Routledge
Taylor & Francis Group

Journal of Broadcasting & Electronic Media

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/hbem20

Examining the Effects of Conversational Chatbots on Changing Conspiracy Beliefs about Science: The Paradox of Interactivity

Jinping Wang & Zeynep Tanes-Ehle

To cite this article: Jinping Wang & Zeynep Tanes-Ehle (2022): Examining the Effects of Conversational Chatbots on Changing Conspiracy Beliefs about Science: The Paradox of Interactivity, Journal of Broadcasting & Electronic Media, DOI: 10.1080/08838151.2022.2153842

To link to this article: https://doi.org/10.1080/08838151.2022.2153842

Published online: 07 Dec 2022.

JOURNAL OF BROADCASTING & ELECTRONIC MEDIA
https://doi.org/10.1080/08838151.2022.2153842

Examining the Effects of Conversational Chatbots on Changing Conspiracy Beliefs about Science: The Paradox of Interactivity

Jinping Wang [a] and Zeynep Tanes-Ehle [b]

[a]School of Journalism and Communication, Chinese University of Hong Kong, Shatin, China; [b]Department of Media, Duquesne University, Pittsburgh, Pennsylvania, USA

ABSTRACT

Conspiracy beliefs are commonly seen during times of uncertainty. This study examined whether a chatbot offering counter-conspiracy information can mitigate conspiracy beliefs and the role of chatbot empathy on its effectiveness. We conducted an online experiment in two different contexts (climate change vs. Covid-19) (N = 189). The results showed that as for Covid-19, participants who interacted with the chatbot with less empathetic expressions showed fewer changes in conspiracy beliefs than those who read the scientific news article. Regarding climate change, a chatbot with more empathetic expressions was more effective in changing conspiracy beliefs than an article, but only for people who can tolerate ambiguity.

When people are faced with a great amount of uncertainty and risks, they are likely to adopt conspiracy beliefs as a way to reclaim their sense of control and reduce feelings of uncertainty (Douglas et al., 2019; Piltch-Loeb et al., 2019). Because conspiracy theories often describe how malevolent groups take secret actions to pursue their own interests in an attempt to explain causes of social events (Douglas et al., 2019; Franks et al., 2013; Wood et al., 2012), they are extremely accessible to laypersons and can help them reduce their sense of uncertainty. For instance, regarding COVID-19, it is estimated that more than 2,000 rumors and conspiracy theories about the disease were generated and proliferated on social media (Islam et al., 2020). Exemplars include that the Covid-19 virus "was intentionally brought into the world to reduce the population" (Imhoff & Lamberty, 2020) or Bill Gates "plans to use Covid-19 vaccine to surveil the population" (Islam et al., 2020).

CONTACT Jinping Wang jwang@cuhk.edu.hk Chinese University of Hong Kong, Shatin, New Territories, 422 Humanities Building, Hong Kong, SAR, China

There can be serious consequences when people fall for conspiracy beliefs. Research has found that people who held more conspiracy beliefs were significantly less likely to follow public health guidelines and perform health-protective behaviors (Allington et al., 2021; Freeman et al., 2020; Jolley & Douglas, 2014). Moreover, conspiracy theories can contribute to science skepticism as they are often associated with alleged wrongdoings of institutions and scientific experts (Rutjens et al., 2021). Therefore, a rapid communication movement to address the challenges exacerbated by conspiracy beliefs is essential.

An innovative media interface that is increasingly being used as a means of communication is chatbot, which is a "machine conversation system" that "interact with human users via natural conversational language" (Shawar & Atwell, 2005, p. 489). Compared to traditional ways of providing information such as presenting scientific reports, chatbots provide users with a more interactive experience. A highly interactive presentation of information is often more engaging and persuasive than a static presentation (Sundar & Kim, 2005). Additionally, chatbots can create a sense of personalized communication for users, which may increase its influence on users. In fact, chatbots have effectively been utilized for marketing (Facebook, 2021), emotional support (Ho et al., 2018), customer service (Cheng & Jiang, 2020), and health communication (Liu & Sundar, 2018). Therefore, it is worth exploring to what extent conversing with a chatbot can be effective in the context of combating conspiracy beliefs about science. Furthermore, to debunk conspiracy beliefs, individual differences such as personality can play a role, considering a potential connection between personality and tendency to believe in conspiracy theories (Gligorić et al., 2021; Goreis & Voracek, 2019; Lazarević et al., 2021). It is thus also important to investigate how relevant personality factors can moderate the effectiveness of the debunking efforts.

With the purpose of providing both practical and academic contribution to the efforts of debunking conspiracy beliefs, we explored the feasibility of using chatbots to provide counter-conspiracy information to individuals who hold conspiracy beliefs. Specifically, we examined the effectiveness of chatbots (vs. scientific news articles) in affecting users' beliefs in conspiracy theories. To increase the generalizability, we tested this question in two different issue contexts; Covid-19 (an emerging issue) and climate change (an enduring issue). Additionally, to understand how communication styles may influence the results, we compared two different versions of chatbots to investigate the effect of empathetic expressions by chatbots on users' attitudes. Finally, we studied whether the effectiveness of chatbots in changing beliefs will be moderated by ambiguity aversion, a relevant personal trait, to further understand the conditional effects.

Literature Review

Conspiracy Beliefs and Corrections

The spread of misinformation and conspiracy theories in the science- and health-related areas are receiving a considerable scholarly attention (e.g., Freeman et al., 2020; Imhoff & Lamberty, 2020; Van Stekelenburg et al., 2020; Vraga & Bode, 2017; Wood, 2018). Conspiracy theories and misinformation are both ways for individuals to deal with their uncertainty during an ongoing sense-making process (Wood, 2018). In addition, although conspiracy theories hypothetically can be true, both misinformation and conspiracy theories are characterized by vague and speculative statements without rigorous support from scientific evidence. In fact, in the health-related context, the vast majority of the conspiracy theories have been proven to be false (Van Prooijen & Douglas, 2018). Believing in these unverified claims is associated with authority mistrust and may further undermine science literacy such as understanding how the scientific community produces information (Freeman et al., 2020; Quinn et al., 2020).

Correcting existing misperceptions and conspiracy beliefs is challenging. First of all, it is less likely for individuals who interact primarily with conspiracy theories to be exposed to corrective information given their selective exposure. This means that once individuals get pulled into a conspiracy theory, they will be more likely to see information consistent with the theory rather than challenging it. For instance, researchers found that very few Facebook users who actively follow conspiracy-like Facebook pages (e.g., "I don't trust the government," "Awakening America," or "Awakened Citizen") interacted with debunking posts (Zollo et al., 2017). Furthermore, even if these individuals have been exposed to the debunking information, they can easily reject the information. For example, regarding the Zika virus, simply providing corrective information failed to combat targeted Zika misperceptions and even increased the publics' uncertainty about the disease (Carey et al., 2020). This type of "backfire effect" of corrective information is particularly strong when the associated beliefs are highly politicized, given that people are more motivated to process the corrective information in a biased manner (Flynn et al., 2017).

