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An exploratory analysis of the relationship of problematic Facebook use with loneliness and self-esteem: the mediating roles of extraversion and self-presentation

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Abstract
Studies indicate that loneliness and self-esteem are predictive factors of problematic social media use. Further, it is proposed that self-presentation and extraversion may explain individual differences in online activity and problematic social media use. The present study confirms the relationship of loneliness and self-esteem with problematic Facebook use and investigates the hypothesis that these psychological factors may be linked to problematic Facebook use through their association with self-presentation and extraversion. The sample of university students consisted of 477 Facebook users, 64% females, aged 18–64. Social media usage intensity was assessed by collecting passive data on the total time spent and the number of sessions on Facebook per day for the last 6 months. The psychological factors, personality, motives and problematic Facebook use were assessed via self-report measures. Results showed that the relationship of loneliness and self-esteem with problematic Facebook use was significantly positive and negative respectively. The relationship between self-esteem and problematic Facebook use was found to be inconsistently mediated by both self-presentation and extraversion, while loneliness was partially mediated by self-presentation only. The total effect of loneliness and self-esteem remained positive and negative respectively, although extraversion and self-presentation had a suppressing effect on the relationship between self-esteem and problematic Facebook use. Further, the prevalence of 'at-risk' Facebook users was found to be 6.0%. It was also determined that the usage intensity of 'at-risk' users was significantly different from other Facebook users. These results highlight the existence of different patterns of associations linking psychological factors, usage intensity and problematic Facebook use.

Keywords Mediation · Problematic Facebook use · Facebook addiction · Extraversion · Self-presentation · Loneliness · Self-esteem

Introduction

Social media usage has increased steadily over the last ten years, with Facebook being the most subscribed of all the platforms. In 2021, the number of Facebook users worldwide stood at approximately 2.9 billion per month, which is twice its closest follower of Instagram at 1.1 billion. (Dean, 2021; Facebook Inc., 2021; Mohsin, 2021). Facebook accounts for more than half of the estimated 4.5 billion social networking sites users worldwide. On average users spent 33 minutes on Facebook per day, which is the longest among social networking sites in 2021(Mohsin, 2021).

The increasing popularity and associated usage intensity of Facebook have been accompanied by negative psychosocial and psychological effects attributable to maladaptive cognitive responses (Balcerowska et al., 2020; Marengo et al., 2020; Smith & Short, 2022). This has given rise to the terms problematic Facebook use and Facebook addiction which is used to refer to individuals who engage in excessive, compulsive Facebook use for the purposes of mood alteration, with negative personal outcomes (Ryan et al., 2014). A systematic review of 65 studies identified positive associations between high Facebook usage intensity and mental health disorders, including anxiety, depression, body image dissatisfaction, life dissatisfactions, decreased

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feelings of happiness and disordered eating (Boer et al., 2021; Casale & Banchi, 2020; Frost & Rickwood, 2017). Further, some researchers regard the excessive and problematic use of Facebook as a behavioral addiction, which leads to users exhibiting Griffith's six criteria of addiction (Ercengiz, 2019; Kuss & Griffiths, 2017). However, other researchers caution the use of the term addiction, suggesting the terms addiction-like behaviors, problematic use and maladaptive cognitive responses are more accurate (Boer et al., 2021; Savci et al., 2020). These researchers suggest that the repeated persistent use of social media is based on a needs affordance mechanism (Kardefelt-Winther, 2017; Montag et al., 2021; Wang et al., 2015). A user initially utilizes social media as a rational choice to fulfill psychological needs in response to common stressors, which evolve into maladaptive cognitive behaviors when increased use no longer correlates to actual utility (Smith & Short, 2022). Although there is some consensus on the negative mental health effects of excessive Facebook use, there is less consistency underlying the broader concept (Andreassen et al., 2016; Caci et al., 2017).

Similar to substance-related addiction empirical research suggests that psychological factors are associated with the addiction-like behaviors of problematic social media use (PSMU) (Baltaci, 2019; Marino et al., 2018a, b; Youssef et al., 2020). However, the empirical analysis of the underlying interaction between these psychological factors and problematic social media or more specifically Facebook use is limited. This study seeks to contribute to the extant literature by confirming the relationship between specific psychological factors and problematic Facebook use (PFU) and engaging in an exploratory analysis into the underlying mechanism of how they interact with PFU. The study as far as is known to the researcher presents the first assessment of personality traits and use motive (gratification) as intervening variables (mediators) in the interaction between psychological factors and PFU. The exogenous (independent) variables of loneliness and self-esteem and the potential mediators of extraversion and self-presentation were chosen based on an assessment of the literature to identify variables that have shown significant relationships with PFU (e.g., Marino et al., 2018a; Omar & Subramanian, 2013; Peris et al., 2020; Youssef et al., 2020). The results will be presented as a complex mediation model to show all interactions and their standard estimates, β. This approach will aid in understanding the underlying mechanism of loneliness and self-esteem in predicting PFU and elucidate paths for future research into causal relationships.

PSMU and Psychological Factors

Empirical data from cross-sectional studies suggest that a relationship exists between PSMU and psychological factors (Bányai et al., 2017; Boer et al., 2021; Casale & Banchi, 2020; Pontes, 2017). Where these psychological factors may be predictive of underlying psychopathologies. However, the nature of the mechanism underlying the relationship is yet to be fully elucidated (Boer et al., 2021). Researchers have hypothesized that psychological factors may elicit problematic use as users utilize the online social environment as a medium for coping with personal problems, depressive feelings, anxiety, and stress (Andreassen et al., 2016; Koc & Gulyagci, 2013). Pre-existing psychological factors initiate the use of social media with a positive feedback loop of increased use expecting greater needs affordance (Casale & Banchi, 2020; Smith & Short, 2022). Interactions facilitated by social media allow users to experience feelings of acceptance, social support and gratification (Omar & Subramanian, 2013; Scissors et al., 2016; Tang et al., 2016).

