Addressing Health Misinformation Dissemination on Mobile Social Media

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Short Paper

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Abstract

With the pervasive use of social media apps, it is now common to see that people share health related information on the mobile social platforms. The spread of health misinformation on social media apps such as Facebook and WeChat poses serious threats to individual and public health. To address this issue, we drew upon reflective-impulsive model and went beyond the traditional view of users as reasoned decision makers by arguing that the health misinformation dissemination on social media apps is primarily driven by the impulsive system (habit and avoidance orientation). To reduce the dissemination, the reflective system should be strengthened. Accordingly, we propose that the presence of a message which emphasizes the negative effects of health misinformation dissemination and/or the accountability for health misinformation dissemination will reduce users' dissemination of the misinformation. Situational factors such as time availability, environmental noisiness and the dispositional moderator trait mindfulness will moderate the intervention effects.

Keywords: Misinformation dissemination, health misinformation, mobile social media

Introduction

In recent years, the wide adoption of handheld mobile devices in tandem with the rapid development of mobile computing technologies has shifted individuals' use of social media from personal computers (PCs) to mobile devices. An increasing number of individuals are joining the massive social media user group on their mobile applications. Currently, there are hundreds of mobile social media platforms (social media apps) servicing over 3.2 billion active users around the globe (List 2019; Statista 2019) and the numbers are still growing. Among the apps, Facebook, WeChat, WhatsApp, Instagram, and Twitter are the most popular and they maintain sizable user bases (List 2019). Research reports showed that the overwhelming majority of users are engaging with social media apps on a daily basis and visit the apps several times every day (GlobalWebIndex 2018).

One key type of information being widely shared on social media apps is health related information, given the broad impact of such information on the general population of different age groups. While the use of social media apps brings many benefits to users and the society, it also causes risks and threats to individual and public health because of the dissemination of scientifically inaccurate or even falsely construed health information (termed as 'health misinformation') across the platforms through social networks. The ubiquitous nature of social media apps makes the diffusion of health misinformation much faster, broader, and deeper than on their PC counterparts.

The spread of health misinformation on social media apps not just negatively influences users' health beliefs and conceptions but it prompted undesirable change in users' health behavior as well. For

example, it was reported that an individual attempted to follow a regimen diet circulated widely on WeChat, which recommended eating only boiled Chinese cabbage for at least 21 consecutive days for getting rid of toxins in the body. After practicing two days, the individual started to suffer from diarrhea and had to stop and consult a doctor (People.com.cn 2014). Despite the suffering, the individual in this report was fortunate compared to the Nigerians in another report: during the Ebola outbreak in West Africa, two Nigerians died from drinking too much salt water as the fake cure claiming that drinking salt water was able to ward off Ebola virus spread widely on the local social media (Wagner 2014).

Not only does the health misinformation on social media apps result in lethal consequences to individuals, it also poses serious threat to public health. For example, the spread of the misinformation on the vaccination-autism link has prompted more American parents to not vaccinate their children. The reduction in vaccination coverage has made the "nearly-eliminated and preventable diseases" such as measles and tetanus return in America (Robeznieks 2019). The World Health Organization now has put vaccine hesitancy among the top 10 threats to global health in 2019 (Robeznieks 2019). Aside from the direct health related consequences, the dissemination of health misinformation on social media apps also increases preventable public expenditure on additional research and public information campaigns for correcting individuals' misbeliefs (Lewandowsky et al. 2012).

The serious issue of health misinformation dissemination on social media has attracted great attention from multiple stakeholders, including governments, health organizations, medical institutions, social media platforms, clinicians and experts, as well as individual users. With many studies exploring the phenomenon, only a few have attempted to develop effective interventions to counteract the issue. Despite these limited academic efforts, extant studies are insufficient, which calls for more research on this topic (see Related Literature subsection). Our study intends to contribute to the research stream by drawing upon the reflective-impulsive model, also known as RIM (Strack and Deutsch 2004; Strack et al. 2006) from social psychology to develop interventions for addressing the health misinformation dissemination on mobile social media platforms. Specifically, we seek to answer the research question: Will a message nudge which emphasizes the negative effects of health misinformation dissemination and/or the accountability for health misinformation dissemination reduce users' dissemination of the misinformation? We plan to test the effectiveness of the message interventions in a mobile social media context and conduct scenario-based lab experiments followed by possible randomized field experiments in the realistic context.

