



Passive social media use and psychological well-being during the COVID-19 pandemic: The role of social comparison and emotion regulation

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ABSTRACT

Social media browsing is commonly seen as a trigger of unhealthy social comparison (i.e., upward contrast), which negatively affects well-being. One underlying assumption is the predominance of positive self-presentation on social media, which may have shifted during the COVID-19 pandemic when negative disclosures have become more prevalent. In this study, we conceptualize social comparison as a multi-dimensional construct based on different comparing targets and processes, and explore how individual (i.e., cognitive reappraisal) and contextual (i.e., quarantine status) factors may influence the relationships among passive social media use, social comparison and stress during the COVID-19 pandemic. Drawing on a survey with 1131 Wuhan residents in China, we found that passive social media use was positively related to both upward contrast and downward identification, which in turn predicted a higher level of stress. Cognitive reappraisal was negatively associated with unhealthy social comparison (i.e., upward contrast and downward identification) but was positively related to healthy social comparison such as upward identification. Quarantined people tended to report more upward contrast, especially when they engaged in more frequent social media browsing. This study contributes to the larger debate about the impact of social media on mental health and offers practical implications.

1. Introduction

There is a pervasive and ongoing debate about the impact of social media on mental health. While research on the generic use of social media has yielded mixed results (Clark et al., 2018; Dienlin et al., 2017; Kross et al., 2020), many studies have consistently found that passive social media use, or consuming information without direct social interactions, can negatively affect well-being (Verduyn et al., 2021). This finding is often attributed to social comparison with those better off than oneself (i.e., upward comparison) and the feelings of envy (Verduyn et al., 2020). Given the prevailing positive self-presentation on social media (Reinecke & Trepte, 2014; Waterloo et al., 2018), browsing content on social media can make people feel inferior to others and experience envy and frustration (Yoon et al., 2019).

However, this norm may have shifted during certain contexts such as the COVID-19 pandemic. Research shows that people tend to share extensive negative experiences on social media during the pandemic (Saha et al., 2020; Shen et al., 2020; Zhang et al., 2021), which is likely to facilitate *downward social comparison* – comparison with worse-off

others (Festinger, 1954). For example, people who are healthy may contrast themselves with those who are suffering and thus experience happiness or *schadenfreude*. Alternatively, being exposed to worse-off others' misery and adversity related to COVID-19 may provoke increased fear or anxiety (Wheaton et al., 2021), especially for healthy people living in the hotspot of the initial outbreak.

Apart from the comparison *target* (upward vs. downward; Festinger, 1954), the underlying *processes* of comparison (identification vs. contrast) may also influence emotions and well-being (Buunk & Ybema, 1997). Although previous studies on social media primarily focus on how people contrast themselves with better-off others, emerging research starts to question this notion by arguing that people can mimic and assimilate others' positive emotions as well (Goldenberg & Gross, 2020; Kramer et al., 2014). Especially during the pandemic when the sense of common fate is salient (Yue & Yang, 2021), seeing others' positive posts may provoke hope and optimism, as people may envision the situation of others as their own future (i.e., upward identification; Buunk & Ybema, 1997; Van der Zee et al., 2000).

Notably, the processes and consequences of social comparison can be

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contingent on individual and contextual factors. For example, people often employ emotion regulation strategies to reappraise a stimulus so as to reduce negative emotional arousal (Gross, 2014). When confronted with positive disclosures on social media, they can use cognitive reappraisal to portray a similar future with better-off others, which likely provoke positive emotions. Besides, substantial changes in life circumstances may also account for different types of social comparison. As many people have been put into quarantine during the pandemic, they may rely more on social media for social interaction and information seeking given the reduced face-to-face communication. More passive browsing could trigger increased social comparison tendency. However, little empirical research has examined how cognitive reappraisal and quarantine status may moderate the relationship between passive social media use on social comparison.

In this study, we extend the conceptualization of social comparison and operationalize it as a multi-dimensional construct based on different comparing targets and processes. In a survey study conducted in the first epicenter of COVID-19 in China, we assessed Wuhan residents' social media use, quarantine status, social comparison and perceived stress. This study has three interlocking goals: (1) to examine the relationship between passive social media use and social comparison, (2) to explore whether the above relationship is contingent on individuals' cognitive reappraisal and quarantine status and (3) to examine how social comparison is related to perceived stress under the backdrop of the COVID-19 pandemic.

