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Edwards, Elizabeth ORCID:

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Running Head: Self Esteem and Smartphone Use

Individual Differences in Self-Esteem and Social Anxiety Predict Problem Smartphone Use  
in Adolescents

\*Elizabeth J. Edwards<sup>1</sup>, Caitlin S. Taylor<sup>2</sup> & Robert S. Vaughan<sup>2</sup>

<sup>1</sup>School of Education, The University of Queensland, Queensland, AUSTRALIA

<sup>2</sup>School of Education, Language and Psychology, York St John University, UNITED  
KINGDOM

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*\*Author for Correspondence:*

Dr Elizabeth J. Edwards

School of Education

The University of Queensland

St Lucia, QLD, 4072

AUSTRALIA

Phone: +61 733656215

Email: elizabeth.edwards@uq.edu.au

**CRedit authorship contribution statement**

**CT, EE & RV:** Conceptualization, Methodology; **CT:** Software, Data curation; Data collection, **CT, EE & RV:** Formal analysis; **EE:** Supervision, Writing – original draft; **RV:** Writing – review & editing

### **Abstract**

Smartphones have many characteristics that make them attractive to adolescents. Recent work, however, has established a link between smartphone-related problems and self-esteem (self-worth) and social anxiety (fear of social relations). To date, little is known about the characteristics underpinning these relationships in combination. Driven by theory, the present study examined the association between self-esteem, social anxiety, and nomophobia (fear of being without access to a smartphone) and problem smartphone use (PSU) in a sample of early adolescents ( $N = 254$ ). Self-esteem (Rosenberg Self Esteem Scale), social anxiety (Social Avoidance and Distress Scale) and their combined contribution (self-esteem x social anxiety) served as predictor variables of nomophobia (Nomophobia Questionnaire) and PSU (Mobile Phone Problem Usage Scale – Adolescent version) in separate moderated regression analyses. We found that lower self-esteem was associated with higher nomophobia and PSU, and that higher self-esteem may be a protective factor in those lower in social anxiety, such that they are not prone to excessive smartphone use. Our findings offer preliminary markers for psychologists addressing the challenges related to excessive smartphone use in this age group.

**Keywords:** social anxiety, self-esteem, nomophobia, smartphone use

## **Introduction**

The extent to which smartphone behaviours are related to psychosocial wellbeing has been the interest of cyber-psychology researchers for over a decade (e.g., Lepp et al., 2014; Thomée et al., 2011). Earlier work suggested that frequent smartphone use lead to mental health problems and addictive behaviours (Kuss et al., 2014; Thomée et al., 2011); however, more recently research implicates smartphone use as a coping mechanism for stressors of everyday life (Kuss et al., 2018). Undoubtedly, smartphones are integral to the social lives of today's adolescents; constantly monitoring peer activity, peer feedback, and encountering peers as (idealised) images (Konijn et al., 2015; Ma & Yang, 2016; Nesi & Prinstein, 2015). Adolescence is a critical period for socialising with peers (Sebastian et al., 2011). Social pressure to fit-in increases adolescents' desire to be socially accepted, and consequently social acceptance activates reward processing (Güroğlu et al., 2008). In adulthood, the incentive processing system (based on the value and prediction of potential rewards) works in tandem with the cognitive control system (which supports goal-directed decision-making); however, during adolescence the incentive processing system favours risky decisions (Chein et al., 2010; Sherman et al., 2016). Younger adolescents have a heightened response to positive social media feedback, which in turn is linked to the intensity of social media use (Meshi et al., 2013). It is therefore plausible that young adolescents are a vulnerable demographic for problem smartphone use (PSU), nomophobia, and associated psychosocial wellbeing factors.

### **Problem Smartphone Use, Nomophobia and Psychosocial Wellbeing**

The term PSU describes a complex pattern of smartphone-related behaviours, characteristic of addictive-like symptoms (i.e., repetitive use of the smartphone known to be counterproductive to health; Lopez-Fernandez et al., 2014). PSU has been associated with psychopathologies such as depression (Thomée et al., 2011), stress (Jeong et al., 2016), poor sleep quality (Woods & Scott, 2016), social anxiety (Reid & Reid, 2007), and low-self-

