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Personality and Nomophobia: A Moderated Mediation Model of Self-Esteem and Non-Self-Determined Solitude

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ABSTRACT

Background: With the development of information technology, mobile phone has brought much convenience to people's lives but also caused many negative consequences due to excessive use, such as mobile phone addiction and nomophobia. Previous studies have explored the relationship between the Big Five Personality and problematic mobile phone use (PMPU). However, they focus on mobile phone addiction. Although there is a correlation between nomophobia and mobile phone addiction, the psychological structure is different. Therefore, it is necessary to explore the relationship between personality and nomophobia and the underlying mechanism. This study aims to examine the relationship between Big Five Personality and nomophobia, then construct a moderated mediation model to explore the mediation effect of solitude between Big Five Personality and nomophobia, as well the moderation effect of self-esteem. **Method:** Data from 678 college students (351 females, 51.77%) were collected. Participants completed the Big Five Personality Inventory, Solitude Behavior Scale, Nomophobia Scale and Self-esteem Scale. Analyses were conducted via mediation and moderated mediation. **Results:** Structural equation models revealed that solitude mediated the relationship between neuroticism and nomophobia. The results showed that neuroticism positively predicted solitude, which in turn positively predicted nomophobia. Four types of solitude partially mediated the relationship between neuroticism and nomophobia. We also found that self-esteem moderated the association between neuroticism and non-self-determined solitude. It is noteworthy that high self-esteem cannot protect people from negative factors. However, because of its characteristics, it is easy to receive more social information, and people high in neuroticism are sensitive to negative social information. It may cause maladaptive behavior. **Conclusion:** Findings demonstrated a process through which neuroticism relates to nomophobia and a context under which these relationships may have occurred.

KEYWORDS

Personality; nomophobia; self-esteem; solitude; structural equation model

1 Introduction

With the development of information technology, mobile phone has become an indispensable part of people's lives. Mobile phone facilitates people's modern lives, while it causes a series of adverse outcomes due to overuse. Mobile phone overuse was also known as "mobile phone addiction", "excessive smartphone use", or "mobile phone dependence". They are collectively called problematic mobile phone use (PMPU) [1]. PMPU had some negative effects, such as low life satisfaction [2], problematic academic behaviors [3] and interpersonal problem [4].

PMPU usually presented an inability to resist mobile phone [5] and discomfort caused by unavailability of mobile phone [6]. And this discomfort isa form of PMPU referring to the anxiety of nomophobia from fear of missing out [1,6]. Specifically, nomophobia, defined as discomfort, nervousness and anxiety that arises from being out of contact with digital devices, has been called a disorder of the modern era [7]. There were some other studies proposed that different ideas on the classification of nomophobia. King et al. [6] depicted nomophobia as a situational phobia that includes the fear of falling ill and being unable to gain immediate assistance. Chiu [8] and Salehan et al. [9] considered it to be a disorder with behavioral addiction to mobile phone, performance psychological and physical dependency, such as anxiety about being without an internet connection to receive information and communication. However, most recent empirical findings on nomophobia were based on the framework of PMPU and addiction criteria [10].

The Interaction of Person-Affect-Cognition-Execution (I-PACE) model [11,12] explains the intrinsic mechanisms of the development and maintenance of the PMPU [13], which was widely accepted by many studies [14,15]. As a process model, PMPU is considered a consequence of interactions of individual factors. Individual factors refer to physical, personality, emotional, cognitive and executive functions that tend to develop Internet addiction or PMPU. The model divides individual factors into P (Person), A (Affect), C (Cognition) and E (Execution). P-component usually represents individuals' core characteristics that are involved in mobile phone use as a predisposing variable. Furthermore, personality could influence individuals' feelings and thoughts, and then affect the PMPU. In other words, affective and cognitive responses mediate mobile phone use processes.

During the last decade, the studies conducted on the association between personality traits and PMPU found that individual differences in certain personality traits led to PMPU [11,16]. Many studies proved that openness, extroversion, conscientiousness and neuroticism could predict PMPU [17–19]. However, it is noteworthy that the conclusions for the associations of personality traits and PMPU were different. Bianchi and Phillips [17] found that high extroversion and low self-esteem were associated with PMPU, except for neuroticism. And some other studies thought that neuroticism was shown to have a significant effect on PMPU [20,21]. For conscientiousness, some researchers found that it had a non-significant association with PMPU [19,22], while contrary points emerged in other studies [18,23]. The personality and its associations with PMPU should be further investigated for the inconsistent conclusions.