2. Literature review

2.1. Passive social media use and social comparison

Social media generally refers to web-based services that allow users to construct public or semi-public images within a social network (Boyd & Ellison, 2007). The asynchronous nature of many social media platforms enables users to enhance their self-presentation in order to manage impressions and relationships (Walther, 2007). Accordingly, researchers observe a positivity norm, such that information on social media is often positively skewed (Reinecke & Trepte, 2014; Waterloo et al., 2018). For example, individuals often edit and optimize their self-images before posting on social media, expecting more favorable feedback from the audience (Yue & Stefanone, 2021).

Indeed, a number of studies have suggested that browsing others' positive posts on social media undermines well-being through upward contrast and feelings of envy (Appel et al., 2020; Tandoc et al., 2021; Verduyn et al., 2021). As people have a natural tendency to compare with others who are either ahead of them (i.e., upward comparison) or behind them (i.e., downward comparison; Festinger, 1954; Buunk & Gibbons, 2007), social media browsing may easily trigger social comparison (Appel et al., 2020). Given the overall positive nature of social media posts, passive social media use is often related to the feelings of envy, lower self-esteem and other mental health issues (Schmuck et al., 2019; Verduyn et al., 2020; Vogel et al., 2015). For example, people who were instructed to spend more time on Facebook reported more depression and loneliness compared to those who limited their Facebook use (Hunt et al., 2018).

However, the positivity norm may have shifted in the time of crises. Specifically, the pandemic seems to promote an environment for downward social comparison given the prevalence of negative expressions (Zhang et al., 2021). A large-scale study that compared tweets posted pre- and peri- COVID-19 showed that negative emotional expressions significantly increased during the pandemic (Saha et al., 2020). Similarly, researchers found that over 400,000 posts on Weibo, a popular Twitter-like social media in China, contained self-report symptoms or diagnoses of COVID-19 between November 2019 and March 2020 (Shen et al., 2020). The changing context calls for a more nuanced examination of social comparison, which goes beyond merely upward contrast.

In this study, we employ identification-contrast model and operationalize social comparison as a four-dimension construct (Buunk & Ybema, 1997). The identification-contrast model (Buunk & Ybema, 1997) posits that social comparison can be interpreted either in a positive or negative way, depending on the *target* and *process*. For example, envy and anxiety might be provoked by *upward contrast*, when people view better-off others as competitors who surpass them. However, people likely experience positive emotions such as hope and optimism when they envision others' success as their own future (i.e., *upward identification*). When comparing with inferior others, individuals may feel worried and frustrated when they imagine others' misfortune will happen to themselves (i.e., *downward identification*). In contrast, positive emotions such as pride and *schadenfreude* can be stimulated when people distance themselves from worse-off others, whose miserable situations are avoidable (i.e., *downward contrast*; Buunk & Ybema, 1997).

Taken together, given the wide array of information on social media during the COVID-19 pandemic, we expect that social media browsing can provide users with information about both better-off others and worse-off others which may trigger different social comparison. We thus hypothesize that:

H1. Passive social media use is positively associated with both (a) upward and (b) downward social comparison.

2.2. Cognitive reappraisal and social comparison

Apart from the comparison *target*, comparison *process* (i.e., identify vs. contrast) may also play an important role in shaping people's emotional reactions (Buunk & Ybema, 1997). When social media provides ample information about others, how do people interpret the information? Despite much literature on the contrasting process with better-off targets (Schmuck et al., 2019; Verduyn et al., 2015, 2017), some scholars argue that people may identify with and synchronize others' emotions on social media as well (Goldenberg & Gross, 2020). For example, Valkenburg et al. (in press) found that only about 20% of adolescents experienced browsing-induced envy, whereas 17% reported positive emotions. Another study showed that Facebook users who were exposed to more positive expressions tended to produce more positive posts and fewer negative ones (Kramer et al., 2015).

Indeed, social comparison is sometimes viewed as a two-step process (Buunk & Gibbons, 2007). The first step is an *automatic* process of instinctively comparing oneself with others and respond negatively to better-off others' information (Buunk & Gibbons, 2007). While the second step is a *conscious* process of "decomparing", where people "undo" the unpleasant effects of the comparison, typically by considering why the target has advantages and providing justification for their own behavior (Gilbert et al., 1995). For example, when people feel a threat to their self-image, they tend to re-interpret the situation and derogate their comparison targets to maintain self-esteem (Fein & Spencer, 1997). Although much empirical research supports the automatic perspective (e.g., Bocage-Barthélemy et al., 2018), less is known about the second step – regulation and justification process. Inspired by previous studies which show that individual difference may influence whether people identify or contrast with others (e.g., de Vries et al., 2018), we aim to explore if individual traits may help shape the *process* of social comparison.