esteem (Ha et al., 2008; Woods & Scott). Nomophobia (no-mobile-phobia) describes a fear, anxiety, or discomfort of not being able to access one's mobile phone, as such it reflects a dependence on smartphone usage and connectivity (King et al., 2010). In a meta-analysis containing studies with young adults, and students at university and high school ( $K = 20$ ,  $N = 12,462$ ), the prevalence rate of moderate to severe nomophobia was reported as 71% (Humood et al., 2021). In two studies with adolescents, nomophobia prevalence was reported as 40% mild, 47% moderate and 12% severe (Yavuz, 2019) and 41% mild, 22% moderate, and 6% severe (Sharma, 2019). Research has shown that nomophobia, like PSU, is related to symptoms of anxiety, depression, social phobia, panic disorder (King et al., 2017), low-self-esteem (Argumosa-Villar et al., 2017), and stress (Tams et al., 2018).

Social anxiety is the fear or worry about being unable to create a positive impression, most notably in interactions with strangers in public or unfamiliar places (Schlenker & Leary, 1982). In the absence of studies exploring the relationship between social anxiety and PSU we turned to studies examining the link between social anxiety and internet use (i.e., smartphones are often the device of choice for adolescent internet use; Pugh, 2017). Morahan-Martin and Schumacher (2003) suggested that individuals with social anxiety have the need for interaction and find positive fulfilment from online interaction. In accord, Reid and Reid (2007) found that socially anxious individuals preferred interacting online versus face-to-face or voice calls, compared to those less anxious. In other work, Caplan (2006) reported that social anxiety moderated the link between loneliness and problematic internet use, such that socially anxious individuals had a tendency to be drawn to the internet. Few studies have examined the link between social anxiety and nomophobia. Uysal et al. (2016) found that nomophobia predicted social anxiety in a sample of university students. Additionally, Yildiz-Durak (2017) found that when adolescents feel anxious about losing access to their smartphones (i.e., elevated nomophobia), they report increased loneliness due

to an inability to meet their social networking and emotional needs. However, Yildiz-Durak's (2017) study did not include a measure of social anxiety per se. Taken together, these findings (e.g., Caplan, 2006; Reid & Reid, 2007; Uysal et al., 2016; Yildiz-Durak, 2017) provide preliminary indications of the influence of elevated anxiety, and specifically social anxiety, on nomophobia and PSU.

Self-esteem is characterised by the self-regard of worth or abilities (Rosenberg, 1965), and is essential to healthy adolescent social development (Trzesniewski et al., 2006). High PSU has been found to be associated with low self-esteem in university students (Ehrenberg et al., 2008) and in adolescents (Yang et al., 2010). In accord, Argumosa-Villar et al. (2017) reported that greater nomophobia was associated with poorer self-esteem in a sample of 16-25 year olds. In other work, Greenberg et al. (1992) found that self-esteem had a buffering effect on anxiety, such that higher self-esteem reduced anxiety. We argue that studies investigating the relationship between self-esteem nomophobia and/or PSU, would do well to consider the contribution of anxiety. This was not the case in previous work (e.g., Argumosa-Villar et al., 2017; Ehrenberg et al, 2008; Yang et al, 2010). Furthermore, given the comorbidity of anxiety/social anxiety and depression (e.g., Clark & Watson, 1991; van Tuijl et al., 2014), and the link between depression and PSU (Yen et al., 2009) it would seem important to recognise depression as a potential confounding factor in a study examining anxiety-related smartphone behaviours.

### **Theoretical Approaches**

Several theories have posited why people develop PSU or become addicted to their smartphone (e.g., Kardefelt-Winther, 2014; Wolneiwicz et al., 2018). Uses and gratifications theory (Wolneiwicz et al., 2018) assumes that people have individual differences in their drives to fulfil their desires by their choice of mass media. Leung and Wei (2000) discovered five gratifications: affection/sociability, relaxation, immediate access, mobility, and

fashion/status. It is plausible therefore that PSU and nomophobia map onto Leung and Wong's immediate access dimension. That is, the smartphone provides an instant gratification to meet the need for information. According to the immediate access proposal of uses and gratification theory it could be argued that while excessive smartphone use may meet a desire for media information, it could also be meeting a need for other gratifications. For example, using a smartphone might satisfy a need for relaxation in an anxious or worried individual or meet a need for affirmation or socialisation in an individual feeling lonely. Compensatory internet use theory (Kardefelt-Winther, 2014) proposes that heightened anxiety and/or low-self-esteem drives individuals to alleviate their negative emotions. Due to heavy reliance on smartphones as a means of coping, it is possible that people become fearful of being unable to access or use their device (i.e., increased likelihood of nomophobia). That is, whilst problematic negative emotions are alleviated short-term via the overuse of their smartphones, it can also lead to long term dependence (Kardefelt-Winther, 2014).