Two psychological factors which have consistently been empirically demonstrated to correlate to PSMU are loneliness and low self-esteem (Andreassen et al., 2016; Baltaci, 2019; Iranmanesh et al., 2021; Skues et al., 2012; Youssef et al., 2020). Loneliness is defined as the subjective perception misalignment of desired and actual social relationships or connectedness (Gierveld & Tilburg, 2006; Hawkley & Cacioppo, 2010). Self-esteem refers to a person's global appraisal of their positive (high self-esteem) or negative (low self-esteem) value based on a personal evaluation of themselves in different roles and domains of life (Mann, 2004; Stangor, 2014). The negative feeling of low self-esteem is experienced when they believe that they are inadequate and less worthy than others. These factors may be considered especially problematic as they are also associated with psychopathologies such as depression, anxiety, eating disorders and suicide ideation (Mann, 2004; McFarland et al., 1984). Researchers have proposed that users experiencing loneliness and low self-esteem engage in increasing use of social media for social reward, establishing social interactions and to fulfill the overall desire to be noticed and appreciated by others (Veissière & Stendel, 2018).

Several researchers have found that low self-esteem is positively correlated with PSMU (Andreassen et al., 2016; Hou et al., 2019; Peris et al., 2020; Smith & Short, 2022). While there are various definitions of self-esteem, in general, it can be described as one's perception of one's value or worth (Adler & Stewart, 2004; Rosenberg, 1965). It is in essence a proxy measure of how much an individual "values, approves of, appreciates, prizes, or likes him or herself" (Adler & Stewart, 2004). It is postulated that persons experiencing low self-esteem attempt to cope by presenting themselves online where they can execute greater control on what others see or perceive about them i.e., self-present an online persona or image (Sun et al., 2017; Yu et al., 2010; Zhao et al., 2008).

There is also empirical evidence that loneliness is correlated to PSMU (Skues et al., 2012; Smith & Short, 2022; Youssef et al., 2020). Further, there is also evidence of a relationship between loneliness and self-esteem (Baltaci, 2019; Baturay & Toker, 2017; Eraslan-Capan, 2015). It is suggested that social media users seek to subsidize the disconnect between their desired and actual level of connectedness in the real world through increased interpersonal interaction on social media (Baltaci, 2019; Primack et al., 2017; Youssef et al., 2020).

The Potential Intervening Actions of Personality Traits and Motives: Extraversion and Self-Presentation

To understand the relationship between mental health and PFU, it is necessary to understand the underlying interactions between the variables. One approach to increasing the depth of knowledge on this relationship is an examination of possible mediators, which may elucidate possible causal pathways. However, as highlighted by Boer et al. (2021) mediation analysis and by extension, the interaction pathways between mental health and PFU have received a dearth of empirical attention. Interestingly within the limited mediation studies use motives and personality traits have been investigated as exogenous variables rather than mediators (e.g., Shao & Lee, 2020).

Social media usage is generally discretionary and as such should cumulatively reflect the influences of personality traits, personal motives (desired gratification) and preferences (e.g., interface, technology, ease of use). Studies show that Big Five personality traits (openness, conscientiousness, extraversion, agreeableness and neuroticism; OCEAN) have significant positive correlation with PSMU (Tang et al., 2016; Vaghefi & Qahri-Saremi, 2018). For example, research found that extraversion is associated with the number of posts made on Facebook (Gosling et al., 2011). In line with the proposal of Eysenck and Eysenck (1985) extraversion is one of the greater contributors to the description of personality traits. Hence, in this exploratory study extraversion was used not only for its noted correlation with PSMU but also its potential representativeness of the overall potential intervening action of personality traits. Studies have shown that people with different personality traits (e.g., extraversion) experience different levels of psychological factors such as loneliness (Heinrich & Gullone, 2006). Though studies are limited there is empirical evidence suggesting a link between loneliness and personality traits, with extraversion having a consistent negative correlation to loneliness (Abdellaoui et al., 2019; Buecker et al., 2020; Mund & Neyer, 2019). It is suggested that for example that extraverts are less likely to feel lonely because they usually have a good interpersonal network and more social support (Zhou et al., 2021). This proposition is supported by empirical evidence suggesting a positive correlation between extraversion and emotional expression (Wu et al., 2018).

Research has also shown that extraversion is positively associated with PFU (Andreassen et al., 2012; Balcerowska et al., 2020; Błachnio et al., 2017; Marino et al., 2018a). Further, most of the research has found a positive correlation between extraversion and social media (Correa et al., 2010; Schrock, 2009). In comparison to introvert users, extravert Facebook users tend to show higher levels of posting activity, larger online networks, and higher 'Likes' counts (Burrow & Rainone, 2017; Shen et al., 2015). This can possibly be explained by an extravert's innate desire to seek out others for interaction i.e., it predicts greater participation in social activity and acquisition of higher social status to enhance social connectedness (Breil et al., 2019; Buecker et al., 2020; Selfhout et al., 2010). Therefore, the perception of the effect of factors such as loneliness must be measured in relation to personality traits, which define an individual's threshold of desired connectedness. For example, the reaction to the loss or absence of social bonds is dependent on an individual's degree of desired social connection, which is strongly related to personality traits (Buecker et al., 2020; Dufner et al., 2015). Hence, the individual's threshold of desire for the given need will define their rational choice to engage in an activity to fulfill a related desire.

Research examining the relationship between gratification sought (use motives) and PSMU found that they were not only linked to problematic use but also personality and psychological factors such as self-esteem and loneliness (Bucknell Bossen & Kottasz, 2020; Omar & Dequan, 2020; Shao & Lee, 2020). Further, Marino et al.'s (2018a) findings show that internal motives such as self-presentation showed the strongest correlation with PSMU. The link between self-presentation and PSMU has been specifically supported in several other studies (e.g., Bodroža & Jovanović, 2016; Chen & Kim, 2013; Tang et al., 2016). As regards Facebook, Nadkarni and Hofmann (2012) identified self-presentation and the need to belong as the two main social needs explaining use of this social networking site.