Drawing from research on emotion regulation theory (Gross, 1999), we expect that individuals with higher capability in cognitive reappraisal will engage in more healthy social comparison processes. Emotion regulation theory (Gross, 1999) offers an important tool to explain how people evaluate information about others. In particular, *antecedent-focused* emotion regulation strategies, such as *cognitive reappraisal*, are typically employed to alter the *meaning* or *relevance* of an emotion-eliciting event before any emotional responses are fully generated (Gross, 2007). In this study, we conceptualize cognitive

reappraisal as an individual trait that is relatively stable and varies from person to person (Gross, 2007) and explore if cognitive reappraisal moderates the relationship between passive social media use and social comparison.

On one hand, cognitive reappraisal may be activated simultaneously when viewing others' posts, which in turn helps shape the process and consequence of social comparison (Gross & Barrett, 2011). In particular, individuals can employ cognitive reappraisal to strategically select the process of social comparison upon exposure to others' posts and generate favorable emotional experience. For example, during stressful events, people often compare themselves with worse-off others to improve well-being and maintain self-esteem (Buunk & Gibbons, 2007; Ruggieri et al., 2021). On the other hand, cognitive reappraisal may help facilitate the self-defense process (e.g., justifying for oneself) and exert a separate, enduring positive impact on emotional experience from social comparison (e.g., Ahn et al., 2015).

Given the scant evidence on the relationships among passive social media use, cognitive reappraisal and social comparison, we propose a research question as follows:

RQ1. Does cognitive reappraisal moderate the relationship between passive social media use and social comparison?

2.3. Social context and quarantine status

Apart from individual differences, social context and life circumstances may also influence the relationship between social media and social comparison. Prior studies have shown that situational factors, such as social environment, interpersonal relationships, and life events, have a bearing on how people use social media and what they use them for (Masur, 2018; Kornfield et al., 2020; Zhang, 2017). Context-aware systems have also been increasingly employed to understand and respond to users' social and physical environment (Burns et al., 2011; Dourish, 2004).

During the outbreak of the pandemic, many countries have implemented a range of quarantine and lockdown measures to combat COVID-19 (WHO, 2020). The restrictions in interpersonal interactions and outdoor activities may lead people to rely more on social media for information and connection. It is likely that more frequent social media browsing may be associated with increased tendency in social comparison. However, it remains unclear regarding the nature and consequences of social comparison between quarantined and unquarantined people. In this study, we sought to examine whether quarantined people differ from non-quarantined people regarding the relationship between passive social media use and social comparison. We propose a research question as below:

RQ2. Does quarantine moderate the relationship between passive social media use and social comparison?

2.4. Passive social media use, social comparison and psychological well-being

So far, we have discussed a range of potential predictors of social comparison. Now we explore possible psychological consequences of different types of social comparison, and whether social comparison mediates the relationship between passive social media use and well-being. Recall that depending on the target and process of social comparison, individuals may experience different emotions that influence well-being (Buunk & Ybema, 1997). Indeed, previous studies have highlighted the utility of upward identification and downward contrast in coping with stressful events (Verduyn et al., 2020). For example, high school students deliberately engage in upward social comparison with those who outperformed them so as to stay motivated (Buunk et al., 2005). In a study among cancer patients, the tendency to identify with better-off others and contrast against worse-off others were significantly associated with active coping strategies and positive attitudes (Van der

Zee et al., 2000). A recent longitudinal study found that during COVID-19 pandemic, a higher social comparison tendency predicted better well-being (Ruggieri et al., 2021). We suspect that upward identification and downward contrast may explain the positive relationship between social comparison tendency and well-being.

In the current study, we focused on four different types of social comparison and their relationships with perceived stress. Stress typically occurs when people feel that they are not capable of accommodating the environment (Cohen et al., 1992). Following the identification-contrast model, we expect that positive emotions derived from social comparison would be negatively associated with perceived stress, and vice versa. Thus, we hypothesize that:

H2. (a) Upward identification and (b) downward contrast are negatively associated with perceived stress, while (c) upward contrast and (d) downward identification are positively associated with perceived stress.

Combining H1 and H2, we propose a mediation hypothesis:

H3. Social comparison mediates the relationship between passive social media use and stress.

3. Method

3.1. Sample

We collected data through a Qualtrics online survey between March 2 and March 10, 2020, in Wuhan, China, where the first case of COVID-19 was identified (WHO, 2020). Starting from January 23, Chinese government placed a range of strict quarantine measures in Wuhan, including the shutdown of public and private transportation, as well as the implementation of stay-at-home order (Pan et al., 2020). Except for those working at essential businesses (e.g., food delivery, hospital and medical staff, etc.), all residents were ordered to stay in their residential community (Pan et al., 2020).