Considerable research has thus been devoted to developing effective communication strategies that can debunk misperceptions and conspiracy beliefs. For instance, Van Stekelenburg et al. (2020) showed that priming people with an accuracy motivation before being exposed to corrective information led to a higher effectiveness of correction. Regarding conspiracy beliefs, researchers suggested that inoculating individuals with debunking information before their exposure to conspiracy theories could successfully prevent them from falling for conspiracy beliefs (Jolley & Douglas, 2017). Or, asking individuals to assess their susceptibility to persuasion by priming

them to fill up the Resistance to Persuasion scale before answering questions about beliefs in conspiracy theories, could successfully reduce their adherence to conspiracy beliefs (Bonetto et al., 2018).

Another important factor that is vital to corrective effect is the *source* of the corrective information. Three major sources of corrective information were examined in previous studies, including authorities, news media, and social peers (Bode & Vraga, 2018; Van der Meer & Jin, 2020; Vraga & Bode, 2017). However, while chatbots have become one of the prevalent sources for persuasion purposes in the digital age (Ischen et al., 2020; Van den Broeck et al., 2019), few studies have investigated using chatbots as the source of the corrective information. In the next section, we discuss what makes a chatbot different from other information sources and what leads them to be persuasive in the context of debunking conspiracy beliefs.

Chatbot as a Persuasive Source of Communication

As a source of communication, chatbots are commonly seen in areas such as customer service, e-commerce, and personal assistants, and can interact with users via text or voice modalities. For instance, on Facebook Messenger, advertisers can use chatbots to deliver sponsored messages to target users (Facebook, 2021). Compared to mass communication or social media campaigns, what makes chatbots distinctive is their ability to host two-way conversations with target users in a personal manner, which provides several advantages over traditional one-way communication sources.

First, the experience of chatting with a text-based bot is often similar to text messaging with a person (Mann, 2021). With a certain level of social cues, chatbots are able to imbue users with a sense of responsive and reciprocal dialogue (Sundar et al., 2016), enhancing the para-social relationship building intention (Tsai et al., 2021). Cheng and Jiang (2020) also found that both technological gratifications and social presence can enhance user satisfactions with customer service chatbots. Moreover, chatting with a support bot or a person provided equal emotional and relational benefits to users (Ho et al., 2018). Therefore, compared to a mass communication source, a personable chatbot with openness to dialogue can be deemed more likable.

Second, in the context of conspiracy correction, chatbots may be perceived as more credible and unbiased compared to traditional media sources. People who hold conspiracy beliefs usually show a higher level of authority mistrust (Freeman et al., 2020; Quinn et al., 2020), which undermines the information credibility conveyed by authoritative sources. Chatbots, however, can trigger "machine heuristics," which are mental shortcuts wherein individuals associate machine characteristics with computers or bots (Sundar & Kim, 2019). For instance, when individuals chat with a bot, they may tend

to believe that "machines are more objective than humans, can perform tasks with greater precision, and handle information in a more secure manner" (Sundar & Kim, 2019, p. 538). Thus, information delivered by chatbots are more likely to be perceived as unbiased and credible. People also believe that chatbots are less likely to judge them than humans, leading to a more comfortable interaction experience (Wang et al., 2020). These machine characteristics may be especially helpful when communicating about controversial topics. For instance, overcoming selective exposure, news users are more likely to accept opposing-view articles recommended by news bots than website articles and perceive chatbot interaction to be more credible (Zarouali et al., 2021). Therefore, for individuals who believe in conspiracy theories and distrust authorities, chatbots can elicit better source perceptions. We thus propose:

H1: Participants will rate chatbot higher than a media source on source perceptions, such as (a) likability and (b) credibility.

Interacting with chatbots can also create better user experiences compared to reading text-based scientific articles. For delivering information, chatbots (vs. scientific articles) represent a higher level of interactivity, as one of the core dimensions of interactivity is the ability to maintain reciprocal communication between the user and the system (Liu, 2003). According to a meta-analysis, website interactivity was positively correlated with user enjoyment and positive attitudes (Yang & Shen, 2018). Therefore, the two-way communication nature of chatbot interaction can potentially produce more user enjoyment. As evidenced in previous research, even when compared with an interactive website, users perceive chatbot interactions to be more enjoyable (Ischen et al., 2020). Therefore, we hypothesize:

H2: Participants who interact with a chatbot will rate their user experience more enjoyable than participants who read a scientific article.

Engaging with media channels that generate positive source perceptions and enjoyment can lead to changes in beliefs and attitudes. Messages delivered by credible, likable sources are more likely to change message recipients' attitudes than sources with low credibility or likability (Brinol & Petty, 2009; Pornpitakpan, 2004). In addition, better user experience can also enhance media effects such that persuasive content would have stronger effect on attitudes and behaviors when the engagement was pleasant and enjoyable (Ischen et al., 2020; Wang & Sundar, 2018). Hence, considering that a chatbot is more likely to elicit better source perceptions (H1) and a pleasant user experience (H2), we propose:

H3: Interacting with a chatbot will reduce conspiracy beliefs more compared to reading a scientific article.

Empathetic Nature of Chatbot

A chatbot can be designed to respond to users in various ways, since responses can be pulled from a pool of possible answers. Therefore, it is important to examine *how* the chatbot should interact with people who hold conspiracy beliefs. When offering advice about how to talk about science to climate change skeptics, experts suggested that communicators should first listen and show empathy (Colarossi, 2019; "How to talk to a climate sceptic," 2011). This is because when individuals' beliefs are challenged in an unsolicited and straightforward manner, they are more likely to feel pressured, which can further strengthen their resistance to persuasion (Fitzsimons & Lehmann, 2004). Conversely, when people receive empathetic messages along with the persuasive messages, such as "I understand where you are coming from," their defensiveness may be eased as they see a greater overlap between two sides (Goldstein et al., 2014). However, for chatbot communication, it is less clear whether its empathy will enhance or weaken its persuasiveness to change conspiracy beliefs. One study found that a chatbot which demonstrated empathy, e.g., by saying "I understand how you feel," was perceived to be more supportive than an advice-only chatbot in the health information seeking context (Liu & Sundar, 2018). Another study found no positive effects of chatbot showing sympathy on users' competence perceptions in the area of customer service (Lou et al., 2021). The result may thus depend on users' expectations of chatbot empathy in different contexts. Therefore, we propose the following research question:

RQ1: Will empathetic expressions (EE) by a chatbot strengthen or weaken the conversation's effect of reducing conspiracy beliefs?

The Moderating Role of Ambiguity Aversion

Personal differences in information processing in relation to uncertainty may play a role in how people hold onto conspiracy beliefs. For instance, an individual's need for cognitive closure, which is the individual's inclination to organize and simplify complex information (DeBacker & Crowson, 2009; Webster & Kruglanski, 1994), can influence their ability to change their conspiracy beliefs. As a key dimension of need for cognitive closure, ambiguity aversion determines the discomfort during decision making when information is incomplete or conflicting (Portnoy et al., 2013). For those

who have high ambiguity aversion, exposure to ambiguous information can be uncomfortable amid a pandemic or environmental crisis. Ambiguity aversion is particularly important when examining the effects of different sources on correcting conspiracy beliefs because ambiguity evokes uncertainty when reliability, credibility and adequacy of the source is perceived as questionable (Simonovic et al., 2020).