### **The Current Study**

The compensatory internet use theory and the uses and gratification theory provide the premise of the present work. To our knowledge this is the first study to examine both the unique and interactive relationships between self-esteem, social anxiety and nomophobia and PSU, after controlling for comorbid depression. Following the immediate access suggestion from uses and gratification theory, it was proposed that individuals reporting lower self-esteem and higher symptoms of social anxiety would experience an excessive need for social fulfilment and therefore report high levels of nomophobia and PSU. According to the compensatory internet use theory, lack of confidence and elevated anxiety may hinder adolescents from being able to achieve this face-to-face, therefore they resort to media technologies (such as their smartphone) to fulfil these needs. Our hypotheses were based on empirical and theoretical literature, and we made three predictions:

Hypothesis 1: Lower self-esteem would be related to higher nomophobia and PSU;

Hypothesis 2: Higher social anxiety would be related to higher nomophobia and PSU; and

Hypothesis 3: After controlling for depression, a two-way interaction between self-esteem and social anxiety would reveal that lower self-esteem would predict higher nomophobia and PSU, but that this pattern would be more pronounced for those with higher social anxiety.

## Method

### Participants

Students in Years 8, 9 and 10 from a high school in the North of United Kingdom were invited to take part in the research. Of the 822 students invited, 331 agreed to participate (approximately 40%). Seventy-seven cases were removed prior to data analyses due to an unavoidable/unexpected interruption during one data collection session, rendering incomplete questionnaires. Data from a final sample of 254 adolescents aged 12 to 16 years ( $M_{\text{age}} = 13.48$  years;  $SD_{\text{age}} = 1.00$  years) were retained for analyses. As G\*Power sample size estimation recommended a minimum sample size of 220 participants (.05,  $1 - \beta = .80$ ,  $\alpha = .05$ ; Faul et al., 2007) for moderated regression with small effect sizes.

### Materials

*Social Avoidance and Distress Scale* (SADS; Watson & Friend, 1969) is a 28-item self-report measure of social anxiety. Participants respond *true* or *false* to items (e.g., “*I feel relaxed even in unfamiliar social situations*” and “*I often want to get away from people*”). The scale has positively phrased items (Items, 1, 3, 4, 6, 7, 9, 12, 15, 17, 19, 22, 25, 27 and 28), where false is scored as 1, and negatively phrased items (2, 5, 8, 10, 11, 13, 14, 16, 18, 20, 21, 23, 24, 26), where true is scored as 1. The scale is scored by summing the score of each item, with total scores ranged from 0 to 28. Higher scores represent greater symptoms. Watson and Friend (1969) provide support for a unidimensional scale which was supported in factor analytic work by Garcia-Lopez et al. (2001). Experimental studies have also supported



the validity of the scale however reliability estimates in an adolescent sample are not available. Internal reliability in the current sample was satisfactory;  $\alpha = .83$ .

**Rosenberg Self Esteem Scale** (RSES; Rosenberg, 1965) includes 10 items measuring self-competence and self-liking (i.e., self-esteem). Items (e.g., “*On the whole, I am satisfied with myself*” and “*I take a positive attitude toward myself*”) are captured on a 4-point Likert scale, from 0 = *Strongly Disagree* to 3 = *Strongly Agree*. Positively worded items (1, 3, 4, 7 & 10) and reverse-scored negatively worded items (2, 5, 6, 8, 9), are summed and total scores range from 0 to 30. The unidimensional factor structure has been well established in adolescent samples via confirmatory factor analysis (Vasconcelos-Raposo et al., 2012). Satisfactory internal reliability has also been reported as Cronbach’s  $\alpha = .80$  (Sinclair et al., 2010), and  $\alpha = .86$  in the current sample.

