

Factors affecting rumor spreading of social network sites

Sheng Wu

Department of Information Management

Southern Taiwan University of Science and Technology

No. 1, Nan-Tai Street

Yongkang Dist., Tainan City 710

Taiwan, R.O.C.

Abstract

The emergence of social network sites (e.g. Facebook, Twitter, and YouTube etc.) has been playing an important role for modern people's lives. The social network sites provide users online maintaining and expanding interpersonal space and opportunities. Many social network sites have been a platform to share the news and information with friends and family. The social network sites facilitate the information flow through user's friend circle, so various information spreads quickly and so does rumor. This study adopts the theoretical perspective of an Elaboration Likelihood Model to identify the informative and normative factors that influence the credibility judgment of online rumors in social network sites context. Based on the 335 valid samples from the online questionnaire, statistical testing of research models using partial least squares. The results of this study are similar to the ELM claim that argument quality and source credibility have significant effects on rumor credibility. This indicates that rumor spreading of SNSs is based not only on the argument quality, but also on the source credibility. Moreover, compared with argument quality, the source credibility has a stronger impact on rumor credibility. This means that the degree to which the user needs source credibility plays a major key role to decide the rumor credibility. The study also suggests the possible importance of argument quality and source credibility of rumor. Specifically, we identified three components of argument quality and four components of source credibility.

Subject Classification: 62P25.

Keywords: Social network sites, Elaboration likelihood model, Argument quality, Source credibility, Rumor credibility, Rumor spreading.

1. Introduction

The innovation of information technology has changed the way of daily human communication and interaction. A prominent example is the social network sites (SNSs) which have been immensely popular in recent years [1-3]. What are the reasons for people to use SNSs? According to a survey conducted overseas of SNSs users' motivations, 91% of the users use SNSs to maintain connections with friends whom they frequently meet, 82% of the users use SNSs to contact with friends and relatives whom they meet less frequently, 49% of the users use SNSs to make new friends [4]. Ridings and Gefen [5] point out that the reasons for people to use SNSs are to obtain the sense of aggregation and belonging, to seek self-identity, and to perform behaviors which are acceptable by others, etc. TWNIC [6] exploring the reasons for internet users to choose Facebook, 98.5% of the users choose Facebook to exchange information with persons having the same habit or make contacts with friends; 57.5% to obtain useful information, 36% to share ideas or trivial things in the daily lives. TNMIC [7] report shows that 60.1% (ranking the first) of broadband internet users access internet to use social communities, 56.3% (ranking the second) use instant messaging software. Additionally, in an investigation report conducted by TWNIC [8], the reasons for using social network: keep an eye on their friend's life (61.49%), pass the time (33.43%), instant sharing, relaxing (28.5%), satisfy social needs (26.33), leisure (23.6%), friends are using (19.89%), and interaction between member of same...(19.26%). The above mentioned survey data provide an overview to reflect a fact that cannot be ignored: more and more internet users spend their time in SNSs, and the social need is an important motivation for the internet users to stay in various SNSs. In fact, the SNSs platforms developed on the basis of information technology provide the space and opportunity for people to maintain and expand interpersonal communication on line [3, 9, 10].

Nowadays, many SNSs have been a platform to share the news and information with friends and family. SNSs facilitate the information flow through user's friend circle, so various information spreads quickly and so does rumor. Therefore, SNSs also have a dark side that misuse SNSs to spread rumors and cause harm [2, 9, 10]. Some of the previous studies focusing on information diffusion use the perspective of tie strength to explain how social bond speeds up the information flow [11, 12]. According to "the strength of weak ties", strong tie refers to one's friendship with whom they have larger time in commitment and the weak tie means the friends of your friend [12]. The former will enhance the spreading speed

in inner-circle; while the latter will make the information diffuse more broaden through outside-circle.

Rumor, as a form of social exchange, is often compared with gossip which is defined as *"In a context of congeniality, gossip is the exchange of personal information (positive or negative) in an evaluative way (positive or negative) about absent third parties"* [13]. Different from gossip, rumor is more focusing on an event rather than people who share the common history [14]. Miller [15] defined rumor as *"distorted, exaggerated, irrational and inauthentic information"*. This kind of rumor mainly indicates the social crisis. For example, Hurricane Katrina in 2005, the Mumbai Terrorist Attack in 2008 and Toyota Recalls in 2010 are related to society and each of them created a big disaster and anxiety at that time [16]. No doubt that everything about these information will be posted on your SNSs. Buckner [17] define rumor as an *"unconfirmed message passed from one person to another that refers to an object, person, or situation"*. Rosnow and Fine [18] define rumor as *"a proposition that is unverified and in general circulation"*. Another definition is *"rumor as a message that is currently unsubstantiated by a message receiver"* [19]. Kapferer's [19] definition is more suitable in the context of this study because this kind of rumor is wide-spreading rather than those which is about disaster in the SNSs, such as Facebook, Tweeter, and Instagram.