It is likely that a non-threatening source with likability (such as a chatbot) may facilitate how individuals respond to information correcting conspiracy beliefs. Nonetheless, interactivity may bring confusion and ambiguity to users (Gupta et al., 2005). That is, having an empathetic two-way communication from a chatbot, can signal an openness for negotiation, suggesting that the conclusion about the conspiracy information may not be certain. Therefore, a novel, interactive source like a chatbot who elicit responses from users may sound less reliable and be perceived to provide less conclusive information to users than a coherent and straightforward scientific article. Therefore, people with high ambiguity aversion may feel greater discomfort to reach a conclusion when interacting with a chatbot, which can contribute to developing extreme and polarizing existing views (Nan & Daily, 2015). In contrast, those who are more comfortable with ambiguity may enjoy the chatbots' interactivity and be more persuaded. Hence, we propose the following hypothesis:

H4: Ambiguity aversion will moderate the relationship between the source of interaction and changes in conspiracy beliefs.

Method

Study Design

This study used a 3-condition (Correction strategy: article, chatbot with more empathetic expressions, chatbot with less empathetic expressions) between-subject experimental design and tested the proposed questions in two different issue contexts, Covid-19 and climate change. The study was approved by the Institutional Review Board in the pertinent institution.

Participants

Participants (N = 189) were recruited in June 2021 using a national opt-in panel from Qualtrics (www.qualtrics.com). To be eligible for this study, participants had to: (1) be 18 years of age or older, and (2) hold an incorrect perception about either the cause of Covid-19 or the data manipulation about climate change. A prescreening question was used to ensure all

participants met the second criteria, which asked them to indicate their agreement on two conspiratorial statements from 1 (strongly disagree) to 7 (strongly agree), including "The novel coronavirus (Covid-19) was engineered in a lab using HIV genes and purposely released" (Reuters, 2021; Straube, 2020) and "Climate scientists manipulate their data sets to show a warming trend for money and prestige" (Douglas & Sutton, 2015; Fountain, 2017). These two statements were chosen because they were popular regarding each issue topic and fit well with the definition of conspiracy beliefs. Participants who selected from 1 (strongly disagree) to 3 (slightly disagree) on both of the statement were considered holding relatively correct perceptions on both issues and screened out from the study, and those who selected from 4 (not sure) to 7 (strongly agree) on either of the statements were eligible. We targeted this group of individuals because they are the key audience of misperception correction.

Participants were predominantly Caucasian (82%) followed by African American (7.4%), Asian/Pacific Islander (3.7%), Hispanic/Latino (3.2%), and Multiracial (2.1%). The majority of the participants were male (70%), and the average age was 50.78 (SD = 18.78) ranging between 18 and 85. More than half of the participants reported having a college education and above (63%). The sample consisted of slightly more Republicans (40.2%) than Democrats (36.5%), while 20.6% of the participants identified as Independents.

Procedure and Stimuli

After agreeing with the informed consent form, participants were assigned to different issue topics (Covid-19 and climate change) based on their answers to the prescreening question. If a participant only believed in one of the conspiracy statements, they were assigned to the issue topic which they held the misperception about. If a participant showed agreement with both conspiracy statements, then they were randomly assigned to one of the issue topics. In total, 101 participants were assigned to the Covid-19 condition and 88 were assigned to the climate change condition. Then, they were randomly assigned to one of the correction-strategy conditions – they interacted with either a chatbot with more empathetic expressions (Covid-19: n = 34; climate change: n = 31), a chatbot with less empathetic expressions (Covid-19: n = 38; climate change: n = 30) or read an article arguing against the conspiracy statements (Covid-19: n = 29; climate change: n = 27). The articles used in the study were modified versions of articles published by credible media sources. Then we wrote chatbot scripts based on the articles to ensure that we provided equivalent information to participants.[1] In the high-empathy-

[1]All the articles and scripts can be accessed via the link: https://osf.io/bex84/?view_only=74b1f0aca9964f61b5ea43046b9b0578

chatbot condition, we added empathetic expressions in the scripts by compassionately showing understanding of the confusion that participants may feel about scientific theories and where the confusion may come from, as well as acknowledging that many people were confused about them. In the low-empathy-chatbot condition, the conversation script addressed the same issue without these empathetic expressions. To avoid the bias associated with existing news sources or organizations, we did not show any organizational source information to users. Instead, we used Alex Brown, a gender-neutral name, in all three conditions. That is, the chatbots and the author of the article were kept consistent and called Alex Brown, so that we can focus on examining the effects of the interactive conversation.

The chatbots were built using the Landbot platform (https://landbot.io/) (see, Figure 1 for the chatbot interface). Their links were inserted in the Qualtrics questionnaire. In the chatbot conditions, participants were directed back to Qualtrics at the end of the conversation and were instructed to answer the remaining questions. One attention-check question was added to make sure that participants did not skip the interaction: A picture of an orange was shown to participants at the end of the chatbot conversation. Upon returning to the questionnaire, participants were immediately asked to choose the correct picture of fruit they saw after chatting with the bots. The participation of those who chose the wrong fruit picture were immediately

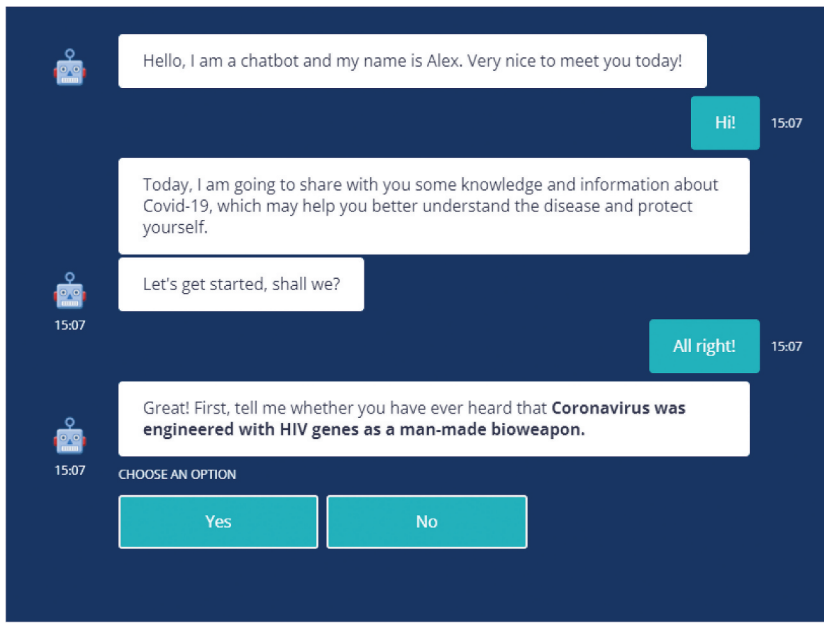

Figure 1. The Chatbot Interface.

ended. In total, 31 participants were excluded based on this attention check question (Covid-19 + more empathetic expressions: n = 9; Covid-19 + less empathetic expressions: n = 6; climate change + more empathetic expressions: n = 8; climate change + less empathetic expressions: n = 8). In the article condition, participants were required to spend at least 20 seconds on the page before the continue button appeared. Then they answered the remaining questions.