**Depression, Anxiety and Stress Scale** (DASS-21; Lovibond & Lovibond, 1995) contains 7 items each for Depression, Anxiety and Stress. For the purposes of the current study, only scores on the DASS-Depression subscale were used. Participants responded to items (e.g., “*I felt I had nothing to look forward to*” and “*I felt I wasn’t worth much as a person*”) on a 4-point Likert scale, where 0 = *Did not apply to me at all*, 1 = *Applied to me to some degree or some of the time*, 2 = *Applied to me to a considerable degree, or a good part of the time*, and 3 = *Applied to me very much, or most of the time*. No items require reverse scoring. Following the standard scoring procedure, the scores were summed and multiplied by two such that possible total Depression scores ranged from 0 to 42, with higher scores representative of greater symptoms. Research supports the factor structure of the DASS-21 as a three-factor and general measure of depression, anxiety, and stress (Vaughan et al., 2020). Internal consistency of the DASS-Depression subscale has been reported as  $\alpha = .91$  (Lovibond & Lovibond, 1995), and  $\alpha = .84$  in the current sample, demonstrative of acceptable reliability.

***Nomophobia Questionnaire*** (NMP-Q; Yildirim & Correia, 2015) is a 20-item measure of four dimensions of nomophobia: not being able to communicate; losing connectedness; not being able to access information; and giving up convenience. Participants respond to items (e.g., “*I would feel uncomfortable without constant access to information through my smartphone*”, and “*If I did not have my smartphone with me, I would feel weird because I would not know what to do*”) on a 7-point Likert-scale, from 1 = *strongly disagree* to 7 = *strongly agree*. Total scores are calculated by summing scores for each item, giving a total nomophobia score ranging from 20-140. A score of < 20 indicates the absence of nomophobia, 21-60 mild nomophobia, 61-100 moderate, and > 101 represents severe nomophobia. Yildirim and Correia (2015) reported support for a one factor solution via factor analysis in development of the scale. The NMP-Q has demonstrated satisfactory reliability with reported Cronbach’s  $\alpha = .95$  (Yildirim & Correia), and  $\alpha = .96$ , in the current sample.

***Mobile Phone Problem Usage Scale - Adolescent version*** (MPPUS-A; Lopez-Fernandes et al., 2014) was adapted from the adult version (Bianchi & Phillips; 2005) to assess PSU. Adolescents respond to 27 items (e.g., “*I have tried to hide from others how much time I spend on my mobile phone*”, and “*My academic performance has decreased as a direct result of the time I spend on my mobile phone*”), on a 10-point Likert-scale, from 1 = *totally false* to 10 = *completely true*. No items require reverse scoring; thus, the total score is the sum of all items. PSU is classified according to criteria used in addiction literature (Chow et al., 2009), that is, the 15<sup>th</sup>, 80<sup>th</sup>, and 95<sup>th</sup> percentiles are used for classifying into four categories: *Occasional use* (< 15<sup>th</sup> percentile), *Habitual use* (15<sup>th</sup> to < 80<sup>th</sup> percentile), *At risk* (80<sup>th</sup> to < 95<sup>th</sup> percentile), and *Problematic use* (> 95<sup>th</sup> percentile). In the current sample, the scores were categorised such that; 27-32 = *Occasional use*, 33-139 = *Habitual use*, 140-165 = *At risk*, and 166-270 = *Problematic* (see Table 1). Lopez-Fernandes et al., (2014) showed

unidimensionality of the scales factor structure in their validation work. The MPPUS-A affords satisfactory internal reliability with Cronbach's  $\alpha = .97$  (Lopez-Fernandes et al.), and  $\alpha = .95$  in the current sample.

## **Procedure**

The present study was approved by the School of Psychological Science and Health Ethics Committee at York St John University (Approval # 3PY340/159017168). Voluntary informed consent and parental permission was obtained prior to participation. Participants completed the measures online using Qualtrics software during group supervised classroom sessions. They were instructed by a teacher to remain quiet and not discuss their answers with each other during participation. Following demographic questions (i.e., age, sex), five questionnaires were completed taking approximately 20 minutes, namely, SADS, RSES, DASS-Depression subscale, NMP-Q, and MPPUS-A. No rewards or incentives were provided. Upon completion, participants were provided with information about depression and anxiety, and thanked for their time.

