Fact-checking about the COVID-19 Pandemic on Social Networking Sites: The Moderating Role of Gender

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Research Article

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Abstract

This study aims to explore the factors related to fact-checking about the pandemic and the moderating role of gender on the effects of explored factors. Based on social cognitive theory and social role theory, we established a research model to explore the factors of fact-checking on the pandemic and the role of gender. To validate the research model, data were collected by survey method and analyzed by partial least squares technique. The analysis results present that personal factor (self-efficacy and outcome expectancy) and environmental factors (perceived skepticism and perceived ambiguity) have significant impacts on fact-checking about the COVID-19 pandemic. Meanwhile, our results reveal that gender moderates the effects of outcome expectancy, perceived skepticism, and perceived ambiguity on users’ fact-checking. Our study uses social cognitive theory to explore the factors impacting fact-checking, while we combine with social role theory to understand the gender differences in the process of COVID-19 fact-checking in SNSs.

1. Introduction

The COVID-19 pandemic has devastated people's lives and economies around the world. The COVID-19 is an infectious disease that propagates rapidly and causes serious health consequences [1]. Since December 2019, the pandemic has led to high burdens of morbidity and mortality worldwide [2]. By 21 December 2022, there were 658,543,735 confirmed cases and 6,674,392 deaths globally. Therefore, the information on this pandemic is critical to the general population, including users of social networking sites (SNSs).

SNSs are internet-based platforms that enable users to generate content and connect with their friends and others [3]. Users can acquire and share information on SNSs (e.g., Facebook, WeChat), just for leisure or solving the problems they encounter in daily life. In the period of a pandemic, people use SNSs to seek and share information about the crisis, and discuss issues related to the crisis with other users [4]. Therefore, SNSs could serve as an important communication platform to afford information about the global health crisis.

However, the etiology of the COVID-19 pandemic is not yet adequately understood, and the continual variance of the COVID-19 can lead to a continuous generation of misinformation and disinformation, resulting in an infodemic [5]. Meanwhile, SNSs can drive the spread of information. The large amount of vague and incorrect information on the pandemic led to information overload and accelerated the sharing of inaccurate information in SNSs [6, 7]. The spread of unverified information not only causes panic among the public [8], but also disrupts the discussion forums on SNSs [5]. Users may even unconsciously encounter various forms of misinformation and disinformation in SNSs. Therefore, fact-checking before sharing on SNSs is critical to reducing disinformation and misinformation.

Fact-checking refers to users’ verifying information posted on SNSs that they will share with other users or use for their own needs. Users may or may not check the information accurately, but their efforts on the fact-checking would contribute to alleviate the infodemic in SNSs. Therefore, we focus on the fact of fact-checking in this study. Although COVID-19 fact-checking is important, few previous literatures have attempted to study the factors related to COVID-19 fact-checking on SNSs. Previous studies have examined information verification on online health information [9], general online information [10, 11] and fake news on the SNSs [12, 13]. Besides, many factors related to information verification also have been examined, such as perceived credibility [10], the style of information [9], information literacy [11], subjective norms [13], fake news awareness, and trust in network [12]. However, few is about on the factors of fact-checking COVID-19 information except Schuetz et al. (2021) [14]. Towards Schuetz et al. (2021), they did not take into account personal and environmental factors of COVID-19 fact-checking [14]. (The details of our literature review are in Appendix A.) Meanwhile, males and females play different social roles that may affect their social behaviors [15, 16]. Given fact-checking COVID-19 in SNSs is a kind of social behavior which impact people’s social interaction with others in SNSs, males and females may behave differently in fact checking COVID-19 on SNSs. Gender differences are also shown in information sharing [17, 18], information seeking [19, 20], and information technology usage [21]. However, few studies have examined the role of gender in COVID-19 fact-checking on SNSs. By following problematization approach [22], we challenge the assumptions of existing literature which neglect the contextual characteristics of fact-checking on COVID-19 in SNSs by adopting a systematic theoretical view to include contextual characteristics from environmental and personal perspectives. Meanwhile, we also problematize existing literature by clarifying one of the boundary conditions of fact-checking COVID-19 in SNSs. Therefore, this study proposes two research questions:

- What are the factors influencing users’ COVID-19 fact-checking on SNSs?
- How could gender moderate the effects of the above factors of COVID-19 fact-checking?

To address above research questions, we developed a research model based on social cognitive theory to explore the factors of COVID-19 fact-checking and social role theory to understand the moderating role of gender. An anonymized survey was conducted to validate the research model. Discussion, implications, limitations, and future directions are provided based on the analysis results. This study has three main contributions: First, we extend social cognitive theory into SNSs to explore the factors of COVID-19 fact-checking on SNSs from
personal and environmental perspectives. Second, this study considers gender a moderating variable to convey the boundary condition of our proposed model of COVID-19 fact-checking. Third, we integrate social cognitive theory and social role theory to provide a more comprehensive theoretical understanding of COVID-19 fact-checking on the SNSs.