We recruited participants through convenience sampling and snowball sampling methods. The recruitment announcement was posted on Weibo and WeChat through both the social media accounts of researchers in our team and the official accounts of the Research Center at Wuhan University. We also reached out to managers at a few essential businesses (e.g., grocery stores and food delivery companies) to help distribute the survey to their employees. The recruitment post included a link to the survey and a note to encourage distribution of the survey to others who are qualified. This study received IRB approval from a northeastern University in the United States, with written consents obtained from the survey participants. All participants were offered an incentive of 5 RMB (0.77 USD).

A total of 1131 eligible participants were included in the final analysis. Those participants were adults, self-identified as healthy, resided in Wuhan at the time of data collection, and completed at least 30% of the questions. We deliberately focus on healthy residents as they are likely to experience both downward comparison with those who were struggling with COVID-19 and upward comparison who live outside the epicenter. Ranging from 18 to 81 ($SD = 10.84$), the average age was 38.99. About 69.6% were female and most participants (67.2%) were being quarantined (0 = quarantined; 1 = non-quarantined residents).

The minimum sample size was determined based on the smallest effect size of interest (SESOI; Lakens et al., 2018). We regarded effects that are at least small – the standardized coefficient β is above 0.10 (Cohen, 1992) – as providing trustworthy support for our hypotheses. To be able to test our hypotheses with at least small effects ($\beta = 0.10$), a desired power of 95% and an alpha level of 5%, we needed at least 1293 participants. Given the final sample size of 1131 participants, the statistical power to detect small effects is 92%.

3.2. Measures

The questionnaire included several established measures, which were originally in English and then translated into Chinese. We pilot tested the questionnaire with 20 participants and asked about their understanding of the items to ensure accuracy in meaning and avoid mistranslation. Table 1 summarizes the correlations among key variables.

Passive social media use was measured with three items. These items captured the extent to which Wuhan residents used social media to: (1) browse others' profiles, pictures, comments and posts that are not relevant to COVID-19; (2) browse others' profiles, pictures, comments and posts that are particularly relevant to COVID-19, and (3) information seeking after Wuhan was locked down (1 = not at all to 5 = very often; $\alpha = 0.77, M = 2.93, SD = 0.97$).

Social comparison was measured by a scale adapted from Van der Zee et al. (2000). Downward contrast was assessed with the item "When I see others who are struggling with the coronavirus, I am happy that I am doing well" (1 = not at all to 5 = very much; $M = 3.25, SD = 1.27$). Downward identification was measured with "When I see more and more people get infected, I experience fear that I would be infected too" ($M = 3.31, SD = 1.09$). Upward contrast was assessed with "When I see the number of coronavirus cases is declining in other cities, I feel frustrated about my situation" ($M = 2.47, SD = 1.14$). Upward identification was measured with "When I see people are allowed to go out in other cities, it makes me feel happy realizing that the tough situation will end soon" ($M = 4.07, SD = 0.85$).

Cognitive reappraisal was measured with three items adapted from the emotion regulation scale (Gross & John, 2003), including "Since Wuhan has been locked down, when I want to feel more positive emotions (such as joy or amusement), I change what I'm thinking about"; "When I want to feel less negative emotions (such as sadness or anger), I change what I'm thinking about" and "When I'm faced with a stressful situation, I make myself think about it in a way that helps me stay calm" (1 = strongly disagree to 5 = strongly agree; $\alpha = 0.69, M = 3.67, SD = 0.57$).

Stress was measured with three items adapted from the perceived stress scale (PSS) by Cohen et al. (1983). Participants' responses were measured on a five-point scale (1 = never to 5 = very often). These items included: "Since Wuhan has been locked down, have you ever 'been upset because of something that happened unexpectedly'; 'felt that you were unable to control the important things in your life' and 'felt nervous and stressed'" ($\alpha = 0.89; M = 2.48, SD = 0.98$).

Control variables. We included active social media use (i.e., direct interactions with others, self-disclosure, COVID-19 information sharing, and online gaming with friends) (1 = never to 5 = very often; $\alpha = 0.65, M = 2.64, SD = 0.81$), gender and age as control variables.

3.3. Open science

To advance open science practices in Communication (Dienlin et al., 2021), we have made our dataset, questionnaire, and data analysis scripts publicly available at: https://osf.io/ktcg3/?view_only=0690e6288b7044178ae0f880564d326a.

Table 1
Zero-order bivariate correlations among key variables.