## **Results**

### **Data Diagnostics and Assumption Checking**

Prior to the main analyses, the predictor and criterion variables were screened for outliers and normality. Univariate outliers were considered significant with z-scores  $> 3.50$ . Using this criterion, 4 outliers were deleted for depression (z-score =  $3.89 \times 4$ ). Using the criterion Mahalanobis Distance,  $p < .001$ , one multivariate outlier was identified for nomophobia and the same outlier was present for PSU. An acquiescent response check revealed that this participant reported extremely high anxiety, yet no symptoms of depression. Given the unlikely possibility of this (van Juijl et al., 2014), the participant's total depression score was Winsorized and replaced with the mean score for depression in the sample. All variables were within acceptable limits for normality and tests for skewness and kurtosis

were acceptable with consideration to the sample (non-clinical, high school students) and the nature of the measures. The assumptions of linearity and homoscedasticity were adequately met. Untransformed variables were used in all analyses and the final sample comprised,  $N = 250$ . Table 1 shows the demographic characteristics and prevalence/severity rates of nomophobia and PSU, across genders, in the sample.

INSERT TABLE 1 HERE

### **Descriptive Statistics**

Table 2 displays the means, standard deviations, zero-order and inter-correlations of predictor and criterion variables. As shown, all variables have significant relationships. In support of our decision to control for depression in our analyses, we noted depression was positively correlated with social anxiety, nomophobia and PSU, such that those who reported higher depression also tended to report higher social anxiety, higher nomophobia and higher PSU. Further, depression, was negatively correlated with self-esteem, such that those experiencing greater depression reported lower self-esteem. In support of Hypothesis 1, self-esteem was negatively correlated with nomophobia and PSU; that is, respondents who reported lower self-esteem also reported higher nomophobia and PSU. In support of Hypothesis 2, social anxiety was positively correlated with nomophobia and PSU, such that higher social anxiety was linked to higher levels of nomophobia and PSU. Furthermore, as would be expected, self-esteem was negatively correlated with social anxiety, and nomophobia was positively correlated with PSU.

INSERT TABLE 2 HERE

### **Main Analyses**

To test Hypothesis 3, we conducted separate moderated multiple regression analyses to examine whether self-esteem and social anxiety and their interactions predicted nomophobia and PSU, after controlling for depression. For each analysis, depression was entered as a covariate at Step 1, the component main effects (social anxiety and self-esteem) were entered at Step 2, and the 2-way interaction term (social anxiety x self-esteem) was entered at Step 3. Predictor variables (social anxiety and self-esteem) were mean centred prior to calculation the interaction term. We conducted all analyses using SPSS version 27 and used Dawson's Macros in Excel (Dawson, 2014) to decompose the interactions and conduct tests of simple slopes at high and low values of social anxiety and self-esteem (calculated at  $\pm 1$  SD from the mean score on each).

### **Nomophobia**

Table 3 displays the unstandardized coefficients, *t*-tests, *p* values, and 95% confidence intervals for all variables. At Step 1, depression accounted for 16% of the variance in nomophobia,  $R = .40$ ,  $F(1, 248) = 45.80$ ,  $p < .001$ . At Step 2, there was no significant increase in  $R^2$  with the addition of the component main effects accounting for 18% of the variance,  $R = .42$ ,  $\Delta R^2 = .02$ ,  $\Delta F(2, 246) = 2.89$ ,  $p = .058$ , despite the overall model being significant,  $F(3, 249) = 17.43$ ,  $p < .001$ . The inclusion of the two-way interaction term at Step 3 brought about a significant increase in  $R^2$ ,  $R = .44$ ,  $\Delta R^2 = .02$ ,  $\Delta F(1, 245) = 5.18$ ,  $p = .024$ , and the full model accounted for 19% of the variance in nomophobia, which was significant,  $F(4, 249) = 14.59$ ,  $p < .001$ . These results suggest that nomophobia varied as a function of social anxiety and self-esteem.

INSERT TABLE 3 HERE

Macros in Excel (Dawson, 2014) were used to decompose the two-way interaction between social anxiety and self-esteem and conduct tests of simple slopes. Figure 1 shows the pattern of interaction plotted at  $\pm 1$  SD from the mean score of social anxiety and self-esteem.

As can be seen, lower self-esteem was associated with greater nomophobia for those who reported lower social anxiety,  $\beta = -1.80$ ,  $t = 3.39$ ,  $p = .001$ . Self-esteem was not related to nomophobia for those who reported high social anxiety,  $\beta = -.30$ ,  $t = .54$ ,  $p = .587$ .