Literature Background

Related Literature

We first survey the key literature related to our study on the dissemination of health misinformation on social media apps. Overall, our literature survey yielded a limited number of studies on this topic compared with those in PC-accessed social media context. Because mobile and PC-accessed social media serve the identical function and differ only in the access devices, we do not distinguish and report studies of both mobile and PC contexts. To address the misinformation dissemination on social media, many studies have conducted descriptive analyses to gain preliminary understanding of the phenomenon. The analyses are on user demographics, calculation of user influence, correctness of information, content type of information, network structure, dissemination patterns, platform-specific features (e.g., hashtag popularity in microblogging platform) and so forth. Chen et al. (2018), for example, examined the nature and diffusion of gynecologic cancer-related misinformation on Sina Weibo, the Chinese equivalent of Twitter. They found that misinformation accounted for approximately 30% of the tweets. The percentage of misinformation is higher in cancer treatment-related tweets than in prevention-related tweets. Prevention-related misinformation spread significantly more broadly and deeply than true information.

A large body of literature has focused on the detection of misinformation on social media platforms. For instance, Kumar and Geethakumari (2014) applied the principles from cognitive psychology and designed a computationally efficient and effective algorithm to detect the spread of misinformation in online social networks. Some studies have developed algorithms to identify users who are *prone to propagate* health misinformation. For example, Ghenai and Mejova (2018) utilized Twitter user attributes, writing style, and sentiment to build a classifier with a high level of accuracy to identify those users who tend to spread fake cancer treatments on Twitter. Although these studies are valuable to targeting particular users for

intervention, they do not address the question of what actions or interventions can be taken to reduce these users' dissemination of health misinformation.

Another stream of research has developed theoretical frameworks for limiting viral propagation of misinformation on online social networks. For instance, Nguyen et al. (2012) have proposed a model of identifying highly influential nodes whose decontamination with authorized corrective information would curb the viral spread of misinformation. The underlying assumption in this research stream is that when an infected user is presented with corrective information, the user will be decontaminated. However, the assumption does not hold because psychology research has found that it is hard to eliminate the persistent influence of misinformation after people accept it (Lewandowsky et al. 2012). Thus, the work in the research stream would probably not really work in reality.

Some researchers have directly examined the effectiveness of interventions which either had been practiced in industry or were developed by themselves. Regarding the already practiced interventions in industry, unfortunately, the findings are discouraging. Instagram imposed such restrictions as banning searches on several pro-eating disorder tags and issuing advisories to searches on others with the goal of reducing the dissemination of pro-eating disorder content. However, pro-eating disorder users were found to adopt nonstandard linguistic variants of moderated tags to circumvent the restrictions (Chancellor et al. 2016). Using such strategy, they posted more toxic, self-harm, and vulnerable content, which is contrary to Instagram's expected intervention outcome (Chancellor et al. 2016). Facebook introduced the "disputed" flag to signify posts of questionable credibility but discontinued this feature just one year later because such feature was found to not reduce the dissemination of fake news on the platform and sometimes even backfire (Murphy 2017). In a recent study, the Facebook feature was also found ineffective (Ross et al. 2018).

Regarding the self-developed interventions, we found three related studies. Motivated by the observation of the failure of Facebook flag, Ross et al. (2018) drew upon signal detection theory to develop a Facebook flag-adjusted warning in which the text "Learn why this is disputed" was replaced with an advice "Research shows that users who fail to verify the story's correctness have an increased risk of being misled by fake news." Their survey experimental results showed *no effect* of the designed warning on subjects. Moravec et al. (2018) suggested that the failure of Facebook flag may be because users did not understand the meaning of the flag and the flag did not create strong or sufficient cognitive dissonance to influence user judgment. Their experiment suggested that training subjects about the meaning of Facebook flag increased the effect of the flag on subjects' believability judgment of fake news. After subjects were trained, the designed flag, which replaced the caution sign with a stop sign and the original text with "Declared Fake by 3rd Party Fact-Checkers," reduced subjects' likelihood of sharing the fake news. Kim and Dennis (2019) investigated the effect of presentation format (highlighting the article source by presenting it before the headline) and source reputation rating (high vs. low) on users' perceived believability and behavioral responses. Their experimental results showed that highlighting the article source reduced subjects' perceived believability of the article, regardless of the source reputation (unknown vs. reputable ABC News). For unknown sources, low source reputation rating led to low believability. Believability influenced subjects' sharing likelihood of the article.

