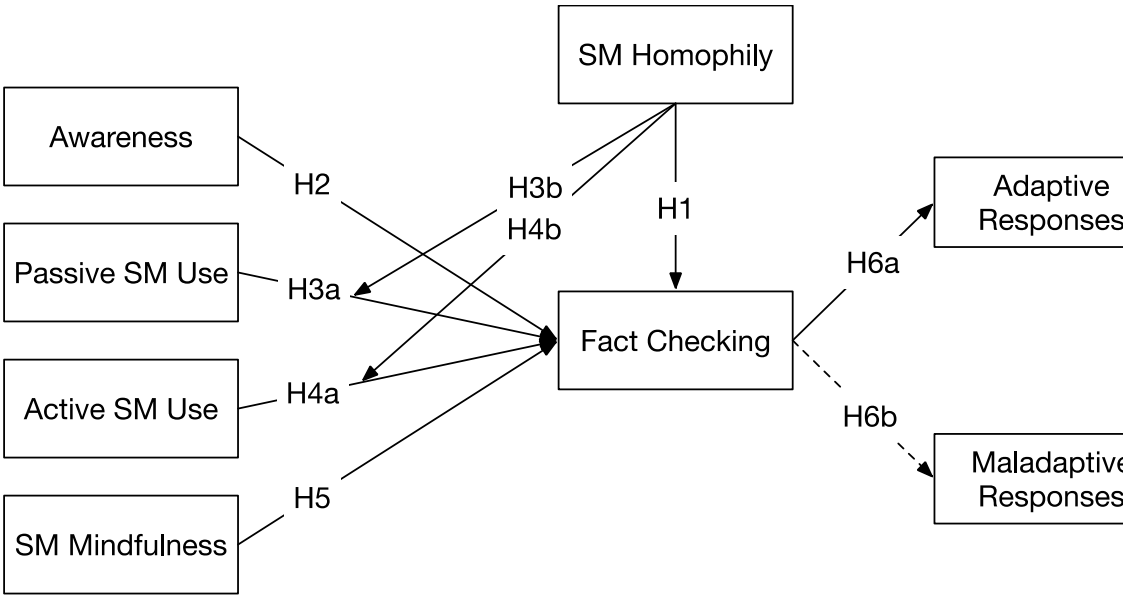

Figure 1. Research Model

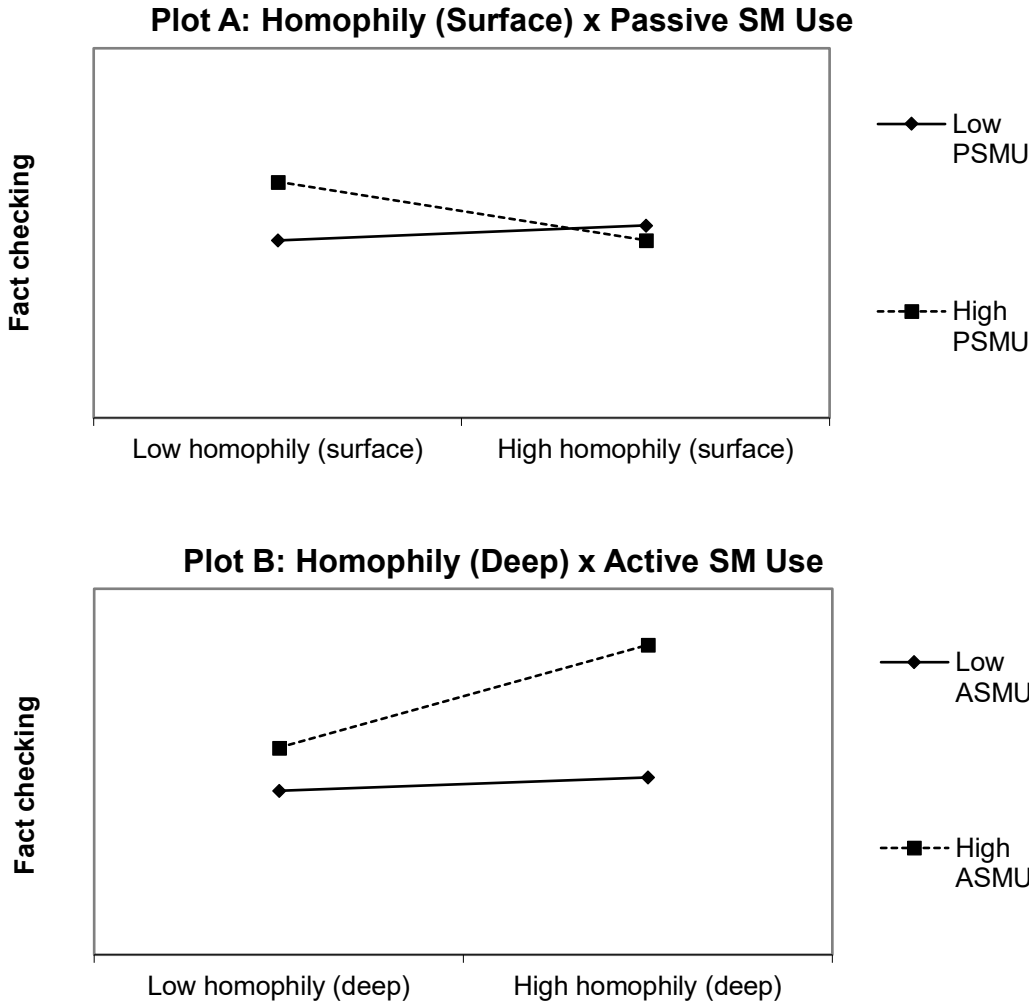

Figure 2. Interaction Plots

Appendix A. Sample

The average age of the sample was 42.6 years and the sample consisted of 47% women, 65% Caucasian, 12% African-American, and 16 % Hispanics. The sample characteristics closely resemble the characteristics of the US population that is, according to the US Census Bureau[3], 38.2 years old, 50.8% women, with 76.5% Caucasian, 13.4% African-American, and 18.3% Hispanics. Further, the majority of participants in our sample had an undergraduate degree (38%), followed by an associate degree (26%), a graduate degree (17%), high school (12%), doctorate (5%), or other degrees and education (2%). About 22% of participants identified themselves as Republican, 50% as Democrat, 26% as independent, and 2% did not disclose their political orientation.