1.1 The Mediating Role of Solitude

The communication function of mobile phone had developed in many aspects (i.e., social communication). Individuals with different motivations used specific mobile phone functions to meet their communication demands [24]. The primary motivation for nomophobia was to meet positive social communication needs. According to Compensatory Internet Use Theory [25], individuals with problems in interpersonal interaction (i.e., social avoidance, seclusiveness) are dissatisfied with social needs. In order to compensate for the demand in real life, they spend more time on mobile phone, which leads to PMPU (i.e., mobile phone addiction, nomophobia) over time. Many empirical studies demonstrated that mobile phone addicts had interpersonal problems and social anxiety [4,26]. Social avoidance was the embodiment of social anxiety [27]. In general, the manifestations of staying alone, such as loneliness and social avoidance, were defined as solitude.

Solitude is defined as the state of being or living alone derived from The Oxford English Dictionary [28]. The different scholar's common understanding of solitude was a psychological experience of being alone [29–31]. It could be positive or negative, self-determined or non-self-determined, depending on motivational, situational and personal factors [31,32]. Dai et al. [33] further divided solitude into 4 types: Positive Solitude (self-determined), Seclusiveness (self-determined), Social Avoidance (non-self-determined) and Loneliness (non-self-determined).

According to social cognitive theory [34], people's behavior is the response to the external environment and internal psychology (i.e., cognition and personality). Burger [30] constructed the Preference for Solitude Scale (PSS) to measure the difference in solitude experience, and the results showed that the correlation between PSS and extroversion was negative, and neuroticism was positive. There was plenty of evidence that personality traits were significant predictors of loneliness [35–37]. Although few existing studies directly investigated the association between positive solitude, seclusiveness, social avoidance and personality traits. In DSM-5's [38] statement, seclusiveness and social avoidance are typical behaviors in many personality disorders. Obviously, personality traits were found to be an important predictor of solitude. Besides, previous studies also found that nomophobia was significantly predicted by social anxiety and loneliness [39,40]. Therefore, the key assumption of the present study was that people with different personality traits differed in the determination to which they prefer to be alone, which further influenced nomophobia.

1.2 The Moderating Role of Self-Esteem

Many studies regarding the relationships between the Big Five Personality Traits and solitude were widely investigated [30,35]. However, we found that the results were not consistent, or mixed with contradictory findings, indicating that such a relationship may be influenced by other factors, which may moderate the impact of personality traits on solitude, for example, self-esteem.

Self-esteem refers to the self-conception which signifies an overall value as a person, including the affective or evaluative [41]. Previous studies revealed that people with low self-esteem experienced more negative self-evaluations, resulting in negative consequences such as depression, loneliness, avoidance and withdrawal [42,43]. Individuals with high levels of self-esteem experienced low negative feelings and increased positive affect [44].

Concerning proposed moderating of self-esteem was based upon the combination of two lines of thinking. First, according to the risk-buffering hypothesis, protective factors, such as high self-esteem, may attenuate the relation between some risk factors and psychological status [45]. Some unfavorable individual characteristics, such as neuroticism, are generally considered as risk factors for loneliness [46]. Second, although previous studies demonstrated that self-esteem and personality traits were important predictors of solitude, few studies investigated the potential interaction of self-esteem and personality traits. Self-esteem could play an important role in affecting the development of personality [47]. The development of self-esteem, meanwhile, could be restricted by personality development. It inferred that there could be an interaction between personality and self-esteem. Exploring the moderating roles between personality traits and their positive/negative outcomes would help to deeply make out conditions under which traits exerted an impact. The current study extended early work by considering that self-esteem moderated the association between personality traits and solitude.