Variables	1	2	3	4	5	6	7	8
1. Age	–							
2. Passive social media use	-.30***	–						
3. Upward contrast	-.11**	.23***	–					
4. Upward identification	.05	.03	-.17***	–				
5. Downward contrast	-.11**	.28***	.23***	.06	–			
6. Downward identification	.04	.21***	.37***	.03	.28***	–		
7. Cognitive reappraisal	.05	.08*	-.17***	.19***	.01	-.08*	–	
8. Stress	-.31***	.35***	.41***	-.07*	.21***	.30***	-.16***	–

Note: * $p < .05$, ** $p < .01$, *** $p < .001$.

3.4. Data analysis

We used SPSS 24.0 for descriptive and correlational analyses and Mplus 7.3 for structural equation modeling (SEM) analysis. Correlations among key variables are reported in Table 1. We first specified a measurement model through confirmatory factor analysis to test the reliability and validity of different latent variables. The measurement model has a good model fit ($\chi^2 = 283.93, df = 59, \chi^2/df = 4.81, RMSEA = .06, SRMR = .06, CFI = .93, TLI = .91$) and all items met the 0.50 minimum level (Genfen et al., 2000).

Then, we performed latent moderated structural modeling to explore whether cognitive reappraisal (RQ1) and quarantine status (RQ2) moderate the relationship between passive social media and social comparison. Log likelihood ration was calculated to determine whether the moderation effects exist. Another structural equation modeling was conducted based on the above results to test whether social comparison mediate the relationship between passive social media use and stress (H1, H2 & H3) (See Fig. 1 for the model and results).

4. Results

4.1. Examining the moderation effect

We first conducted latent moderated structural equation modeling to test whether cognitive reappraisal (RQ1) and quarantine status (RQ2) moderated the relationship between passive social media use and social comparison. Latent moderated structural equation modeling has been widely used for estimating latent interaction effects because of its great statistical efficiency (Kline, 2006). We included passive social media use as an independent variable, cognitive reappraisal and quarantine status as moderators, and four types of social comparison as dependent variables. Active social media use and demographics were included as covariates. All variables were standardized in Mplus before model estimation (Maslowsky et al., 2015).

Our results showed that the interaction between passive social media use and quarantine in predicting upward contrast was significant ($\beta = -.14, p < .05, 95\% CI = [-.26, -.03]$). Simple slope analysis showed that the relationship between passive social media use and upward contrast was significant only for people who were quarantined ($\beta = .22, p < .001, 95\% CI = [.18, .39]$) (vs. non-quarantined people: $\beta = 0.07, p > .05, 95\% CI = [-.05, .21]$). None of the other interactions was significant.

Log-likelihood ratio test, denoted as D, was calculated using the following equation to compare the Model 1 with interaction terms and the Model 0 without estimating interactions:

$$D = -2 [(\text{log-likelihood for Model 0}) - (\text{log-likelihood for Model 1})]$$

$$\text{Thus, } D = -2 [(-15249.57) - (-15241.68)] = 15.78, \Delta df = df_1 - df_0 = 79 - 71 = 8.$$

Upper-tail 97.5% critical values of chi-square distribution (when $df = 8$) = 17.54.

$D = 15.78 < \text{the threshold value } 17.54$, thus D is not statistically significant.

The insignificant log-likelihood ratio suggested that Model 0 without estimating the interaction effect did not represent a significant loss in fit

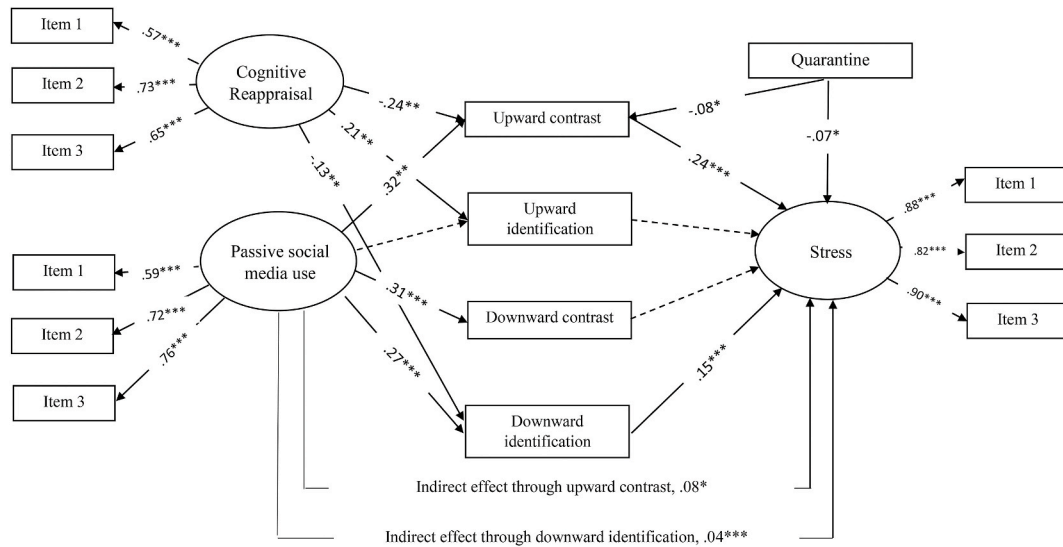


Fig. 1. Structural equation modeling testing mediation hypothesis.

related to Model 1 (Satorra & Bentler, 2010). Accordingly, we examined a parsimonious mediation model in the following structural equation modeling, without specifying interaction terms (See Fig. 1 for the model).