2. Theoretical foundation

2.1 Social cognitive theory

Social cognitive theory proposes that individuals can learn by observing and imitating others, and acting in a social environment [23]. Individual behaviors changes are not only affected by personal cognitive factors but also by environmental factors. The personal and environmental factors interact with people's behaviors dynamically with feedback loops. According to social cognitive theory, individual cognitive factors describe the individual's perceived ability to perform a behavior successfully and the likelihood that this behavior may lead to a particular outcome [24]. Environmental factors reflect the characteristics of the information environment in SNSs. Thus, people's fact-checking not only comes from personal motivation but is also influenced by environmental factors perceived by participants, we leverage social cognitive theory to support our theorizing of fact-checking.

Among the personal factors, two factors are emphasized: self-efficacy and outcome expectancy [23]. To be specific, self-efficacy emphasizes the judgment about an individual's ability to complete certain tasks, while outcome expectancy reflects the individual's judgment about the possible outcome of the task. Regarding the environmental factors, they should be identified according to the characteristics of the environment. The information pervaded in SNSs composes the environments of users. Therefore, we propose two factors related to the attributes of information that may trigger people to verify whether the information is authentic or useful: perceived skepticism and perceived ambiguity. Based on this theory, we explore the factors that impact people's fact-checking from a personal and environmental perspective. To be specific, we use self-efficacy and outcome expectancy as the personal factors, while perceived skepticism and perceived ambiguity as to the environmental factors.

2.2 Social role theory

The moderating role of gender is understood based on social role theory in our study. The different division of social roles between males and females leads to gender differences in social behavior [15]. The social role of the male is independent and competent, while the social role of the female is friendly and unselfish [15]. In terms of processing and judging information, males are "selective processors", task-oriented, and goal-oriented [25], while females are "comprehensive processors", focusing on the internal relationships between things [26]. Meanwhile, males tend to have confident and independent behavioral patterns, while females tend to have facilitating and friendly behaviors [27]. Therefore, given COVID-19 fact-checking may involve their social networks, they would behave differently in line with their gender. Therefore, we can use social role theory to understand the differential effect of gender.

Previous studies have used social role theory to explain the moderating role of gender. For example, Lin & Wang (2020) used social role theory to investigate gender differences in decisions about information sharing in SNSs [18]. Li et al. (2021) studied gender differences in the information disclosure in location-based services (LBS) based on social role theory [28]. Lin et al. (2013) investigated gender differences in users’ Facebook usage drawing from social role theory [29]. Therefore, it is validated to apply social role theory to analyze the gender differences.

To conclude, our study uses social cognitive theory to explore the factors impacting fact-checking, while we combine with social role theory to understand the gender differences in the process of COVID-19 fact-checking in SNSs. In specific, we ground on the three main factors in social cognitive theory which include environmental, personal, and behavioral factors to explore factors of fact-checking and their impacts, while we use social role theory to understand the differential effect of gender since social role theory is mainly about the gender's different social roles. Therefore, social role theory could complement social cognitive theory to solve our research question systematically. Our approach of theoretical perspectives combination and use has been demonstrated in the previous literature [30–32].

3. Research model and hypothesis development

Based on social cognitive theory and social role theory, we propose a research model for COVID-19 fact-checking on SNSs. We hypothesize the personal factors, which include self-efficacy and outcome expectancy, and the environmental factors which contain perceived skepticism and perceived ambiguity influence the COVID-19 fact-checking. Then, fact-checking could link to people's sharing checked facts behavior. Meanwhile, the effects of personal and environmental factors are assumed to be moderated by gender. Besides, age, education, the intensity of using SNSs, and length of using SNSs serve as control variables in this model. The hypothetical relationships are shown in Fig. 1.
3.1 Self-efficacy and fact-checking

Self-efficacy refers to individual's beliefs of completing a task and impacting effort and persistence [33]. Self-efficacy determines how long individuals will persevere and how much effort they will spend on the solution. The higher self-efficacy, the greater the effort and persistence [34]. Thus, the effort and persistence would promote conducting specific behaviors. In our study, self-efficacy would motivate people to verify information when information environment of SNSs is cluttered. Because self-efficacy determines people's effort and persistence to verify the information on COVID-19 pandemic, then people would spend effort to find and verify the information on COVID-19 pandemic. Therefore, we hypothesize that:

H1: Self-efficacy positively affects fact-checking on COVID-19 pandemic on SNSs.

3.2 Outcome expectancy and fact-checking

Outcome expectancy refers to the individual's judgment of probable outcome, which is mainly related to the reward for completing a certain task [23]. Material rewards, reputation, recognition are usually the expected results of the individual's behavior. The expected reward will positively motivate individual behaviors. In our study, when users find that verifying information about the pandemic on SNSs could help them gain recognition from other users on SNSs, they perceived the recognition as a reward for themselves. Such perceived rewards may drive them to have COVID-19 fact-checking on SNSs. Thus, we hypothesize that:

H2: Outcome expectancy positively affects fact-checking on COVID-19 pandemic on SNSs.