1.3 Current Study

In this study, we explore how solitude could explain the relationship between personality traits and nomophobia. Thus, this study firstly investigated the relationships between the Big Five Personality traits and PMPU. In addition, personality could affect PMPU indirectly. People's tendency towards solitude was considered to be related to their personality traits [30]. Gezgin et al. [39] found that loneliness was a

significant predictor of high levels of nomophobia. Consequently, solitude would mediate the relationship between personality traits and PMPU. Meanwhile, the role of self-esteem was considered. Therefore, a theoretical model was proposed to describe the mechanism between PMPU and personality traits. Specifically, personality traits predicted nomophobia, with solitude acting as a mediator and self-esteem acting as a moderator (see Fig. 1).
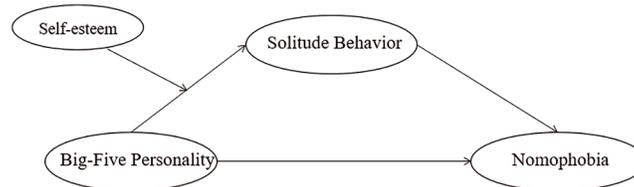

Figure 1: Theoretical model

2 Materials and Methods

2.1 Participants and Procedure

The anonymous questionnaire comprising several self-report inventories and personal questions was conducted online after informed consent was obtained from participants. Participants were college students from Tianjin and Guangzhou, China. Samples in the present study consisted of 678 individuals, of which all participants were examined as valid. A total of 351 (51.77%) participants were female. Of them, 212 freshmen, 193 juniors, 186 seniors and 87 graduates. The study involving human participants was reviewed and approved by the ethics committee of Tianjin Normal University (Ethical review number: XL2020-08). The participants provided their written informed consent to participate in this study.

2.2 Measures

2.2.1 Chinese Big Five Personality Inventory Brief Version

We used the Chinese brief version of the Big Five Personality Inventory (CBF-PI-B) [48], which comprises 40 items. The respondents were asked to complete each item on a six-point Likert-type scale where 1 = "very inconsistent" through 6 = "very consistent". Cronbach's α of the scale was 0.86.

2.2.2 Solitude Behavior Scale for Short Version

On the basis of Chen's [49] Solitude Behavior Scale, Luo et al. [50] developed Solitude Behavior Scale for short version (SBS-S), which contains 16 items. Participants answered items on a five-point Likert-type scale ranging from 1 = "strongly disagree" to 5 = "strongly agree". Cronbach's α in this study was 0.86 for the whole scale.

2.2.3 Nomophobia Scale

Problematic smartphone use was assessed with the Nomophobia Scale of a self-reported questionnaire [51]. The scale on 7-point Likert-type ranged from 1 = "strongly disagree" to 7 = "strongly agree", with higher scores representing higher nomophobia. The Nomophobia Scale has been shown to be a reliable measure in this study, for Cronbach's α was 0.93.

2.2.4 Self-Esteem Scale

The first assessment study of self-esteem is the Rosenberg Self-esteem Scale [52]. Wang et al. [53] introduced the Chinese version of the Self-esteem Scale and tested its reliability and validity. After Tian [54] discussed the cultural adaptation of the Chinese version of the Self-esteem Scale, the Chinese Self-Esteem Scale was revised by Shen et al. [55]. We used Shen's Chinese version to assess self-esteem,

whose ten items were on a 4-point Likert-type scale ranging from 1 = "very consistent" to 4 = "very inconsistent". Cronbach's α of the scale in this study was 0.81.

2.3 Common Method Bias Test

Harman's single factor test was used to test the common method bias. The results of exploratory factor analysis showed that there were 16 factors with an eigenvalue greater than 1, and the first factor accounted for 17.12% of the total variance, which was less than the critical standard of 40%. There was no serious common method variance in this study.

2.4 Data Analysis

All the data were enrolled into excel, and the analyses were performed using Mplus, R language and IBM SPSS software. IBM SPSS 21.0 were used to preprocess the data. The correlation heat map was generated by "ggcorrplot" package for R-4.1.1 [56]. Two structural equation modeling frameworks (the mediation model and the moderated mediation model) using Mplus 8.0 was employed to test all hypotheses. The hypotheses formed that a mediation model refers to the phenomenon in which independent variable X through mediator M affects dependent variable Y, for a moderated mediation model is that the moderation effect between X and moderator W exists above-noted mediation model. The analysis process is performed by three steps. First, as all the data were logged on the computer, we conducted some descriptive analyses, like correlation and common method bias (CMB). Second, we tested 20 mediation models that mediating effect on the relationship between big five personalities and nomophobia. Third, we examined whether the influence of the interaction between Big Five Personality and self-esteem on nomophobia was mediated by solitude behavior. The effects were tested with bias-corrected bootstrapping, based on 5000 bootstraps and 95% confidence intervals (CIs) for the indices. If CIs exclude zero, it will indicate the effect is considered statistically significant.