With the popularization of the SNSs, more and more people have shared the message what they saw, even though they do not know the truth of the message. But how do they distinguish the information between true and false. Previous review has proactively shown that believability is one of the main predecessors of adoption [20]. But there have been very few studies to discuss rumors and how to evaluate credibility of on-line rumor. As pointed out by McKnight and Kacmar [20], information credibility is a fundamental indicator of an on-line people's farther activity. Since rumor is message that happens in our life, it is difficult to observe the process of rumor spreading. Also, evaluation about whether rumor credibility needs to be elaborate concretely.

This study takes the Elaboration Likelihood Model (ELM) as the theoretical basis, and then explores the informative and normative factors that affect the credibility judgment of online information in SNSs context. Essentially, ELM [21] postulates that there are two distinct paths through which information readers' attitudes can be influenced: (1) attitude formation is regarded as the central route of the result of careful consideration of the message content by the receiver; and (2) Peripheral routes require less cognitive work to adapt to simple cues

affecting attitudes. The motivation and the ability of information readers are important factors affecting information credibility. According to the traditional communication theory, information factors with source, message, and receiver are the main factors that affect receiver's evaluation of information [3, 22]. Such as, the reliability of the message is determined by the reliability of the message source and the quality of the message parameters. Each dimension has internal sub-construct. According to previous studies, we will discuss the details of sub-constructs and the relationship between those factor and information credibility in SNSs context. Therefore, it would be an important and interesting topic to study how people evaluate rumors of SNS trustworthiness compared with other attitudinal dimensions, which can advance the understanding of the process of rumor usage.

2. Theoretical background and hypotheses

2.1 The elaboration likelihood model

The Elaboration Likelihood Model (ELM) was first introduced by Petty and Cacioppo [23] and widely adopted by many disciplines, including psychology, marketing, communication, information management and so on. ELM of persuasion is an information processing theory that shows that there are two main approaches to persuasive information: the central route and the peripheral route.

ELM pointed out that the more carefully the central path examines the content of the information; the more influence it will make on the readers to perceive the content of the information [21, 24]. As recipients process the message through the central path, they will carefully consider the issues that arise in the message and assess the value of the argument. In this case, the recipient will engage in more detailed cognitive processing and work harder to assess the information. Many previous studies [25-27] tend to regard information quality as the most important key factor, and verify that information quality has an important impact on readers' perceived information credibility: that is, the higher the information quality, the more likely they will agree with the content of the information. In contrast, people engaged in the peripheral route did not require as much cognitive work. Generally speaking, people can use simple heuristic clues or information indicators to judge, such as source credibility, to evaluate the credibility of the message [28].

In addition, ELM argues that the attitudes of information readers form or change depending on the degree of refinement possibilities. In situations where the likelihood of refinement is high, information readers invest more cognitive effort to assess the quality of the information received, and they carefully consider the problem of information delivery. Therefore, information factors are often the most important factors leading the attitude of information readers. However, information readers are also less aware of the content of the received information when the likelihood of refinement is low; instead, they use factors unrelated to the information (peripheral pathways) to evaluate the content of the information. In summary, as the level of refinement likelihood decreases, the central factor's dominance over information readers' perceptions, attitudes, or beliefs also decreases, while the dominance of peripheral factors becomes more critical [29].

Additionally, ELM argues that the degree of refinement depends on the capabilities and motivations of the recipient, whether through a central or peripheral route [25-28]. They also confirmed that these factors play a moderating role for both central and peripheral factors. In everyday situations, the influence of information will be related to both central and peripheral factors [26]. The theory underlying the importance of information quality and source credibility used in advertising to influence consumer decision making [30].

2.2 *Argument quality*

In the extant persuasion and communication literature, message quality has always been recognized as a major key factor [31]. In ELM, argument quality refers to *"the audience's subjective perception of the arguments in the persuasive message as strong and cogent on the one hand versus weak and specious on the other"* [32]. When assessing the quality of the received unverified message, it is important to consider the argument strength as well [33]. Argument strength is the degree of convincing of argument or valid in supporting position of argument. In order to study these questions concretely, whereas the quality of argument consists of three parts: consistency, plausibility of arguments, and supported by data in our study.

Consistency refers to unverified message about the extent to which the behavior between one actor and one stimulus is the same across time and circumstances. We can say that whether the message people received is identical with related professional knowledge When acquiring new

unverified message which is consistent with a one's former cognition, this will invoke the heuristic that "this is likely to be true in case that it is consistent with what I have already known is true,". Therefore, it make people to adopt the value of message and let people to believe it.

Plausibility is seemingly or apparently valid, likely, or acceptable. A plausible delusion make people to believe that what they see is true. Recipient's judgment of the message's plausible makes up an individual's mind in the message accuracy that received. Accuracy is the result of the value which is compute as the same as it in the other database. Especially the unverified message on the Internet environment [34, 35]. If the unverified message is think of intelligent contents, recipient's attitude toward the unverified message may be positively and tend to believe this unverified message; conversely, while the received unverified message content is unreasonable, the recipient's attitude toward the unverified message will become negative and think the message is less credible. In prior researches, scholars have proved that plausibility of argument on perceived credibility would be influenced in two situations which were communication studies and spreading information base on computer [36, 37].