Measures

Changes in Conspiracy Beliefs

Before being exposed to stimuli, participants rated their level of agreement on a 7-point scale with two statements measuring their perception about the cause of the Covid-19 outbreak and the data validity of climate change: "The novel coronavirus (Covid-19) was engineered in a lab using HIV genes and purposely released" (M = 5.24, SD = 1.21) and "Climate scientists manipulate their datasets to show a warming trend for money and prestige" (M = 5.45, SD = 1.13). The same statements were asked again after they interacted with the chatbots or read the article (Covid-19: M = 5.01, SD = 1.45, climate change: M = 5.18, S.D. = 1.32). Participants' perception changes for each issue were the arithmetic difference between their pre- and post- ratings on the same statement, with a higher positive score indicating a higher effectiveness of correction (Covid-19: M = 0.23, SD = 1.01, climate change: M = 0.27, S.D. = 0.87).

Source Credibility

The credibility scale was composed of six semantic differential items adapted from O'Hara et al. (1991), measuring participants' perception that the source of interaction was knowledgeable, competent, expert, trained, trustworthy, reliable, sincere, and honest. The answers ranged from 1 to 8 (M = 5.92, SD = 1.77). The scale reliability was α = .94.

Source Likability

The likability of the source of interaction scale was composed of three semantic differential items including attractive – unattractive, friendly – unfriendly, and likable – unlikable (O'Hara et al., 1991), ranging from 1–8. The three items were then reversed coded and combined into an index, with higher score indicating greater likability of the source of the interaction (α = .87, M = 5.36, SD = 2.04).

Ambiguity Aversion

To assess participants' discomfort with ambiguity (Kosic, 2002), ten items of Webster & Kruglanski (1994) Need for Closure Scale were adopted. Sample

items include "I don't like situations that are uncertain," "I feel uncomfortable when I don't understand the reason why an event occurred in my life," and "I'd rather know bad news than stay in a state of uncertainty." Participants were asked to rate their agreement from 1 (strongly disagree) to 7 (strongly agree). One item "When I am confused about an important issue, I feel very upset" was eventually dropped because including it lowered the reliability (Cronbach's α = .67). The final scale was composed of nine items (α = .70, M = 4.67, SD = .70).

User Experience

Participants' experiences of reading the article or interacting with the chatbot were assessed using two items. Participants were asked to rate their experience from extremely unpleasant (1) to extremely pleasant (7), and rate their willingness to recommend the article/chatbot to their family members or friends from extremely unlikely (1) to extremely likely (7). Two items were highly correlated ($r(189) = .77$, $p < .01$) and averaged to form an index to assess user experience (M = 5.13, SD = 1.67).

Results

To test our hypotheses, a series of analyses of covariance (ANCOVAs) were performed for each issue topic, with the experimental condition (scientific news article vs. the chatbot with more empathetic expressions vs. the chatbot with less empathetic expressions) entered as the main factor, while controlling for age, gender, education, and political party identification.

Issue 1: The Cause of Covid-19

All the following analyses were conducted using the data of participants who were assigned to the Covid-19 condition (n = 101).

Source Perceptions

Two ANCOVAs were run separately to test if source credibility and likability varied among experimental conditions. Results showed no effects of experimental conditions on participants' source perceptions, neither source credibility ($F(2, 88) = 0.64$, $p = .53$) nor source likability ($F(2, 88) = 0.85$, $p = .43$) were significant (See, Table 1 for means and standard errors).

User Experience

Another ANCOVA showed that participants in different experimental conditions rated their experience similarly, $F(2, 88) = 2.92$, $p = .06$, partial $\eta^2 = .062$. Post-hoc results showed that interacting with either the chatbot with more empathetic expressions (M = 5.52, SE = 0.25, p = .04) or the chatbot with less

Table 1. Source Perceptions of Participants Assigned to Covid-19 Issue Conditions.

	Article M(SE)	Chatbot with more empathetic expressions M(SE)	Chatbot with less empathetic expressions M(SE)
Source Credibility	5.62 (.23)	6.13 (.21)	6.11(.20)
Source Likability	5.01 (.29)	5.73(1.27)	5.38(.25)

empathetic expressions (M = 5.60, SE = 0.23, p = .03) would create a more pleasant user experience than reading the article (M = 4.73, SE = 0.29).

Change in Conspiracy Perceptions

An ANCOVA was performed to compare the perception changes of participants. Results showed a main effect of the experimental condition, $F(2, 88)$ = 3.11, p = .05, partial η^2 = .066. Using a Least Standard Differences (LSD) comparison, the post-hoc analysis revealed that contrary to H1, participants who read the article showed a larger change in perceptions (M = 0.52, SE = 0.17) than those who interacted with the chatbot with less empathetic expressions (M = 0.03, SE = 0.14, p = .02). In addition, the perception changes of participants in the more empathetic condition being in the middle (M = 0.18, SE = 0.13), which was not significantly different from participants in the article condition (p =.09) or the chatbot with less empathetic expressions (p =.40).

Ambiguity Aversion as a Moderator

To test the proposed H4, we used Model 1 in the PROCESS Macro in SPSS (Hayes, 2017) to examine the interaction effects of experimental conditions and ambiguity aversion on changes in conspiracy perceptions. We chose PROCESS models for this analysis because it allows researchers to examine the interaction effect between a categorical independent variable and a continuous moderator (Hayes, 2017; Hayes & Montoya, 2017). The analysis would report unstandardized coefficients of the experimental condition among participants with low level (16th percentile), medium level (50th percentile), and high level (89th percentile) ambiguity aversion if the interaction term was significant.

Results showed no significant moderating effects of ambiguity aversion on the chatbot with more empathetic expressions – article comparison (B =–.04, SE = .36, 95%CI [–.76, .68], p = .91) or the chatbot with less empathetic expressions – article comparison (B =–.10, SE = .39, 95%CI [–.88, .69], p = .81). Therefore, H4 was not supported in this context.

Issue 2: Climate Change Data Manipulation

We replicated the above analyses using the data of participants who were assigned to the climate change condition *(n* = 88).

Source Perceptions

We found that similar to participants in the Covid −19 conditions, participants in different conditions of climate change did not show significant differences in source perceptions (source credibility: $F(2, 75) = 1.55$, $p = .22$; source likability, $F(2, 75) = 0.94$, $p = .40$) (See, Table 2 for estimated means and standard errors).

User Experience

Regarding user experience, there was no main effect of experimental conditions, $F(2, 75) = 1.68$, $p = .19$. Participants who read the article rated their experiences ($M = 4.52$, $SE = 0.30$) similar to those who interacted with the chatbots (More empathetic expressions: $M = 5.26$, $SE = 0.30$, Less empathetic expressions: $M = 5.12$, $SE = 0.28$).