3 Results

3.1 Descriptive Statistics and Correlation Analysis

Table 1 showed the descriptive statistics of Big Five Personality Traits, self-esteem, nomophobia and solitude among participants.

Table 1: Descriptive statistics among variables

Variable	Total sample (n = 678)					
	M	SD	Min	Max	Skew	Kurt
Self-esteem	29.33	4.66	11	40	0.289	0.036
Nomophobia	58.96	19.27	16	112	−0.048	−0.101
Openness	31.87	7.72	8	48	−0.236	0.368
Conscientiousness	34.21	8.00	11	48	−0.459	−0.222
Extroversion	30.91	6.42	14	48	0.145	0.023
Agreeable	34.54	6.43	19	48	0.113	−0.568
Neuroticism	21.93	7.62	8	46	0.249	−0.402
Positive solitude	14.04	3.61	4	20	−0.512	0.130
Seclusiveness	9.20	3.71	4	20	0.483	−0.303
Social avoidance	11.83	3.84	4	20	−0.103	−0.295
Loneliness	11.12	3.60	4	20	0.060	−0.394
Solitude	46.20	10.52	16	80	−0.119	1.037

The results of the inter-correlations of variables were shown in Fig. 2. As expected, self-esteem was positively correlated with Big Five Personality, except neuroticism. It also negatively correlated with nomophobia and solitude behavior, and higher levels of self-esteem were associated with higher positive solitude. There was a significant correlation between nomophobia and the four dimensions of solitude behavior. The total score of nomophobia was significantly correlated with neuroticism and openness.
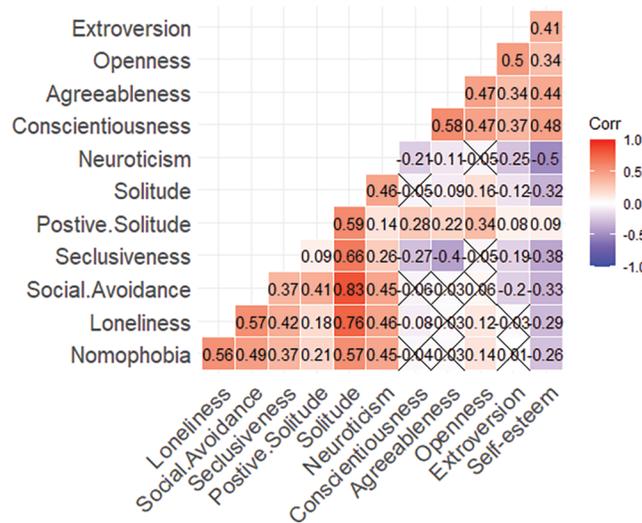

Figure 2: Correlation between variables

3.2 Testing the Mediating Role of Solitude Behavior

Structural equation model (SEM) was tested on the indirect effect of the predictor variable (Big Five Personality) through mediated variable (solitude behavior) on the dependent variable (nomophobia). The latent variables of nomophobia were extracted from four project packages. Mplus software was used to construct the mediating structural model. The model indices showed in Table 2.

Table 2: Structural mediating model fit indices

Model	$\chi^2(df)$	CFI	TLI	RMSEA	SRMR
O→PS→Nomophobia	937.99 (101)	0.825	0.792	0.111	0.072
O→S→Nomophobia	983.69 (101)	0.827	0.794	0.114	0.072
O→SA→Nomophobia	923.97 (101)	0.831	0.800	0.110	0.067
O→L→Nomophobia	904.37 (101)	0.824	0.791	0.108	0.065
C→PS→Nomophobia	589.26 (101)	0.904	0.886	0.084	0.073
C→S→Nomophobia	605.71 (101)	0.907	0.889	0.086	0.075
C→SA→Nomophobia	566.02 (101)	0.910	0.893	0.082	0.076
C→L→Nomophobia	569.52 (101)	0.904	0.886	0.083	0.075
E→PS→Nomophobia	1057.12 (101)	0.766	0.722	0.118	0.100
E→S→Nomophobia	1066.02 (101)	0.781	0.740	0.119	0.105

