Who is more likely to spread rumors? A study of the relationship between critical thinking, health anxiety, helpfulness, exhibitionism, and health rumor transmission on WeChat among older adults in China

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Abstract: With the popularity of social networking sites, rumors also found their way in these sites. Health is one of the most popular rumor topics on WeChat, one of the most popular social networking sites in China[1]. Among the people who transmit health rumors, older adults have become the main force[2].

Classical studies on rumor mainly focused on the predictors of the transmission of specific rumor messages under extreme events, such as war or earthquake[3-4] and overlooked the group or sociocultural determinants of rumor transmission[5]. This study examined the trait predictors of the transmission of health rumor in everyday life, and included predictor variables that reflect interpersonal influence. Specially, we hypothesized that older people who are low in critical thinking, high in health anxiety, helpfulness and exhibitionism are more willing to transmit rumor on SNSs.

Results from a survey with Chinese older adults who are 50 years or older (n = 914) showed that critical thinking was negatively related to rumor transmission intention, helpfulness was positively related to rumor transmission intention, while health anxiety and exhibitionism were not significantly related to rumor transmission intention.

Keywords: Rumor; critical thinking; health anxiety; helpfulness; exhibitionism

誰更有可能散佈謠言？ 微信上中國老年人的批判性思維、健康焦慮、樂於助人，自我宣傳癖和健康謠言傳播的關係研究

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摘要：隨著社交網站的普及，謠言也出現在了這些網站上。健康謠言是微信（中國最受歡迎的社交軟件之一）上最流行的謠言話題之一[1]。在傳播健康謠言的人群中，老年人已成為主要力量[2]。

關於謠言的經典研究主要集中在諸如戰爭或地震等極端事件下特定謠言資訊傳播的預測因數[3-4]，而忽視了謠言傳播的群體或社會文化決定因素[5]。本研究探討了日常生活中健康謠言傳播的個人特質預測變量，以及反映人際影響的預測變量。具體來說，我們假設批判性思維低、高健康焦慮、樂於助人和自我宣傳癖的老年人更願意在SNS上傳播謠言。

這項針對中國50歲以上老年人（n = 914）的調查結果表明，批判性思維與謠言傳播意圖呈負相關，樂於助人與謠言傳播意圖呈正相關，而健康焦慮和自我宣傳癖與謠言傳播意圖沒有明顯的相關關係。

關鍵詞：謠言；批判性思維；健康焦慮；樂於助人；自我宣傳癖

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0 Introduction

Rumor generally refers to an unverified proposition for belief that has topical relevance for people who are actively involved in its dissemination[6]. As one of the most popular applications for sharing information, social media has become a common platform for spreading rumors[7]. In 2017, WeChat, one of the most popular social networking sites in China, has found and refuted rumor 490 million times, covering 140 million users[8]. Health is one of the most popular rumor topics on WeChat[1]. The overflow of health rumors not only misguides public opinion and creates public panic, but also triggers actual imitation behavior of individuals, which endangers their health and even their lives[9].

China has become an aging society since 1999[11]. According to the data released by the National Bureau of statistics, by the end of 2019, China's elderly population aged 60 and above reached 254 million, accounting for 18.1% of the total population, and the elderly population aged 65 and above reached 176 million, accounting for 12.6% of the total population. Data from China Internet Network Information Center (CNNIC) showed that the number of elderly users of social networking increased rapidly in the past few years [12].

As a "new generation" of social networking sites, older adults are actively sharing information on WeChat[10]. Along with the information being shared are rumors. According to WeChat statistics, in 2016, 80% of users who forwarded more than five rumors on WeChat every month were people who were over 50 years old[2]. How to understand this rumor transmission behavior among older adults is the focus of this study.

Many scholars have tried to explain the motivations behind rumor transmission. Allport and Postman's[3] rumor model proposed two predictors of rumor transmission: ambiguity and importance. Rosnow[13] extended the model and included four factors behind rumor transmission: uncertainty of the situation, relevance of the rumor to the person, anxiety associated with the rumor, and trust in the rumor based on its perceived accuracy. However, these models focused mainly on factors influencing the transmission of a specific rumor; few studies have tried to explore what individual characteristics lead to habitual rumor transmission.