INSERT FIGURE 1 HERE

### **Problem Smartphone Use**

The unstandardized coefficients,  $t$ -tests,  $p$  values, and 95% confidence intervals for all variables are shown in Table 3. At Step 1, depression accounted for 21% of the variance in PSU,  $R = .46$   $F(1, 248) = 65.85$ ,  $p < .001$ . At Step 2, there was a significant increase in  $R^2$  with the inclusion of the main effects  $R = .48$ ,  $\Delta R^2 = .02$ ,  $\Delta F(2, 246) = 3.08$ ,  $p = .048$ , and the model was significant and accounted for 18% of the variance,  $F(3, 249) = 24.37$ ,  $p < .001$ . The addition of the two-way interaction term at Step 3 further contributed to a significant increase in  $R^2$ ,  $R = .50$ ,  $\Delta R^2 = .02$ ,  $\Delta F(1, 245) = 5.93$ ,  $p = .016$ , and the full model was significant,  $F(4, 249) = 20.13$ ,  $p < .001$  and accounted for 25% of the variance in PSU.

Macros in Excel (Dawson, 2014) were again used to deconstruct the two-way interaction and perform tests of simple slopes at high and low values of social anxiety and self-esteem ( $\pm 1$  SD from the mean score on each). A conceptually similar pattern of the interaction (to nomophobia) is shown in Figure 2. As shown, lower self-esteem was associated with greater PSU for those who reported lower social anxiety,  $\beta = -2.96$ ,  $t = 3.50$ ,  $p = .001$ , however, self-esteem was not related to PSU for those who reported high social anxiety,  $\beta = -.46$ ,  $t = .51$ ,  $p = .610$ .

INSERT FIGURE 2 HERE

### **Discussion**

The present research was the first known study to examine the relationship between self-esteem and social anxiety as predictors nomophobia and PSU in adolescents. As specified in Hypothesis 1, our results confirmed that lower self-esteem was related to higher

nomophobia and PSU. Consistent with Hypothesis 2, bivariate tests confirmed that social anxiety was related to both nomophobia and PSU. However, these unique relationships were subsumed by the interplay of social anxiety and self-esteem in full tests of the models for nomophobia and PSU, suggesting shared variance might hold important explanatory power in these relationships. In Hypothesis 3, after controlling for depression, we predicted a two-way interaction between self-esteem and social anxiety such that lower self-esteem would predict higher nomophobia and PSU, but that this pattern would be more pronounced for those higher in social anxiety. We found mixed support for this hypothesis, such that lower self-esteem was related to higher nomophobia and PSU, but only for those lower in social anxiety.

Our data were consistent with Argumosa-Villar et al. (2017), Ehrenberg et al. (2008), and Yang et al. (2010) who found lower self-esteem was related to higher nomophobia and PSU. As confirmed in our bivariate tests, adolescents with elevated social anxiety also tended to report higher nomophobia and PSU. These results broadly correspond with Morahan-Martin and Schumacher (2003) and Caplan (2006) who reported links between social anxiety and increased internet use, and with Uysal et al. (2016) and Yildiz-Durak (2017) who found higher social anxiety was related to higher nomophobia. As suggested by Argumosa-Villar et al., adolescents lower in self-esteem tend to prefer indirect smartphone communication to seek reassurance which, in turn, makes them susceptible to smartphone dependence. It is plausible that similar processes might apply in social anxiety.

The interaction between social anxiety and self-esteem for both nomophobia and PSU further qualifies these results. Contrary to our prediction, however, our data confirmed the relationship between self-esteem and nomophobia/PSU was restricted to those lower (rather than higher) in social anxiety. The exact reason for this pattern is puzzling. It seems likely that for those lower in social anxiety, higher self-esteem protects against smartphone-related problems and may act as an important behaviour and/or mood regulation characteristic. At

higher anxiety, it is possible that the inversely related traits, of social anxiety and self-esteem, act to cancel each other out (i.e., those higher in social anxiety experience heightened apprehension about their impression, and their anxiety is lowered because of their excessive smartphone use). Although plausible, this explanation requires a-priori testing before it can be more fully accepted.