(Continued)

Table 2 (continued)

Model	χ^2(df)	CFI	TLI	RMSEA	SRMR
E→SA→Nomophobia	1058.36 (101)	0.775	0.732	0.118	0.108
E→L→Nomophobia	999.46 (101)	0.769	0.725	0.115	0.096
A→PS→Nomophobia	988.39 (101)	0.795	0.756	0.114	0.106
A→S→Nomophobia	1149.70 (101)	0.781	0.740	0.124	0.137
A→SA→Nomophobia	1000.20 (101)	0.798	0.760	0.115	0.112
A→L→Nomophobia	1004.52 (101)	0.783	0.742	0.115	0.113
N→PS→Nomophobia	326.42 (101)	0.954	0.946	0.057	0044
N→S→Nomophobia	358.236 (101)	0.952	0.942	0.061	0.041
N→SA→Nomophobia	308.03 (101)	0.960	0.952	0.055	0.040
N→L→Nomophobia	293.98 (101)	0.960	0.953	0.053	0.032

Note: O, Openness; C, Conscientiousness; E, Extroversion; A, Agreeableness; N, Neuroticism; PS, Positive Solitude; S, Seclusiveness; SA, Social Avoidance; L, Loneliness.

With the standard of χ^2/df < 5, CFI > 0.9, TLI > 0.9, SRMR < 0.08, RMSEA < 0.08 [57,58], Table 2 showed the structural relationship among neuroticism, solitude behavior (positive solitude, seclusiveness, social avoidance and loneliness), and nomophobia variables fit the data well. Therefore, neuroticism influenced nomophobia via four dimensions of solitude behavior can be ensured. Based on this result, the bootstrap method (n = 5000) was tested the significance of the mediation effect value in four well-fitting models. The results are shown in Table 3.

Table 3: Indirect and direct effects of mediating structural model

Predictor variable	Mediated variable	Dependent variable	Indirect effect	Direct effect
Neuroticism	Positive solitude	Nomophobia	0.024*	0.518**
	Seclusiveness		0.096**	0.445**
	Social avoidance		0.203**	0.338**
	Loneliness		0.337**	0.203**

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

Table 3 showed that the standardized indirect effect of neuroticism on nomophobia via four dimensions of solitude behavior was significant. These results indicated that different solitude behavior had a partial, positive, and significant effect as a mediator in the relationship between neuroticism and nomophobia.

3.3 Testing for Moderated Mediation

After establishing a significant mediating effect of four solitude behavior types in the relationship between neuroticism and nomophobia, four moderated mediating structural models were constructed in Fig. 3 to examine whether self-esteem moderates the mediating effect of different solitude behaviors between neuroticism and nomophobia. Figs. 3C and 3D showed the interaction of neuroticism and self-esteem had a significant effect on social avoidance and loneliness (neuroticism × self-esteem on social avoidance, β = 0.211, p < 0.001; neuroticism × self-esteem on loneliness, β = 0.319, p < 0.001).
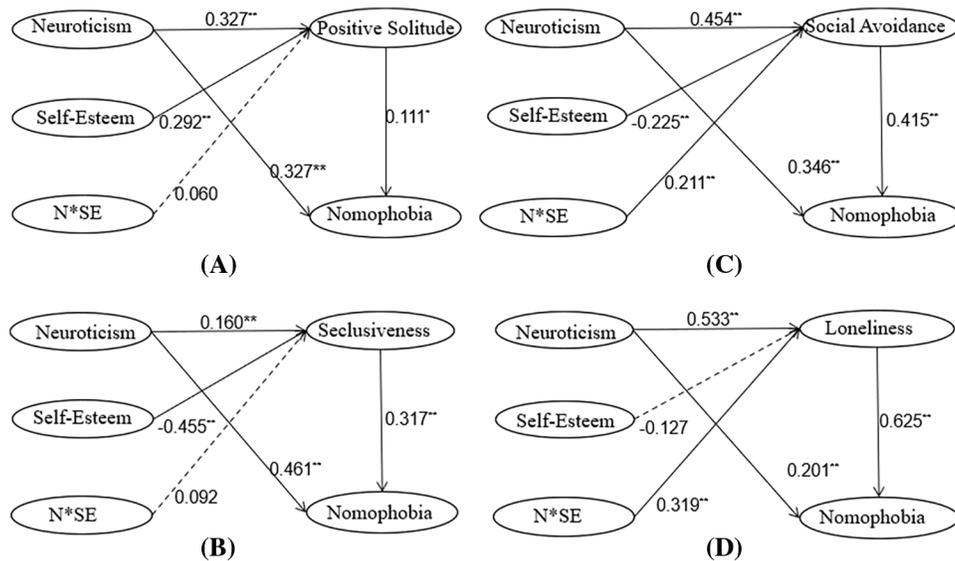
Figure 3: Latent moderated mediation structural equation modeling results. **$p < .01$, ***$p < .001$. (A) Neuroticism × Self-esteem on Positive Solitude. (B) Neuroticism × Self-esteem on Seclusiveness. (C) Neuroticism × Self-esteem on Social Avoidance. (D) Neuroticism × Self-esteem on Loneliness. Note: The solid line represents significant, the dotted line indicates nonsignificant; N, Neuroticism; SE, Self-esteem