What is more, Bordia and DiFonzo[5] criticized the fact that rumor transmission is a group phenomenon, yet these models did not include the group impact factor. This study will add to the literature by examining two group-related variables: helpfulness and exhibitionism.

The third contribution of the study is that previous studies on rumor mainly focused on the extreme-event scenarios, such as earthquakes[14], war[3], terrorist attack[15] and kidnapping[16]. Few studies have investigated rumors in normal everyday life. This study will focus on the most popular everyday rumor, namely health-related rumor, to fill the gap in the literature.

As transmission of rumor is socially undesirable, few people would admit that they have transmitted rumors and talk about their motivations for doing so. Therefore we want to explore whether there are some common personal traits that affect their willingness to transmit rumors. To explore this question, we borrow insights from previous theoretical perspectives, that is Bordia and DiFonzo's[17] three motivations underlying the spreading of rumor (fact finding, relationship building and self-enhancement) and the anxiety factor identified in previous research[18]. Specially, people who are motivated by fact-finding motivations are likely to spread rumors in the hope that collective wisdom can help them to varify the information in the rumor. Those who are high in critical thinking may not need other people's wisdom to verify the information in the rumor. They may verify the information themselves before forwarding the information to others. Whereas, those who are low in critical thinking may forward rumor information without verifying it themselves, in the hope that others may verify it for them. People who are motivated by relationship building and self-enhancement motivations may spread rumors to get the attention of the listener, appear "in the know", and show their status or prestige by knowing valuable information before others. Therefore, those who are high in exhibitionism may forward rumors more than those who are low in exhibitionism. Appearing helpful

may be another factor behind the relationship building motivation as it can enhance interpersonal relationships. Finally, as health rumors are specifically related to health issues, elderly people who are highly concerned about their health conditions may forward health rumors more than others. Therefore, we hypothesize that that older people who are low in critical thinking, and high in health anxiety, helpfulness and exhibitionism, are more willing to transmit rumor on social networking sites (SNSs).

Critical thinking and health rumor transmission.

Critical thinking is reflective and rational thinking, which focuses on deciding what to believe or do[17]. Critical thinking is an important part of media literacy, which allows the public to discover the truth and refute the misinformation in rumors[20]. Many scholars believed that there should be a negative relationship between critical thinking and rumor transmission[20,21~22]. However, there are few empirical studies that specifically test this hypothesis, thus we shall test this hypothesis in the current study.

As people get older, their cognitive abilities also get worse[23]. Zhao[24] found that critical thinking is positively related to the cognitive ability of the elderly. Therefore, we can infer that critical thinking also declines with age. What is more, the educational level of older adults currently in China is relatively low[25]. Zhao[24] found that education is positively correlated with the cognitive ability of the elderly. Thus, the low education level of Chinese older adults may be another factor leading to their low critical ability.

As the critical thinking ability of Chinese older adults is relatively low, when faced with a large amount of health information on WeChat, they lack the relevant knowledge and critical ability to judge and resist rumors, and may end up transmitting rumors. Therefore our first hypothesis is as follows:

H1: Critical thinking is a negative predictor of health rumor transmission on SNSs for older adults.

Health anxiety and health rumor transmission.

Anxiety is an acute or chronic emotional state that arises from or is associated with an impending, potentially disappointing outcome [13]. Knapp[26] argued that one of the purposes of rumor transmission is to share one's anxiety with other people and to get reassurance and emotional support. Bordia, DiFonzo, Haines, and Chaseling[27] argued that although anxiety encourages people to find the truth, excessive anxiety also inhibits people's ability to rationally assess the situation they face.

Many studies have found that anxiety can lead to rumors[4~5,28]. However, most of these studies have focused on situational anxiety. Studies have shown that chronic anxiety can also lead to rumors [18].

Older adults are prone to have health problems, which may lead to high chronic health anxiety[29]. Lagoe and Atkin[30] found that health anxiety is positively related to health information seeking on the Internet. This heightened health anxiety may also lead older people to be more willing to spread health rumors to reduce their health anxiety[3]. Therefore, our second hypothesis is the following:

H2: Health anxiety is a positive preditor of health rumor transmission on WeChat for older adults.