4.2. Examining the mediation effect

To assess the mediation effect, we included passive social media use, cognitive reappraisal and quarantine status as independent variables, social comparison as mediators, and stress as dependent variables. Active social media use and demographics were included as covariates (See Fig. 1 for the model and results). The mediation model shows a good model fit ($\chi^2 = 450.43$, $df = 139$, $\chi^2/df = 3.24$, RMSEA = .05, SRMR = .06, CFI = .93, TLI = .90), explaining 37.0% of the variance in perceived stress.

H1 examined the relationship between passive social media use and social comparison. The results showed that passive social media use was positively related to downward contrast ($\beta = .31$, $p < .001$, 95% CI = [0.24 0.38]), upward contrast ($\beta = .32$, $p < .01$, 95% CI = [.07, .57]) and downward identification ($\beta = .27$, $p < .001$, 95% CI = [.19, .35]). Thus, H1 was partially supported. Cognitive reappraisal was negatively associated with upward contrast ($\beta = -0.24$, $p < .001$, 95% CI = [-.32, -.15]) and downward identification ($\beta = -.13$, $p < .01$, 95% CI = [-.23, -.04]), but was positively associated with upward identification ($\beta = .21$, $p < .001$, 95% CI = [.12, .31]). Quarantined people reported more upward contrast ($\beta = -.08$, $p < .05$, 95% CI = [-.15, -.02], $M = 2.63$ vs 2.15, $SD = 1.19$ vs 0.97). Women engaged in more upward contrast ($\beta = .08$, $p < .05$, 95% CI = [.02, .14], $M = 2.53$ vs. 2.35, $SD = 1.16$ vs. 1.15) and downward identification ($\beta = .11$, $p < .01$, 95% CI = [.04, .17], $M = 3.41$ vs. 3.15, $SD = 1.04$ vs. 1.16). Older people reported more downward identification ($\beta = .14$, $p < .001$, 95% CI = [.07, .21]).

H2 examined the relationship between social comparison and stress. The results showed that both upward contrast ($\beta = .24$, $p < .001$, 95% CI = [.16, .32]) and downward identification ($\beta = .15$, $p < .001$, 95% CI = [0.08, 0.22]) were positively related to stress; H2 was partially supported. The direct effect of passive social media use on stress was significant ($\beta = .26$, $p < .001$, 95% CI = [.18, .34]). H3 examined whether social comparison mediated the relationship between passive social media use and stress. The indirect effect of passive social media use on stress was significant through upward contrast ($\beta = .08$, $p < .05$, 95% CI = [.16, .32]) and downward identification ($\beta = .04$, $p < .001$, 95% CI = [.08, .22]), lending partial support to H3. Also, age ($\beta = -.18$, $p < .001$, 95% CI = [-.25, -.11]) was negatively related to stress. Women reported

higher stress than men ($\beta = .08$, $p < .01$, 95% CI = [.02, .13], $M = 2.55$ vs 2.33, $SD = 1.02$ vs 0.87). Quarantined people reported higher stress ($\beta = -.07$, $p < .05$, 95% CI = [-.13, -.01], $M = 2.65$ vs 2.10, $SD = 1.04$ vs 0.71).

5. Discussion

Understanding the mechanism by which social media affects mental health presents an intriguing and important question for communication scholars. A plethora of research has identified passive social media use as the culprit of stress and anxiety, largely due to upward social comparison triggered by prevailing positive self-presentations (Schmuck et al., 2019; Verduyn et al., 2015, 2017). While previous social media research has primarily focused on upward social comparison, there is a pressing need to go beyond the mere focus on upward contrast and examine other types of social comparison, which vary based on the comparison target (upward vs. downward) and the process of comparison (identification vs. contrast).

Integrating the scholarship on social comparison and emotion regulation, this study investigates the relationships among passive social media use, social comparison, and perceived stress during the COVID-19 pandemic. Our results showed that passive social media use was positively associated with both upward and downward social comparison, which in turn predicted levels of stress. Cognitive reappraisal and quarantine status both influenced the processes and consequences of social comparison. This study provides important insights to the larger debate about the impact of social media on mental health and offers practical implications.