3.3 Perceived skepticism and fact-checking

Perceived skepticism refers to one's perception of doubting, disbelieving, and questioning information of COVID-19 on SNSs [35]. Such skepticism is resulted after people question messages on COVID-19 pandemic on SNSs and carefully consider its quality [36]. Therefore, perceived skepticism reflects the environment of SNSs. When people face information on COVID-19 pandemic on SNSs and question the credibility of the information, they will be acutely aware of the existence of fake information. Then, they are more likely to check whether it's the fact [12]. Thus, we hypothesize that:

H3: Perceived skepticism positively affects fact-checking on COVID-19 pandemic on SNSs.

3.4 Perceived ambiguity and fact-checking

Perceived ambiguity can be defined as one's perception of the degree of uncertainty in judgment [37, 38]. Inaccuracy information on COVID-19 fosters confusion and perceptions of ambiguity [39]. Perceived ambiguity may induce people's negative emotional states such as anxiety [40]. Perceptions of uncertainty is also shown to be related to anxiety in previous literature [41]. To deal with the negative emotional states, people would take action to reduce the perception of ambiguity such as verifying the information. In our study, when the information on the COVID-19 pandemic disseminated is perceived as uncertain [42], they would feel anxiety or worry about using the information. Then, they would verify the information to reduce their anxiety or worry. Therefore, we can hypothesize that:

H4: Perceived ambiguity positively affects fact-checking on COVID-19 pandemic on SNSs.

3.5 Fact-checking and sharing checked facts

Fact-checking can be defined as people's efforts to verify the existence of information through a variety of different sources [12, 43]. However, fact-checking is not the ultimate goal and does not produce direct feedback. To realize the value of fact-checking on SNSs, people will share their checked facts to earn social benefits, such as reputation, which is an external reward that provokes people to share checked facts on SNSs [44, 45]. Therefore, after checking the fact of information on COVID-19 on SNSs, people are willingness to share the checked facts to realize their value on SNSs. Thus, we hypothesize that:

H5: Fact-checking positively affects sharing checked facts on COVID-19 on SNSs.

3.6 The moderating effect of gender

To explicate gender differences in fact-checking, it is necessary to explain on how males and females perceive and behave differently on SNSs. Archer (1996) argued that females are characterized as communal, and males are characterized as agentic [16]. Therefore, gender differences could play a vital role in fact-checking on SNSs.

For the effect of self-efficacy, since males appears to be more confident than female in their ability to search and judge information on the SNSs [46], they may be more likely to check the information on COVID-19 than females. Previous studies have shown that males have more
positive computer-related self-efficacy than females [47, 48]. Towards the effect of outcome expectancy, since the male is task-oriented and goal-oriented, while a female is social-oriented and intrinsically compassionate [49], males would pay more attention on the outcome of fact-checking on COVID-19 pandemic rather than females. Meanwhile, fact-checking is thought to be associated with a goal-oriented approach rather than a social-oriented approach [15]. Therefore, we hypothesize that:

H6a: Self-efficacy has a stronger impact on fact-checking for males than females.

H6b: Outcome expectancy has a stronger impact on fact-checking for males than females.

Regarding the effect of perceived skepticism, because a female who is considered as a more comprehensive information processor than a male, would take more information clues, including inconsistent clues to make decisions [50, 51], females are more likely to seek more clues and verify information on COVID-19 than males when they feel the information is suspicious. Considering the effect of perceived ambiguity, since females have lower tolerance for ambiguity in medical information [52], they also would have a higher propensity to reduce the ambiguity by verifying information on COVID-19 pandemic than males. Therefore, we hypothesize that:

H6c: Perceived skepticism has a stronger impact on fact-checking for females than males.

H6d: Perceived ambiguity has a stronger impact on fact-checking for females than males.

4. Research method

4.1 Measurement instrument

The survey method was adopted in this study. The measurement instrument was developed by adapting previously validated scales. Items for self-efficacy were adapted from Chen et al. (2001) [53], items for outcome expectancy were from Zmud & Robert (1999) [54]. Items for perceived skepticism were from Thakor & Gorneau-Lessard (2009) [55]. Items for perceived ambiguity were adapted from Kardes et al. (2007) [56]. Items for fact-checking were from Flanagan & Metzger (2000) [57]. Finally, items for sharing checked facts were from Lin & Wang (2020) [18]. All items were measured by using a 5-points Likert scale (from “1 = strongly disagree” to “5 = strongly agree”). In addition, our study included several control variables, such as age, education, length, and experiences of using social network sites [58, 59].

We used a back-translation method to translate the survey instrument from English to Chinese and planned to collect data in China [60]. By following the back-translation method, one bilingual author translated the developed English version into Chinese, while another bilingual author translated the Chinese version back into English. Then they compared the back-translation version with the original one to examine the degree of consistency between the two versions. After confirming the translated survey instrument, a pilot survey was conducted by interviewing twelve social network site users. Four experts in medical informatics and information systems were also surveyed in the pilot to provide overall evaluations of the quality of our survey instrument. We revised the questionnaire according to their comments and suggestions. The final survey instrument is attached in Appendix B.

