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Is there any 'Facebook Depression'? Exploring the moderating roles of neuroticism, Facebook social comparison and envy

Tak Sang Chow *, Hau Yan Wan

Hong Kong Shue Yan University, Hong Kong

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ABSTRACT

Mixed results have been found regarding the relationship between social media use and depressive symptoms. This study aims to explore the moderating roles of neuroticism, envy and Facebook social comparison in the relationship between Facebook usage and depressive symptoms. A sample of 282 participants were recruited from Amazon Mechanical Turk. They completed a battery of online questionnaires including measures of neuroticism, Facebook use, Facebook social comparison, envy and depressive symptoms. In the present study, the correlation between Facebook use and depressive symptoms was not statistically significant. Nevertheless, we found a significant interactive effect between time spent on Facebook and neuroticism. The positive association between time spent on Facebook and depressive symptoms was only found among those high in neuroticism but not among those low in neuroticism. Facebook social comparison and envy did not significantly moderate the effect of time spent on Facebook on depressive symptoms. Potential explanations and implications of the results were discussed.

1. Introduction

There are 1.71 billion monthly active users on Facebook, the most popular social networking site (Facebook Information, 2016). Since Facebook is an important part of many people's social life, it is essential to understand the interrelationship between Facebook usage and psychological well-being. In 2011, the American Academy of Pediatrics (AAP) published a communication and media report warning that excessive exposure to Facebook might lead to depression especially among children and adolescents (O'Keeffe & Clarke-Pearson, 2011). However, this report has been proven to be controversial. It cited some media reports which misunderstood the original studies. For instance, it cited the media coverage of Davila et al. (2009) as evidence to support the negative causal impact of social media use on mental health but the original study did not involve any data about depressive symptoms and social media use.[1] It has also been criticized that conflicting evidence such as the positive association between Facebook use and self-esteem (Gonzales & Hancock, 2011) was omitted in the report.

The "Facebook depression" claim has been attracting much attention and has been widely reported in media. However, ongoing investigation on the association between Facebook usage and psychological well-being has yielded inconsistent results. For example, Wright et al. (2012) found that time spent on Facebook positively correlated with depressive symptoms. In contrast, Jelenchick, Eickhoff, and Moreno (2013) found in another one-week experience sampling study that Facebook usage did not associate with depressive symptoms. Valenzuela, Park, and Kee (2009) even suggested a positive association between Facebook usage and life satisfaction. Evidence regarding the "Facebook Depression" hypothesis has been mixed with studies that showed a negative association (Kross et al., 2013; Labrague, 2014; Sagioglou & Greitemeyer, 2014), no association (Datu, Valdez, & Datu, 2012; Jelenchick et al., 2013) or even a positive association (Gerson, Plagnol, & Corr, 2016; Valenzuela et al., 2009) between Facebook usage and psychological well-being. More research is warranted to examine the relationship between Facebook use and psychopathology. Using an age and ethnic diverse sample, the present research aimed to provide additional data on the association between Facebook usage and depression.

Furthermore, these contradictory findings in the literature might imply that the relationship between Facebook usage and depressive symptoms are more complicated than a one-to-one relationship and it is important to explore potential moderators. Emerging research suggests that personality traits may moderate the Facebook-Depression linkage (Simoncic, Kuhlman, Vargas, Houchins, & Lopez-Duran, 2014; Ryan & Xenos, 2011). Personality traits may not only affect the

* Corresponding author at: Department of Counselling and Psychology, Hong Kong Shue Yan University, Room LG224, Academic Building, 10 Wai Tsui Crescent, Braemar Hill, North Point, Hong Kong.
E-mail address: tschow@hksyu.edu (T.S. Chow).

[1] In her website, Dr. Joanne Davila has also clarified that her paper (Davila et al., 2009) did not involve any data on Facebook and depressive symptoms. Her work was being inaccurately quoted by the media. The AAP report (O'Keeffe & Clarke-Pearson, 2011) used the inaccurate media reports as evidence to support the "Facebook Depression" claim.