Self-presentation is a use motive used by individuals to show their creativity and present themselves in what they perceive as a suitable form to encourage acceptance from their peers to foster a sense of belongingness i.e., management of a desired impression to others (Goffman, 1959; Marino et al., 2018a; Omar & Subramanian, 2013). Further, past research suggests that users' public persona is sculptured and motivated by the need for self-presentation, and it could be reflected by Facebook profiles (Nadkarni & Hofmann, 2012). Therefore, social media self-presentation has been highlighted as a potentially important variable in understanding the relationship between psychological factors (mental health) and PSMU (Skogen et al., 2021). One

study found a positive correlation between self-presentation and problematic Instagram use (Kalalo, 2018). It is hypothesized in this study that self-presentation has an intervening effect on loneliness and self-esteem as it defines the level of coping (gratification) that can be obtained. If social media is not being used or effectively used for self-presentation, there is unlikely to be a reasoned choice to increase usage as it would not be reflective of any utility i.e., needs affordance. The Needs-Affordance-Features (NAF) Model of Technology and the theory of Uses and Gratifications suggests that the intensity of a person's use of media is related to fulfillment of their individual psychological needs or motivations and the media's ability to provide affordance that satisfy these basic needs (Chen, 2019; Huang et al., 2017; Karahanna et al., 2018; Smith & Short, 2022). Therefore, the likelihood of a psychological need leading to problematic use is dependent on the media's ability to provide needs affordance.

This study argues that personality traits and use motives may be linked to PSMU by virtue of their associations with certain motivational mechanisms. The mediating effect of extraversion for example has been previous demonstrated in relation to psychological distress and the dorsolateral prefrontal cortex, which affects emotional regulation (Chernova et al., 2021; Kong et al., 2015). Further, in terms of use motives and desired gratification self-presentation has been empirically demonstrated to enhance friendship development on social media (Lee & Borah, 2020). Also, self-presentation has been found to mediate the relationship between self-esteem and shyness (Bober et al., 2021), and anticipatory attitude change (McFarland et al., 1984) which can be an important inhibiting factor to making desired connections. Therefore, this study advances understanding of the relationship between psychological factors, personality traits, use motives and PSMU (specifically Facebook). The investigation into Facebook is likely generalizable to social media in general given Balcerowska et al.'s (2020) demonstration of the high-level overlap of addiction pathways between PFU and PSMU.

Study Aim and Hypotheses

The present study aimed to investigate the impacts of loneliness and self-esteem (exogenous variables) on PFU (endogenous variable) while considering the possible mediation effects of variables identified in the literature as being related to the construct of interest (i.e., personality trait - extraversion and use motive -self-presentation). Specifically, the hypotheses were as follows:

1. **Hypothesis 1 (H1)**: The following correlations identified in the literature would be supported
   a Positive correlation between loneliness and PFU
   b Negative correlation between self-esteem and PFU
2. **Hypothesis 2 (H2)**: There would be an effect of the exogenous variable on the mediators and an effect of the proposed mediators on the endogenous variable
   a Extraversion mediates the relationships between loneliness and FPU, and self-esteem and FPU
   b Self-presentation mediates the relationships between loneliness and FPU, and self-esteem and FPU
3. **Hypothesis 3 (H3)**: An effective complex mediation model could be established including both exogenous variables, both mediators and the endogenous variable. The proposed model is shown in Fig. 1.

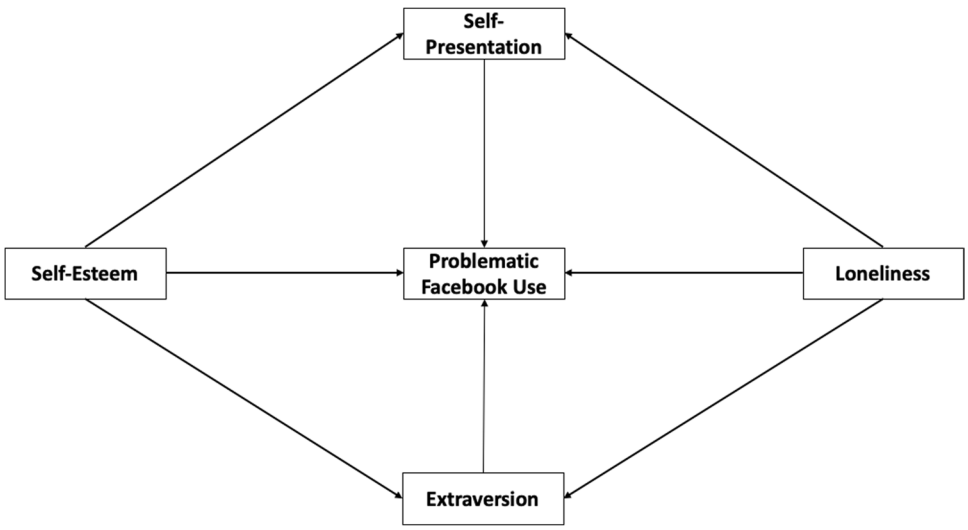

Fig. 1 Proposed mediation model. Note. Self-esteem = exogenous variable 1, Loneliness = exogenous variable 2, Problematic Facebook Use = endogenous variable, Self-Presentation = mediator 1, Extraversion = mediator 2

Methods

Participants

In compliance with the Helsinki Declaration the research protocol employed was approved by the Research Ethics Committee of the University of Trinidad and Tobago (UTT) and informed consent was acquired from each participant prior to data collection. The study recruited 477 respondents 63.7% of whom were female (and 36.3% male), aged 18 to 64 years ($M = 26.9$, $SD = 8.3$) through emails distributed to students of the UTT through their school-issued email addresses. A density histogram is given in Fig. 2 showing the age distribution of participants. It was found that 88% of participants were between ages 18–34. Data for the study was collected in 2021, during the COVID-19 pandemic, which restricted physical access to potential respondents. The respondents completed a self-administered survey hosted on SurveyMonkey on a voluntary basis. Informed consent was obtained from all participants.

Measures

PFU The Bergen Facebook Addiction Scale (BFAS; Andreassen et al., 2012) is a six-item scale encompassing the six dimensions of addiction (i.e., salience, mood modification, tolerance, withdrawal, conflict, and relapse) according to Griffith's model (Griffiths, 2005). Each item is assessed on a 5-point Likert type scale ranging from very rarely (1) to very often (5). The scale is the most frequently used by researchers in the study of PFU and has consistently shown good validity and reliability (Balcerowska et al., 2020; Monacis et al., 2017; Primi et al., 2021; Smith & Short, 2022). In the present study, the Cronbach α was .847 and the McDonald's ω was .840.