5.1. Dual mechanisms of the effects of passive social media use on stress

Particularly, our results showed that passive social media use was positively associated with upward contrast, downward contrast, and downward identification. Extending previous research that mainly focuses on upward contrast, this study suggests that browsing others' posts may provoke social comparison with not only those who are better off but also those in worse situations. Against the backdrop of the COVID-19 pandemic, it is reasonable to believe that the predominance of positive self-presentations on social media may have declined due to the collective stressors that people are going through (Saha et al., 2020; Shen et al., 2020). Viewing negative disclosures is likely to provoke comparison with people who are suffering, either contrasting or identifying with them. Meanwhile, the positive relationship between passive use

and upward contrast suggests that upward social comparison persisted during the pandemic. This might be because of the varied influence of COVID-19 on people in different parts of the world. By the time of our data collection, Wuhan was the epicenter of COVID-19 pandemic (WHO, 2020), and it is possible that seeing pictures of friends living elsewhere partying and travelling might trigger upward contrast and feelings of frustration.

This study also sheds light on the mechanisms through which social media affects well-being. Our results reaffirmed the role of upward contrast in mediating the relationship between passive social media use and perceived stress (e.g., Verduyn et al., 2017). Notably, we identified downward identification as an additional mediator through which social media use predicts stress. In other words, browsing others' posts on social media may promote identification with worse-off others, resulting in elevated level of stress. One potential explanation is that being exposed to others' misery and adversity related to COVID-19 may induce emotional contagion and increased fear and anxiety, especially for people living in the hotspot of the initial outbreak (Goldenberg & Gross, 2020). This corresponds to experimental evidence for large-scale emotional contagion via social media (Kramer et al., 2014), and a recent study that highlighted the role of social media in spreading pandemic-related panic (Ahmad & Murad, 2020).

The mediating effect of downward identification also suggests the dynamics in the norms of online self-disclosure. Specifically, positivity norms (Reinecke & Trepte, 2014; Waterloo et al., 2018) can shift during crises such as a pandemic and social unrest (e.g., Saha et al., 2020; Shen et al., 2020; Zhang & Fu, 2020). Since individuals are less likely to be judged for experiencing commonly faced stressors and challenges, barriers to posting personal misery and sorrow may have lessened. However, given the progression of the pandemic, social media norms are likely to be in flux over time. Longitudinal research is needed to investigate the fluctuating norms on social media using a situational approach (Masur, 2018).

5.2. The roles of cognitive reappraisal and social comparison

While we hypothesized that individual trait (i.e., cognitive reappraisal) moderated the relationship between passive use and social comparison, the results refuted this hypothesis and showed a direct link between cognitive reappraisal and social comparison. Specifically, cognitive reappraisal was negatively associated with upward contrast and downward identification, and positively associated with upward identification. Viewing others' positive self-presentation may trigger upward contrast, but people who are more adept at identifying their negative thoughts and replacing them with positive interpretations tend to experience less upward contrast. Moreover, although fear and anxiety are highly contagious, people with higher cognitive reappraisal were more likely to look on the bright side and maintain a generally positive mood. Taken together, cognitive reappraisal might function as a protective factor that alters individuals' initially negative thoughts triggered by social media use.

The finding is consistent with the two-step process of social comparison (Buunk & Gibbons, 2007). Social media may provide different targets (and behaviors) for comparison, but cognitive reappraisal may influence how people interpret the information, which in turn shape the emotional outcomes. For example, when seeing better-off others' posts, more upward comparison, especially upward contrast, will be automatically triggered. But people with higher cognitive reappraisal tend to experience more positive emotions rather than negative emotions by re-interpreting the information. Future research can investigate the dynamics in different types of social comparison and how cognitive reappraisal can shift the emotional consequences.

Interestingly, post hoc analysis showed that Wuhan residents generally engaged in significantly more upward identification than other types of social comparison. This is in line with previous findings that higher social comparison tendency predicted higher well-being

during Quarantine (Ruggieri et al., 2021), such that people may strategically use social comparison for protective purposes. Although our study did not reveal a significant relationship between upward identification and stress, future research should examine the potential benefits of upward identification on other well-being indicators.

5.3. The social context of social media use

Our results also suggest that the relationship between social media use and social comparison is contingent on social context. Quarantined people were more likely to engage in upward contrast, and more passive social media use appeared to reinforce this tendency. This might be explained by our findings that quarantined people engaged in significantly more passive social media use than those who were not confined at home. Thus, quarantined people may have more exposure to information posted by those who were allowed to go out, leading to upward contrast and feelings of frustration. In contrast, essential workers engaged in less browsing due to the work demand and offline social interactions, which might reduce the likelihood of negative social comparison. This finding underscores the importance of considering people's social context and life circumstances in examining the impact of social media on well-being.