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frequency of using Facebook but also the way people use it and interpret information on Facebook (Hamburger & Ben-Artzi, 2000; Hughes, Rowe, Batey, & Lee, 2012; Moore & McElroy, 2012; Ryan & Xenos, 2011; Shchebetenko, 2016). For instance, Gerson et al. (2016) found that Goal-Drive Persistence moderated the impact of Facebook social comparison on well-being. Seidman (2013) also showed that the Big Five personality traits differentially associated with actual and ideal self-presentation on Facebook. To enhance understanding of the interrelationships among Facebook use, personality traits and depressive symptoms, the present study examined the moderating roles of neuroticism, Facebook social comparison and envy in the relationship between time spent on Facebook and depressive symptoms.

1.1. 'Facebook depression'? The potential moderating roles of neuroticism, Facebook social comparison and envy

Neuroticism is a personality trait characterized by negative affectivity, nervousness and sense of insecurity (Suls & Martin, 2005) and it has long been thought as related to life stress exposure (Fergusson & Horwood, 1987) and onset of depression (Farmer et al., 2000, 2002).

Neuroticism also affects people's online social behaviors. For instance, neuroticism is related to a greater tendency to present ideal and false self on Facebook (Michikyan, Subrahmanyam, & Dennis, 2014; Seidman, 2013). In addition, recent research in the realm of body images suggests that thin-ideal media images might only occur among people who have preexisting problems, which include neuroticism (Ferguson, 2013a). Idealized body images or life images are abundant on social networking sites since people have a tendency to portray their "good self" on Facebook (Nadkarni & Hofmann, 2012). Frequent exposure to these idealized images on Facebook might have negative impacts on neurotic people's well-being since they experience more negative emotion after unfavorable social comparison (Buunk, Van Der Zee, & Vanyperen, 2001). In this regard, Roberts and Good (2010) found that when exposed to idealized media images, neurotic females showed a greater decrease in body satisfaction than their less neurotic counterparts.

Furthermore, people with higher neuroticism show stronger preference for passive engagement features in Facebook (Ryan & Xenos, 2011), while passive Facebook usage (e.g. viewing others' profiles and updates) but not active Facebook usage (e.g. using Messenger to talk with others) were found to undermine affective well-being (Verduyn et al., 2015). Thus, in the present research we hypothesized that neuroticism moderate the association between Facebook usage and depressive symptoms.

Recent research also suggested that Facebook social comparison and envy are important mechanisms underlying the effect of Facebook use on depressive symptoms (Appel, Gerlach, & Crusius, 2016; Chou & Edge, 2012; Feinstein et al., 2013; Lin & Utz, 2015; Tandoc, Ferrucci, & Duffy, 2015; Muise, Christofides, & Desmarais, 2009). In particular, Tandoc et al. (2015) found that envy mediated the effect of surveillance use of Facebook on depressive symptoms. Feinstein et al. (2013) also found that Facebook social comparison associated with depressive symptoms.

Indeed, social comparison and envy are among the most frequently documented stressors associated with Facebook use (Appel et al., 2016; Fox & Moreland, 2015; Vogel, Rose, Okdie, Eckles, & Franz, 2015). The present research also tested whether the tendency to make unfavorable social comparison on Facebook and to envy moderated the association between time spent on Facebook and depressive symptoms.

Hypotheses: The association between time spent on Facebook and depressive symptoms is moderated by neuroticism/Facebook social comparison/envy. Time spent on Facebook positively is associated with depressive symptoms among people high in neuroticism/Facebook social comparison/envy but not among people low in neuroticism/Facebook social comparison/envy.

In addition to testing the above prespecified hypotheses, exploratory analyses were conducted to examine the interactive effects between other Big Five traits, age, gender, and time spent on Facebook in predicting depressive symptoms.

Big Five personality traits have been commonly found to link with motivation and the frequency of Facebook use (Amichai-Hamburger & Vinitzky, 2010; Correa, Hinsley, & De Zuniga, 2010; Moore & McElroy, 2012; Ross et al., 2009; Seidman, 2013). For instance, Seidman (2013) found that low conscientiousness associated with self-presentational motivations while agreeableness and extraversion associated with the tendency to present the actual self on Facebook. Although we did not have explicit prior hypothesis regarding how conscientiousness, extraversion, openness and agreeableness interacted with time spent on Facebook in predicting depressive symptoms, we wished to explore their potential moderating effects to enhance understanding of the complex interaction between personality and Facebook use.