Supported by data is that whether exists all of the data related to that application. The unverified message cannot be spread widely in the usual situations. In addition, a credibility of unverified message usually judge by a good characteristic of structure, there is convincing arguments, proper references, or relevant examples and so on. If there is a high degree of legibility and readability in text and pictures, it would become a key strong point. The old saying "seeing is believing". However, the following case is verified not to correct despite that it accompanied with the picture.

2.3 Source credibility

Foog [38] pointed out that four kinds of credibility can be developed according to different contexts or channels: presumed credibility, reputed credibility, experienced credibility, and surface credibility. The above four kinds of credibility are not mutually exclusive, in the sense that a person's perception of credibility in one context can evolve into the basis of credibility in another context. Source credibility is the perceived expertise and credibility of the source of the content by the recipient of the information [39]. Previous research [40, 41] have found that the credibility of sources can directly form or change the attitude of recipients, but the information provided by sources with high credibility has a greater

impact on the credibility of perceived information. Therefore, the receiver is more prone to accept the position of the information. Examine these issues specifically, considering that resource quality consists of four elements—such as, visual appeal, trustworthiness, expertise, and attractiveness in our study.

Visual appeal. When we are opening a website the background design is usually displayed well before the content appears. It is generally believed that the aesthetics of a website contribute to the happiness and harmony that humans can experience [42]. The best clustering predicted attractiveness ratings from the visual attributes of density, contrast, and graphics [43]. Past research has shown that there is a positive relationship between website visual appeal and perceived usability [44]. Empirical research shows that the aesthetics of website design will have a great impact on the user trust of e-commerce websites [45]. According to result of Fogg, Soohoo [45] show that most consumers measure the trustworthiness of a website “based in part on the appeal of the overall visual design”. Generally, users who prefer a clean web design style are more likely to trust such web content [46]. These past findings agree that visual appeal rating is an important factor, and therefore, visual appeal will be a predictable source of credibility for information.

Trustworthiness. To calculate the credibility, trustworthiness plays an important role. When considering the credibility, it is important to evaluate the truthful, unbiased and so on. The level of the website’s rating is a guiding of the website’s credibility. In Wathen and Burkell [22]’s research, Web recipients view source credibility of the website as an important guiding of unverified message credibility [22]. This means the usefulness of virtual certification. When measuring trustworthiness dimension of credibility, the key points is perceived goodness and morality of the source. For example, using secure badges like McAfee SECURE to reveal that website is safe. With that in mind, it is significant to show obviously that a visitor browses on the website is secure. Those website’s reputations could also be conferred by third-party certification on past performance. As a result, website’s reputations can be view as a basis that make recipients to perceive the website is credible. Therefore, according to previous studies, we assume that the high degree of trustworthiness will be increase in the credible of website [47, 48].

Expertise. Many researchers agree that perceived trustworthiness plays a different role in rumor spreading than under normal circumstances, where people tend to trust professional sources more than generalist sources. [49, 50]. Nass, Reeves [50] found that people tend to have faith

in specialist TV (e.g. news channel or entertainment channel) set than in generalist channel set despite of the contents are the same. In spreading rumors, people are more likely to rely on content from unofficial sources than from official sources from government agencies. In Leshner, Reeves [51] study, there is a similar result. In their study, specialized TV channels (eg, CNN News) were rated higher than generalist channels (eg, ABC, CBS). Consider that the expertise with professional ability in commenting on the product is the advocator. Consumer believe the comment to the product or not is decided by the communicator's professional experience. To sum up the view point above, we think that an expertise of a source website has the impact on source credibility as well. Therefore, people also believe unverified message because of the highly expertise of a source of website and more readily accept the unverified message.

Attractiveness. In the past, the link between unverified message recipient and broadcaster's persuasion will be influenced by the attractiveness [52]. Beside, celebrity, expert and so on can easily make people to believe what they said. However, those people without popular is hard to make people to believe. The attractiveness of the website would effect that people to change his attitude about transmutation of opinion, message judgment, and other measurement. The increasing of attractiveness may has positive effect to enhance the attractiveness about using of the product, service or social motives [53]. There was a similar concept about process of credibility judgment was proposed in the research that authored by Wathen and Burkell [22]. They point out that people often be attracted by the first impression of website when they visit the website in first time. Internet is a visual medium, people may be conscious of the first credibility cues very in a short time. When users browse the web site, there stimuli presented is based on highly subjective reaction. For example, people's judgment will be influenced due to the appearance such as colors, layout, art design or presentation of tabular data and so on. For those reason, website can be view as the individual or organizational message database, some of those would have their own design in order to highlight their characteristics. This is very subjective. However, a well-designed web site can be a signification of more reliable unverified message. Well-designed helps making unverified message more easily accessible. To sum up the view point above, we think that attractiveness of website has impact on credibility of website. The more popular the website, the more willingness that recipients are able to believe it. Therefore, people also believe unverified message because of

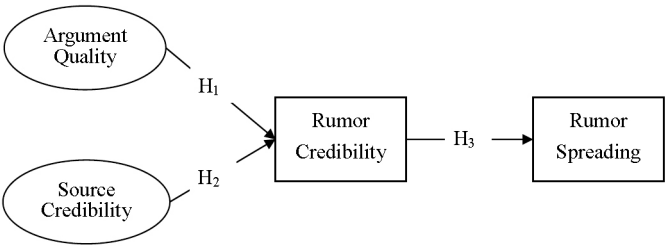


Figure 1
Research model

the highly attractiveness of a source of website and tend to accept the unverified message.