Different results were found between neuroticism on positive solitude and neuroticism on seclusiveness (neuroticism × self-esteem on positive solitude, $\beta = 0.060$, $p > 0.05$; neuroticism × self-esteem on seclusiveness, $\beta = 0.092$, $p > 0.05$). According to the results, there was a difference in the effect of neuroticism on nomophobia via two kinds of solitude (active or passive) at different levels of self-esteem. We could conclude that self-esteem moderated the first half of the mediating effect of passive solitude, and the hypothesis was validated.

We examined the indirect effect of neuroticism on nomophobia through social avoidance and loneliness at different levels of self-esteem (1 *SD* below and above the mean). At low self-esteem (M-1 *SD*), the indirect effect of neuroticism on nomophobia via social avoidance was 0.400, $p < 0.001$, loneliness was 0.530, $p < 0.005$; at high self-esteem (M + 1 *SD*), the indirect effect of social avoidance was 1.096, $p < 0.001$, loneliness was 2.105, $p < 0.001$. Moreover, the indexes of two moderated mediation models were found to be significant (social avoidance, effect = 0.348, $p < 0.001$; loneliness, effect = 0.788, $p < 0.001$), demonstrating the moderated mediation effect had occurred.

Following Aiken et al. [59], simple slope tests were conducted to examine the nature of the interaction. We plotted the interaction in Figs. 4 and 5. As shown in Figs. 4 and 5, the result showed that neuroticism had a stronger effect on social avoidance and loneliness when self-esteem was high (M+1 SD) rather than when it was low (M-1 SD).

Above all, it can be considered that neuroticism affected nomophobia through the mediation of active solitude (loneliness & social avoidance), and conditional indirect occurred.
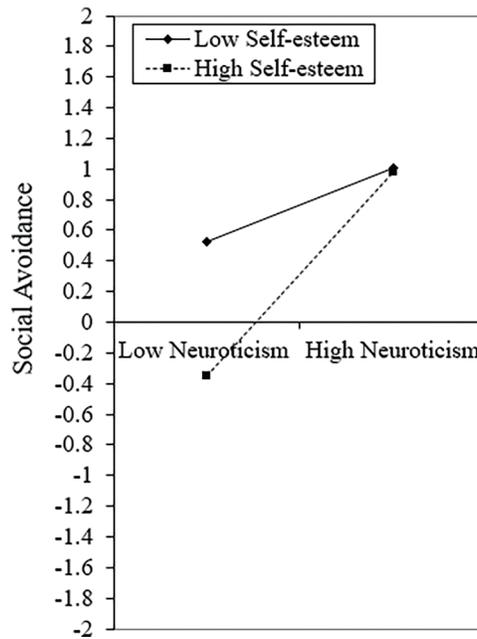
Figure 4: The moderating effect of self-esteem on the relationship between neuroticism and social avoidance
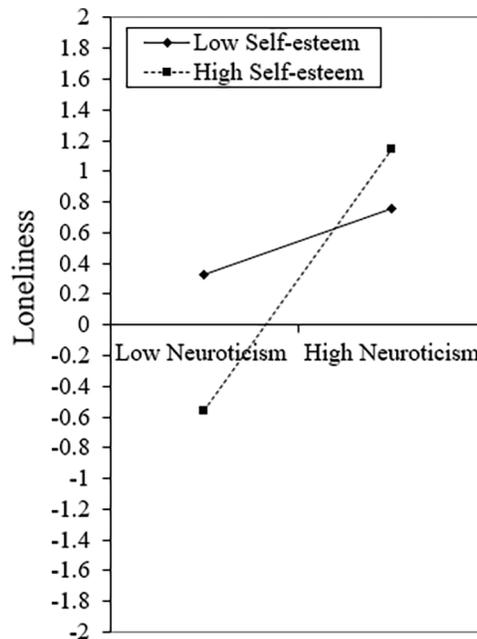