Past research found that gender and age predicted patterns of Facebook use (e.g. women and elder people engaged in more online activities with families) (McAndrew & Jeong, 2012). In a recent study, Simoncic et al. (2014) also found a three-way interaction among gender, Facebook usage and neuroticism in predicting depressive symptoms. Thus, we also conducted exploratory analyses to examine the moderating effects of age and gender.

2. Method

2.1. Participants

Two hundred and eighty-two participants (195 males, 87 females; Age: 18 to 73; $M_{age} = 33.19$, $SD_{age} = 10.10$) participated in exchange for US$ 0.4 in Amazon's Mechanical Turk. Recent studies have shown that research data collected from Mechanical Turk is reliable (Buhrmester, Kwang, & Gosling, 2011; Paolacci, Chandler, & Ipeirotis, 2010). In the present sample, 51.4% of participants are Caucasian, 20.2% are Hispanic, 16.0% are Asian, 11.3% are Native Americans or others and 1.1% are African American.

2.2. Measures

Participants were invited to participate in a study about personality and Facebook use. They completed an online questionnaire assessing personality, Facebook use, Facebook social comparison, envy, depression and satisfaction with life.

2.2.1. Big-Five personality traits

Participants' personalities were measured by the 44-item Big Five Personality Inventory (John & Srivastava, 1999). The Cronbach's alphas of the Neuroticism, Extraversion, Openness to experience, Agreeableness and Conscientiousness subscales ranged from 0.71 to 0.77 in the present sample.

2.2.2. Time spent on Facebook

To assess frequency of Facebook use, participants were asked to report the average time spent (in minutes) on Facebook per day. We also assessed the size of network circle (the number of Facebook friends).

2.2.3. Facebook social comparison

Social comparison in the context of social networking sites was measured using the Facebook Social Comparison Scale (Lee, 2014). Sample items are "I think I often compare myself with others on Facebook when I am reading news feeds or checking out others' photos" and "I've felt pressure from the people I see on Facebook to have perfect appearance". The Cronbach's alpha was 0.68 in the present sample.

2.2.4. Envy

Envy was assessed by a scale developed by Tandoc et al. (2015). Sample items are "It somehow doesn't seem fair that some people seem to have all the fun", "It is so frustrating to see some people always having a good time". The Cronbach's alpha was 0.78 in the present sample.

2.2.5. Depressive symptoms

Depressive symptoms were measured using the Depression Anxiety and Stress Scale (Lovibond & Lovibond, 1995). Sample items are "I found it difficult to work up the initiative to do things" "I felt down-hearted and blue". The Cronbach's alpha was 0.91 in the present sample.

3. Results

3.1. Descriptive statistics and correlations among key variables

Table 1 presents the descriptive statistics of all major variables in the study. The average time spent on Facebook was 100.87 min per day. Bonferroni adjusted alpha level ($p = 0.01$) was used because we have conducted several correlations with the same set of variables. The correlation between Facebook time and depressive symptoms was $r(272) = 0.12$, $p = 0.04$. The correlation was non-significant after Bonferroni adjustment was applied. In addition, neuroticism had no significant association with time spent on Facebook, $r(282) = 0.04$, $p = 0.52$. However, neuroticism significantly correlated with Facebook social comparison, envy and depressive symptoms, (*rs* ranged from 0.16 to 0.50, *ps* < 0.01.). Table 2 presents the correlation coefficients among the key variables.

3.2. Hierarchical regression analysis

A hierarchical regression analysis was conducted to examine the interactive effects between time spent on Facebook and i) neuroticism, ii) Facebook social comparison, and iii) envy on depressive symptoms. Past studies suggested that age, gender and the number of Facebook friends are related to patterns of Facebook use and well-being (McAndrew & Jeong, 2012; Kalpidou, Costin, & Morris, 2011; Kim & Lee, 2011; Nabi, Prestin, & So, 2013). Thus, we planned to include these variables as covariates in our regression model. Further analysis suggested that male participants ($M = 1.82$, $SD = 0.70$) scored higher on depressive symptoms than female participants ($M = 1.65$, $SD = 0.58$), $t(270) = 2.05$, $p < 0.05$. Age was also significantly correlated with depressive symptoms, $r(270) = -0.20$, $p < 0.01$. Both of them were included as covariates in our regression model. However, the number of Facebook friends was not correlated with depressive symptoms or other variables. Thus, it was not included as a covariate in our regression model.