Changes in Conspiracy Perceptions

Different from Covid-19 conditions, there was no main effect of experimental conditions, $F(2, 75) = 0.56$, $p = .58$, partial $\eta^2 = .015$. Participants who read the news article ($M = 0.16$, $SE = 0.17$) and who interacted with chatbots (More empathetic expressions: $M = 0.43$, $SE = 0.17$, Less empathetic expressions: $M = 0.29$, $SE = 0.16$) showed similar levels of changes in conspiracy perceptions.

Ambiguity Aversion as a Moderator

Using PROCESS Model 1, we investigated the interaction effects of experimental conditions and ambiguity aversion on changes in perceptions. The analysis ($R^2 = .18$, $F = 2.09$, $p = .06$) showed a significant moderating effects of ambiguity aversion with the chatbot with more empathetic expressions – article comparison ($B = -.94$, $SE = .42$, 95%CI [−1.78, −.10], $p = .03$) on changes in perceptions, but not the chatbot with less empathetic expressions – article comparison ($B = -.31$, $SE = .39$, 95%CI [−1.08, .46], $p = .43$).

Table 2. Source Perceptions of Participants Assigned to Climate Change Conditions.

	Article M(SE)	Chatbot with more empathetic expressions M(SE)	Chatbot with less empathetic expressions M(SE)
Source Credibility	5.46 (.32)	6.28 (.32)	5.93(.30)
Source Likability	5.03 (.41)	5.84(.42)	5.59(.39)

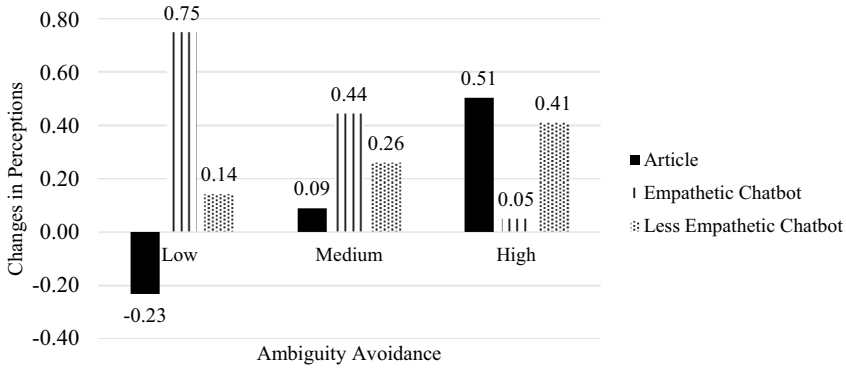

Figure 2. Interaction Effects of Ambiguity Aversion and Experimental Conditions on Changes in Perceptions.

Probing the interaction effect, we observed that for low ambiguity aversion individuals (16th percentile), the chatbot with more empathetic expressions was more effective in affecting perceptions than the article (B =.98, SE = .40, 95% CI [−.18, 1.78], p = .02). However, for individuals with medium-level ambiguity aversion (50th percentile) or high-level ambiguity aversion (84th percentile), there were no differences between reading the article and interacting with the chatbot (medium: B =.35, SE = .29, 95%CI [−.22, .93], p = .22; high: B =−.46, SE = .46, 95%CI [−1.39, .47], p = .33) (see, Figure 2 for estimated conditional means).

It is worth noting that, as the level of ambiguity aversion increased, the perception changes of participants in the chatbot with more empathetic expressions condition was showing a decreasing trend, while the perception changes of participants in the article condition or the chatbot with less empathetic expressions condition were increasing. This pattern was aligned with our hypothesis that ambiguity aversion moderated the relationship between source of interaction and changes in conspiracy beliefs.

Discussion

This study empirically analyzed the effectiveness of chatbot communication on changing conspiracy beliefs about Covid-19 and climate change. Results suggest that all three sources of information, namely news article, chatbot with more and less empathetic expressions, were perceived to be equally credible and likable. However, contrary to the expectation, those who received information on Covid-19 by reading a news article held weaker conspiracy ideas afterward, compared to those who received the same information by interacting with a chatbot with less empathetic expressions. In addition, adding more empathetic expression to the chatbot conversation did

not make a significant impact on conspiracy belief change. As for the issue of climate change, there was a moderation effect of ambiguity avoidance on the effectiveness of information source on changing conspiracy beliefs: interacting with an empathetic chatbot led to greater conspiracy perception change compared to reading an article only for those who were comfortable with ambiguity.

We did not find any significant differences in source perceptions when comparing chatbots and human authors, confirming previous research that when chatbots deliver the same content as a human source, they are perceived as similarly attractive and credible (Beattie et al., 2020). We removed any source information (e.g., organizations who built the chatbot or published the article) in the experimental conditions. Therefore, participants judged the credibility of the sources merely relying on the information they received, which were consistent among conditions. Although this helped us exclusively focus on the effects of interactivity, it may not be applicable to natural settings where multiple source cues are observable.

Moreover, the results show a paradoxical role of interactive chatbots in changing individuals' conspiracy beliefs about Covid-19. Participants of this study perceived their interaction with a chatbot more pleasant, however, their experience did not lead to a larger perception change. This contradicts previous findings that more enjoyable experiences translated into higher persuasive outcomes (Ischen et al., 2020). It is possible that the conversational nature of the interaction, where individuals were asked by chatbots to provide their thoughts, allowed them to formulate their opinions in writing, thus leading to stronger attachment to those beliefs. In other words, participants were able to counterargue, while the chatbot could not provide adequate refutation of their counterarguments, resulting in less persuasion (McGuire, 1961). It is also possible that the chatbot interaction was causing cognitive efforts to be put toward preparing an answer rather than accepting the information. As indicated in previous research, users may not always gain cognitive benefits from interactivity due to limited cognitive bandwidth (Yang & Shen, 2018). Further research is necessary to underpin the psychological mechanisms. Overall, our study suggests that for changing conspiracy beliefs regarding a novel issue while people are still forming perceptions, it may be better practice to deliver the information in a non-interactive manner, such as via an article.

Additionally, we did not observe significant differences between a chatbot with more (vs. less) empathetic expressions. This may suggest that the effect of chatbot empathy could be context dependent. In the area of seeking advice, a chatbot's affective empathy that focused on emotional responses was effective in eliciting perceived social support (Liu & Sundar, 2018), whereas for soliciting donations (Park et al., 2022) or increasing competency in customer services (Lou et al., 2021), chatbot empathy/sympathy had no

significant main effects. From this perspective, individuals may not be particularly sensitive to empathetic expressions when communicating scientific information. It is also possible that our study had a weak representation of chatbot empathy. Future research can delve into the effectiveness of different forms of chatbot empathy (e.g., cognitive vs. affective) and expand the ways of chatbot exhibiting empathy (e.g., adding visual cues during the interaction).