The preceding studies are important since they have made valuable attempts to develop and examine interventions for reducing users' dissemination of fake news. Nevertheless, several important points need to be noted. First, the studies have mostly focused on political fake news. This is understandable because political fake news has reportedly been deliberately created and spread to (attempt to) exert influence on the U.S. presidential election. Nonetheless, the issue of health misinformation on social media is also important and even more critical, because unlike political misinformation, health misinformation causes direct, immediate, and negative consequences to users and sometimes the consequences are fatal, as mentioned in the Introduction section. Therefore, it is compelling to directly examine interventions for curbing health misinformation. Second, the underlying assumption behind the intervention studies is that believability determines dissemination. However, it is noteworthy that believability has been found to be not the one and only determinant of sharing. Emotional arousal can overpower believability in affecting sharing (Lewandowsky et al. 2012). Consequently, the interventions developed in extant studies may not work in field settings.

Third, Huang et al. (2019) have theorized and demonstrated in their online field experiment that interventions which speak directly to individuals' motives can influence the corresponding behavior. We

opine that their theorization is applicable to our research context of social media. Notably, it has been suggested that users' sharing health and political information are driven by distinct motives such that the former is motivated primarily by altruism, relationship enhancement, and emotional coping (DiFonzo et al. 2012) and the latter primarily by persuading/informing, entertaining/trolling, and debating (Chadwick et al. 2018). Therefore, interventions which are designed to speak to user motives to reduce political misinformation dissemination are likely to be ineffective for health misinformation.

Fourth, the studies are all in PC use and Facebook context. The mobile use of online services is distinct from the PC-accessed use (Gu et al. 2013; Jung et al. 2019). Users' cognitive and decision making processes can change in mobile use context (Jung et al. 2019). Thus, the interventions which were found effective in PC context may become ineffective in mobile channel. Besides, though Facebook is the most popular social media around the world, other major social media platforms such as WeChat in China are unneglectable. Different platforms have different interfaces and require distinct operations. Interventions that are effective on a platform do not necessarily work on a different platform. Last, but not the least, all the three studies have used survey experiments and measured users' self-reported sharing likelihood. Given that using experimental surveys greatly simplifies the real use context, such design suffers more from the lack of realism than designs that are more realistic (e.g., an app specially developed to mimic a realistic app). Furthermore, because it is known that behavioral intention does not necessarily lead to behavior, gauging subjects' actual behavior will afford direct and more persuasive findings.

In summary, there is a dearth of research on developing effective interventions to address misinformation dissemination on social media. More research, particularly which caters specifically to health misinformation, accounts for the influence of emotions, adopts a more realistic research design, and/or uses a mobile social media and other-than-Facebook context, is needed. Indeed, continued research on designing new effective interventions has also been called for in the three studies.

Reflective-Impulsive Model of Human Behavior

RIM describes a two-system model positing that individuals' social behavior is a joint outcome of reflective and impulsive systems (Strack and Deutsch 2004; Strack et al. 2006). Similar to other dual process theories and models such as elaboration likelihood model (ELM, Petty and Cacioppo 1986) and heuristic-systematic model (HSM, Chaiken 1980), RIM proposes two processing mechanisms, one is associative processing (impulsive) and the other is rule-based processing (reflective). The impulsive system is relatively fast, requires little cognitive efforts, and depends on prior knowledge, heuristics, instant experience, and affect, whereas the reflective system is generally slow, requires a considerable amount of cognitive resources, and draws on rules and logic. Due to the advantage of requiring little cognitive efforts, the impulsive system generally possesses more primacy over the reflective system in influencing individual behavior. While sharing with other dual process theories the common feature regarding the existence of two modes of processing, RIM is distinct from those theories in that it goes beyond information processing and judgment by focusing on the behavioral outcome of the two mechanisms, and it particularly concerns how the two mechanisms compete to determine individual behavior (Strack and Deutsch 2004).