Participants' age and gender were entered in the first step, followed by time spent on Facebook in the second step, neuroticism, Facebook social comparison and envy in the third step and the three interaction terms (*Facebook time X neuroticism*, *Facebook time X Facebook Social Comparison* and *Facebook time X envy*) in the fourth step. Gender was dummy coded as a dichotomous variable in our analyses where male = 0 and female = 1. Neuroticism, Facebook social comparison, envy and time spent on Facebook were mean centered before they were multiplied to form the interaction term. There was no evidence of multicollinearity among the independent variables as all of the variables showed a variance inflation factor (VIF) around 1 (Menard, 1995).

The overall model explains 41% of the total variance in depressive symptoms. As predicted, neuroticism significantly interacted with Facebook time in predicting depressive symptoms, $\beta = 0.14$, $t(262) = 2.67$, $p < 0.01$. A simple slope analysis (Aiken & West, 1991) suggested that the relationship between time spent on Facebook and depressive symptoms was significant at the high level (1 SD above mean), $\beta = 0.22$, $t(268) = 2.86$, $p < 0.01$, but not at the low level of neuroticism (1 SD below mean), $\beta = -0.05$, $t(268) = -0.49$, $p = 0.62$. However, the interaction between Facebook time and Facebook social comparison, $\beta = 0.02$, $t(262) = 0.38$, $p = 0.73$ and that between Facebook time and envy, $\beta = 0.03$, $t(262) = 0.49$, $p = 0.62$ were not significant. In the full model, gender, Facebook social comparison, neuroticism, envy and the *Facebook time X neuroticism* interaction were significant predictors of the score of depressive symptoms (see Table 3).

Table 1
Mean, standard deviation and range of the major variables.

Variables	n	M	SD	α	Range
Time spent on Facebook (min)	282	100.87	115.65	–	0–600
Facebook friends	282	316.29	712.13	–	0–10,001
Neuroticism	282	2.81	0.65	0.77	1.00–4.50
Social comparison	282	2.67	0.95	0.68	1.00–5.00
Envy	282	2.84	0.72	0.78	1.13–4.88
Depression	272	1.77	0.67	0.91	1.00–3.86

Table 2
Correlations among major variables.

Variable	1	2	3	4	5	6	7
1. Gender[a]	–						
2. Age	0.15*	–					
3. FB time[a]	0.03	−0.12	–				
4. FB friends[a]	−0.04	−0.14*	0.11	–			
5. Neuroticism	0.03	−0.07	0.04	0.03	–		
6. Compare[a]	0.04	−0.23**	0.16**	0.05	0.16**	–	
7. Envy	0.08	−0.23**	0.05	−0.02	0.49**	0.44**	–
8. Depressive symptoms	−0.12*	−0.20**	0.12*	0.00	0.50**	0.32**	0.51**

[a] Note: Dummy code was created for gender (Male = 0; Female = 1); FB Time: Time spent on Facebook (in mins); FB Friends: Number of Facebook friends; Compare: Facebook social comparison.
* $p < 0.05$.
** $p < 0.01$.

Table 3
Hierarchical regression analysis for variables predicting depressive symptoms ($N = 272$).

	B	SE B	β	ΔR^2
Step 1				0.05**
Age	−0.01**	0.00	−0.19**	
Gender[a]	−0.14	0.09	−0.10	
Step 2				0.01
Age	0.01**	0.00	−0.18**	
Gender	−0.14	0.09	−0.10	
FB time[a]	0.00	0.00	0.11	
Step 3				0.33**
Age	0.00	0.00	−0.06	
Gender	−0.21**	0.07	−0.15**	
FB time[a]	0.00	0.00	0.07	
Compare[a]	0.00	0.04	0.12*	
Neuroticism	0.35**	0.06	0.34**	
Envy	0.26**	0.06	0.28**	
Step 4				0.02*
Age	−0.00	0.00	−0.07	
Gender	−0.22**	0.07	−0.16**	
FB time[a]	0.00	0.00	−0.07	
Compare[a]	0.08*	0.04	0.12*	
Neuroticism	0.37**	0.06	0.36**	
Envy	0.27**	0.06	0.29**	
Time × neuroticism	0.00**	0.00	0.14**	
Time × compare	0.00	0.00	0.02	
Time × envy	0.00	0.00	0.03	

[a] Note: Dummy code was created for gender (Male = 0; Female = 1); FB Friends: Number of Facebook friends; FB Time: Time spent on Facebook (in minutes); Compare: Facebook social comparison.
* $p < 0.05$.
** $p < 0.01$.