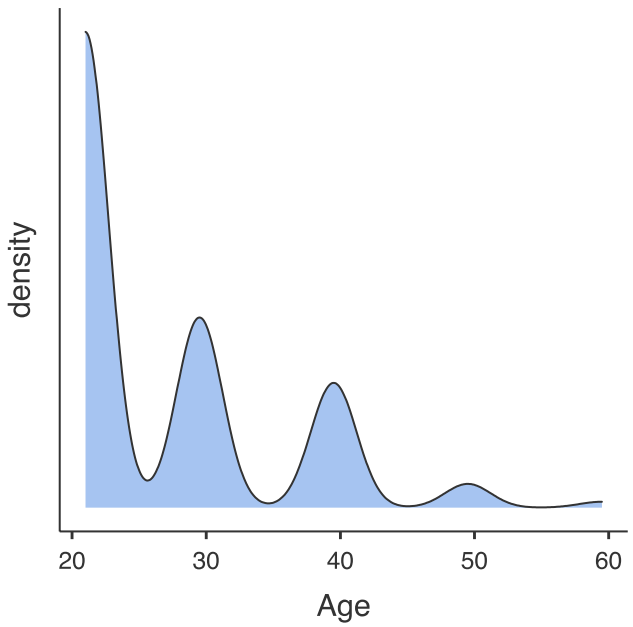

Fig. 2 Distribution of participants by age

Cut-off scores for the classification of Problematic Facebook users to identify those that may be classified as 'at-risk' have not been established for the BFAS. However, the authors proposed classifications schemes to identify 'at-risk'; 1) polythetic e.g., responding 3 or above in the response scale on at least four of the six items, thus having at least a summed total score of 12, 2) monothetic scheme, e.g., responding 3 or above in the response scale on all six items, thus having at least a summed total score of 18 (Primi et al., 2021).

Usage Intensity Two items assessed the respondents' Facebook use intensity, by measuring the duration (HPD) and frequency (TPD) of use. The first item examined 'In the last 14 days on an average day how many hours did you spend using Facebook/Tik Tok?'. The second item examined 'How many times per day do you use Facebook/Tik Tok?'

Psychological Factors In this study, two psychological variables were examined namely, self-esteem and loneliness. Self-esteem was assessed using the Rosenberg Self-Esteem Scale (RSES; Bányai et al., 2017; Jordan, 2020), which is represented by 10 items on a 4-point Likert-type ("strongly agree" to "strongly disagree") items. The score range is between 0 and 30 with higher scores translating to higher feelings of self-esteem. In this study, the Cronbach α and McDonald's ω were found to be .876 and .858 respectively for the RSES.

Loneliness was assessed using the University of California Los Angeles (UCLA) UCLA three-item loneliness scale (Hughes et al., 2004; Igarashi, 2019; Liu et al., 2020), which consists of three items on a 3-point Likert-type scale ('Hardly ever', 'Some of the time', 'Often'). The score range is 3–9, where a higher score corresponds to greater feelings of loneliness. The reliability of the UCLA in this study was acceptable with a Cronbach α of .842 and a McDonald's ω of .715.

Extraversion The extraversion subscale of the Ten-Item Personality Inventory (TIPI), a short, validated measure of five personality traits (extraversion, agreeableness, conscientiousness, emotional stability, and openness) (Nunes et al., 2018) was administered. The scale consists of two items (1 reverse coded) each rated on a seven-point Likert-type scale (1 = strongly disagree; 7 = strongly agree). Despite its brevity, the extraversion subscales have shown remarkable psychometrical qualities in terms of (a) convergence with widely used Big-Five measures in self, observer, and peer

reports, (b) test-retest reliability, (c) patterns of predicted external correlates, and (d) convergence between self and observer ratings (Atroszko et al., 2018; Gosling et al., 2003; Nunes et al., 2018). However, given the low number of items by design the subscale is expected to show low reliability. The Cronbach α for the extraversion scale was found to be .463.

Self-Presentation Questions to as self-presentation as a type of gratification sought by users were adapted from the works of Liu et al. (2010) and Omar and Subramanian (2013). The scale consisted of three questions, which were assessed using a 5-point Likert type scale ranging from strongly disagree (1) to strongly agree (5). The Cronbach α and McDonald's ω for the self-presentation scale items were .880 and .811 respectively.

Demographics Information regarding the age and sex of participants were also collected. Sex was represented as a dichotomous variable, while age was given as ordinal with options ranging from 18 to older than 75.

The items on the questionnaire associated with each measure is given in Appendix A.

Analysis

A series of regressions were performed using the jAMM module in Jamovi statistical software version 2.2. for Windows (The jamovi project, 2021; R Core Team, 2021). The Generalized Linear Model (GLM) mediation analysis within the jAMM module facilitates the development of multiple mediation models with maximum likelihood regression (Gallucci, 2020; Rosseel, 2019). This allowed the researcher to enter both covariates and both potentially intervening variables into the models simultaneously. The output of direct, indirect and total effects was then examined based on the four steps for testing mediational hypotheses as discussed by Baron and Kenny (1986), Frazier et al. (2004), James and Brett (1984) and Judd and Kenny (1981). The steps in testing the hypothesis of mediation are 1) show that the exogenous variable is correlated to the endogenous variable, 2) show that the exogenous variable is correlated to the mediator, 3) show that the mediator affects the endogenous variable 4) assess if the mediator completely mediates the relationship between the exogenous and endogenous variables i.e., the total effect should be zero (Baron & Kenny, 1986). It is accepted in practice that if all four steps are met, then there is support for the existence of complete mediation. However, if Step 4 is not met the results suggest partial mediation. The results of this approach were formally tested using the Sobel's (1982) indirect test for mediation (MacKinnon et al., 2004).

Although the causal steps approach presented by Baron and Kenny (1986) is historically popular concerns have been raised regarding the number of assumptions and its coherence (Hayes, 2013). Therefore, other methods of testing have emerged which are thought to hold greater statistical power. In this study in order to validate the findings of the causal steps approach (Baron & Kenny, 1986) the bootstrapping approach (MacKinnon et al., 2004) was used. The bootstrapping method was implemented in Jamovi with 1000 random samples with replacement at the 95% confidence interval. For a mediated process the confidence interval should not be inclusive of zero i.e., zero should not be a plausible value for the indirect effect (MacKinnon et al., 2004).