Helpfulness and health rumor transmission.

Helpfulness is defined as the tendency of an individual to provide helps to needy others[31]. Penner, Fritzsche, Craiger, and Freifeld[31] treat helpfulness as a stable personal trait, rather than a situational choice, and proposed that it is one of the two components of a prosocial personality. As there is still debate about the motivational mechanisms behind prosocial behaviors, that is, whether people help others out of altruism or egotism[32], we shall use helpfulness as a trait without distinguishing the motivations behind it.

Knapp[26] argued that the motivation to transmit rumors, especially panic rumors, may come from the desire to inform others of impending danger or threat. Health-related rumors often appeal to fear to attract the attention of the reader. Thus, older adults who are high in helpfulness may forward these rumors to inform others of their potential health problem.

Altruism has been found to be a major motivation for online knowledge sharing[33-36]. Studies showed that prosocial tendencies increase with age[37]. Thus, helpful older adults may be highly motivated to share health

information online. However, as health information involves medical science and other professional knowledge, which makes it difficult to distinguish between true and false for nonprofessional people, knowledge sharing may unintentionally become rumor dissemination. A study with members of online cancer discussion groups found that altruistic motivation is one of the most frequently mentioned motivations for cancer rumor transmission[38]. Based on the above literature, our third hypothesis is:

H3: Helpfulness is a positive predictor of health rumor transmission on WeChat for older adults.

Exhibitionism and health rumor transmission.

Exhibitionism is one of the seven components of narcissism[39]. Exhibitionists have a relentless need to validate their self-beliefs in front of others, and are characterized by prestige seeking, trendsetting and compliment seeking[40]. Exhibitionism has been found to be positively related to self-promoting SNS behaviors such as interacting with a large, public Facebook community[41]. Song, Cho, and Kim[42] found that exhibitionism positively predicts the propensity to become an opinion leader in social media.

To enhance their social images, exhibitionists may resort to rumormongering as a means of heightening their personal status with their peers[26]. Norris[43] argued that members of online communities who share the latest news or rumors are providing a valuable and desired resource to the community. If the rumors turn out to be true, then the rumormonger will gain the prestige of being an expert[44] and will be reflected favorably by others[45]. Marett and Joshi[46] found that reputation-related motivations were significantly related to rumor transmission.

Older adults high in exhibitionism usually play the authority role in offline everyday life. They may also wish to extend their authority to the Internet. In order to win their right of speech, older adults may play an active role in information dissemination, among which may be rumors, so as to create an image of an opinion leader. Therefore, our fourth hypothesis is as follows:

H4: Exhibitionism is a positive preditor of health rumor transmission on WeChat for older adults.

1 Material and methods

1.1 Participants and Survey development

As older adults aged over 50 contributed a great proportion of the rumors on WeChat[2], we asked undergraduate students to refer participants who are 50 or older that have used WeChat before. The students received extra course credits for referring participants. A total of 1222 questionnaires were collected. After excluding ineligible participants that were younger than 50, a total of 914 valid questionnaires were included in the sample (509 females) with an average age of 55.09 (SD = 6.48) among the participants concerned.

The rumor materials in this study were mainly obtained from “WeChat rumor-refuting assistant”, a small program launched by WeChat. After screening a large number of rumors, we divided health rumors into three categories: food/health care, disease-related lifestyle and medical science rumors and selected nine health rumors (three for each category) for pretest.

A pretest (n = 84) was conducted to test the trustworthiness and familiarity of the nine health rumors. Familiarity was measured by the information familiarity scale adjusted from Gao, Xu and Liu[47]. Respondents were asked their agreement to three questions: “I am very familiar with this news.” “My relatives and friends have mentioned this message before.” “I have heard or seen media report on this message.” Credibility was measured by the credibility scale developed by Lichtenstein and Bearden[48]. The scale has 5 questions, but due to the similarity of the Chinese translation, only 3 distinct questions were remained the scale. “I think this information is very real.” “I think this information is very credible.” “I think this information is very reliable.” The two scales were both coded on a five point Likert scale (1=strongly disagree, 5= strongly agree).