According to RIM, individual behavior is neither purely impulsive nor purely reflective. Both impulsive and reflective components contribute to individual behavior. The impulsive and reflective systems operate in parallel instead of consecutively and the two concurrently active systems may synergistically or antagonistically influence individual behavior. The contribution of impulsive elements to individual behavior can be strengthened through habits and motivational orientation. According to RIM, "the more often a motor schema is triggered at the exposure to a certain stimulus, [thereby facilitating the development of a habit], the more likely is its elicitation in the future" (Strack et al. 2006, p. 212, the content in brackets is added by us). Furthermore, individuals at the state of a certain motivational orientation are prone to perform motivationally compatible behaviors. That is, individuals at the state of an approach orientation are more likely to perform an approach behavior rather than an avoidance behavior and vice versa. Regarding the contribution of reflective system to individual behavior, the contribution is stronger when the behavioral consequences are important to the individual and/or the individual expects to be accountable for her behavior (Strack et al. 2006).

Research Hypotheses

Applying RIM to our research context and based on extant literature on fake news, we argue that user dissemination of health misinformation is driven dominantly by the impulsive system and the influence of reflective system should be strengthened to reduce user dissemination of health misinformation. Regarding the influence of impulsive system, we argue that users' habit of disseminating health information and the avoidance orientation induced by health misinformation strengthen the contribution of impulsive system to user dissemination of health misinformation.

Habit results from frequently repeated behavior and reflects automatic behavioral tendency outside conscious awareness. Abundant literature in psychology and IS fields has documented the facilitating role of habit in affecting individual behavior (Limayem et al. 2007; Ouellette and Wood 1998). Compared to true information, misinformation on social media more likely evokes negative arousing affect such as fear and disgust (Vosoughi et al. 2018). When people are experiencing negative affect, they are prone to engage in avoidance rather than approach behavior (Mehrabian and Russell 1974). In our research context, we argue that health misinformation triggers users' avoidance motivational orientation by evoking negative arousing affect in users; consequently, users engage in avoidance behavior by sharing out the health misinformation. Furthermore, psychology research has proven that arousal boosts information sharing (Berger 2011); people are more likely to share emotional arousal-inducing content than content which does not induce arousal. This supports our notion that social media app users' dissemination of health misinformation is driven dominantly by the impulsive system. Also, Jung et al. (2019) demonstrated that compared to PC-accessed use, mobile use of social media induces more impulsivity in users.

According to RIM, to reduce user dissemination of health misinformation, the contribution of reflective system should be strengthened. Toward this end, we propose that highlighting the negative effects of disseminating health misinformation on other users in the focal user's social network as well as on the focal user herself (e.g., self-image, self-integrity) is potentially effective. Undoubtedly, in general, users disseminate health information to bring about positive outcomes, such as informing and helping friends and family in improving their health and averting potential harm, building a positive self-image, and feeling self-worth (DiFonzo et al. 2012). We argue that when shown a message highlighting the potential negative outcomes resulting from disseminating health misinformation, users are expected to *give "a second thought"* before deciding to share the information rather than impulsively share out the misinformation without deliberation.

Abundant literature has established that individuals weigh negative information more heavily than positive information in information processing and decision making across a wide range of situations (Baumeister et al. 2001). Furthermore, individuals engage in more thinking and reasoning about negative events than positive events (Baumeister et al. 2001). In our context, the presence of a message highlighting the potential negative outcomes will prompt users to *pause and ponder,* take care to consider the information, and therefore users are more likely to raise doubts and questions or even to identify the information as false. Consequently, the likelihood of disseminating health misinformation is reduced.

Based on RIM, emphasizing the potential accountability of disseminating the health misinformation (e.g., facing possible regulations from platforms or legal punishment) is another potentially effective approach to strengthening the contribution of reflective system and thereby reducing misinformation dissemination. "*Think before you act*." We argue that administering a message which highlights the accountability of disseminating health misinformation may induce a temporary state of vigilance, nudging users to more carefully consider their sharing impulsivity and self-regulate the sharing behavior. Thus, the following hypotheses are proposed:

> **H1:** The habit of disseminating health information on the platform and the avoidance orientation induced by health misinformation increase users' dissemination of the misinformation.
>
> **H2:** The presence of a message which contains the negative effects of health misinformation dissemination and/or the accountability for health misinformation dissemination will reduce users' dissemination of the misinformation.