Final, our model is based on the ELM and the review of the literature; this study describes the research model shown in Figure 1. We regard argument quality, source credibility, and rumor credibility as important predictors to influence rumor spreading. Thus, we propose the following hypothesis one to three.

Hypothesis 1 (H₁). *Argument quality is positively related to rumor credibility.*

Hypothesis 2 (H₂). *Source credibility is positively related to rumor credibility.*

Hypothesis 3 (H₃). *Rumor credibility is positively related to rumor spreading.*

3. Research methodology

3.1 Sampling

As to the selection of the research framework, this study explores related issues regarding different dimensions of the self of SNS users. In order to focus on current major participants in social activities, this study initiates the analysis of current data. According to a recent survey of the life styles of netizens in Taiwan conducted by the TWNIC [6], the most popular social network group is Facebook, which has 98.5% of the users, compared with Instagram (38.8%), Twitter (5.1%), Weibo (4.0%) and Google+ (2.8%). The abovementioned research shows that social networks have become the most visited network groups by internet users in Taiwan, and Facebook, among others, is the major interactive platform. Thus the subjects of this study are Facebook users, and an on-line questionnaire is used to collect data from Facebook users. The number of valid samples is

335, wherein the samples comprise 144 male and 191 female; 180 students, 151 salary persons, and 4 unemployed; 43 of high schools /vocational schools, 215 of colleges, 77 of graduate schools in terms of education; 150 users spend less than 3 hours, 97 users spend 3-5 hours, 51 users spend 5-7 hours, 37 users spend more than 7 hours in terms of the amount of time used in visiting Facebook.

3.2 *Measurement development*

Totally four constructs are employed in our study: argument quality, source credibility, rumor credibility, and rumor spreading. Through literature review, two professors and three master students were selected as expert judges, and the relevant samples were tested in the pilot test, which improved the applicability of the revised items. In the process, as construct understanding improves, scale items are tailored and refined, and dimensions are modified to maintain content validity.

All items used seven-point Likert scales anchored from “strongly disagree (=1)” to “strongly agree (=7)”. Argument quality and source credibility were treated as second-order constructs. This study identified three factors contributing to the argument quality: consistency, plausibility of arguments, and supported by data. These three factors were referenced from Cheung, Sia [54] and Braddy, Meade [55]. This study identified four factors contributing to the source credibility: visual appeal, trustworthiness, expertise, and attractiveness. These four factors were referenced from Cheung, Sia [54]. The construct “Rumor credibility” was referenced from Cheung, Sia [54]. The construct “Rumor spreading” was referenced from Lee and Ma [56].

3.3 *Reliability and validity*

We employed SmartPLS 3 to test the measurements and hypotheses proposed in this study. Reliability is ensured by composite reliability (CR>0.7), and the CR values are between 0.858-0.971. Cronbach’s alpha (>0.7) with all the alpha values fall between 0.751-0.960, factor loading (>0.7) with all the factor loading values fall between 0.735-0.956, and item-total correlation (ITC) value greater than 0.5 with all the ITC value fall between 0.486-0.920. When multiple metrics are used to measure a construct, convergent validity needs to be tested. We test by requiring a CR value greater than 0.7 and an extracted mean variance value greater than 0.5 with all the AVE fall between 0.669-0.892 by constructs. For the condition of good discriminant validity, the correlation coefficient between

construct pairs should be less than 0.90, and the square root of AVE should be greater than the correlation coefficient between constructs. From the data shown in Table 1 and Table 2, it shows that all meet the requirements of meeting the minimum threshold [57].

Treat the argument quality of the rumour's pay as a second-order structure consisting of three first-order reflective structures. Calculating the weights of the first-order structure by principal component analysis [58]. The impact of all first-order constructs on argument quality is significant ($p < 0.001$) with all the weight values fall between 0.735-0.937. In addition, the correlation coefficients between the first-order factors are all less than 0.65 and significant ($p < 0.01$), thus indicating that a reflection model is unlikely [58]. Finally, the VIF values of these three first-order factors are all lower than 3 (consistency=1.813, plausibility of arguments=2.061, and supported by data=1.502), indicating that the possibility of collinearity problems is very small. The above evidence suggests that second-order constructs adequately capture the predictive power of those first-order structures [59]. Similar tests were performed to assess the second-order construct of source credibility. The impact of all first-order constructs on source credibility is significant ($p < 0.001$) with all the weight values fall between 0.751-0.953. Source Credibility has the conditions of a second-order structure: (1) these four first-order constructs are theoretically independent of each other, (2) the correlation coefficients between the first-order variables are all less than 0.66, and (3) the VIF values of these four first-order factors are all lower than 3 (visual appeal=1.978, trustworthiness=2.165, expertise=2.100, and attractiveness=1.912). The data in Table 3 shows that all meet the minimum threshold level.

