Does Fact-Checking Habit Promote COVID-19 Knowledge During the Pandemic? Evidence from China

Abstract

Objective: Promoting health knowledge during a public health crisis is essential. The study aims to examine how fact-checking habit affects the obtainment of COVID-19 knowledge under the influence of COVID-19 infodemic.

Study Design: This study uses a cross-sectional survey.

Methods: During the early outbreak of COVID-19 in China, we conducted an online survey and collected data from three thousand representative samples of Chinese internet users. The study measured COVID-19 knowledge as a dependent variable, fact-checking habit as an independent variable, and general science knowledge and negative emotion as moderators. Internet use and a host of demographical factors were used as control variables. OLS linear regression analysis was conducted to examine the relationship between fact-checking habit and COVID-19 knowledge as a function of science knowledge and negative emotion.

Results: Fact-checking habit was negatively associated with COVID-19 knowledge, and the relationship was moderated by general science knowledge and negative emotion. For those with less science knowledge or higher levels of negative emotion, COVID-19 knowledge was lower with the increase of experience in fact-checking.

Conclusions: During a pandemic, people may not be able to obtain high-quality information even if they have a good habit of information fact-checking, especially when they lacked knowledge about science or were influenced by negative emotion. To promote health knowledge during a health crisis, practitioners shall not forget about promoting basic science literacy and paying attention to people's mental health during the crisis.

Keywords: COVID-19, coronavirus, knowledge, emotion, fact-checking

Introduction

Amidst the COVID-19 global pandemic, people were eager for knowing more about the virus, which can be demonstrated by the sharp rises of information seeking related to COVID-19 [1]. Health knowledge can advance health behaviors [2, 3]. Therefore,improving health knowledge becomes one of the goals of health promotion [4]. However, during the pandemic, the overabundance of both accurate and inaccurate information makes it difficult for people to obtain knowledge about COVID-19 [5]. Oftentimes, people are submerged in the infodemic and misled by inaccurate information [6]. According to the World Health Organization, an infodemic is "too much information including false or misleading information in digital and physical environments during a disease outbreak. It causes confusion and risk-taking behaviors that can harm health." [7] During the early outbreak of COVID-19 in China, a massive amount of inaccurate information about COVID-19 misled people into excessive prevention behaviors[8]. Beyond China, misleading preventive advice (e.g., drinking bleach goes viral on the internet) has caused about 5,800 people to be admitted to hospitals and at least 800 deaths by August 12, 2020[9].

Given the increasing need for COVID-19 knowledge and the negative impacts of low-quality information, there is an urgent call for fact-checking in coping with the COVID-19 infodemic [10]. It is expected that individuals can identify inaccurate information and obtain useful knowledge by fact-checking what they read [10]. Against this background, this study aims to examine how fact-checking practices can influence COVID-19 knowledge obtainment.

Research Framework

Obtaining knowledge from a massive amount of information requires skills and literacy. Fact-checking is one of the applications of information literacy [11-13]. Fact-checking (also known as "verification" or "authentification" [13, 14]) refers to an individual's behaviors of determining whether a piece of information exists or is true (e.g., using a search engine to search for more related information). Therefore, fact-checking is a process of learning. Ideally, individuals who fact-check what they read are more likely to obtain knowledge instead of inaccurate information [10], and the knowledge can help people make correct decisions [15]. An increasing number of journalists and scholars are encouraging people to fact-check what they read [16-18]. Eysenbach [10] considered fact-checking as one of the four pillars of infodemic management. However, to date, the relationship between fact-checking and knowledge obtainment has not been empirically examined yet. Do people who are more experienced in fact-checking obtain more knowledge about COVID-19 than those who are not? This study aims to answer this question.

When individuals perform fact-check, they expose themselves to more information. However, not everyone can refine knowledge from what they read efficiently. Whether people can gain new knowledge largely depends on their existing knowledge, which is concluded as the Matthew effect in education [19]. Those who have more reading ability obtain more literacy by reading [20]. Following this line of reasoning, those who have more existing science knowledge should be more capable of judging the authenticity of COVID-19 information and obtain more knowledge by fact-checking.