Results showed that of the nine messages that we tested, only four messages’ credibility score exceeded 3.00, which means respondents found them credible. Of these four messages, we chose the three least familiar

messages as the rumor messages for the main test (See Appendix: Figure 1).

1.2 Measures

1.2.1 Dependent variable: Rumor transmission intention.

To test the transmission intention of older adults, we developed a scale based on previous studies[49~51]. To control for source credibility, we did not mention who the sender of the rumor was. We asked respondents: "If you see this message from WeChat, what will you do?" Respondents were asked their agreement to three statements: "I will forward this message to my friends/relatives." "If my friends/relatives are in line with the above situations, I will forward this message to them." "If my friends/relatives talk about topics similar to this, I shall forward this message to them." Responses were coded with a five-point Likert scale (1=strongly disagree, 5= strongly agree). Cronbach's Alpha was 0.94.

1.2.2 Independent variables

1) Critical thinking.

Critical thinking was measured by the Chinese version of the California Critical Thinking Disposition Inventory[52]. It asked respondents' agreement to seven statements, such as "There are four reasons for agreeing on something and one reason for disagreeing, I will choose to agree." on a five point Likert scale (reverse coded as strongly agree =1,strongly disagree =5). Higher score indicates higher critical thinking. Cronbach's Alpha was 0.74.

2) Health anxiety.

Health anxiety was measured by the Chinese version of Short Health Anxiety Inventory[53]. Sample of the questions are: "I worry about my health", "I will lose my dignity if I get a severe disease." Responses were coded on a 0-3 scale (never = 0, sometimes = 1, often = 2, always = 3). Cronbach's Alpha was 0.85.

3) Helpfulness.

Helpfulness was measured by the 8-item "help" subscale of the warm-heartedness scale [54]. It asked respondents' agreement to questions such as "I assist someone when he/she needs it." Responses were coded on a 5-point Likert scale (1= "Strongly Disagree" to 5 = "Strongly Agree"). Cronbach's Alpha was 0.85.

4) Exhibitionism.

Exhibitionism was measured by the 7-item exhibitionism subscale of narcissism[39]. Sample of the questions are: "I like to be the center of attention", "I am apt to show off if I get the chance." Responses were coded on a 5 point scale (1= "Strongly Disagree" to 5 = "Strongly Agree"). Cronbach's Alpha was 0.86.

1.2.3 Control variables

The control variables were gender (female = 1, male = 0), age (years), education (recoded as years of education), the frequency of forwarding messages on WeChat (recoded as times per day), severe disease history (yes =1, no =0), and medical profession/major (yes = 1, no = 0).

2 Result

2.1 Descriptive statistics

Table 1 Descriptive statistics

	N	%	M	SD
Age	914		55.09	6.48
Gender	914			
Male	405	44.3%		
Female	509	55.7%		
Years of education	914		14.18	2.86
Forward frequency (times/day)	914		0.49	0.84
Medical profession/major (Yes =1, No =0)	914		0.09	0.29
Severe disease history (Yes =1, No =0)	914		0.56	0.50

Results showed that respondents' average years of education were 14.18 years (M = 2.86), which means their average educational level is higher than high school. They forwarded 0.49 messages per day on average (SD = 0.84) (Table 1). Few people were medical profession or major (M = 0.09, SD = 0.29). More than half of the respondents have had a serious medical disease (M = 0.56, SD = 0.50).

2.2 Correlations

Table 3 showed that the predictor variables were moderately correlated, which indicates an acceptable degree of multicollinearity among predictors.

Table 3 Descriptive statistics and correlations.

	1	2	3	4	5	M	SD
1. Critical thinking	1	-0.30**	-0.29**	-0.42**	-0.34**	2.85	0.62
2. Health anxiety		1	0.13**	0.28**	0.14**	2.24	0.44
3. Helpfulness			1	0.44**	0.35**	3.75	0.51
4. Exhibitionism				1	0.22**	2.79	0.66
5.Rumor transmission intention					1	3.62	0.98

** p < .01.

2.3 Regression

To examine factors that predict rumor transmission intention, a hierarchical multiple regression analyses was conducted by entering demographic variables and SNS message forward frequency in the first step, critical thinking in the second step, health anxiety in the third step, helpfulness in the fourth step, followed by exhibitionism in the fifth step. Control variables, such as age, gender and severe disease history were not related to the dependent variables, and were excluded in the regressions.