4. Data analysis and results

Structural equation modeling was used to evaluate hypotheses in our study because of its ability to verify multiple causal relationships simultaneously. PLS has minimal requirements on measurement scale, sample size, and distributional assumptions [60]. Based on the above conditions, hypothesis testing is performed by using SmartPLS 3 PLS with bootstrapping as 5000 random a resampling to estimate the significance of structural models and paths. Evaluate the model by joint path coefficient (t value) and R^2 value [61]. All path coefficients and explained variance in the study model are shown in Figure 2. All the hypotheses of this study are met.

Table 2
Descriptive statistics and correlation matrix

Variables	Mean	Std. Dev.	M3	M4	AQ_C	AQ_POA	AQ_SBD	SC_VA	SC_T	SC_E	SC_A	RC	RS
AQ_C	3.63	1.28	-0.06	-0.31	0.93								
AQ_POA	3.78	1.38	-0.16	-0.56	0.65	0.92							
AQ_SBD	3.68	1.33	0.00	-0.27	0.46	0.55	0.82						
SC_VA	4.04	1.26	-0.29	0.13	0.35	0.56	0.49	0.91					
SC_T	3.92	1.27	0.11	-0.08	0.41	0.60	0.49	0.58	0.91				
SC_E	3.90	1.32	-0.03	-0.17	0.46	0.55	0.49	0.58	0.66	0.92			
SC_A	4.40	1.19	-0.35	0.30	0.39	0.58	0.45	0.61	0.60	0.57	0.86		
RC	3.61	1.38	0.07	-0.29	0.53	0.71	0.54	0.54	0.65	0.67	0.54	0.94	
RS	2.74	1.56	0.60	-0.67	0.37	0.49	0.42	0.46	0.45	0.45	0.42	0.62	0.94

M3: Skewness; M4: Kurtosis
The diagonal line of the correlation matrix represents the square root of AVE

Table 3
The weight and t-value of formative indicators

Latent variable	Indicators	Weight	t-value	VIF
Argument quality	Consistency	0.437	31.140***	1.813
	Plausibility of arguments	0.293	18.116***	2.061
	Supported by data	0.446	32.325***	1.502
source credibility	Visual appeal	0.299	28.850***	1.978
	Trustworthiness	0.313	31.125***	2.100
	Expertise	0.314	28.408***	2.165
	Attractiveness	0.264	25.292***	1.912

Note:***p<0.001

First, we found that both argument quality ($\beta=0.418$) and source credibility ($\beta=0.433$) have an impact on rumor credibility. Therefore, H1 and H2 are supported. These two variables explain over 60% of the variance of rumor credibility ($R^2=61.6\%$). Second, Hypothesis 3 proposed a link between rumor credibility and rumor spreading. According to our findings, rumor credibility is significantly associated with rumor spreading ($\beta=0.623$). Rumor credibility explains over 35% of the total

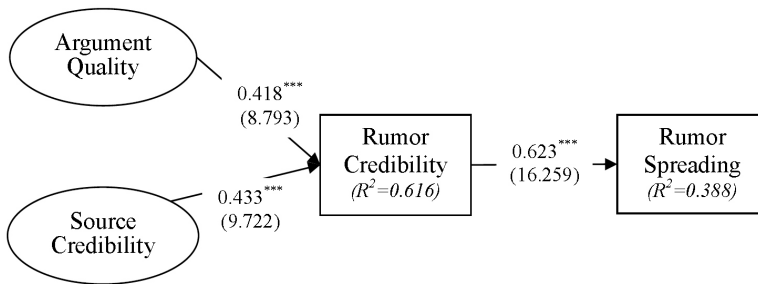


Figure 2

Structure model and path coefficients

variance of rumor spreading ($R^2=38.8\%$). Hence, H3 is supported. In the end, explanatory power is well above the 10% acceptance level [62, 63]. The data in Figure 2 show that all minimum threshold requirements are met.

4.1 Analysis of mediation: Rumor credibility

This study follows the proposal of Hair Jr, Hult [61]'s variance accounted for (VAF) approach to detect mediation effect. The VAF value determines the size of the indirect effect in relation to the total effect (full mediation: $VAF > 80\%$; partial mediation: $80\% > VAF > 20\%$; no mediation: $VAF < 20\%$). The 73.25% ($VAF=0.378/0.516$) of argument quality's mediation effect on rumor spreading is explained via the rumor credibility. Similar tests were performed to assess the VAF of source credibility. The 65.86% ($VAF=0.355/0.539$) of source credibility's mediation effect on rumor spreading is explained via the rumor credibility. Finally, the results showed that VAF greater than 20% but less than 80% was a partial mediation. It can be seen that rumor credibility is an important mediating variable in the rumor propagation environment.

5. Conclusions and discussion

This study focused on understanding how argument quality of rumor, source credibility of rumor, and rumor credibility affect rumor spreading. Our survey data of 335 facebook users supports all the research hypotheses we propose. Our findings are similar to those of ELM, that is, argument quality and source credibility have significant effects on rumor credibility. This indicates that rumor spreading of SNSs is based not only on the argument quality, but also on the source credibility. Moreover,

compared with argument quality, the source credibility has a stronger impact on rumor credibility. This means that the user's degree of source credibility plays a more important role in determining the credibility of rumors. We found that the argument quality and source credibility of rumor are partially mediated by rumor credibility. Additionally, rumor credibility has positive effect on rumor spreading.