Once all mediational hypotheses were tested a complex mediation model showing all interactions was generated using the jAMM module (Soetaert, 2019).

Results

The study was conducted to examine the impacts of loneliness and self-esteem on PFU considering the possible mediation effects of extraversion and self-presentation. This section presents the results of a series of regression analyses to confirm or refute the presence of mediation. The results are presented based on each potential mediator and the pair of independent variables. Lastly, an overall model of interaction is presented showing only statistically significant interactions. Additionally, descriptive statistics for the observed variables are provided.

Descriptive Statistics

Table 1 presents the descriptive statistics for the main study measures. Acceptance of the sample size of $N = 477$ was accepted for analysis based on two assessments. First power analysis was done post hoc using G*Power version 3.1 with

Table 1 Descriptive statistics of main study measures (N = 477)

	PFU	Loneliness	Self-Esteem	Self-Presentation	Extraversion	HPD	TPD
Mean	10.3	4.70	18.6	7.18	6.25	66.6	3.44
Std. error mean	0.211	0.112	0.371	0.165	0.164	3.73	0.159
Standard deviation	4.61	2.44	8.10	3.60	3.59	81.5	3.46

PFU Problematic Facebook use, *HPD* Facebook hours per day, *TPD* Frequency of Facebook use per day

$\alpha = 0.05$, $f^2 = 0.02$ (small effect size) and $N = 477$ for a two-tail test, which suggested that power (1-β err prob) = .869.

To test for any gender difference in the variables examined in the study two one-sided t-test (TOST) is used to determine if the means of the two populations are equivalent. Table 2 shows that when the two one-sided null hypotheses were tested directly all p-values obtained were less than alpha = .05, thus it was concluded that no gender difference exists in the examined variables.

To examine the possible differences in participants responses based on age the data was separated into two groups based on generational labels of Millennials (18–34) and GenX/Boomers (35–69) (Pew Research Center, 2015). Application of the TOST gave the results shown in Table 3, which suggest that Facebook usage patterns are equivalent between the generations. However, the propensity to experience the psychological factors of loneliness and self-esteem and the personality trait of extraversion differs between the generations. Millennials were found to have significantly higher loneliness scores ($p < .001$; $H_a\ \mu_1 > \mu_2$) than the GenX/Boomer group. While GenX/Boomer generations tend to have higher self-esteem ($p < .001$; $H_a\ \mu_1 < \mu_2$) and be more extraverted ($p = .002$; $H_a\ \mu_1 < \mu_2$) than Millennials.

Prevalence of Persons Classifiable as Being 'at-Risk' of PFU According to the findings obtained from this study it was seen that based on the monothetic (cut-off score of 18) approach to classifying persons as 'at-risk' there was a prevalence of 6.0%.

Table 2 TOST Results

		t	df	p
PFUS	t-test	0.374	283	0.709
	TOST Upper	−4.30	283	< .001
	TOST Lower	5.04	283	< .001
HPD	t-test	0.818	285	0.414
	TOST Upper	−3.85	285	< .001
	TOST Lower	5.49	285	< .001
TPD	t-test	−0.278	286	0.781
	TOST Upper	−4.95	286	< .001
	TOST Lower	4.40	286	< .001
Self-Presentation	t-test	−0.782	300	0.435
	TOST Upper	−5.50	300	< .001
	TOST Lower	3.93	300	< .001
Loneliness	t-test	−1.928	284	0.055
	TOST Upper	−6.60	284	< .001
	TOST Lower	2.75	284	0.003
Extraversion	t-test	0.789	327	0.431
	TOST Upper	−4.01	327	< .001
	TOST Lower	5.58	327	< .001
Self-Esteem	t-test	0.439	314	0.661
	TOST Upper	−4.32	314	< .001
	TOST Lower	5.20	314	< .001

Welch's t-test

Table 3 TOST Results

		t	df	p
PFUS	t-test	−0.691	113	0.491
	TOST Upper	−4.635	113	< .001
	TOST Lower	3.25	113	< .001
HPD	t-test	−1.236	113	0.219
	TOST Upper	−5.173	113	< .001
	TOST Lower	2.70	113	0.004
TPD	t-test	−1.276	108	0.205
	TOST Upper	−5.125	108	< .001
	TOST Lower	2.57	108	0.006
Self-Presentation	t-test	1.401	114	0.164
	TOST Upper	−2.554	114	0.006
	TOST Lower	5.36	114	< .001
Loneliness	t-test	4.511	118	< .001
	TOST Upper	0.493	118	0.689
	TOST Lower	8.53	118	< .001
Self-Esteem	t-test	−6.602	124	< .001
	TOST Upper	−10.700	124	< .001
	TOST Lower	−2.50	124	0.993
Extraversion	t-test	−2.764	110	0.007
	TOST Upper	−6.658	110	< .001
	TOST Lower	1.13	110	0.130

Welch's t-test

Facebook Usage Intensity The mean number of hours spent on Facebook per day was 66.6 (SD = 81.5) minutes, while the number of times a user accessed Facebook per day was 3.44 (SD = 3.46) times. Hence, the average duration of a session was 19.4 minutes. The usage intensity classified by PFU status ('at-risk' vs 'not at-risk') was also examined and presented in Table 4. The tables suggest an average session duration for 'at-risk' and 'not at-risk' individuals as 27.8 (SD = 37.8) minutes and 22.5 (SD = 34.1) minutes. Tests of the significance of the difference in the usage intensity of 'at-risk' and 'not at-risk' users (see Table 5) indicated that

Table 4 Group descriptive of usage intensity

	Group	N	Mean	SD	SE
HPD	Not at-risk	449	58.70	75.70	3.573
	At-risk	27	198.06	59.43	11.437
TPD	Not at-risk	449	3.06	3.13	0.148
	At-risk	27	9.78	2.49	0.478
ASD	Not at-risk	449	22.53	34.13	1.611
	At-risk	27	27.76	37.76	7.268

Table 5 Independent Samples T-Tests

	Statistic	df	p	Mean difference	SE difference	Effect Size (Cohen's d)
HPD	−9.390	474	< .001	−139.36	14.842	−1.861
TPD	−10.949 [a]	474	< .001	−6.72	0.614	−2.170
ASD	−0.769	474	0.443	−5.23	6.805	−0.152

HPD Facebook hours per day, *TPD* Frequency of Facebook use per day, *ASD* average session duration. [a] Levene's test is significant (p < .05), suggesting a violation of the assumption of equal variances

'at-risk' individuals significantly used Facebook for longer durations and higher frequency daily. However, the average session length was not significantly different.