4.2 Data collection

To access users of SNSs, we used a paid survey service from an online professional survey company in China². There are two reasons for choosing to collect data in China. First, China has a large population of social media users which reach 1 billion till 2022 [61]. Second, China has suffered from the COVID-19 on the earliest. Moreover, the online survey company could recruit a large number of voluntary respondents who were from different regions of China with different occupations. The online survey company also can effectively manage online surveys for different research purposes [62]. Therefore, it is appropriate to leverage the online survey company to administrate our survey. Since the aim of this study was mainly to investigate users’ fact-checking and sharing checked facts about COVID-19 pandemic on SNSs, we randomly invited respondents who had checked the facts about the COVID-19 pandemic on SNSs to fill out our questionnaire through the online survey company. After three weeks of the survey, we received a total of 335 responses.

To ensure the quality of data collection, we referred to recent guidelines for online surveys to take several actions in the data collection [63]. First, to ensure study instructions are clear, a pilot test was conducted with 20 participants. Second, participants filled out an informed consent form before they completed the questionnaires, which includes verifying and blocking web robots by asking participants to correctly answer a set of tests (e.g., identifying pictures, typing words). Third, several screening questions were set to check whether the participants checked the fact on COVID-19, such as “whether you have checked information about the COVID-19 pandemic on social network sites”, “What are the main online channels you have used to check information on COVID-19 pandemic?” Fourth, only respondents who checked the fact on the COVID-19 pandemic were invited and paid to participate in the questionnaire. Fifth, to prevent the same participant from completing the questionnaire many times, examining IP addresses and removing duplicates were applied by the market research company.
Sixth, attention-traps and reverse-coded questions were used in the questionnaire to check whether participants were reading all the questions completely and giving honest responses. Seventh, all cases which had missing values or similar values were not included. We finally decided 301 valid samples. The demographic information of our final sample is summarized in Table 1.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 25</td>
<td>66</td>
<td>21.9%</td>
</tr>
<tr>
<td>25–30</td>
<td>78</td>
<td>25.9%</td>
</tr>
<tr>
<td>&gt; 30</td>
<td>157</td>
<td>52.2%</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>133</td>
<td>44.2%</td>
</tr>
<tr>
<td>Female</td>
<td>168</td>
<td>55.8%</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High school</td>
<td>9</td>
<td>3%</td>
</tr>
<tr>
<td>College</td>
<td>260</td>
<td>86.4%</td>
</tr>
<tr>
<td>Master degree and above</td>
<td>32</td>
<td>10.6%</td>
</tr>
<tr>
<td>Length of using social network sites within a day</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 2h/day</td>
<td>77</td>
<td>25.6%</td>
</tr>
<tr>
<td>2–4 h/day</td>
<td>168</td>
<td>55.8%</td>
</tr>
<tr>
<td>&gt; 4 h/day</td>
<td>56</td>
<td>18.6%</td>
</tr>
<tr>
<td>Experiences of using social network sites</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 1 year</td>
<td>4</td>
<td>1.3%</td>
</tr>
<tr>
<td>1–5 years</td>
<td>84</td>
<td>27.9%</td>
</tr>
<tr>
<td>More than 5 years</td>
<td>213</td>
<td>70.8%</td>
</tr>
</tbody>
</table>

5. Data analysis

This study uses the partial least square (PLS) to analyze collected data based on SmartPLS [64]. We chose PLS for two reasons. First, PLS can account for the maximum variance of the endogenous construct [65]. Therefore, we can better predict users’ fact-checking behavior based on our proposed factors. Second, PLS is suitable for non-normally distributed data [66]. By using the Shapiro-Wilk tests, we found our data is not normally distributed (P < 0.05). Therefore, PLS is suitable to be used in our study. The measurement and structural models are analyzed by PLS algorithm and bootstrapping, respectively [67].

5.1 Measurement model analysis

In Table 2, the results of reliability and convergent validity are presented. The values of Cronbach's alpha are between 0.61 and 0.88 [68], and composite reliabilities are above 0.7 [69], then, indicating the good reliability for the measurement model. Meanwhile, all the values of average variance extracted (AVE) of each item are above 0.5, and item loadings are also all above 0.7, indicating the measurement model have a good convergence validity [70]. Furthermore, we judge the discriminant validity by comparing the square root of the AVE of constructs with their correlation coefficients. Table 3 shows that values of the square root of AVE of each construct are larger than their correlation with other constructs, which implies a good discriminant validity for the measurement model [71]. In addition, the Heterotrait-Monotrait Ratio (HTMT) is included and Table 4 reveals that all values of HTMT in this study are less than 1.00 [72], which further strengthens the good discriminant validity of this measure. Hence, we conclude that the quality of the measurement model is sufficient to test hypothesized relationships.
Given the data was obtained through a cross-sectional survey, it is important to examine whether common method bias (CMB) becomes a problem in our study. First, Harman's single-factor test was conducted by using principal component analysis [73]. The results showed five factors were extracted and the first factor in the unrotated solution explained 25.39% of the variance, which is less than 50%. Second, a marker variable technique was also used to assess the CMB [74]. We chose organizational commitment as the marker variable, which has no theoretical relevance to our research model. The analysis result presented that organizational commitment was not related with COVID-19 fact-checking ($\beta = 0.063$, $p > 0.05$). Therefore, CMB was unlikely to be an issue in our study.