Figure 5: The moderating effect of self-esteem on the relationship between neuroticism and loneliness

4 Discussion

Although previous research in psychology focused on mobile phone addiction, some researchers have turned their attention to the other side of PMPU, such as nomophobia [60]. Many studies on personality towards mobile phone addiction can be found, but few focused on the relationship between traits and

nomophobia. The present study aimed to explore the mechanisms underlying the association between Big Five Personality and nomophobia. The results showed that four types of solitude played a mediating role in the relationship between neuroticism and nomophobia. Besides, the mediating effects of four types of solitude were all moderated by self-esteem.

Firstly, our study found that there were significant correlations between certain traits and the nomophobia of the participants. There was a low but significant correlation between openness and nomophobia. A possible explanation could be that individuals with openness tend to be more curious, happier and creative than others, and these people are willing to accept new ideas [61]. It is more likely that people with openness who use smartphone as a medium to meet their needs for curiosity will grow anxious and unable to do their necessary tasks when they are not on their smartphones. Another finding of this study was the significant relationship between neuroticism and nomophobia. The link between neuroticism and nomophobia could be explained by a biological theory that people with high neuroticism are naturally insecure and may react with discomfort and even anxiety whenever their phones are not around. This finding was also consistent with the study of Okoye et al. [62] and Dib et al [7]. Therefore, it is possible to affirm that individuals with high levels of neuroticism will exhibit nomophobic behavior if unable to access smartphone. Additionally, studies on personality traits and PMPU abound, but the nearly exclusive focus exists on mobile phone addiction. Nomophobia is not equaled with mobile phone addiction as they are two different constructs that emerged around PMPU [51,63]. The results highlighted the nomophobia found among openness and neuroticism participants, despite more studies regarding mobile phone addiction in five traits, respectively [17,64,65], which partially verified the difference between mobile phone addiction and nomophobia.

Secondly, for the mediation model, with the exception of neuroticism, there had no solitude in playing a mediating role between other traits and nomophobia. One angle of emotional stability is that people with high neuroticism perform emotional instability more than other traits. They may prefer to use new social media for reassurance behind screens rather than traditional social interactions (i.e., face to face interactions). One model of social cognition developed by Bandura [34] holds that personality traits influence behavior. People with emotional instability tend to lack control, social anxiety, depression and withdrawal [66]. They are always unable to construct positive interpersonal relationships in real life, producing social disorders such as social anxiety, which further induces social avoidance and loneliness [67]. The scarcity of positive social experiences in real life makes them turn to virtual reality to seek psychological satisfaction. Among the mediating effects of four types of solitude, the effects of positive solitude and seclusiveness were the weakest. The main reason lies in the initiative, which is different from social avoidance and loneliness when solitude is an active choice, negative emotions cannot be generated, and then anxiety was relatively low in the no-phone state. The findings are well explained by the I-PACE model, personality traits influence the state of individuals, and then the demand for smartphone use is triggered to be satisfied. Individuals' state also affects their thoughts and feelings, and enhances individuals' desire to use certain media to alleviate their negative experience. In the state of social avoidance and loneliness, individuals passively choose to be alone. As a result, individuals with high neuroticism are more afraid of losing contact and communication with others in negative emotional states. Therefore, social avoidance and loneliness had stronger mediating effects. In addition, Lu et al. [68] also found that only non-self-determined and negative solitude behavior could predict nomophobia.