Our findings partially align with uses and gratification theory such that it is possible that adolescents lower in self-esteem could be driven to excessively use their smartphone in an attempt to alleviate these negative emotions. Our data also offers partial support for compensatory internet use theory that suggests lower confidence and elevated anxiety may deter adolescents from socialising face-to-face and make them more reliant on their smartphone for such social interactions. It should be noted, however, that despite our data offering some promise that these suggestions based on theory hold true, our explanations are not able to be fully supported by the present data and remain somewhat speculative.

### **Limitations**

The present study has several shortcomings. The data was collected from a single high school in UK; therefore, replication studies are called for to confirm the generalisability of these results. Whilst self-report measures are an efficient and practical method of capturing psychological factors, they are subject to social desirability bias. Further, cross-sectional designs also afford an efficient way to test a hypothesis yet cannot offer causal inferences. As such, the present research was not able to conclude whether elevated social anxiety and low self-esteem follow PSU/nomophobia or whether PSU/nomophobia resulted from high social anxiety or low self-esteem. Future research is warranted to investigate the reciprocity of these relationships and could include a quasi-experimental design to minimise the use of subjective measures or ideally a longitudinal study to enable causal inferences to be made. Equally, qualitative researchers could further explore these findings through reflective interviewing



with patients at risk of nomophobia to gain a depth of understanding the individual experience of smartphone related problems.

### **Clinical Implications**

The present results hold valuable clinical implications for the treatment of smartphone related problems in adolescents. Given the increasing rates of smartphone ownership amongst young people globally, school psychologists are often tasked with assisting students to manage a range of mental health issues which in many cases may co-occur with excessive smartphone use. Our findings suggest that for adolescents where social anxiety is not an issue (lower social anxiety), yet self-esteem is lower, clinical efforts may prioritise techniques that focus on building self-esteem and allow smartphone usage to resolve itself as a consequence. Although for young people with greater symptoms of social anxiety, irrespective of self-esteem, it may be more helpful to directly target the excessive smartphone behaviours.

### **Conclusion**

The present study makes an important contribution to understanding smartphone-related problems in early adolescents. We investigated the interactive link between social anxiety and self-esteem on nomophobia and PSU in early adolescence and found that lower self-esteem was associated with greater nomophobia and PSU and that self-esteem might afford a protective factor in those with lower, but not higher social anxiety. Importantly, our data cannot be explained by depression, which was statistically controlled. Despite our robust approach, our data were limited by the well-documented problems associated with the use of questionnaire measures. Nonetheless, the present approach and data form a solid foundation for future research into elucidating the characteristics which might play a role in predicting and preventing problem smartphone behaviours in adolescents.

### **Declarations and competing interest**

All authors declare that they have no conflict of interest.

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**Table 1***Demographic Characteristics and Prevalence Rates of Nomophobia and Problem**Smartphone Use (N = 250)*

<b>Sex</b>	<b>Age = 12y</b>	<b>Age = 13y</b>	<b>Age = 14y</b>	<b>Age = 15y</b>	<b>Age = 16y</b>
Male (%)	24 (51%)	42 (52%)	38 (47%)	16 (40%)	1 (100%)
Female (%)	22 (47%)	37 (46%)	42 (52%)	16 (40%)	0
Prefer not to say (%)	1 (2%)	2 (2%)	1 (1%)	8 (20%)	0
<b>Nomophobia</b>	<b>None</b>	<b>Mild</b>	<b>Moderate</b>	<b>Severe</b>	
Male (%)	15 (12%)	62 (51%)	34 (28%)	10 (9%)	
Female (%)	2 (2%)	40 (34%)	54 (46%)	21 (18%)	
Prefer not to say (%)	1 (8%)	6 (50%)	4 (34%)	8 (8%)	
<b>Problem Smartphone Use</b>	<b>Occasional</b>	<b>Habitual</b>	<b>At Risk</b>	<b>Problematic</b>	
Male <sup>a</sup> (%)	9 (8%)	86 (71%)	10 (8%)	10 (8%)	
Female (%)	4 (3%)	86 (74%)	14 (12%)	13 (11%)	
Prefer not to say <sup>b</sup> (%)	0	9 (76%)	1 (8%)	1 (8%)	

<sup>a</sup>6 (5%) males scored below the threshold for PSU.<sup>b</sup>1 (8%) participant who preferred not to identify sex scored below the threshold for PSU.