Table 2
Construct reliability and convergent validity

<table>
<thead>
<tr>
<th>Construct</th>
<th>Items</th>
<th>Full sample</th>
<th>Male subgroup</th>
<th>Female subgroup</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>loadings</td>
<td>CR</td>
<td>AVE</td>
</tr>
<tr>
<td>OE</td>
<td>OE1</td>
<td>0.877</td>
<td>0.871</td>
<td>0.693</td>
</tr>
<tr>
<td></td>
<td>OE2</td>
<td>0.778</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>OE3</td>
<td>0.837</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SE</td>
<td>SE1</td>
<td>0.888</td>
<td>0.853</td>
<td>0.744</td>
</tr>
<tr>
<td></td>
<td>SE2</td>
<td>0.835</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PS</td>
<td>PS1</td>
<td>0.765</td>
<td>0.832</td>
<td>0.624</td>
</tr>
<tr>
<td></td>
<td>PS2</td>
<td>0.741</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PS3</td>
<td>0.856</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PA</td>
<td>PA1</td>
<td>0.863</td>
<td>0.868</td>
<td>0.768</td>
</tr>
<tr>
<td></td>
<td>PA2</td>
<td>0.889</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FC</td>
<td>FC1</td>
<td>0.785</td>
<td>0.844</td>
<td>0.643</td>
</tr>
<tr>
<td></td>
<td>FC2</td>
<td>0.812</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>FC3</td>
<td>0.808</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SCF</td>
<td>SCF1</td>
<td>0.799</td>
<td>0.835</td>
<td>0.627</td>
</tr>
<tr>
<td></td>
<td>SCF2</td>
<td>0.808</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SCF3</td>
<td>0.767</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Legends: FC = Fact-checking; OE = outcome expectancy; SE = Self-efficacy; SCF = Sharing checked facts; PA = Perceived ambiguity; PS = Perceived skepticism.
Table 3
Discriminant validity

<table>
<thead>
<tr>
<th></th>
<th>FC</th>
<th>OE</th>
<th>PA</th>
<th>PS</th>
<th>SE</th>
<th>SCF</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.802</td>
<td>0.277</td>
<td>0.175</td>
<td>0.185</td>
<td>0.375</td>
<td>0.362</td>
</tr>
<tr>
<td></td>
<td>0.832</td>
<td>0.876</td>
<td>0.304</td>
<td>0.790</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.876</td>
<td>0.790</td>
<td>0.342</td>
<td>0.792</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FC</td>
<td>0.775</td>
<td>0.336</td>
<td>0.132</td>
<td>0.200</td>
<td>0.393</td>
<td>0.342</td>
</tr>
<tr>
<td>OE</td>
<td>0.849</td>
<td>0.856</td>
<td>0.803</td>
<td>0.849</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PA</td>
<td>0.775</td>
<td>0.809</td>
<td>0.882</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PS</td>
<td>0.240</td>
<td>0.123</td>
<td>0.246</td>
<td>0.780</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SE</td>
<td>0.353</td>
<td>0.384</td>
<td>-0.007</td>
<td>-0.016</td>
<td>0.863</td>
<td></td>
</tr>
<tr>
<td>SCF</td>
<td>0.362</td>
<td>0.324</td>
<td>0.032</td>
<td>-0.041</td>
<td>0.362</td>
<td>0.779</td>
</tr>
</tbody>
</table>

Legends: FC = Fact-checking; OE = Outcome expectancy; SE = Self-efficacy; SCF = Sharing checked facts;
PA = Perceived ambiguity; PS = Perceived skepticism.
Table 4
Heterotrait-monotrait ratio (HTMT)

<table>
<thead>
<tr>
<th></th>
<th>FC</th>
<th>OE</th>
<th>SE</th>
<th>SCF</th>
<th>PA</th>
<th>PS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FC</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>OE</td>
<td>0.363</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SE</td>
<td>0.539</td>
<td>0.485</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>SCF</td>
<td>0.501</td>
<td>0.437</td>
<td>0.495</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>PA</td>
<td>0.247</td>
<td>0.126</td>
<td>0.108</td>
<td>0.076</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PS</td>
<td>0.244</td>
<td>0.187</td>
<td>0.160</td>
<td>0.167</td>
<td>0.457</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OE</td>
<td>0.452</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>SE</td>
<td>0.612</td>
<td>0.489</td>
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<tr>
<td>SCF</td>
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<td>0.406</td>
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<tr>
<td>PA</td>
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<td>0.070</td>
<td>0.168</td>
<td>0.196</td>
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</tr>
<tr>
<td>PS</td>
<td>0.267</td>
<td>0.246</td>
<td>0.296</td>
<td>0.235</td>
<td>0.561</td>
<td></td>
</tr>
<tr>
<td>Female</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OE</td>
<td>0.287</td>
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<td>SE</td>
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<tr>
<td>SCF</td>
<td>0.503</td>
<td>0.452</td>
<td>0.524</td>
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<tr>
<td>PA</td>
<td>0.278</td>
<td>0.196</td>
<td>0.123</td>
<td>0.079</td>
<td></td>
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<tr>
<td>PS</td>
<td>0.250</td>
<td>0.133</td>
<td>0.121</td>
<td>0.141</td>
<td>0.381</td>
<td></td>
</tr>
</tbody>
</table>