A more salient difference was observed between a chatbot with more empathetic expressions and a news article when communicating about an enduring issue like climate change. On the one hand, "empathy" is always recommended in science communication (Colarossi, 2019); on the other hand, scholars argue that a clear corrective message will be more effective in correcting misperceptions than offering any forms of balanced information (Van Stekelenburg et al., 2020). Our work instead highlights the role of ambiguity avoidance in the process of persuasion in a more nuanced manner. For an issue that has been debated for a long time such as climate change, an interaction with a chatbot that generates empathetic responses can be more persuasive than an article only among those who are comfortable with ambiguity. For individuals who dislike ambiguity, it may be a better practice to provide direct and one-sided information to change their conspiracy beliefs.

In addition, this study indicates that changing conspiracy beliefs may be issue relevant. Debate on climate change has been ongoing for a longer period of time compared to Covid-19 with an abundance of scientific research to challenge conspiracy beliefs. The novelty of the topic may allow more individuals to be skeptical of scientific information or fill the knowledge gap with conspiracy theories in addition to rejecting the existence of the issue. Moreover, when the issue topic itself is associated with a large degree of ambiguity and the knowledge about it is still in the process of updating, it makes empathetic expressions during conversations and ambiguity avoidance less relevant. It is therefore important to conduct more research focusing on various issues to identify patterns between issues that generate conspiracy theories.

From a practical perspective, this study has implications for science communication experts aiming to reduce conspiracy beliefs, suggesting that (1) the same information can be communicated via interactive chatbots and non-interactive platforms and still be perceived credible and likable, (2) for emerging issues such as Covid-19, non-interactive methods of information delivery can lead to greater reduction in conspiracy beliefs, and (3) for long-debated issues, empathetic interactions with chatbots can lead to greater perception changes only if the individual is comfortable with ambiguity.

Apart from the contributions of this study, it has certain limitations. First of all, this study did not thoroughly examine how the participants have

interacted with the chatbots. Hence it is yet unknown whether the participants were more or less likely to counterargue or how much cognitive effort they have exhibited during their experience with the chatbot or the article. The current study should be expanded with a closer look into the dynamics of human-chatbot interaction in relation to perception change. We also excluded individuals who hold more correct perceptions in this study, which undermines the generalizability of the findings. In addition, we constructed two conspiracy statements in this study, which were not rigorously tested before. Future studies can vary the statements to test the effectiveness. Many non-significant results may also be explained by the fact that the small sample size of this study did not have enough power to detect the differences. Future studies can therefore investigate the source perceptions of chatbots in diverse contexts, compare them with more well-known, authoritative sources, and with a larger sample size, deepening our understanding of the broader concept chatbot interaction.

In conclusion, this experiment is the first empirical study to examine the effects of a chatbot being a source for changing conspiracy beliefs, contributing to existing literature in human-machine interaction as well as communication strategies to combat misperceptions and conspiracy thinking. Debunking existing conspiracy beliefs can be particularly challenging as they are sometimes derived from non-verifiable allegations. While an interactive chatbot cannot provide an easy solution to tackle this challenge, our study does show its promise in being a communication entity in science communication. In times that uncertainty permeates society, more research efforts are needed to understand how to better integrate chatbots in our communication campaigns and provide scientific explanations to individuals in both an effective and pleasant manner.

Disclosure Statement

No potential conflict of interest was reported by the author(s).

Funding

This work was supported by the Duquesne University McAnulty College & Graduate School NEH Endowment Fund [NJWF20E].

Notes on contributors

Dr. Jinping Wang (Ph.D., Pennsylvania State University) is an Assistant Professor at the School of Journalism and Communication at the Chinese University of Hong Kong. Her research focuses on how affordances of media technologies shape communication behaviors and communication effectiveness.

Dr. Zeynep Tanes-Ehle (Ph.D., Purdue University) is an Associate Professor at Duquesne University Media Department. Her research focuses on the impact of interactive media on the individual and the society. She is particularly interested in cognitive and behavioral outcomes of gamification in risk communication.

ORCID

Jinping Wang http://orcid.org/0000-0001-8164-8025

References

Allington, D., Duffy, B., Wessely, S., Dhavan, N., & Rubin, J. (2021). Health-protective behaviour, social media usage and conspiracy belief during the COVID-19 public health emergency. *Psychological Medicine*, *51*(10), 1763–1769. https://doi.org/10.1017/S003329172000224X

Beattie, A., Edwards, A. P., & Edwards, C. (2020). A bot and a smile: Interpersonal impressions of chatbots and humans using emoji in computer-mediated communication. *Communication Studies*, *71*(3), 409–427. https://doi.org/10.1080/10510974.2020.1725082

Bode, L., & Vraga, E. K. (2018). See something, say something: Correction of global health misinformation on social media. *Health Communication*, *33*(9), 1131–1140. https://doi.org/10.1080/10410236.2017.1331312

Bonetto, E., Troïan, J., Varet, F., Lo Monaco, G., & Girandola, F. (2018). Priming resistance to persuasion decreases adherence to conspiracy theories. *Social Influence*, *13*(3), 125–136. https://doi.org/10.1080/15534510.2018.1471415

Brinol, P., & Petty, R. E. (2009). Source factors in persuasion: A self-validation approach. *European Review of Social Psychology*, *20*(1), 49–96. https://doi.org/10.1080/10463280802643640

Carey, J. M., Chi, V., Flynn, D. J., Nyhan, B., & Zeitzoff, T. (2020). The effects of corrective information about disease epidemics and outbreaks: Evidence from Zika and yellow fever in Brazil. *Science Advances*, *6*(5), eaaw7449. https://doi.org/10.1126/sciadv.aaw7449

Cheng, Y., & Jiang, H. (2020). How do AI-driven chatbots impact user experience? Examining gratifications, perceived privacy risk, satisfaction, loyalty, and continued use. *Journal of Broadcasting & Electronic Media*, *64*(4), 592–614. https://doi.org/10.1080/08838151.2020.1834296

Colarossi, J. (2019, November 22). *How to deal with climate skeptics at thanksgiving dinner*. Boston University. https://www.bu.edu/articles/2019/how-to-talk-to-climate-skeptics-at-thanksgiving-dinner/

DeBacker, T. K., & Crowson, H. M. (2009). The influence of need for closure on learning and teaching. *Educational Psychology Review*, *21*(4), 303–323. https://doi.org/10.1007/s10648-009-9111-1

Douglas, K. M., & Sutton, R. M. (2015). Climate change: Why the conspiracy theories are dangerous. *Bulletin of the Atomic Scientists*, *71*(2), 98–106. https://doi.org/10.1177/0096340215571908

Douglas, K. M., Uscinski, J. E., Sutton, R. M., Cichocka, A., Nefes, T., Ang, C. S., & Deravi, F. (2019). Understanding conspiracy theories. *Political Psychology*, *40*(S1), 3–35. https://doi.org/10.1111/pops.12568

Facebook. (2021). Advertising on messenger: Extend your reach and find more customers with messenger ads. Retrieved July 15, 2021, from https://www.facebook.com/business/ads/messenger-ads

Fitzsimons, G. J., & Lehmann, D. R. (2004). Reactance to recommendations: When unsolicited advice yields contrary responses. *Marketing Science*, *23*(1), 82–94. https://doi.org/10.1287/mksc.1030.0033