3.3. Exploratory analyses

In addition to neuroticism, the present research also measured other Big Five personality traits including Extraversion, Openness to Experience, Agreeableness and Conscientiousness. We did not have explicit prior hypothesis regarding how these personalities traits interacted with time spent on Facebook. As an exploratory analysis, we conducted 4 additional hierarchical regression analyses to test the potential interactive effects between these personality traits and Facebook use in predicting depression. The regression models were the same as the ones reported in Section 3.2 but neuroticism was replaced by these 4 personality traits in 4 regression models. No significant interactive effects were found in these exploratory analyses.

Past research suggested that there might be a three-way interaction among gender, time spent on Facebook and neuroticism in predicting depressive symptoms (Simoncic et al., 2014). Exploratory analysis was conducted to examine this possibility. A dummy code using male as 0 and female as 1 was created to represent gender in the model. Neuroticism, Facebook time, and gender were entered in step 1, followed by their two-way interactions in step 2 (*Facebook time X gender*; *neuroticism X gender*; *neuroticism X Facebook time*) and the three-way interaction in step 3 (*Facebook time X Gender X neuroticism*) of the hierarchical regression model. Among the two-way interactions, only the interactive effect between neuroticism and Facebook time was statistically significant, $\beta = 0.15$, $t(264) = 2.88$, $p < 0.01$. The three-way interaction among Facebook time, neuroticism and gender was not significant, $\beta = 0.04$, $t(264) = 0.72$, $p = 0.46$.

The same analytic strategy was used to examine the three-way interaction among age, Facebook time and neuroticism in predicting depressive symptoms. Age did not interact with Facebook usage, $\beta = 0.02$, $t(264) = 0.39$, $p = 0.69$; or with neuroticism, $\beta = -0.09$, $t(264) = -1.54$, $p = 0.12$ in predicting depressive symptoms. The three-way interaction among age, Facebook use and neuroticism was also non-significant, $\beta = -0.03$, $t(264) = -0.53$, $p = 0.59$. However, we are fully aware that strong conclusion could not be drawn from these exploratory analyses.

4. Discussion

Research regarding the "Facebook depression hypothesis" has yielded mixed results. Using an ethnic and age diverse sample, we found a significant interactive effect between neuroticism and time spent on Facebook use on depressive symptoms, such that the association between Facebook use and depressive symptoms was only found among people with a high level of neuroticism. However, the interactive effect between time spent on Facebook and i) Facebook social comparison, and ii) envy were not statistically significant.

4.1. Is there any negative mental health consequence of using Facebook?

In the past two decades, social media has become an indispensable part of people's life. This trend has aroused public concerns over the potential negative effects of prolonged exposure to social media such as Facebook. The term "Facebook Depression" has been popularized after the release of the AAP communication and media report (O'Keeffe & Clarke-Pearson, 2011). However, the report relied heavily on media coverage rather than the original studies.[1] In the present study, we did not find a significant association between time spent on Facebook and depressive symptoms in an age and ethnic diverse sample. This pattern is consistent with a recent experience sampling study (Jelenchick et al., 2013). Overall speaking, in the literature, inconsistent findings have been found regarding the relationship between social medias and psychological well-being (Gerson et al., 2016; Jelenchick et al., 2013;Kross et al., 2013; Sagioglou & Greitemeyer, 2014; Valenzuela et al., 2009). At this stage, it is premature for researchers or practitioners to conclude that spending time on Facebook would have detrimental mental health consequences.

4.2. Individual differences: the moderating roles of neuroticism, Facebook social comparison and envy

Instead of focusing on whether Facebook *is absolutely linked* with depressive symptoms, a different approach considers how the linkage varies according to situational or personal factors. The current research extends the literature of social media by examining the moderating roles of personality traits (Big-five traits), Facebook social comparison and envy. In the present data, the association between Facebook use and well-being varied depending on individuals' level of neuroticism but we did not find any moderating effects of Facebook social comparison and envy. In particular, the Facebook-depression linkage was only observed among people high in neuroticism.