Situational moderators According to RIM, situational and dispositional moderators shift the relative impact of impulsive and reflective systems on individual behavior. When individuals do not possess

sufficient processing resources, the impulsive system has a stronger impact than reflective system on their behavior (Strack et al. 2006). The behavior is more likely to be determined by individuals' immediate and transient affect and less by their reflective judgment about behavioral consequences. In the current research, different from the primarily stable environment for social media use on PCs, the use context of social media apps is dynamic. It is common that social media app users browse articles when she is on subway or on bus, or when awaiting them. A user, for example, just reads to the half of an article and hears from the broadcast that her destination will be arrived at in one minute. In this case, the user will probably skim, trying to make an end with the article before getting off the vehicle. We focus on two contextual factors in this study, namely time availability and environmental noisiness. Time availability refers to the length of time available to users to process health misinformation and environmental noisiness refers to the noisiness of the surrounding environment when users process the misinformation. A high level of time availability and a low level of environmental noisiness mean that users have more cognitive processing resources; hence, the impact of reflective system on users' dissemination of health misinformation will be stronger. Therefore, we propose that

H3: Time availability positively (negatively) moderates the effect of reflective (impulsive) system on users' health misinformation dissemination.

H4: Environmental noisiness negatively (positively) moderates the effect of reflective (impulsive) system on users' health misinformation dissemination.

Dispositional moderator The relative impact of impulsive and reflective systems on individual behavior is also contingent upon certain individual traits (Strack et al. 2006). We focus on an individual trait pertinent to our research context, namely trait mindfulness. Mindfulness is defined as "the state of being attentive to and aware of what is taking place in the present" (Brown and Ryan 2003, p.822). It "captures a quality of consciousness that is characterized by clarity and vividness of current experience and functioning and thus stands in contrast to the mindless, less 'awake' states of *habitual or automatic functioning* that may be chronic for many individuals. Mindfulness may be important in *disengaging individuals from automatic thoughts, habits*, and unhealthy behavior patterns and thus could play a key role in *fostering informed and self-endorsed behavioral regulation*" (Brown and Ryan 2003, p.823). Therefore, the effect of reflective system should be stronger for users with a high level of trait mindfulness.

H5: Trait mindfulness positively (negatively) moderates the effect of reflective (impulsive) system on users' health misinformation dissemination.

Research Methodology

The aim of our study is to address health misinformation dissemination on mobile social media. Therefore, our focus is the examination of hypotheses H2 through H5. Regarding the test of H1, a survey method is suitable. To causally evaluate H2~H5, a readily feasible and suitable approach for us is to conduct a scenario-based lab experiment, which is a common approach in prior social media research (e.g., Choi et al. 2015). The rationale behind our plan is that in lab experiments, confounding factors can be well controlled and random assignment of subjects to treatment and control conditions can be easily achieved, so we are able to clearly test the effectiveness of the proposed interventions. After establishing intervention effectiveness, we believe that the industry would be more interested and motivated in collaborating with us to run randomized trials on their platforms.

The lab experiment will involve a between-subjects 4 (message manipulation: no message, message emphasizing negative effects, message emphasizing personal accountability, and message emphasizing both) × 2 (time availability: high vs. low) × 2 (environmental noisiness: noisy vs. quiet) full factorial design. A self-developed social media app which resembles a real-life one (e.g., WeChat) will be used to create a pseudo realistic environment. Subjects will be presented with a health article which contains health misinformation in their wall. They will be told to imagine that they are browsing the news feeds in their wall and read the presented article; after reading the article, they can respond to the article (share, like, and comment) as they want. The articles used in our experiment will be selected from Rumor Filter, an official rumor verification WeChat account of Tencent company. A pilot study will be conducted to further select those articles which are not well-known and are not obviously false to the subjects.