Flynn, D. J., Nyhan, B., & Reifler, J. (2017). The nature and origins of misperceptions: Understanding false and unsupported beliefs about politics. *Political Psychology*, *38*, 127–150. https://doi.org/10.1111/pops.12394

Fountain, H. (2017, February 7). *No data manipulation in 2015 climate study, researchers say*. New York Times. https://www.nytimes.com/2017/02/07/science/2015-climate-study-data.html

Franks, B., Bangerter, A., & Bauer, M. (2013). Conspiracy theories as quasi-religious mentality: An integrated account from cognitive science, social representations theory, and frame theory. *Frontiers in Psychology*, *4*, 424. https://doi.org/10.3389/fpsyg.2013.00424

Freeman, D., Waite, F., Rosebrock, L., Petit, A., Causier, C., East, A., … Lambe, S. (2020). Coronavirus conspiracy beliefs, mistrust, and compliance with government guidelines in England. *Psychological Medicine*, 1–13. https://doi.org/10.1017/S0033291720001890

Gligorić, V., da Silva, M. M., Eker, S., van Hoek, N., Nieuwenhuijzen, E., Popova, U., & Zeighami, G. (2021). The usual suspects: How psychological motives and thinking styles predict the endorsement of well-known and COVID-19 conspiracy beliefs. *Applied Cognitive Psychology*, *35*(5), 1171–1181. https://doi.org/10.1002/acp.3844

Goldstein, N. J., Vezich, I. S., & Shapiro, J. R. (2014). Perceived perspective taking: When others walk in our shoes. *Journal of Personality and Social Psychology*, *106*(6), 941–960. https://doi.org/10.1037/a0036395

Goreis, A., & Voracek, M. (2019). A systematic review and meta-analysis of psychological research on conspiracy beliefs: Field characteristics, measurement instruments, and associations with personality traits. *Frontiers in Psychology*, *10*, 1–13. https://doi.org/10.3389/fpsyg.2019.00205

Gupta, R., Nadkarni, S., & Gould, S. J. (2005). "Is this site confusing or interesting?" A Perceived Web site Complexity (PWC) Scale for Assessing Consumer Internet Interactivity. *Advances in Consumer Research*, *32*(1), 42–50. https://www.acrwebsite.org/volumes/9024/volumes/v32/NA-32

Hayes, A. F. (2017). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. Guilford publications.

Hayes, A. F., & Montoya, A. K. (2017). A tutorial on testing, visualizing, and probing an interaction involving a multicategorical variable in linear regression analysis. *Communication Methods and Measures*, *11*(1), 1–30. https://doi.org/10.1080/19312458.2016.1271116

Ho, A., Hancock, J., & Miner, A. S. (2018). Psychological, relational, and emotional effects of self-disclosure after conversations with a chatbot. *Journal of Communication*, *68*(4), 712–733. https://doi.org/10.1093/joc/jqy026

How to talk to a climate sceptic. (2011, August 25). The Guardian. https://www.theguardian.com/environment/2011/aug/25/how-talk-climate-sceptic

Imhoff, R., & Lamberty, P. (2020). A bioweapon or a hoax? The link between distinct conspiracy beliefs about the Coronavirus disease (COVID-19) outbreak and

pandemic behavior. *Social Psychological and Personality Science*, *11*(8), 1110–1118. https://doi.org/10.1177/1948550620934692

Ischen, C., Araujo, T., van Noort, G., Voorveld, H., & Smit, E. (2020). "I Am here to assist you today": The role of entity, interactivity and experiential perceptions in chatbot persuasion. *Journal of Broadcasting & Electronic Media*, *64*(4), 615–639. https://doi.org/10.1080/08838151.2020.183429

Islam, M. S., Sarkar, T., Khan, S. H., Kamal, A. H. M., Hasan, S. M., Kabir, A., … Seale, H. (2020). COVID-19–related infodemic and its impact on public health: A global social media analysis. *The American Journal of Tropical Medicine and Hygiene*, *103*(4), 1621–1629. https://doi.org/10.4269/ajtmh.20-0812

Jolley, D., & Douglas, K. M. (2014). The effects of anti-vaccine conspiracy theories on vaccination intentions. *PloS One*, *9*(2), e89177. https://doi.org/10.1371/journal.pone.0089177

Jolley, D., & Douglas, K. M. (2017). Prevention is better than cure: Addressing anti-vaccine conspiracy theories. *Journal of Applied Social Psychology*, *47*(8), 459–469. https://doi.org/10.1111/jasp.12453

Kosic, A. (2002). Need for cognitive closure and coping strategies. *International Journal of Psychology*, *37*(1), 35–43. https://doi.org/10.1080/00207590143000153

Lazarević, L. B., Purić, D., Teovanović, P., Lukić, P., Zupan, Z., & Knežević, G. (2021). What drives us to be (ir)responsible for our health during the COVID-19 pandemic? The role of personality, thinking styles, and conspiracy mentality. *Personality and Individual Differences*, *176*, 110771. https://doi.org/10.1016/j.paid.2021.110771

Liu, Y. (2003). Developing a scale to measure the interactivity of websites. *Journal of Advertising Research*, *43*(2), 207–216. https://doi.org/10.1017/S0021849903030204

Liu, B., & Sundar, S. S. (2018). Should machines express sympathy and empathy? Experiments with a health advice chatbot. *Cyberpsychology, Behavior and Social Networking*, *21*(10), 625–636. https://doi.org/10.1089/cyber.2018.0110

Liu, B., & Sundar, S. S. (2018). Should machines express sympathy and empathy? Experiments with a health advice chatbot. *Cyberpsychology, Behavior, and Social Networking*, *21*(10), 625–636. http://doi.org/10.1089/cyber.2018.0110

Lou, C., Kang, H., & Tse, C. H. (2021). Bots vs. humans: How schema congruity, contingency-based interactivity, and sympathy influence consumer perceptions and patronage intentions. *International Journal of Advertising*, 1–30. https://doi.org/10.1080/02650487.2021.1951510

Mann, C. B. (2021). Can conversing with a computer increase Turnout? Mobilization using chatbot communication. *Journal of Experimental Political Science*, *8*(1), 51–62. https://doi.org/10.1017/XPS.2020.5

McGuire, W. J. (1961). Resistance to persuasion conferred by active and passive prior refutation of the same and alternative counterarguments. *The Journal of Abnormal and Social Psychology*, *63*(2), 326–332. https://doi.org/10.1037/h0048344

Nan, X., & Daily, K. (2015). Biased assimilation and need for closure: Examining the effects of mixed blogs on vaccine-related beliefs. *Journal of Health Communication*, *20*(4), 462–471. https://doi.org/10.1080/10810730.2014.989343

O'Hara, B., Netemeyer, R., & Burton, S. (1991). An examination of the relative effects of source expertise, trustworthiness, and likability. *Social Behavior and Personality*, *19*(4), 305–314. https://doi.org/10.2224/sbp.1991.19.4.305