Hierarchical multiple regression analyses showed that education (β = -0.07, p < 0.05), WeChat message forward frequency (β = 0.08, p < 0.05), medical profession/major (β = -0.06, p < 0.05), critical thinking (β = -0.26, p < 0.001), helpfulness (β = 0.27, p < 0.001) were significantly related to rumor transmission intention, while health anxiety and exhibitionism were not significantly related to rumor transmission intention (Table 4). The results supported H1 and H3, and rejected H2 and H4.

For the indicators predicting rumor transmission intention, the largest R2 change was caused by critical thinking (ΔR2 = 0.11), followed by helpfulness (ΔR2 = 0.06), and demographic variables and WeChat message forward frequency (ΔR2 = 0.03). Together, the predictor variables explained 20% of the variance

Table 4 Hierarchical multiple regression analyses.

Predictors and Steps	β	R2	Δ R2	ΔF
Step 1				
Education	-0.08*			
Forward frequency	0.13***			
Medical profession/major	-0.06	0.03	0.03	8.45***
Step 2				
Education	-0.06			
Forward frequency	0.11***			
Medical profession/major	-0.07*			
Critical thinking	0.33***	0.14	0 . 1 1	
110.05***				
Step 3				
Education	-0.06			
Forward frequency	0.11***			
Medical profession/major	-0.07*			
Critical thinking	-0.32***			
Health anxiety	0.04	0.14	0.00	0.23
Step 4				
Education	-0.08*			
Forward frequency	0.08*			
Medical profession/major	-0.07*			
Critical thinking	-0.25			
Health anxiety	0.03			
Helpfulness	0.26***	0.20	0.06	67.37***
Step 5				
Education	-0.07*			
Forward frequency	0.08*			
Medical profession/major	-0.06*			
Critical thinking	-0.26***			
Health anxiety	0.03			
Helpfulness	0.27***			
Exhibitionism	-0.02	0.20	0.00	0.18

* p < .05, ** p < .01, *** p < .001.

in the criterion variable (R2 = 0.20).

3 Discussion

This study aimed to examine the trait predictors of health rumor transmission for older adults in China. Although correlation analysis supported all of our hypotheses, in multiple regression analysis, only critical thinking and helpfulness were significant predictors, while health anxiety and exhibitionism were not strong predictors of health rumor transmission for older adults in China.

H1 hypothesized that critical thinking is a negative preditor of older adults' health rumor transmission intention on WeChat, which was supported by the data. The mean score of critical thinking was 2.95 (SD = 0.62), which means that the critical thinking level of older adults in the sample is a bit low. Critical thinking became the core of American education in the 1980s and 1990s. It was only at the end of the twentieth century that the concept was introduced into China[55]. At the end of the twentieth century, most of the adults in our sample were in their thirties (age: M = 55.09, SD = 6.48), thus they may have lacked training in critical thinking. Moreover, Ku and Ho[56] argued that the reason that Chinese people generally have a lower critical thinking ability than westerners is because of the traditional Confucian-collectivistic values, which stress respect for authority, tradition and social harmony. Accordingly, critical thinking, which leads to diversity in opinions, may not be appreciated. Thus, when facing new information, older adults who are low in critical thinking often make judgments based on their own experience or intuition, and may end up trusting and transmitting rumors.

At the same time, the lack of critical thinking among older adults is also linked to the lack of media literacy, as critical thinking is an important part of media literacy[20]. Older adults have just started to use new media in recent years, and they are quick to trust information on the Internet[12]. Thus they may easily trust misinformation on WeChat because of their trust in the media.