**Table 2**

*Means, Standard Deviations, Zero-Order and Inter-Correlations of Depression, Social Anxiety, Self-Esteem, Nomophobia and Problem Smartphone Use*

	<i>M</i>	<i>SD</i>	<i>D</i>	<i>SA</i>	<i>SE</i>	<i>N</i>
Depression (D)	7.67	8.82				
Social Anxiety (SA)	9.10	5.61	.41***			
Self-Esteem (SE)	18.44	5.24	-.56***	-.41***		
Nomophobia (N)	62.63	32.17	.37***	-.34***	.18**	
Problem Smartphone Use	97.48	53.53	.49***	-.38***	.22**	.72***

\*\*  $p < .01$ , \*\*\*  $p < .001$

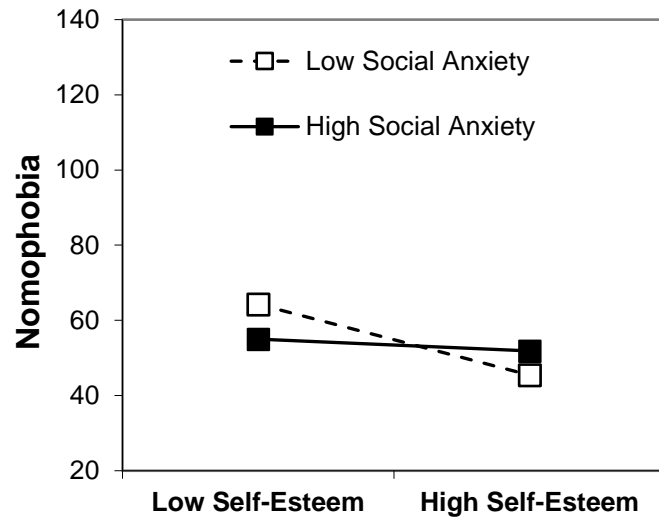
**Table 3**

*Unstandardised Coefficients, t values, p values, and 95% Confidence Intervals for all Variables at each Step for Nomophobia and Problem Smartphone Use*

		Unstandardised Coefficients			95% Confidence Intervals for B		
		B	SE	t	p	Lower Bound	Upper Bound
<b>Nomophobia</b>							
Step 1	(Constant)	50.77	2.53	20.06	.000	45.79	55.76
	Depression	1.63	.24	6.77	.000	1.16	2.11
Step 2	(Constant)	53.31	2.88	18.54	.000	47.65	58.98
	Depression	1.28	.31	4.12	.000	.67	1.89
	Social Anxiety	-.23	.38	-.62	.537	-.97	.51
	Self-Esteem	-1.07	.45	-2.40	.017	-1.96	-.19
Step 3	(Constant)	54.15	2.88	18.84	.000	48.48	59.81
	Depression	1.38	.31	4.45	.000	.77	2.00
	Social Anxiety	-.13	.38	-.33	.738	-.87	.61
	Self Esteem	-1.05	.44	-2.36	.019	-1.92	-.17
	Social Anxiety X Self-Esteem	.13	.06	2.28	.018	.19	.25
<b>Problem Smartphone Use</b>							
Step 1	(Constant)	74.15	3.98	18.65	.000	66.32	81.98
	Depression	3.07	.38	8.12	.000	2.33	3.82
Step 2	(Constant)	78.44	4.51	17.38	.000	69.55	87.33
	Depression	2.47	.49	5.08	.000	1.51	3.43
	Social Anxiety	-.31	.59	-.52	.603	-1.47	.85
	Self-Esteem	-1.74	.70	-2.48	.014	-3.18	-.36
Step 3	(Constant)	79.83	4.51	17.72	.000	70.96	88.71
	Depression	2.65	.49	5.45	.000	1.69	3.61
	Social Anxiety	-.13	.59	-.22	.828	-1.29	1.03
	Self Esteem	-1.70	.70	-2.44	.015	-3.07	-.33
	Social Anxiety X Self-Esteem	.22	.09	2.44	.016	.04	.40

**Figure 1**

*Relationship between Social Anxiety, Self-Esteem, and Nomophobia. Simple Slopes are calculated at  $\pm 1$  SD from the Mean Score on each of High and Low values on Social Anxiety and Self-Esteem*

**Figure 2**

*Relationship between Social Anxiety, Self-Esteem, and Problem Smartphone Use. Simple Slopes are calculated at  $\pm 1$  SD from the Mean Score on each of High and Low values on Social Anxiety and Self-Esteem*