Assessment of Mediation

Self-Presentation The results from the Baron and Kenny's (1986) causal step approach show that loneliness positively predicts PFU (β = .12, $z = 2.34$, $p = .020$). Regarding self-esteem, the results suggest that it negatively predicts PFU (β = − .19, $z = -3.40$, $p < .001$). Analyzing the indirect effects reveals that self-presentation significantly mediates the relationship between loneliness and PFU (β = .05, $z = 2.43$, $p = .015$) and similarly between self-esteem and PFU (β = .02, $z = 2.10$, $p = .036$).

The bootstrapping approach provided similar results indicating that self-presentation mediates the relationship between loneliness and PFU (effect = .09, 95% C.I. [0.01,0.19], $p = .030$) and similarly between self-esteem and PFU (effect = .03, 95% C.I. [0.01,0.05], $p = .004$).

Extraversion Analyzing the indirect effects reveals that extraversion significantly mediates the relationship between self-esteem and PFU (β = .07, $z = 2.28$, $p = .022$). Extraversion was not found to significantly mediate the relationship between loneliness and PFU (β = .01, $z = 1.80$, $p = .072$). According to the Baron and Kenny (1986) causal step approach, given that the intervening effect of extraversion was not significant further evaluation for mediation ceased.

The bootstrapping approach provided similar results indicating that extraversion mediates the relationship between self-esteem and PFU (effect = .06, 95% C.I. [0.01,0.1], $p = .008$). Further, the indirect effect of loneliness on PFU (effect = .02, 95% C.I. [−0.02,0.07], $p = .298$) when mediating for extraversions was found to be insignificant.

Total Effects and Percent Contribution Further, the results suggest that even after accounting for the mediating role of self-presentation, loneliness has an overall positive impact on PFU (β = .17, $z = 3.77$, $p < .001$). When accounting for the mediating roles of self-presentation and extraversion the effect of self-esteem was found to be overall negative (β = − .1, $z = -2.12$, $p = .034$). Calculation of the proportion of the effect mediated based on the formula 1 – c'/c (Ananth, 2019; Baron & Kenny, 1986) suggests that self-presentation accounts for 33.6% of the total effect of loneliness on PFU i.e., partial mediation. While the cumulative interaction of extraversion and self-presentation result in a 47.6% decrease in the direct effect of self-esteem on PFU i.e., there is inconsistent mediation where the exogenous variables act as suppressors on the endogenous variable. The derived model of the mediated relation of loneliness and self-esteem with PFU is shown in Fig. 3, the supporting direct and indirect effect obtained from the GLM mediation analyses is given in Table 6.

Discussion

In this study, the effect of self-esteem and loneliness on PFU was examined. In addition, the mediating roles of extraversion and self-presentation on these effects were evaluated. Thus, the hypotheses identified in the study were tested by analyzing direct and mediating effects. Accordingly, hypotheses H1 (a-b), H2 (a-c), H3 were accepted, and H2 (d) was rejected. Additionally, differences in relation to Facebook usage intensity were found to be significantly different between persons 'at-risk' of PFU in comparison to those 'not at-risk'.

The study revealed that extraversion had a mediator role in the effect of self-esteem on PFU. The inconsistent mediating effect of extraversion in the effect of self-esteem on PFU was determined. According to the data, extraverted behaviors improve as self-esteem increases. Additionally, higher levels of extraversion had a positive and significant effect on PFU. However, the direct effect of higher levels of self-esteem on PFU was negative. Accordingly, increased self-esteem negatively affected PFU through the extraversion mediation variable. Since the direct effect between self-esteem and PFU continues, extraversion was partially mediating. However, given that the indirect effect and the total effect are different the process follows what MacKinnon et al. (2007) refer to as inconsistent mediation. In this case, extraversion acts as a suppressor to the direct effect of self-esteem on PFU.

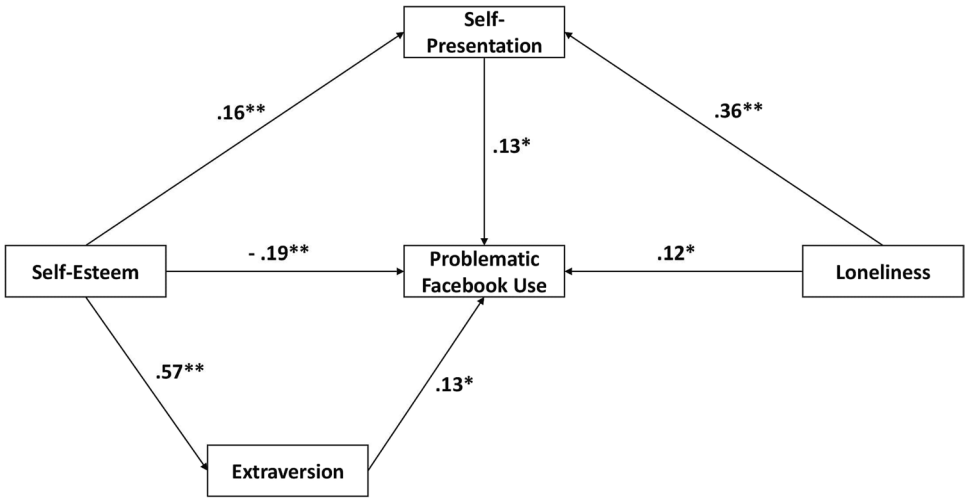

Fig. 3 *The proposed model on the mediated connection of loneliness and self-esteem on PFU. Note:* All reported estimates are the maximum likelihood standardized point-estimates. Significant point estimates with $p < .05$ are marked with an asterisk, while those with $p < .001$ are marked with two asterisks