Our second predictor, health anxiety, was not significantly related to older adults' rumor transmission intention on WeChat in controlling for other independent variables. There are two possible reasons for failing to find support for this hypothesis. The first is because the three rumor messages we selected were not directly related to the respondents' health problems. The respondents in the current study were not very old with a mean age of 55.09 years old (SD = 6.48), and their health anxiety was also not very high (M = 2.24, SD = 0.44). Perhaps the reason some of them want to forward these health rumors is that they think that others may need this information, rather than that the message is of great importance to themselves. Second, when answering questions about severe disease and death, older adults may consider them taboo and may not answer them truthfully. Some of the participants in the pretest reported feeling unpleasant emotions after answering the health anxiety questions. Future research could develop a new health anxiety scale that can reflect respondents' health anxiety level without directly touching on their taboo.

H3 hypothesized that helpfulness is a positive predictor of health rumor transmission intention on WeChat, which was supported by the data. The average value for helpfulness was 3.77 (SD = 0.51), which means older adults in our sample were generally very helpful. Warm-hearted older adults may transmit health information to show their concern for others and hope to help others. This helpful behavior may help older adults to build and maintain relationships with their friends and relatives, which is consistent with Bordia and DiFonzo's[17] argument that rumors serve the purpose of relationship building. However, this well-intended knowledge-sharing behavior may end up being rumor dissemination.

H4 hypothesized that exhibitionism is a positive predictor of health rumors transmission intention on WeChat, which was not supported by the data. There are two possible reasons for failing to find support to this hypothesis. The first is that the design of the study did not really allow them to show

messages to their peers. Without actual transmission behavior, one cannot show off one's knowledge to others, and will not get social approval from others. Thus exhibitionism may be related to rumor transmission in real life, but cannot be detected by the current study due to the limitations of the current design. Second, due to social desirability bias, older adults may not want to admit that they like to show off. The mean score of exhibitionism was only 2.79 (SD = 0.66). Future research could design more realistic field studies that address the first problem and use better measurements that could reduce social desirability bias.

In addition, the study also found a significant relationship between the control variables and rumor transmission. The more education one received, the less likely one will transmit health rumors. Medical profession/major older adults were less likely to transmit health rumors than others, which is consistent with Chuaa and Banerjee's[57] study. Older adults who report forwarding WeChat message frequently in their everyday life are also more likely to transmit the health rumor messages.

4 Conclusions

To sum, this study found that critical thinking, helpfulness were significantly related to WeChat rumor transmission for older adults in China, while health anxiety and exhibitionism were not strong predictors of WeChat rumor transmission for older adults in China. The practical implication of this study is to cut down the rumor transmission by "taking advantage" of the two factors that significantly increase the transmission of rumors by elderly people—the lack of critical thinking and the desire to help others. With regards to the lack of critical thinking, we suggest the community colleges for elder people in China to launch courses or programs of media literacy. Regarding "helpfulness", we suggest that the government and media platforms to release more posts on refuting rumors. Out of the desire to help others, the helpful elderly people in China may also forward the counter-rumor posts, which can cut down the rumor transmission efficiently.

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Appendix

Figure 1. Rumors in the survey

"Be vigilant! The appearance of these vertical lines on the nails is an omen of serious illness." Under ideal conditions, the nail surface should be free of vertical and horizontal grooves. Therefore, once the nail surface is found to be rough and dull, and even appear the following vertical lines, you should be careful! Vertical lines mean poor digestion, malnutrition, calcium deficiency; black vertical lines mean liver and kidney failure, toxins in the body; blue vertical lines mean body hypoxia, lung infection or pneumonia. If there are vertical lines on the nails, then you must look after yourself in time. Hurry up and send the health code on your nails to every friend around you!

"Leaving cellphone by the pillow is very harmful to your body; 99% people have been affected." Taking cellphone with you for a long time will cause irreversible damage to your body, and even pose a threat to your life when it is serious. If you put your cellphone by your pillow before going to bed, the radiation from the phone will delay your sleep for 6 minutes and shorten your deep sleep by 8 minutes. Electromagnetic radiation is quite harmful to the head, and it can cause headaches, dizziness, insomnia, dreaminess, hair loss and other symptoms.

"Three kinds of vegetables can reduce fever. Don't always get infusion."
Take three to four pieces of coriander, get rid of the leaves and use their stems and roots, get two to three slices of white radish, get one to two slices of ginger, add rock sugar and boil for 15 minutes. Wait until the temperature is moderate and let the patient take it. It will make the patient sweat and cure fever. It's very effective!