While social media is often blamed for causing stress, anxiety, and depression (Liu et al., 2019; Verduyn et al., 2015, 2017), this narrative may fall into the trap of technological determinism. Theorists of the social construction of technology (Pinch & Bijker, 1984) have long refuted this deterministic view and argued that technology is social embedded — only when we understand the social context of use can we fully grasp the use and effect of technology. Our findings further corroborate this proposition by suggesting that the extent to which social media use relates to unhealthy social comparison is contingent on personal circumstances such as quarantine status. Thus, researchers need to pay more attention to the dynamic, emergent, and sometimes messy social context in understanding the impact of social media on mental health.

5.4. Practical and design implications

Our study also has several practical implications. Given the negative impact of upward contrast, social media platforms may need to assist users to manage content that can trigger unhealthy social comparison. For example, it is important for social media platforms to provide features that allow users to hide certain posts or users. More accessible user guides and tutorials are also needed to ensure that these features are accessible to those with low digital literacy or limited experience with social media. Besides, it may be helpful to provide the option to automatically hide certain content/people based on users' preferences and privacy needs.

Social media platforms may also employ automated conversational agents or chatbots to provide users with cognitive reappraisal interventions, which could help them identify maladaptive thoughts and then re-interpret them in a positive light. For example, when upward contrast and negative emotions are reported, a chatbot can help users analyze the factors that may trigger the negative affect and provide personalized suggestions.

During a global crisis, another possible way for social media platforms to support the users and communities is to launch more meaningful features or tools that allow users to express care and support to each other. A good example can be Facebook's launch of "Care" emoji during the outbreak of the pandemic, which facilitates the provision of empathy and reassurance. While these stickers are by no means more effective than a real hug, they may play an important role when face-to-face interactions are restricted, and panic and anxiety abound (Ahmad & Murad, 2020).

5.5. Limitations

This study has several limitations. First, our reliance on self-report data may be subject to various measurement biases. For example, self-reported data are far from an accurate reflection of logged media use (Parry et al., 2021). Future research could use a combination of smartphone logging and experience sampling methods to more precisely investigate passive social media use and its associations with users' emotions and attitudes. The recent work using eye tracking to measure the type and amount of passive use also presents a promising direction of future research (Ellison et al., 2020).

Second, the nature of our cross-sectional study makes it difficult to draw causal conclusions. Future studies should aim to use experimental or longitudinal designs to test possible temporal orders and causal relationships among the variables of our interest. For example, future studies can employ mobile applications to track the actual amount of passive social media use and perform regular mental health assessment to tackle possible causality.

Third, we used only one item to measure each social comparison tendency in our study, which may raise concerns about the internal reliability of the variables. Although it is novel to adapt and test this scale in the unique context, future studies could develop a more comprehensive identification-contrast scale.

Finally, the direct correlation between passive social media use and stress suggests that there might be other mediators and mechanisms apart from social comparison. For example, emotion contagion might come into play when social media is rife with negative emotions (Kramer et al., 2014), which calls for more empirical research in the future.

6. Conclusion

During the ongoing pandemic, people tend to share more negative experience online, which may problematize the proposition that browsing on social media undermines well-being through upward social comparison. This study extends the conceptualization of social comparison by taking account into both comparison targets and processes, exploring the relationships among passive social media use, social comparison and well-being. Our results showed that passive social media use is negatively related to perceived stress through both upward and downward social comparison during the COVID-19 pandemic. This complements the existing literature that mainly focuses on upward comparison, highlighting the importance in examining the target and process of social comparison. Cognitive reappraisal was negatively associated with unhealthy social comparison and positively related to healthy social comparison. Mental health counseling and training centering on cognitive reappraisal might be helpful during the global crisis. In addition, contextual factors, such as being quarantined, further reinforce the positive link between social media browsing and upward contrast. Although our cross-sectional data is limited in establishing causality, our findings enrich the existing literature and provides important practical implications.

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Credit author statement

Zhiying Yue (First and corresponding author): Conceptualization, Methodology, Formal analysis, Investigation, Writing- Original draft; Writing – Review and Editing, Visualization. Renwen Zhang (Second author): Conceptualization, Methodology, Investigation, Writing- Original draft; Writing – Review and Editing, Supervision. Jun Xiao (Third

author): Conceptualization; Resources; Data collection; Supervision.

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