Among the three identified argument quality, with the exception of supported by data which has a slightly lower weighting (0.293), the weightings for the various types of argument quality are similar (ranging from 0.437 to 0.446). This indicates that supported by data is not as important as the other three types of argument quality. This is understandable due to the supported by data of rumor in SNSs context, leading users not to regard this as the most important quality. The remaining three types of quality contribute to the second-order argument quality in a similar manner and, therefore, are of equal importance. However, the weightings of the four source credibility range slightly differently. Trustworthiness and expertise have relatively strong weighting (0.313 for trustworthiness and 0.314 for expertise), compared with visual appeal (0.299) and attractiveness (0.264). This result indicates that both trustworthiness and expertise can be considered as critical credibility while attractiveness is not as critical as the other two.

This study shows the direct and indirect effects of various dimensions of rumor spreading by calculating path coefficients. The total effects of each research construct on the spread of rumors is ranked as follows: rumor credibility (0.623), source credibility of rumor (0.270) and argument quality of rumor (0.260). Result of total effect show that the rumor credibility has relatively strong total effect, compared with argument quality of rumor, source credibility of rumor on rumor spreading.

This study has the following contributions to academia, as described below. First, the academic contribution of this study successfully show that ELM in social media for rumor theme. This study focus on what kind of antecedents will enhance the rumor credibility and spreading. Hence, our research model provides a theoretical foundation from which to explore further the influence of what kind of factors on rumor credibility and spreading in social media context. Second, this study also suggested the possibility argument quality and source credibility of rumor. We clearly identified three components components of argument quality (consistency, plausibility of arguments, and supported by data) and four components of source credibility (visual appeal, trustworthiness, expertise, and attractiveness). In addition, the relatively strong impact

of source credibility on rumor credibility, compared with the impact of argument quality, implies that source credibility plays a more important role in identifying the rumor spreading of SNSs context.

There are three limitations to this study. First, due to time constraints, a convenient sample of Facebook in Taiwan was selected for this study. Further understanding is needed whether these results can be generalized to users of other social networks. Second, the independent and dependent variables of this study are from the same respondent. Afterwards, data collection from different sources or different time periods is required to avoid the risk of common method variance. Final, it does not measure how the argument quality of rumor, source credibility of rumor, rumor credibility and rumor spreading change over time. All constructs are measured at the same time point.

Acknowledgments

The author is thankful to the Ministry of Science and Technology under the Grants MOST 105-2410-H-218-006-MY2. Taiwan, Grants

References

- [1] Sweetser, K.D. and E. Metzgar, Communicating during crisis: Use of blogs as a relationship management tool. *Public Relations Review*, 2007. 33(3): p. 340-342.
- [2] Liu, F., A. Burton-Jones, and D. Xu. Rumors on social media in disasters: Extending transmission to retransmission. in *Proceeding of the 19th Pacific Asia Conference on Information Systems*. 2014.
- [3] Kaur, A. and A. Sinha, Multi-contextual spammer detection for online social networks. *Journal of Discrete Mathematical Sciences and Cryptography*, 2021. 24(3): p. 777-786.
- [4] Lenhart, A. and M. Madden, Teens, privacy & online social networks: How teens manage their online identities and personal information in the age of MySpace. 2007, Pew Internet & American Life Project.
- [5] Ridings, C.M. and D. Gefen, Virtual community attraction: Why people hang out online. *Journal of Computer-Mediated Communication*, 2004. 10(1): p. 1-15.
- [6] TWNIC. Taiwan internet report. 2018 [cited 2021 7/19]; Available from: https://report.twnic.tw/2018/TWNIC_TaiwanInternetReport_2018_CH.pdf.