Our study showed that neuroticism significantly increased nomophobia levels via four solitude behaviors. Afterward, we examined the moderating effect of self-esteem on the link between neuroticism and solitude of college students. On the other side, it seemed like the moderation of self-esteem occurred in the relationship between neuroticism and two types of solitude with a clear affective component, namely social avoidance and loneliness (negative affect).

The interaction effect of neuroticism and self-esteem on social avoidance and loneliness indicated that high self-esteem could act as a buffer to develop resilience to social avoidance and loneliness and consequently to nomophobia when people have low neuroticism, but individuals in high levels of neuroticism whose self-esteem was low or high did not make a difference in terms of individuals' resilience to social avoidance and loneliness. Conversely, compared with college students with lower self-esteem, the mediating effects of social avoidance and loneliness were stronger in college students with higher self-esteem. Higher levels of self-esteem are associated with a tendency to seek self-promotion and self-protection. In order to avoid damage to self-esteem, people with high self-esteem instead adopt a maladaptive coping strategy to improve and maintain their self-esteem levels when facing negative social feedback.

As for solitude, Dai et al. [33] classified it into two negative solitudes (social avoidance and loneliness). Neuroticism could strongly predict social avoidance and loneliness with high levels of self-esteem, and the function of prediction changed weaker in low levels of self-esteem. This may be related to the stability of self-esteem, which frequently fluctuates for certain traits and is stable over time for others. People with unstable self-esteem (high neuroticism) are more sensitive and defensive, and they are easily under a higher risk of social avoidance and loneliness (and consequently nomophobia). Moreover, we failed to find significant moderation of self-esteem in the predictive effect of neuroticism on non-negative solitude in our study. Individuals with posing positive self-views are vulnerable to receiving social information, which may increase the likelihood of maladaptive behavior [69]. Another good indicator of sensitivity to social context is neuroticism [70]. In this context, it could be claimed that neuroticism and high self-esteem are similar in terms of this feature. Furthermore, one theory of self-esteem focused on the dark side by David et al. [71] also holds that high self-esteem can also be maladaptive, which poses backfire on human functioning. Therefore, among those high in neuroticism, high self-esteem's dark side may increase negative outcomes, such as social avoidance and loneliness.

5 Implication and Limitations

This study is one of the few that have researched teenagers' capacity for solitude, personality traits, and physical and mental health. In fact, the interaction patterns between neuroticism and self-esteem have also been found in other studies. The influence of neuroticism on individual behavior was moderated by the level of self-esteem. However, the moderating role of self-esteem in personality traits is still unknown. In addition, some limitations of the current study should be acknowledged. First, this study is a cross-sectional design which could not determine the causal link among the variables. Thus, future research should adopt a longitudinal design to verify the prospective association among these variables. Second, the participants were college students from Tianjin and Guangzhou in China. The sample could cover a wider age range to generalize results to all people. In addition, this study only found that solitude mediated the relationship between neuroticism and nomophobia. Whether other personality traits affect nomophobia and the psychological mechanism behind the relationship need to be further explored in the future.

6 Conclusion

The present study suggested the mediating effects of solitude behavior on the association between neuroticism and nomophobia, as well as the moderating role played by self-esteem. Moreover, high self-esteem is not always a protective variable that buffers the impact of risk factors. Specifically, high self-esteem cannot protect people from negative factors. On the contrary, it is easy to receive more social information because of its characteristics, while people high in neuroticism are sensitive to negative social information and may be maladaptive. More attention should be paid to people with high neuroticism and high self-esteem. Encouraging them to actively participate in social activities to reduce loneliness, negative feelings, and maladaptive behaviors so that they will not use smartphone problematically.

Author Contributions: The authors confirm contribution to the paper as follows: YL: writing–original draft preparation, and writing, reviewing. FY: data collection and investigation. YZ: performed the data analyses. ML: data collection and investigation. TL: conceptualization, methodology, and writing–reviewing and editing. All authors reviewed the results and approved the final version of the manuscript.

Conflicts of Interest: The authors declare that they have no conflicts of interest to report regarding the present study.

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