Meanwhile, the outcome of learning can be affected by emotion as well. Studies suggest that students' learning outcomes can be enhanced by positive (e.g., happy, joyful) but not negative emotion (e.g., anxious, fear) in learning [22, 23]. However, fact-checking under the influence of infodemic is different from learning in school. People are exposed to both accurate

and inaccurate information when they fact-check. Usually, negative emotion alerts individuals and elicits systematic as well as accommodative information processing, which leads them to focus on the actual details of the world [24, 25]. On the contrary, positive emotion signals a predictable environment and induces assimilative and constructive processing so the individuals rely more on existing knowledge and heuristic, schematic thinking to perform a task [24, 25]. As a result, people with positive emotion are more likely to fall for misleading clues when they are exposed to both accurate and inaccurate information [26]. Also, people tend to hold false memories of what they have seen [27]. Therefore, when individuals perform fact-check, negative emotion can help them process the given information more systematically, while positive emotion increases the likelihood of being misled by inaccurate information.

Based on the literature outlined above, the present study aims to investigate the impacts of fact-checking habit on the obtainment of COVID-19 knowledge, and to examine how the effects vary with different levels of science knowledge and negative emotion. The findings help to understand the determinants of health knowledge during a public health crisis.

Method

Data collection

The data for this study was collected between 2 March and 23 March 2020 in mainland China. The data collection was outsourced to a commercial survey research company with a four-million internet panel members in China. In order to achieve a representative sample, we employed a stratified quota sampling technique to recruit respondents. The quotas for subcategories of gender, age, and education groups are based on the most recent CNNIC (China Internet Network Information Center) report [28]. This sampling method was used to recruit 3,000 respondents above 18 years with a response rate of 24.6%.

Sample size

We follow Daniel and Cross's formula[29] to calculate the survey sample size. The population size of Chinese internet users is 939,840,000 according to the 44th CNNIC report[28]. To reach a criterion of 3.0% margin of error and 99.0% confidence level, the sample size should be 1,844. But given the geographical diversity of the Chinese population, we increased the target sample size to 3,000.

Measures

COVID-19 knowledge. This study measured COVID-19 knowledge by examining respondents' trust in six popular false statements about COVID-19 in China. To avoid the examination effect, two of them were reversely stated as true statements. Respondents were asked to indicate whether they believed the statements on a 4-point scale, ranging from 1 "definitely false" to 4 "definitely true". The answers for the false statements were reversely coded. Respondents scored 1 when they think the statement was "definitely true" or "true", while those who think the statement was "definitely false" or "false" scored 0. The total score of all six items form the knowledge index (M = 1.41, SD = 0.35).

Fact-checking. By adapting Edgerly et al.'s[30] measures of fact-checking, we asked how likely the respondents will do the following things when they read information online: check other major news outlets, ask friends/family members, use search engines, check social media (e.g., Weibo, WeChat), and consult other sources. Respondents reported their answer on a 5-point Likert scale, from 1 "very unlikely" to 5 "very likely". The average of these items form the fact-checking index (α = .88, M = 3.74, SD = 0.87).

Science knowledge. It is important to measure people's objective science knowledge instead of perceived science knowledge, because extremists in science topics tend to overestimate their knowledge[31]. To measure people's objective knowledge about science, we

selected 10 out of the 15 items from Fernbach et al.'s [32] scales of scientific literacy. Respondents were asked whether the 10 statements are correct or not. We added up the number of correct answers to form the science knowledge index (M = 2.74, SD = 0.38).

Negative emotion. By adapting Yeung and Fung's (2007) measures of emotion responses, participants were asked to rate the levels of "sadness", "fear", "anger" and "shock" in response to COVID-19 on a 5-point Likert scale (1 = not at all, 5 = very intensive). The items were averaged for each respondent as an indicator of negative emotion (α = .85, M = 3.47, SD = 1.08).