*Legends: FC = Fact-checking; OE = Outcome expectancy; SE = Self-efficacy; SCF = Sharing checked facts; PA = Perceived ambiguity; PS = Perceived skepticism.*

5.2 Structural model analysis

We examined the structural model by testing the hypothesized relationships in Table 5. It can be found that the main effects in the model have been significantly verified and analyzed. The $R^2$ values for fact-checking and sharing checked facts in this study model were 0.208 and 0.152 both higher than 0.1 [75], indicating that the structural model in this study has an acceptable predictive ability.
Table 5
Results of Hypotheses Testing

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Path Coefficient</th>
<th>T Statistics</th>
<th>Supported</th>
</tr>
</thead>
<tbody>
<tr>
<td>SE→FC</td>
<td>0.308</td>
<td>5.471***</td>
<td>H1: Yes</td>
</tr>
<tr>
<td>OE→FC</td>
<td>0.124</td>
<td>2.321*</td>
<td>H2: Yes</td>
</tr>
<tr>
<td>PS→FC</td>
<td>0.111</td>
<td>2.311*</td>
<td>H3: Yes</td>
</tr>
<tr>
<td>PA→FC</td>
<td>0.159</td>
<td>3.201**</td>
<td>H4: Yes</td>
</tr>
<tr>
<td>FC→SCF</td>
<td>0.343</td>
<td>5.502***</td>
<td>H5: Yes</td>
</tr>
</tbody>
</table>

Legends: FC = Fact-checking; OE = outcome expectancy; SE = Self-efficacy; SCF = Sharing checked facts; PA = Perceived ambiguity; PS = Perceived skepticism.

Note: * 0.05 significance; ** 0.01 significance; *** 0.001 significance.

Structural results in Fig. 2, for personal factors, self-efficacy ($\beta = 0.308, p < 0.001$) and outcome expectancy ($\beta = 0.124, p < 0.05$) have a significant impact on fact-checking. Therefore, H1 and H2 are supported. Meanwhile, considering the environmental factors, both perceived skepticism ($\beta = 0.111, p < 0.05$) and perceived ambiguity ($\beta = 0.159, p < 0.01$) significantly affect fact-checking. Therefore, H3 and H4 are supported. Finally, fact-checking ($\beta = 0.343, p < 0.001$) has a significant effect on sharing checked facts. Therefore, H5 is supported. To conclude, the analysis results show that social cognitive theory is appropriate to be used in our study and has been verified in our research.

Meanwhile, we also consider the roles of control variables, including age, education, length, and intensity of using SNSs and find that length of using SNSs has a significant impact on fact-checking ($\beta = 0.124, p < 0.05$) and sharing checked facts ($\beta = 0.128, p < 0.05$). In addition, age is associated with sharing checked facts significantly ($\beta = 0.127, p < 0.05$).

5.3 Moderating effect analysis

To test gender differences in this study, we used the multi-group analysis. First, separate tests were conducted for the male and female groups to obtain the path coefficients. The results are described in Table 6 and Fig. 3. We then used the formula\(^7\) proposed by Keil et al. (2000) [76] to compare the differences of path coefficients between males and females groups (see Table 7). Figure 3 reveals that gender differences exist in our study. Especially, the $R^2$ indicates that the research model explains 26.6% of the variance in fact-checking and 15.2% of the variance in sharing checked facts for the male subgroup. In contrast, for the female subgroup, the model accounts for 22.1% of the variance in fact-checking and 17.6% of the variance in sharing checked facts.

Table 6
Hypotheses, path coefficients and t-values.

<table>
<thead>
<tr>
<th>Constructs</th>
<th>Males</th>
<th></th>
<th></th>
<th>Females</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Beta_M</td>
<td>T Statistics</td>
<td>Supported</td>
<td>Beta_F</td>
<td>T Statistics</td>
<td>Supported</td>
</tr>
<tr>
<td>SE→FC</td>
<td>0.298</td>
<td>5.436***</td>
<td>Yes</td>
<td>0.302</td>
<td>5.210***</td>
<td>Yes</td>
</tr>
<tr>
<td>OE→FC</td>
<td>0.203</td>
<td>3.647***</td>
<td>Yes</td>
<td>0.079</td>
<td>1.339(ns)</td>
<td>No</td>
</tr>
<tr>
<td>PS→FC</td>
<td>0.015</td>
<td>0.270(ns)</td>
<td>No</td>
<td>0.176</td>
<td>3.167**</td>
<td>Yes</td>
</tr>
<tr>
<td>PA→FC</td>
<td>0.151</td>
<td>2.295*</td>
<td>Yes</td>
<td>0.177</td>
<td>3.638***</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Note: * 0.05 significance; ** 0.01 significance; *** 0.001 significance; ns = statistically not significant.
Table 7