Park, G., Yim, M. C., Chung, J., & Lee, S. (2022). Effect of AI chatbot empathy and identity disclosure on willingness to donate: The mediation of humanness and

social presence. *Behaviour & Information Technology*, 1–13. https://doi.org/10.1080/0144929X.2022.2105746

Piltch-Loeb, R., Zikmund-Fisher, B. J., Shaffer, V. A., Scherer, L. D., Knaus, M., Fagerlin, A., … Scherer, A. M. (2019). Cross-sectional psychological and demographic associations of Zika knowledge and conspiracy beliefs before and after local Zika transmission. *Risk Analysis*, *39*(12), 2683–2693. https://doi.org/10.1111/risa.13369

Pornpitakpan, C. (2004). The persuasiveness of source credibility: A critical review of five decades' evidence. *Journal of Applied Social Psychology*, *34*(2), 243–281. https://doi.org/10.1111/j.1559-1816.2004.tb02547.x

Portnoy, D. B., Han, P. K., Ferrer, R. A., Klein, W. M., & Clauser, S. B. (2013). Physicians' attitudes about communicating and managing scientific uncertainty differ by perceived ambiguity aversion of their patients. *Health Expectations*, *16*(4), 362–372. https://doi.org/10.1111/j.1369-7625.2011.00717.x

Quinn, E. K., Fazel, S. S., & Peters, C. E. (2020). The Instagram infodemic: Cobranding of conspiracy theories, coronavirus disease 2019 and authority-questioning beliefs. *Cyberpsychology, Behavior and Social Networking*, *24*(8), 573–577. https://doi.org/10.1089/cyber.2020.0663

Reuters. (2021, January 7). *Fact check: SARS-CoV-2 was not created using genes from HIV, Fauci does not hold patents for an 'HIV component' to SARS-CoV-2*. https://www.reuters.com/article/uk-factcheck-hiv-covid-explained-idUSKBN29C26E

Rutjens, B. T., van der Linden, S., & van der Lee, R. (2021). Science skepticism in times of COVID-19. *Group Processes & Intergroup Relations*, *24*(2), 276–283. https://doi.org/10.1177/1368430220981415

Shawar, B. A., & Atwell, E. S. (2005). Using corpora in machine-learning chatbot systems. *International Journal of Corpus Linguistics*, *10*(4), 489–516. https://doi.org/10.1075/ijcl.10.4.06sha

Simonovic, N., Taber, J. M., Klein, W. M. P., & Ferrer, R. A. (2020). Evidence that perceptions of and tolerance for medical ambiguity are distinct constructs: An analysis of nationally representative US data. *Health Expectations*, *23*(3), 603–613. https://doi.org/10.1111/hex.13037

Straube, T. (2020 February,5). *Was the New Coronavirus (COVID-19) Created in a lab using HIV genes?*, POZ. https://www.poz.com/article/new-coronavirus-created-lab-using-hiv-genes

Sundar, S. S., Bellur, S., Oh, J., Jia, H., & Kim, H. S. (2016). Theoretical importance of contingency in human-computer interaction: Effects of message interactivity on user engagement. *Communication Research*, *43*(5), 595–625. https://doi.org/10.1177/0093650214534962

Sundar, S. S., & Kim, J. (2005). Interactivity and persuasion: Influencing attitudes with information and involvement. *Journal of Interactive Advertising*, *5*(2), 5–18. https://doi.org/10.1080/15252019.2005.10722097

Sundar, S. S., & Kim, J. (2019, May). Machine heuristic: When we trust computers more than humans with our personal information. In *Proceedings of the 2019 CHI Conference on human factors in computing systems*, (pp. 1–9). https://doi.org/10.1145/3290605.3300768

Tsai, W. H. S., Liu, Y., & Chuan, C. H. (2021). How chatbots' social presence communication enhances consumer engagement: The mediating role of parasocial interaction and dialogue. *Journal of Research in Interactive Marketing*, *15*(3), 460–482. https://doi.org/10.1108/JRIM-12-2019-0200

Van den Broeck, E., Zarouali, B., & Poels, K. (2019). Chatbot advertising effectiveness: When does the message get through? *Computers in Human Behavior*, *98*, 150–157. https://doi.org/10.1016/j.chb.2019.04.009

van der Meer, T. G., & Jin, Y. (2020). Seeking formula for misinformation treatment in public health crises: The effects of corrective information type and source. *Health Communication*, *35*(5), 560–575. https://doi.org/10.1080/10410236.2019.1573295

van Prooijen, J. W., & Douglas, K. M. (2018). Belief in conspiracy theories: Basic principles of an emerging research domain. *European Journal of Social Psychology*, *48*(7), 897–908. https://doi.org/10.1002/ejsp.2530

van Stekelenburg, A., Schaap, G., Veling, H., & Buijzen, M. (2020). Correcting misperceptions: The causal role of motivation in corrective science communication about vaccine and food safety. *Science Communication*, *42*(1), 31–60. https://doi.org/10.1177/1075547019898256

Vraga, E. K., & Bode, L. (2017). Using expert sources to correct health misinformation in social media. *Science Communication*, *39*(5), 621–645. https://doi.org/10.1177/1075547017731776

Wang, R., & Sundar, S. S. (2018). How does parallax scrolling influence user experience? A test of TIME (Theory of Interactive Media Effects). *International Journal of Human–Computer Interaction*, *34*(6), 533–543. https://doi.org/10.1080/10447318.2017.1373457

Wang, J., Yang, H., Shao, R., Abdullah, S., & Sundar, S. S. (2020, April). Alexa as coach: Leveraging smart speakers to build social agents that reduce public speaking anxiety. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*, (pp. 1–13). https://doi.org/10.1145/3313831.3376561

Webster, D. M., & Kruglanski, A. W. (1994). Individual differences in need for cognitive closure. *Journal of Personality and Social Psychology*, *67*(6), 1049–1062. https://doi.org/10.1037/0022-3514.67.6.1049

Wood, M. J. (2018). Propagating and debunking conspiracy theories on Twitter during the 2015–2016 Zika virus outbreak. *Cyberpsychology, Behavior and Social Networking*, *21*(8), 485–490. https://doi.org/10.1089/cyber.2017.0669

Wood, M. J., Douglas, K. M., & Sutton, R. M. (2012). Dead and alive: Beliefs in contradictory conspiracy theories. *Social Psychological and Personality Science*, *3*(6), 767–773. https://doi.org/10.1177/1948550611434786

Yang, F., & Shen, F. (2018). Effects of web interactivity: A meta-analysis. *Communication Research*, *45*(5), 635–658. https://doi.org/10.1177/0093650217700748

Zarouali, B., Makhortykh, M., Bastian, M., & Araujo, T. (2021). Overcoming polarization with chatbot news? Investigating the impact of news content containing opposing views on agreement and credibility. *European Journal of Communication*, *36*(1), 53–68. https://doi.org/10.1177/0267323120940908

Zollo, F., Bessi, A., Del Vicario, M., Scala, A., Caldarelli, G., Shekhtman, L., … Quattrociocchi, W. (2017). Debunking in a world of tribes. *PloS One*, *12*(7), e0181821. https://doi.org/10.1371/journal.pone.0181821