- [7] TNMIC. A survey on broadband internet usage in Taiwan. 2015 [cited 2021 7/21]; Available from: <http://www.twnic.net.tw/download/200307/20150901d.pdf>.
- [8] TWNIC. Broadband network usage survey in Taiwan. 2010 [cited 2021 12/28]; Available from: <http://www.twnic.net.tw/download/200307/1001b.pdf>.
- [9] Ahmad, T., S.U. Ahmed, S.O. Ali, and R. Khan, Beginning with exploring the way for rumor free social networks. *Journal of Statistics and Management Systems*, 2020. 23(2): p. 231-238.
- [10] Mittal, R. and M. Bhatia, Discovering bottlenecks entities in multi-layer social networks. *Journal of Discrete Mathematical Sciences and Cryptography*, 2019. 22(2): p. 241-252.
- [11] Bakshy, E., I. Rosenn, C. Marlow, and L. Adamic, The role of social networks in information diffusion, in Proceedings of the 21st international conference on World Wide Web. 2012, ACM: Lyon, France. p. 519-528.
- [12] Granovetter, M.S., The strength of weak ties. *American Journal of Sociology*, 1973: p. 1360-1380.
- [13] Foster, E.K., Research on gossip: Taxonomy, methods, and future directions. *Review of General Psychology*, 2004. 8(2): p. 78-99.
- [14] Rosnow, R.L. and E.K. Foster, Rumor and gossip research, in Psychological Science Agenda. 2005. p. 1-10.
- [15] Miller, D.E., "Snakes in the greens" and rumor in the innercity. *The Social Science Journal*, 1992. 29(4): p. 381-393.
- [16] Oh, O., M. Agrawal, and H.R. Rao, Community Intelligence and social media services: A rumor theoretic analysis of tweets during social crises. *MIS Quarterly*, 2013. 37(2): p. 407-426.
- [17] Buckner, H.T., A theory of rumor transmission. *Public Opinion Quarterly*, 1965. 29(1): p. 54-70.
- [18] Rosnow, R.L. and G.A. Fine, Rumor and gossip: The social psychology of hearsay. 1 ed. 1976, New York: Elsevier.
- [19] Kapferer, J.-N., Rumors: Uses, interpretations, and images. 2013, New Brunswick: Routledge.
- [20] McKnight, H. and C. Kacmar. Factors of information credibility for an internet advice site. in Proceedings of the 39th Annual Hawaii International Conference on System Sciences. 2006. Kauai, HI, USA: IEEE.

- [21] Cacioppo, J.T. and R.E. Petty, Central and peripheral routes to persuasion: Application to advertising. 1 ed. Advertising and Consumer Psychology, ed. L.P.A. Woodside. 1983, Lexington, MA: D. C. . 3-23.
- [22] Wathen, C.N. and J. Burkell, Believe it or not: Factors influencing credibility on the Web. *Journal of the American Society for Information Science and Technology*, 2002. 53(2): p. 134-144.
- [23] Petty, R.E. and J.T. Cacioppo, Forewarning, cognitive responding, and resistance to persuasion. *Journal of Personality and Social Psychology*, 1977. 35(9): p. 645-655.
- [24] Zhang, Y., Responses to humorous advertising: The moderating effect of need for cognition. *Journal of Advertising*, 1996. 25(1): p. 15-32.
- [25] Cheung, M., C.-L. Sia, and K.K. Kuan, Is this review believable? A study of factors affecting the credibility of online consumer reviews from an ELM perspective. *Journal of the Association for Information Systems*, 2012. 13(8): p. 618-635.
- [26] Sussman, S.W. and W.S. Siegal, Informational influence in organizations: An integrated approach to knowledge adoption. *Information Systems Research*, 2003. 14(1): p. 47-65.
- [27] Zhang, W. and S. Watts. Knowledge adoption in online communities of practice. in Proceedings of the International Conference on Information Systems. 2003. Seattle, Washington, USA: Association for Information Systems.
- [28] Bhattacharjee, A. and C. Sanford, Influence processes for information technology acceptance: An elaboration likelihood model. *MIS Quarterly*, 2006. 30(4): p. 805-825.
- [29] Luo, C., X.R. Luo, L. Schatzberg, and C.L. Sia, Impact of informational factors on online recommendation credibility: The moderating role of source credibility. *Decision Support Systems*, 2013. 56: p. 92-102.
- [30] Soliha, E., B.S. Dharmmesta, B. Purwanto, and S.P. Syahlani, Message framing, source credibility, and consumer risk perception with motivation as moderating variable in functional food advertisements. *American International Journal of Contemporary Research*, 2014. 4(1): p. 193-208.
- [31] Slater, M.D. and D. Rouner, How message evaluation and source attributes may influence credibility assessment and belief change. *Journalism & Mass Communication Quarterly*, 1996. 73(4): p. 974-991.

- [32] Petty, R.E. and J.T. Cacioppo, Attitudes and persuasion: Classic and contemporary approaches. 1 ed. 1981, New York: Routledge
- [33] Petty, R.E. and K. Morris, Effects of need for cognition on message evaluation, recall, and persuasion. *Journal of Personality and Social Psychology*, 1983. 45(4): p. 805-818.
- [34] Cacioppo, J.T., R.E. Petty, and K.J. Morris, Effects of need for cognition on message evaluation, recall, and persuasion. *Journal of Personality and Social Psychology*, 1983. 45(4): p. 805-818.
- [35] Sia, C.-L., B.C. Tan, and K.-K. Wei, Can a GSS stimulate group polarization? An empirical study. *IEEE Transactions on Systems, Man, and Cybernetics, Part C (Applications and Reviews)*, 1999. 29(2): p. 227-237.
- [36] Bunker, A.M., Credibility and argument strength: persuasive effects when processing ability is impaired. 1 ed. 1994, East Lansing: Michigan State University Press.
- [37] Nabi, R.L. and A. Hendriks, The persuasive effect of host and audience reaction shots in television talk shows. *Journal of Communication*, 2003. 53(3): p. 527-543.
- [38] Fogg, B.J., Persuasive technology: using computers to change what we think and do, in *Ubiquity*. 2002. p. 1-5.
- [39] Sternthal, B., L.W. Phillips, and R. Dholakia, The persuasive effect of scarce credibility: a situational analysis. *Public Opinion Quarterly*, 1978. 42(3): p. 285-314.
- [40] Cheung, M.Y., C. Luo, C.L. Sia, and H. Chen, Credibility of electronic word-of-mouth: Informational and normative determinants of online consumer recommendations. *International Journal of Electronic Commerce*, 2009. 13(4): p. 9-38.
- [41] Hovland, C.I. and W. Weiss, The influence of source credibility on communication effectiveness. *Public Opinion Quarterly*, 1951. 15(4): p. 635-650.
- [42] Lindgaard, G., Aesthetics, Visual Appeal, Usability and User Satisfaction: What Do the User's Eyes Tell the User's Brain? *Australian Journal of Emerging Technologies & Society*, 2007. 5(1): p. 1-14.
- [43] Lindgaard, G., C. Dudek, D. Sen, L. Sumegi, and P. Noonan, An exploration of relations between visual appeal, trustworthiness and perceived usability of homepages. *ACM Transactions on Computer-Human Interaction*, 2011. 18(1): p. 1-30.