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Constructs</th>
<th>Males (n = 133)</th>
<th>Females (n = 168)</th>
<th>( t_{\text{pooled}} )</th>
<th>Support?</th>
</tr>
</thead>
<tbody>
<tr>
<td>H6a</td>
<td>SE→FC</td>
<td>Beta_M = 0.298</td>
<td>Beta_F = 0.302</td>
<td>-0.630(ns)</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>(M &gt; F)</td>
<td>SE_M = 0.057</td>
<td>SE_F = 0.058</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H6b</td>
<td>OE→FC</td>
<td>Beta_M = 0.203</td>
<td>Beta_F = 0.079</td>
<td>20.122***</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>(M &gt; F)</td>
<td>OE_M = 0.056</td>
<td>OE_F = 0.059</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H6c</td>
<td>PS→FC</td>
<td>Beta_M = 0.015</td>
<td>Beta_F = 0.176</td>
<td>-26.555***</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>(F &gt; M)</td>
<td>PS_M = 0.055</td>
<td>PS_F = 0.055</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H6d</td>
<td>PA→FC</td>
<td>Beta_M = 0.151</td>
<td>Beta_F = 0.177</td>
<td>-3.953***</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>(F &gt; M)</td>
<td>PA_M = 0.066</td>
<td>PA_F = 0.049</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: * 0.05 significance; ** 0.01 significance; *** 0.001 significance; ns = statistically not significant.

Based on the comparison results presented in Table 7 for personal factors, outcome expectancy has a stronger effect on fact-checking for the male than for the female (\( \beta_M = 0.203, \beta_F = 0.079, t_{\text{pooled}} = 20.122 \)). However, self-efficacy failed to have stronger effects on fact-checking for the male than for the female (\( \beta_M = 0.298, \beta_F = 0.302, t_{\text{pooled}} = -0.630 \)), which provides support for H6b but not for H6a. For environmental factors, perceived skepticism (\( \beta_F = 0.176, \beta_M = 0.015, t_{\text{pooled}} = -26.555 \)) and perceived ambiguity (\( \beta_F = 0.177, \beta_M = 0.151, t_{\text{pooled}} = -3.953 \)) have a greater effect on fact-checking for the female than for the male. The results supported H6c and H6d.

6. Discussion

Based on social cognitive theory and social role theory, we theoretically propose and validate the effect of personal and environmental factors on fact-checking and test the moderating effect of gender on individuals’ COVID-19 fact-checking on SNSs empirically. Overall, our findings provide strong support for our proposed hypotheses. However, it is worth noting that there is no significant differential effect of self-efficacy across genders. This may be because the COVID-19 pandemic presents so severe risk for both males and females that their beliefs on the abilities to deal with the crisis may not differ significantly.

6.1 Theoretical implications

This study provides some theoretical contributions. First, we extend social cognitive theory into SNSs by dividing factors of fact-checking on SNSs into personal and environmental factors. Compared with previous literature which focuses less on verifying information on SNSs, we ground on solid theory-social cognitive theory by considering both personal (self-efficacy and outcome expectancy) and environmental characteristics (perceived skepticism and perceived ambiguity) to explore the factors of COVID-19 fact-checking systematically. Meanwhile, our study results also show that the proposed personal factors and environmental factors have significant impacts on fact-checking. The validated factors enrich the literature on fact-checking and reflect the characteristics of the global health crisis and SNSs.

Second, this study uses gender as a moderating variable to reflect the boundary condition of our proposed research model. Few of previous literature have focused on the moderating effect of gender on COVID-19 fact-checking. Our analysis results show the significant moderating role of gender in the effects of personal and environmental factors. To be specific, males are goal-oriented, they pay more attention on the outcome of fact-checking on COVID-19 pandemic. In contrast, females are social-oriented, they are more likely to be influenced by informational and environmental cues, such that perceived skepticism and perceived ambiguity of information are shown to have stronger influence on their fact-checking on COVID-19. Therefore, our study provides an in-depth understanding of COVID-19 fact-checking on SNSs with gender differences.

Third, we integrate social cognitive theory and social role theory to provide a comprehensive understanding of COVID-19 fact-checking on SNSs. These two theories serve as different but complementary roles in establishing our research model. Social cognitive theory supports us in exploring the factors of fact-checking on the COVID-19 pandemic, while social role theory guides us in understanding the moderating effect of gender on the proposed factors. Since these two theories both concern people’s behaviors in a social context, we could integrate...
them to better understand people's social behaviors [77]. Therefore, by integrating the two theories, we not only explore the factors on COVID-19 fact-checking on SNSs, but also uncover gender as the boundary condition of the effects of explored factors.

6.2 Practical implications

Besides the theoretical implications, this study has practical implications. First, COVID-19 fact-checking can be encouraged from personal perspective. For example, policymakers and regulators should take into consideration the importance of media literacy in combating the impact of disinformation and misinformation of COVID-19, as it may contribute to increase users' self-efficacy. Such improved media literacy will empower people to adequately read and assess information on SNSs before sharing it [78]. Meanwhile, the managers of SNSs could set up feedback mechanisms like highlighting real-time recognition of information verification, such as likes, virtual gifts, to stimulate verifiers' sense of self-achievement based on the effects of outcome expectancy.