Table 6 Indirect and Total Effects of the complex mediation model

Type	Effect	Estimate	SE	95% C.I. (a)		β	z	p
				Lower	Upper			
Indirect	Self_Esteem ⇒ Self_Pres ⇒ PFUS	0.0113	0.00536	7.59e-4	0.02179	0.0199	2.10	0.036
	Self_Esteem ⇒ Extraversion ⇒ PFUS	0.0409	0.01775	0.00614	0.07570	0.0723	2.31	0.021
	Loneliness ⇒ Self_Pres ⇒ PFUS	0.0856	0.03517	0.01668	0.15453	0.0455	2.43	0.015
Component	Self_Esteem ⇒ Self_Pres	0.0706	0.01887	0.03365	0.10762	0.1590	3.74	< .001
	Self_Pres ⇒ PFUS	0.1596	0.06285	0.03642	0.28277	0.1253	2.54	0.011
	Self_Esteem ⇒ Extraversion	0.2527	0.01664	0.22009	0.28531	0.5709	15.19	< .001
	Extraversion ⇒ PFUS	0.1619	0.06942	0.02588	0.29799	0.1267	2.33	0.020
	Loneliness ⇒ Self_Pres	0.5364	0.06272	0.41348	0.65934	0.3633	8.55	< .001
Direct	Self_Esteem ⇒ PFUS	−0.1063	0.03159	−0.16823	−0.04439	−0.1879	−3.36	< .001
	Loneliness ⇒ PFUS	0.2175	0.09245	0.03633	0.39874	0.1157	2.35	0.019
Total	Self_Esteem ⇒ PFUS	−0.0559	0.02631	−0.10745	−0.00434	−0.0984	−2.12	0.034
	Loneliness ⇒ PFUS	0.3293	0.08744	0.15790	0.50067	0.1743	3.77	< .001

Confidence intervals computed with method: Standard (Delta method); Betas are completely standardized effect sizes

This mediational pathway may be interpreted by considering theoretical associations existing between extraversion and a heightened sensitivity to rewards, need for interaction-based stimulation and 'social extension'. Studies show self-esteem and extraversion are correlated as persons with high self-esteem are more likely to attach desirable characteristics to themselves. Therefore, high self-esteem should increase social desirability and the willingness to engage in extraverted behaviors (Paulhus & Reid, 1991; Robins et al., 2001). This is supported by evidence showing a strong positive correlation between body-esteem (attitudes, evaluations, and feelings an individual holds about various parts of their body and the appearance of those parts) and self-esteem (Skorek et al., 2014). Research suggests that extraversion predicts a higher frequency of status updates, which in turn may result in higher levels of positive feedback (i.e., higher Likes counts) (Corr, 2004; Mitchell et al., 2007). This provides the need affordance related to positive interaction, which ultimately may promote an increase in PFU. Scholars propose that extraverts will partake in activities if they find it significant, enjoyable and if it facilitates their need for social interaction and being appreciated for their expression of their 'real' self (DeYoung et al., 2013; Eysenck, 1967; Servidio, 2014). Further, the Social Enhancement Hypothesis proposes that persons such as those with higher extraversion who are 'popular' in the real-world seek to extend their social interactions and amplify their popularity by using Facebook (Tosun & Lajunen, 2010; Zywica & Danowski, 2008). However, the data suggest that the direct effect of high self-esteem is to lower PFU, possibly due to a high likelihood of significant real-world relationships. Therefore, as proposed in multiple studies an individual's predisposition to higher PFU is linked to a coping mechanism (Akin & Iskender, 2011; Buckner et al., 2012). If self-esteem is

high and individuals are satisfied with what others, see or perceive about them in the real-world there is less motivation to self-present an online persona (Sun et al., 2017; Yu et al., 2010; Zhao et al., 2008).

The study revealed that self-presentation had a mediator role in the effect of self-esteem and loneliness on PFU. The partial mediating effect of self-presentation in the effect of loneliness on PFU and the inconsistent mediation effect of self-presentation in the effect of loneliness on PFU were determined. According to the data, self-presentation increases as loneliness increases. Further, as feelings of loneliness increases, there is a corresponding positive and significant effect on PFU. Accordingly, increased feelings of loneliness positively affected PFU through the self-presentation mediation variable. However, since the direct effect between loneliness and PFU continues, loneliness was partially mediated. The data also revealed that engagement in the use motive of self-presentation increases with higher self-esteem. Further, self-presentation showed a positive effect on PFU. While self-esteem has a positive effect on self-presentation, self-esteem had a negative and significant direct effect on PFU. Accordingly, increased self-esteem negatively affected PFU through the self-presentation mediation variable. Therefore, inconsistent mediation was also observed in the mediating effect of self-presentation on the interaction between self-esteem and PFU i.e., self-presentation had a suppressing effect.

The intervening role of self-presentation in loneliness can be explained by an assumed rational choice to seek to cope with a lack of sufficient social interaction in the real-world by seeking relationships on social media. Self-presentation is a process of presenting controlled images of oneself to audiences to affect others' opinions of them to produce a desired outcome, such as approval or reduce disapproval (Omar & Subramanian, 2013). Therefore, through self-promotion as a form of self-presentation an individual can more likely acquire the needs affordance desired through social media i.e., social media has utility in potentially reducing loneliness. The motivating desire to reduce loneliness and the positive feedback of successful self-presentation may then lead the individual to increase usage intensity in hopes of increasing utility (Chen, 2019; Montag et al., 2021; Tarafdar et al., 2020; Wang et al., 2015). However, this increases the likelihood of maladaptive cognitive response where increased use is no longer tied to utility (Smith & Short, 2022).