One potential mechanism that underlies the interactive effect between Facebook usage and neuroticism may relate to the way neurotic people use Facebook. Previous research found that passive engagement but not active activities on Facebook undermine psychological well-being (Verduyn et al., 2015). Meanwhile, neurotic people show stronger preference for passive engagement features on Facebook (Ryan & Xenos, 2011). Thus, it is possible that neurotic people spend more time on passive engagement (e.g., checking friends' updates) than on active Facebook activities (e.g., sending messages via Facebook messengers) and this pattern of Facebook use undermines psychological well-being.

In addition, neurotic people reacted more negatively toward unfavorable comparison (Buunk et al., 2001). The Facebook environment, which is full of perfect life images (Mehdizadeh, 2010; Nadkarni & Hofmann, 2012), might be even more threatening than the offline social world to highly neurotic people. Consistent with this reasoning, neuroticism was correlated with Facebook social comparison and envy in the present study.

Interestingly, Simoncic et al. (2014) found that for females (but not males), more frequent Facebook use associated with lower depressive symptoms among those with a high level of neuroticism. However, this three-way interaction was not observed in the present data. The seemingly differing results could be attributable to the fact that Simoncic et al. (2014) looked at *active Facebook activities* while the present study looked at the total duration of using Facebook. Active Facebook activities such as using messenger might partially compensate neurotic people's deficiencies in offline social functioning since it allows careful crafting of messages. These active usages might help highly neurotic people to maintain relationships. However, spending more time on Facebook might not necessarily help if people were just checking others' pictures or status. Future research could illuminate whether differentiating the types of Facebook engagement is the key to reconciling these discrepant findings.

However, since the present study adopted a cross-sectional design, *we could not rule out the possibility that depressive symptoms increased Facebook time among highly neurotic people*. Difficulty in establishing causal relationship between Facebook use and emotional outcomes is a major concern in this field (Appel et al., 2016). In the present study, it is also possible that neurotic individuals spent more time on Facebook because they felt depressed. Indeed, depressive symptomology is sometimes caused by unsatisfied relatedness needs (Deci & Ryan, 2000). Since neurotic people might experience difficulties in offline social functioning, they might rely on Facebook as a way to connect with others.

To our surprise, Facebook social comparison and envy did not interact with time spent on Facebook in predicting depressive symptoms. One potential reason is that the moderating effects of Facebook social comparison and envy may exist in certain domains but not in others. Emerging research has found conflicting results in different domains of Facebook social comparison. For example, Haferkamp and Krämer (2011) found that viewing Facebook profile pictures of beautiful people

resulted in more negative body image while viewing Facebook profiles of people with high career achievement did not affect satisfaction with one's own career achievement. Furthermore, females' trait appearance comparison tendency did not moderate the impacts of Facebook exposure on negative mood and body dissatisfaction (Fardouly, Diedrichs, Vartanian, & Halliwell, 2015). Vogel, Rose, Roberts, and Eckles (2014) also found that Facebook social comparison in popularity had stronger deleterious impacts on self-esteem than comparison in health domain. The present study measured the general tendency to envy and to make unfavorable comparison. However, there are many different domains of comparison on Facebook such as relationship status, popularity, career or academic achievement, attractiveness and wealth. The effects of social comparison might vary across these domains. In addition, people might experience upward comparison in some domains but downward comparison in others. Thus, future research might need to specify the domains of comparison to truly understand whether, when and on whom Facebook social comparison and envy would have detrimental effects.