To manipulate the message intervention, we will use the function of a pop-up window in which the manipulated message is presented. The message window will pop up after subjects click the share button. There are four conditions for the message manipulation. In the control condition, there is no pop-up. In the three treatment conditions, namely the NE, AC, and NE+AC conditions, a message window will pop up. The messages will be designed to reflect the emphasis as described in the hypotheses. Specifically, in the NE condition, the message emphasizes negative effects of health misinformation dissemination and is designed as "disseminating health misinformation will mislead and harm your family and friends in your network who see the misinformation and will also damage your personal image in their minds." In the AC condition, the message emphasizes personal accountability for health misinformation dissemination and is designed as "disseminating health misinformation may constitute a violation of the law and require you to take legal responsibility." Lastly, in the NE+AC condition, the message emphasizes both by saying that "disseminating health misinformation will not only mislead and harm your family and friends in your network who see the misinformation and thereby damage your personal image in their minds, but also may constitute a violation of the law and require you to take legal responsibility."

To manipulate the situational moderator *time availability*, participants in the high time availability condition will be told to take their time in reading the article. Participants in the low time availability condition will be asked to read the article as quickly as possible and to finish the task within 10 seconds (the specific time will be determined by a pilot study on the average time needed to finish reading the article). The other situational moderator *environmental noisiness* will be manipulated by playing sound which is ex ante recorded at real-life sites to create the variation in the noise level.

Manipulation checks will be conducted via post-experiment surveys. The dispositional moderator trait mindfulness will be measured using the *Mindful Attention Awareness Scale* (Brown and Ryan 2003) before the experiment. Regarding the impulsive system factors, namely habit and avoidance orientation, will be measured using items adapted from Limayem et al. (2007) and Carver and White (1994), respectively. Perceived believability will be measured with items from Kim and Dennis (2019) as a control variable. Lastly, the dependent variable is the specific response made by subjects at the end of experiment.

Concluding Remarks

Before discussing the potential contributions, we first note some limitations of our study. As with most experiments, it is possible that our findings may not hold for all settings. As we plan to conduct the experiments on WeChat, it is unclear whether the designed interventions will work effectively on other platforms such as Facebook. Though we will recruit subjects comprising both young and old-age users to enhance the sample representativeness, the generalizability of our findings to a broader audience still needs more future research. Although the study of the moderators can provide us with a more nuanced and realistic understanding of the effectiveness of our intervention messages and also generate important theoretical implications, it is acknowledged that they are hard to manipulate by social media platforms. Future research can explore other factors such as design-related factors.

Our research is expected to make several theoretical contributions. First and foremost, it will contribute to the ongoing literature on the design of effective interventions for addressing the dissemination of fake news in general and health misinformation in particular on social media. The misinformation dissemination on social media platforms is an intractable problem to be solved imperatively for governments, platform operators, users, and various organizations, however, extant research on effective intervention design is sparse. Furthermore, scholars (Kim and Dennis 2019; Moravec et al. 2018; Ross et al. 2018) have made calls for more research on this topic. Our study represents an important contribution to extant literature and a response to the call. Second, our study can contribute to the literature on information sharing on social media as it essentially studies users' sharing behavior in social media context. As mentioned earlier, the motivation of users' sharing health information is distinct from that of sharing information of other topics (e.g., politics). Our designed intervention speaks directly to users' sharing motives for health information. As such, the study constitutes a valuable contribution to behavioral IS research on social media.

Third, to our knowledge, our study is among the earliest studies to endeavor to develop interventions for reducing health misinformation dissemination in mobile and non-Facebook contexts. Such endeavor is necessary and important because on one hand, the mobile use of online services is distinct from the use

on PCs in multiple ways (Gu et al. 2013; Jung et al. 2019), and on the other hand, the global social media landscape features multiple major players instead of monopoly. Fourth, this study goes beyond traditional view of social media users as rational decision makers and argues that the dissemination of health misinformation is driven by the impulsive system. Our point of view is valuable because extant research has been based upon the assumption that perceived credibility is the primary determinant of sharing, but psychology research has suggested that emotional arousal overpowers perceived credibility in influencing information transmission (Lewandowsky et al. 2012). Finally, our study contributes to RIM by extending it to social media app use context. Our model incorporates a complete RIM by not only including antecedents but also boundary conditions, thus, our study represents another valuable research in examining the efficacy of RIM.

On the practical side, first and most important, our study is expected to inform mobile social platform operators of actionable interventions to combat the misinformation. Second, by examining situational and dispositional moderators, our research is expected to yield more nuanced understanding of the boundary conditions and is able to offer more customized suggestions which consider the use context and individual difference for platform operators. Last, our research can contribute to the social media industry and the society as our interventions should be applicable to the PC context and other social media platforms.

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