Appendix B. Measurement Instrument

All items were anchored to a 7-point Likert scale (1=strongly disagree, 2=disagree, 3=slightly disagree, 4=neutral (neither disagree/agree), 5=slightly agree, 6=agree, 7=strongly agree) if not indicated otherwise.

Table A1. Main Instruments	
Construct	**Items**
Instructions for participants	This survey is about the COVID-19 (coronavirus) crisis and its consequences. Hereafter, mentions of the word crisis are made in reference to the COVID-19 crisis.
SM Tie Homophily	**Appearance (Surface-level homophily):** Please rate to what extent people the people you interact with on social media (have): 1. Look similar to me – Look different from me 2. Same size than I am – Different size than I am 3. Appearance like me – Appearance unlike mine 4. Resemble me – do not resemble me **Values (Deep-level homophily):** 1. Morals like mine – Morals unlike mine 2. Sexual attitudes like mine – Sexual attitudes unlike mine 3. Share my values – Do not share my values 4. Treat people like I do – Do not treat people like I do

[3] https://www.census.gov/quickfacts/fact/table/US/PST045219#PST045219

	Items from McCroskey et al. (1975).
Awareness	When reading news on social media, 1. I am very familiar with the problem of *crisis*-related fake news on social media 2. I have frequently seen *crisis*-related fake news being shared on social media 3. I can quickly recall some instances of *crisis*-related fake news being shared on social media Adapted from Collins (2007).
SM Use	**Passive SM Use:** 1. I pay attention to other users' posts about the *crisis* on social media 2. I read content shared by other users on about the *crisis* 3. I view videos and links posted by others about the *crisis* 4. I look for posts on the *crisis* **Active SM Use:** 1. I actively participate in discussions about the *crisis* on social media 2. I comment on other's peoples content related to the *crisis* 3. I share and like discussions on the *crisis* on social media 4. I react to content shared by others on the *crisis* on social media Based on the passive and active Facebook use measures (Gerson et al., 2017).
SM Mindfulness	When browsing social media: 1. I am quick to forget the content that I have seen 2. I find it difficult to stay focused 3. I browse through content without being really attentive to them 4. I browse automatically, without being aware of what I am doing 5. I find myself preoccupied with the future or the past 6. I find myself doing things without paying attention Based on general state mindfulness measure of Brown and Ryan (2003).
Fact Checking	In the past, 1. I actively fact checked suspicious *crisis*-related news that I found on social media 2. I tried to verify the truthfulness of suspicious *crisis*-related news that I found on social media 3. I earnestly attempted to find out the truth about suspicious *crisis*-related news shared on social media Based on Posey et al. (2015)

Adaptive Responses	Please answer the following questions on how you are dealing with the crisis: 1. I wash my hands frequently 2. I maintain a safe distance from others 3. I avoid leaving the house whenever possible 4. I avoid touching my eyes, nose and mouth 5. I cover my mouth and nose with a tissue or my elbow when coughing or sneezing 6. I am aware of the symptoms and if I experience symptoms, I plan on seeking medical care quickly Based on advice given by the WHO (2020) in March 2020.
Maladaptive Responses	Please answer the following questions on how you are dealing with the crisis: 1. I take hot baths to protect myself against the coronavirus 2. I spray alcohol and chlorine on my body to kill the coronavirus 3. I took a pneumonia or flu vaccine to protect against the coronavirus 4. I regularly rinse my nose with saline to help prevent infection from the corona virus 5. I eat garlic to prevent infection from the coronavirus 6. I take antibiotics to avoid infection from the coronavirus Based on myths busted by the WHO (2020) in March 2020.

Table 2. Controls and Demographics	
Age	1. What is your age?
Gender	1. What gender do you identify with? [Male/Female/Intersex]
Education	1. What is your highest obtained educational degree? [high school, some college, bachelor's degree, master's degree, doctorate, other]
Ethnicity	1. Which of the following best describes your ethnicity? [Caucasian, African American, Hispanic, Other (please specify)]
Political Orientation	1. Generally speaking, do you usually think of yourself as a Republican, Democrat, or Independent? [Republican, Democrat, Independent]
SM use (Minutes per day)	On average, how much time do you spend daily on social media to [Study 1: read news/ Study 2: to read news about the *crisis*]? [slider 0 to 12h in 15-minute increments] Based on McKnight et al. (2002).
ias	1. I mostly read [Study 1: news / Study 2: *crisis*-related news] from sources that share my views 2. I predominantly read [Study 1: news / Study 2: *crisis*-related news] that are aligned with my views 3. The [Study 1: news / Study 2: *crisis*-related news] that I typically read conform with my views 4. I often read [Study 1: news / Study 2: *crisis*-related news] that take opposing views to what I belief (reverse coded) This scale was self-developed.

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