Control variables. Respondents were also asked to report their age, gender, education, income, region of residence, and internet use frequency. For internet use, respondents were asked how often they use the desktop and mobile devices to access the internet, from 1 "never" to 5 "always". The average scores of these two items form the index of internet use (α = .69, M = 4.24, SD = 0.78). The items used to measure demographical characteristics and their frequencies were listed in Table 1.

[insert Table 1. here]

Further details about the measures were shown in Table 2.

[insert Table 2 here]

Analysis

To analyze the data, a series of OLS linear regression analyses were performed with SPSS version 26.0. We first tested a model with demographic and control variables only as a baseline model. Then the key independent variable fact-check habit and the two moderators science knowledge and negative emotion were entered into the model sequentially. Finally, we explored the moderation effects by including interaction terms in the regression equations.

Results

Before formal analysis, we checked the sample representativeness of our data. The

demographic information is summarized in Table 1. The distributions of demographic variables (age, gender, education, and income) of the sample are very close to those reported in the 44thCNNIC report [28], which is also shown in Table 1.

We also checked the descriptive statistics of the main variables, which are shown in Table 2. Most people (70.5%) knew that the statement "Drinking alcohol won't reduce coronavirus risk" is not true. But only 51.8% of respondents know that "The coronavirus lasts longest on the smooth, non-porous surface; thus the virus survives shorter on a sweater than the metal surface." The accuracy rates of science knowledge items ranged from 44.0% to 79.7%. As for emotional reactions to the pandemic, more respondents felt shocked (58.4%) than fear (44.1%), sad (49.6%), or angry (40.4%). In general, the likelihood of fact-checking was not low (see Table 2). More than half of the respondents reported that they were likely to fact-check online information by checking major news outlets and using the search engine. About a half would perform fact-check by asking friends or family members and checking social media like Weibo and WeChat. We also examined how diverse one's fact-checking strategies are. The percentages of people that are "likely" or "very likely" to adopt one, two, three, and four types of fact-checking strategies when reading online information are 13.2% (n = 242), 17.2% (n = 315), 15.3% (n = 281), and 14.4% (n = 265) respectively. One out of five (21.5%, n = 395) reported that they were "likely" or "very likely" to adopt all of the fact-checking strategies, and 18.5% (n = 338) respondents reported no intention to use any of the examined fact-checking strategies when reading online information.

The regression results were shown in Table 3. Among the control variables, age (b = 0.14, 95%CI = 0.01-0.02, p < .001), education level (b = 0.06, 95%CI = 0.02-0.12, p < .01), and income (b = 0.04, 95%CI = 0.00-0.11, p < .05) all have positive effects on the obtainment of

COVID-19 knowledge. Individuals who use the internet (b = -0.15, 95%CI = 0.04-0.17, p < .001) more know more about COVID-19. However, fact-checking was negatively related to the obtainment of COVID-19 knowledge, b = -0.36, 95%CI = -0.66-0.53, p < .001.

[insert Table 3 here]

The relationship between fact-checking habit and obtainment of COVID-19 knowledge depends on levels of science knowledge, b = 0.05, 95%CI = -0.34-0.25, p < .01. Science knowledge had a direct effect on susceptibility to misinformation, b = 0.36, 95%CI = 1.24-1.48, p < .001. The interaction effect is shown in Figure 1. For people with high science knowledge, their past experience of fact-checking barely changed their knowledge about COVID-19. However, for people with less science knowledge, people who fact-check more obtained less COVID-19 knowledge.

[insert Figure 1 here]

Negative emotion also moderated the impact of fact-checking habit on COVID-19 knowledge, b = -0.12, 95%CI = -0.21-0.13, p < .001. Results also showed that negative emotion towards the pandemic had a negative effect on COVID-19 knowledge, b = -0.23, 95%CI = -0.33-0.24, p < .001. The interaction effect is shown in Figure 2. However, contrary to our hypothesis, for people with more negative emotion, knowledge about COVID-19 dropped significantly if they fact-check more. Among those who had a high level of negative emotion, COVID-19 knowledge decreased slightly as their fact-checking experience increased.