4.3. Moral panic over Facebook?

There is a lot of scholarly discussion on moral panic over technology and new media, and how it contributes to false positive in science (Bowman, 2016; Ferguson, 2013b). "Moral panic" refers to the overreaction toward certain social problems to create a concern that is exaggerated as compared to the reality of the actual problem (Cohen, 1972; Rohloff & Wright, 2010). In the realm of video games, there is a warning sign that the scientific community is involved in creating the moral panic over violent video games by selectively reporting research that fits pre-existing beliefs, publication biases (i.e. null findings are more difficult to get published than significant findings) or using small effects to derive strong conclusions on intervention (For a review, see Ferguson, 2013b). There is a question whether such moral panic exists in psychological research on social media. Contradictory to the popular claim of "Facebook Depression", the present study found no significant correlation between Facebook and depressive symptoms in an age and ethnic diverse sample. The observed effect size, even for the neurotic participants ($\beta = 0.22$), is quite small (Ferguson, 2009). In addition, two of the most well-reported stressors associated with Facebook use (Facebook social comparison and envy) were not found to moderate the association between Facebook use and depressive symptoms. We are cautious that any conclusions about clinical and educational practices and the optimal amount of social media uses are not warranted at this stage. Future research could consider to do a meta-analytic review on the Facebook-Depression linkage with sufficient use of publication bias analysis to examine the overall association between Facebook use and depressive symptoms. Researchers could also investigate whether it is the social media itself or preexisting problems that affect well-being. Importantly, more discussion on how to conduct and present research to objectively evaluate the interrelationship between social media usage and well-being is the crucial next step.

4.4. Limitations and suggestions for future research

The present study was subjected to several limitations. First, as discussed, we could not establish causal relationships with a cross-sectional design. Future research is encouraged to adopt experimental and longitudinal design to further examine the interactive effects between personalities and Facebook uses. In this regard, Shakya and Christakis (2017) have analyzed three waves of Gallup Panel Social Network Study survey and found that Facebook use predicted a lower level of subjective well-being prospectively. However, the role of personality traits has not been examined in their study. Thus, future research could manipulate frequency of Facebook engagement and measure personality traits to investigate whether these factors interact to predict depressive symptoms over a period of time. Second, the present research focuses on the total time spent on Facebook. However, previous research suggested that active use (posting comments, updating status) and passive use (e.g. viewing others' photos and updates) might have different effects on psychological well-being (Verduyn et al., 2015). Thus, future research could differentiate active and passive Facebook use and see if the interactive effect between personality and time spent on Facebook is mediated by preference for different Facebook activities. Fourth, memory biases could affect the accuracy of self-report time estimation of Facebook use. Objective measures of time spent on social media can be adopted in future study. For instance, there are now APPs (e.g. *QualityTime*, *AntiSocial*) that can track the duration of using social media on mobile phones. These new technologies could help researchers to obtain objective measures of social media usage. Fifth, the sample of the present study is predominantly male (30.9% female). In addition, males reported a higher level of depressive symptoms in the present study. This pattern is contradictory to the vast majority of literature which suggests a female predominance in depression (Hankin & Abramson, 2001; Nolen-Hoeksema, 2001). These characteristics of our sample might also contribute to the discrepancies between our findings and Simoncic et al. (2014)' findings on the moderating effect of gender in the association between Facebook use and depressive symptoms. Future research is needed to further explore how social media use affects males and females differently. Sixth, precaution is needed in interpreting the results obtained in Mturk participant pool. Although Mturk studies enjoy benefits such as its cost-effectiveness and the more diversified demographic background of participants (Buhrmester et al., 2011; Hauser & Schwarz, 2016), it is still not representative of the general population. It also has the problem of cross-contamination and selective dropouts but these problems are more relevant to experimental studies (Zhou & Fishbach, 2016). Last but not least, the current research focuses on Facebook since it is the largest social networking site. However, there are other popular social medias that do not have exactly the same features. For example, Twitter allows more anonymity since users do not need to post information about themselves to seek connection. It would be interesting to see if there are any interactive effects between preexisting proclivities (such as neuroticism) and the types of social networking sites on well-being. These future investigations could enhance understanding of the interrelationship among personalities, social media use and well-being.

5. Conclusion

The current study investigated whether preexisting proclivities such as neuroticism, tendency to engage in Facebook social comparison and envy interacted with time spent on Facebook to predict depressive symptoms. An overall association between Facebook use and depressive symptoms was not found. Among the three individual differences variables, only neuroticism was found to interact with time spent on Facebook to predict depressive symptoms. We proposed that how neurotic people use Facebook and interpret the information on Facebook might explain this interactive effect. Research on mental health consequences of social media is still in its infancy, and it is important for future research to elucidate how preexisting problems, types of social media and ways of using social media interact to affect people's well-being. At this stage, it is premature to conclude that social media uses are detrimental to mental health.

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