- [44] Lavie, T. and N. Tractinsky, Assessing dimensions of perceived visual aesthetics of web sites. *International Journal of Human-Computer Studies*, 2004. 60(3): p. 269-298.
- [45] Fogg, B.J., C. Soohoo, D.R. Danielson, L. Marable, J. Stanford, and E.R. Tauber. How do users evaluate the credibility of Web sites?: a study with over 2,500 participants. in Proceedings of the 2003 conference on Designing for user experiences. 2003. ACM.
- [46] Karvonen, K. The beauty of simplicity. in Proceedings on the 2000 conference on Universal Usability. 2000. ACM.
- [47] Fogg, B., E. Lee, and J. Marshall, Interactive technology and persuasion. *The Handbook of Persuasion: Theory and Practice*. Thousand Oaks, CA: Sage, 2002.
- [48] Fogg, B. and H. Tseng. The elements of computer credibility. in Proceedings of the SIGCHI conference on Human Factors in Computing Systems. 1999. ACM.
- [49] Koh, Y.J. and S.S. Sundar, Effects of specialization in computers, web sites, and web agents on e-commerce trust. *International Journal of Human-Computer Studies*, 2010. 68(12): p. 899-912.
- [50] Nass, C., B. Reeves, and G. Leshner, Technology and roles: A tale of two TVs. *Journal of Communication*, 1996. 46(2): p. 121-128.
- [51] Leshner, G., B. Reeves, and C. Nass, Switching channels: The effects of television channels on the mental representations of television news. *Journal of Broadcasting & Electronic Media*, 1998. 42(1): p. 21-33.
- [52] Chaiken, S., Communicator physical attractiveness and persuasion. *Journal of Personality and social Psychology*, 1979. 37(8): p. 1387-1397.
- [53] Joseph, W.B., The credibility of physically attractive communicators: A review. *Journal of Advertising*, 1982. 11(3): p. 15-24.
- [54] Cheung, C.M.-Y., C.-L. Sia, and K.K. Kuan, Is this review believable? A study of factors affecting the credibility of online consumer reviews from an ELM perspective. *Journal of the Association for Information Systems*, 2012. 13(8): p. 618-635.
- [55] Braddy, P.W., A.W. Meade, and C.M. Kroustalis, Online recruiting: The effects of organizational familiarity, website usability, and website attractiveness on viewers' impressions of organizations. *Computers in Human Behavior*, 2008. 24(6): p. 2992-3001.

- [56] Lee, C.S. and L. Ma, News sharing in social media: The effect of gratifications and prior experience. *Computers in Human Behavior*, 2012. 28(2): p. 331-339.
- [57] Fornell, C. and F. Bookstein, Two structural equation models: LISREL and PLS applied to consumer exit-voice theory. *Journal of Marketing Research*, 1982. 19(4): p. 440-452.
- [58] Pavlou, P.A. and O.A. El Sawy, From IT leveraging competence to competitive advantage in turbulent environments: The case of new product development. *Information Systems Research*, 2006. 17(3): p. 198-227.
- [59] Diamantopoulos, A. and H.M. Winklhofer, Index construction with formative indicators: An alternative to scale development. *Journal of Marketing Research*, 2001. 38(2): p. 269-277.
- [60] Hair, J.F., J.J. Risher, M. Sarstedt, and C.M.J.E.B.R. Ringle, When to use and how to report the results of PLS-SEM. 2019. 31(1): p. 2-24.
- [61] Hair Jr, J.F., G.T.M. Hult, C. Ringle, and M. Sarstedt, A primer on partial least squares structural equation modeling (PLS-SEM). 1 ed. 2016: Sage publications.
- [62] Phang, C.W., J. Sutanto, A. Kankanhalli, Y. Li, B.C.Y. Tan, and H.H. Teo, Senior citizens' acceptance of information systems: A study in the context of e-government services. *IEEE Transactions on Engineering Management*, 2006. 53(4): p. 555-569.
- [63] Falk, R.F. and N.B. Miller, A primer for soft modeling. 1 ed. 1992: University of Akron Press.

Received July, 2021

Revised January, 2022