[insert Figure 2 here]

Discussion

Previous studies suggest that if individuals perform fact-check on the information they consume, they are more likely to obtain knowledge [13]. Our findings suggest the opposite in the context of coronavirus pandemic: people may not be able to obtain high-quality information even

if they have a good fact-checking habit , especially when they lacked knowledge about science or were influenced by negative emotion.

First, fact-checking habit had a negative relationship with COVID-19 knowledge. There are several possible explanations for the result. First, the new coronavirus brings a new health crisis to the world. When the virus swept through China, lots of unverified information about the virus appeared on the internet while scientists or health departments are still striving to understand the virus. Therefore, when facts are missing, the habit of fact-checking does not necessarily help to identify the useful knowledge. Second, people tend to fact-check what they believe for confirmation [30]. Meanwhile, it is more difficult to counter wrongful beliefs when individuals have accepted them, which is called the continued or persistent effect of inaccurate information [33, 34]. According to the cognitive bias theory, people prefer messages that are congruent with their prior beliefs and resist the opposite [35]. Thus, if people have accepted a wrongful idea, pre-existing bias will make people less likely to obtain the facts about COVID-19 even if they fact-check what they read from the internet. Third, even if people fact-check without the influence of pre-existing beliefs, the information environment they are facing may not allow them to encounter diverse opinions. The internet, especially social media, makes it easier for individuals to block voices of opposing opinions, and selectively expose themselves to information that supports their views [36, 37]. Fact-checking in a homogenous information environment or social network keeps people away from information they need.

This study further examined whether the effects of fact-checking habit on knowledge obtainment depends on existing science knowledge and negative emotion. The result is largely consistent with the Matthew effect in literacy acquisition [19]. The data showed that people with less science knowledge gain less knowledge about COVID-19 as their experience of fact-

checking increases. Among people with high science knowledge, COVID-19 knowledge barely changed with fact-checking habit. The finding highlights the importance of early science education in increasing the likelihood of knowledge intake. However, many reports demonstrated the difficulties in promoting science education. Although both developed and developing countries see the necessity of science education, there are lots of challenges and problems, such as declining interest in science studies, inequality in teaching recourses, and insufficient family involvement [38, 39].

Third, among people who hold more negative emotion towards the pandemic, their fact-checking habit decreases the likelihood of knowledge obtainment. The finding implies that mental health matters in knowledge obtainment during a public crisis. Recent studies show that the problem of negative emotion during the pandemic is commonly seen. A study in China showed that young people suffer more from anxiety disorders and depressive symptoms than others, and healthcare workers have the highest rate of poor sleep quality [40]. For another example, a study in the U.S. found depression skyrocketed during the COVID-19 pandemic among adults [41]. Therefore, health care departments and organizations should pay more attention to people's mental issues during the pandemic given its potential to influence knowledge gaining.

It is important to point out the limitations of this study. First, the fact-checking measurement scale[30] adopted by this study did not capture all aspects of fact-checking behavior and ignored some unmeasured fact-checking strategies people use[14].Therefore, developing a comprehensive scale for fact-check behavior could benefit similar research endeavors in future. Second, since this study is conducted during the COVID-19 pandemic context, and people were not very likely to hold a positive emotion toward the pandemic, this study only examined the effects of negative emotions. Future studies can examine the effects of positive emotions on fact-

checking and knowledge gain. Third, future studies should further explore the mechanisms behind information verification and the obtainment of science knowledge. People's information sources and their trust in the sources might play a role[42].

In conclusion, the study has made two main contributions. For one, we found a negative relationship between fact-checking habit and levels of COVID-19 knowledge during the pandemic. The result indicates that encouraging fact-checking behaviors might not be an effective solution to fighting an infodemic. Governments, the media, and NGOs should directly engage in promoting scientific health knowledge instead of encouraging people to fact-check in a low-quality information environment. For the other, this study sheds light on the practice of knowledge promotion by suggesting that a lack of general science knowledge and an overdose of negative emotion can make people obtain less knowledge even if they are active in information fact-checking. To promote health knowledge during a health crisis, practitioners shall not forget about promoting basic science literacy and paying attention to people's mental health during the crisis. In the long run, science literacy education is important to alleviate the inequality in health knowledge obtainment.

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