Second, COVID-19 fact-checking also can be encouraged based on environmental perspective. The managers of SNSs could provide alerts or notifications of potential disinformation and misinformation on SNSs. Fact-checking alerts could be flagging features applied to help users to quickly spot disinformation and misinformation. The alerts could also be the warnings of showing that some information is highly risky and encourage users to evaluate or avoid the inaccuracy of the information carefully. Meanwhile, policymakers could advocate improving individuals' e-health literacy which could improve users' ability and awareness to discern the authenticity of information.

Third, gender difference should be taken into account for fact-checking on the COVID-19 pandemic. Our study shows that males are more focused on outcome expectancy in fact-checking compared to females. Therefore, the managers of SNSs could use reward-based gamification elements to increase males' extrinsic motivation [79] and enhance the fun of verifying information by males. For example, reward-based gamification elements such as badges, points, and leaderboards could be added in SNSs for fact-checking. Meanwhile, our research results show that females emphasize perceived skepticism and perceived ambiguity in fact-checking than males. Therefore, managers of SNSs could provide more targeted notifications for female users to verify information about the COVID-19 pandemic before they share it.

6.3 Limitations and future directions

This study contains some limitations. First, we focus only on the factors of fact-checking and do not consider the consequences of fact-checking in this study. Detecting the consequences of fact-checking quantitatively could help determine whether users' fact-checking is effective. Therefore, future studies could explore the consequences of fact-checking to highlight the role of fact-checking further.

Second, more factors can be considered to study fact-checking. For example, many factors like trust or rumor awareness which have been confirmed in previous literature also could be considered in our study in the future [12]. Meanwhile, in addition to gender, future research can further explore the role of other individual differences such as age or e-health literacy as the moderators.

Third, our study could be validated in other contexts, not just in SNSs. Our study results may be limited in understanding COVID-19 fact-checking on SNSs. However, people not only verify and share information in SNSs, but also in other online applications or offline environments. Meanwhile, COVID-19 fact-checking may differ from fact-checking on other sensitive topics. Therefore, in the future, we can explore factors of fact-checking on other sensitive topics in other contexts.

Fourth, our study used a cross-sectional survey, in which the dynamics of constructs may not be captured. The variables included in our study may be changed over time. Meanwhile, since the measurements of independent and dependent variables were performed at the same point in time, the time sequence of the change of independent and dependent variables could not be shown in the cross-sectional survey. Therefore, future studies can use longitudinal research designs to collect data of different variables at different times.

7. Conclusions

Based on social cognitive theory and social role theory, we proposed a research model to explore the factors related to fact-checking about the COVID-19 pandemic and the moderating role of gender on the impacts of the explored factors. Our study results support the effect of explored factors on users' COVID-19 fact-checking. Meanwhile, gender is shown to moderate the effects of outcome expectancy, perceived skepticism, and perceived ambiguity but not on self-efficacy. Our study shows the necessity of encouraging users' COVID-19 fact-checking and provides guidance to SNSs' managers and policymakers to encourage fact-checking.

Declarations

Acknowledgements
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Author contributions

JBX, TLW, ZC and LQZ contributed to the conception and design of the study. JBX participated in data collection, data analysis, and manuscript writing. TLW and ZC participated in manuscript editing and supervision. LQZ obtained project administration and funding acquisition. All authors read and approved the final manuscript.

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Data Availability

The data that support the findings of this study are available on request from the corresponding author.

Ethical approval and consent to participate.

This study was approved by the Ethics Review Committee of Tongji Medical College, Huazhong University of Science and Technology. Informed consent was obtained from all individual participants included in the study. All methods and procedures were carried out in accordance with relevant guidelines and regulations.

Conflict of interest

The authors report there are no competing interests to declare.

Consent for publication

Not applicable.

References


Footnotes


2. The URL of the company is https://www.wjx.cn/.

3. $s_{\text{pooled}} = \sqrt{\frac{N_1 - 1}{s_1^2} + \frac{N_2 - 1}{s_2^2}} \quad t = \frac{P_{i1} - P_{i2}}{s_{\text{pooled}} \sqrt{\frac{1}{N_1} + \frac{1}{N_2}}}$

Where $s_{\text{pooled}} = \text{pooled estimator for the variance}$

$t = \text{t-statistic with } N_1 + N_2 - 2 \text{ of freedom}$

$SE_i = \text{standard error of path in structural model of gender } i$

$PC_i = \text{path coefficient in structural model of gender } i$

Figures
Figure 1
Research model and hypothesized relationships.

Figure 2
Structural results.

Note: * 0.05 significance; ** 0.01 significance; *** 0.001 significance.
Figure 3

(a) PLS analysis for the male sample (N1 = 133).

(b) PLS analysis for the female sample (N2 = 168).

Note: * 0.05 significance; ** 0.01 significance; *** 0.001 significance; ns = statistically not significant.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- AppendixALiteraturereviewoffactchecking.docx
- AppendixBConstructsandmeasurements.docx