Research suggests that self-esteem is not related to self-presentation (Krämer & Winter, 2008; Mehdizadeh, 2010), however, it is possibly related to the form of self-presentation employed (Bober et al., 2021). It is proposed that self-presentation is a tool used to strengthen self-esteem, with successful self-presentation having a positive effect and unsuccessful self-presentation having a negative effect on self-esteem levels (Leary & Hastorf, 1996; Yang & Brown, 2016). Lewis and Neighbors (2005) interpretation of self-presentation suggests that it serves to enhance or strengthen self-concepts and feelings of self-worth. Therefore, successful self-presentation will provide the desired aim of enhancing already high self-esteem. It follows that having the need for increased feelings of self-worth afforded by online social recognition gives social media utility, which can stimulate increased usage intensity and potentially maladaptive cognitive responses. Chen and Kim (2013) suggest that based on the Theory of Uses and Gratification that excessive social media use is driven by diversion, self-presentation and relationship building, which align with the individual's specific emotional and psychological needs.

Although not a primary aspect of the study, it was determined that the prevalence of problematic use among the university students was 6.0%. Studies from numerous countries report different PFU prevalence rates ranging from 2% to 10% among adolescents and young adults (Ahmed & Hossain, 2018; Marino et al., 2018b). However, due to inconsistent psychometric assessments, heterogeneous theoretical frameworks, and multiple measurement tools it is difficult to compare prevalence rates (Bányai et al., 2017; da Veiga et al., 2019; Kuss & Griffiths, 2017). Additionally, it was also observed that 'at-risk' users had significantly higher usage intensity than users deemed 'not at-risk' based on a monothetic approach of differentiation. It was observed that daily total use and frequency of use were significantly different, however, the average duration of a session was not. The majority of contemporary studies suggest that while usage intensity is related to PFU, high usage intensity does not imply PFU as average use or acceptable use is tied to societal/group norms and platforms, making it subjective (Boer et al., 2021; Smith & Short, 2022). However, this study's findings do indicate a significant difference in usage patterns between risk classifications. Therefore, it is possible that the identifiable link between usage intensity and PFU is the pattern of usage rather than 'absolute' use, such as session duration.

This study has several research implications. First, the conceptualization of the interaction of psychological factors with FPU and the intervention in this relationship by personality traits and use motives provide a broad foundation for future inquiry that could advance our understanding of the process through which psychological factors influence PSMU. Second, it highlights the multi-dimensional relationship of psychological factors such as self-esteem, suggests that both high- and low-self-esteem can be associated with PFU through different interactive mechanisms. Thus, the approach to identifying predisposing factors should not be oversimplified in clinical analysis. Third, this type of study helps develop a susceptibility profile of social media users, particularly inclusive of personality traits that may be persistent throughout life and are determinants of behavior, which

is pivotal in identifying at-risk groups. Fourth, insight into the relationship between Facebook usage intensity and PFU was also obtained, which may provide a new perspective to defining the relationship between the two factors. This is useful in the development of strategies and approaches to identify at-risk persons, potentially diagnose the underlying cause of not the negative outcome associated with problematic Facebook use but also the push factors. This can potentially allow practitioners to better identify and treat the root causes of the observed negative outcomes. Fifth, studies that increase understanding of problematic social media use are important given the ever-increasing number of social media users, the evolution of these media through Artificial Intelligence, which seek to enhance attractiveness to users through pattern learning algorithms and the links of the studied psychological factors and problematic use itself to psychopathologies such as depression and anxiety.

While Facebook remains a major contender among Social Networking Sites other platforms such as Instagram and TikTok are becoming increasingly popular (Montag et al., 2021; Smith & Short, 2022), particularly among adolescents. Therefore, it is also important that researchers examine other platforms such as Instagram and TikTok. Smith and Short's (2022) recent study emphasizes the need for studying these new platforms by demonstrating that behavioral patterns and the underlying problematic use pathways differ between platforms.

Limitations

As with all studies, there were some limitations that must be identified and considered to frame the interpretation of the results and provide a path for improvement in future work. First, causal conclusions or the direction of effects could not be established due to the cross-sectional research design. For this reason, it cannot be ruled out that, in some cases, there may have been bi-directional influence. Such as changes in self-esteem and loneliness resulting from PFU in the short or long-term. It should be considered in future work that while loneliness and low self-esteem may motivate Facebook use through coping processes, it is also possible that they may result from negative or unsuccessful self-presentation experiences on social media. Future studies, employing longitudinal designs might help further clarify the nature of the underlying mechanism linking the observed endogenous and exogenous variables. Second, the study used self-report measures to assess PFU and variables related to psychological factors, personality traits and use motives rather than clinical tests and conditions. Further, researchers repeating the study should consider using the long version of the personality trait scales i.e., a more extensive personality assessment. Third, given that the study was performed during the COVID-19 pandemic, which presents environmental factors such as lockdowns, fear of COVID-19, mandatory remote school etc. which may decrease the opportunity for real-world interaction. Hence, to maintain social interaction/connectivity, individuals increased social media use. Further, the conditions increase the time spent online and hence the opportunity for social media use. Fourth, since the sample was done on university student the sample may not be generalizable to the broader population. Lastly, self-response surveys are generally limited to by its dependence on a user subjective perception of their own behavior and thus may not be an accurate representation of their 'true' behavior. Future, studies may seek to examine actual behavior by using software applications that can capture information on a participant's real use.

Conclusion

The current study demonstrated significant relationships between higher feelings of loneliness and low self-esteem with PFU. Further, these interactions are mediated by extraversion and self-presentation. Specifically, self-esteem which is negatively correlated to PFU was found to be inconsistently mediated by extraversion and self-presentation, while loneliness is partially mediated by self-presentation. Self-presentation was found to increase the effect size of loneliness on PFU. Conversely, extraversion and self-presentation had a suppressing effect on self-esteem's negative relationship with PFU. However, the overall effect remained negative. This still suggests a dual action of self-esteem with low self-esteem increasing PFU through a coping mechanism and high self-esteem potentially increasing PFU through its interaction with other personality traits and use motives. Therefore, the interaction between self-esteem and PFU be considered complex and sensitive to initial conditions. Thus, the current study adds to the argument that certain personality traits and use motives are essential in understanding the relationship between psychological factors and PFU. Further, the interaction between psychological factors and PFU is complex and cannot be fully understood in isolation from other factors.

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Author contribution There was one sole contributor to this study/manuscript.

Data availability Data can be made available upon reasonable request to the author.

Declarations

Conflicts of interest/Competing None to report

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