Original Research Article

The Effect of Loneliness and Life Satisfaction on Problematic Internet Use

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ABSTRACT

Few innovations in history have left such an indelible mark on people's daily lives as the Internet has, representing a boundless and endlessly exciting frontier of human ingenuity and connectivity. However, its ever-increasing importance and variety of activities has led to its uncontrolled use, known as problematic Internet use. The relationship between problematic Internet use and psychosocial well-being, including loneliness and life satisfaction, has greatly attracted much research interest over the years, with consistently mixed findings. Therefore, the current study examined the effect of loneliness and life satisfaction on problematic Internet use. A factorial (2x2) independent measures ANOVA was used with a total of 200 participants, of which 125 were females and 75 were males aged 18 to 49 years (M=25.7; SD=7.27). The UCLA Loneliness Scale, Satisfaction With Life Scale and Problematic Internet Use Questionnaire were administered. The results revealed that there was a significant main effect of loneliness on problematic Internet use $(F(1,196)=18.05, p<0.001)$. Similarly, life satisfaction significantly affected problematic Internet use $(F(1,196)=13.1, p<0.001)$. However, the interaction effect of loneliness and life satisfaction on problematic Internet use, produced non-significant results $(F(1,96)=3.46, p=0.064)$. The limitations of the study were also discussed. Further research is needed to explore the longitudinal patterns of problematic Internet use, including additional influencing factors, in order to facilitate targeted interventions and prevention strategies.

Keywords: Problematic Internet use (PIU), Loneliness, Life Satisfaction, Online Communication, Social Isolation

INTRODUCTION

The Internet has nowadays become an integral part of our lives as it is not only a tool, but a social environment (Musetti & Corsano, 2018). It is viewed with both optimism and concern (Dahl & Bergmark, 2023), since although it can positively affect an individual's social development (enhancing self-confidence, unity, exposure to new ideas etc.) (Borca et al., 2015), it carries a serious risk of excessive use, known as Problematic Internet Use (PIU) (Schimmenti et al., 2014). Problematic Internet Use is defined as ''the uncontrollable Internet use behavior'' (Beard & Wolf, 2001), which can have negative psychological, academic, and occupational consequences (Saletti et al., 2021) and significantly affect the individual's social functioning (Zhang et al., 2014). The constructs that PIU includes and appear to be responsible for its negative effects are neglect of basic drives, obsession with Internet activities, and control disorder as well as conflict, withdrawal or experiencing a bad mood when Internet is not accessible (Demetrovics et al. 2016). Different labels

have been used in the literature to characterize Internet-related behavioral problems, including ''Internet addiction'', however Problematic Internet Use appears to be a more appropriate psychological term that describes a broader range of issues other than addiction, such as stress and compulsive behavior (Prievara et al., 2019; Yellowlees & Marks, 2007). Indeed, although problematic Internet use is not listed in the Diagnostic and Statistical Manual of Mental Disorders (DSM-5), it has been proven to be mediated by increased psychological distress (Wong et al., 2015) and closely linked to psychopathologies such as Internet Gaming Disorder (Casale et al., 2021) and Major Depressive Disorder (Lakkunarajah et al., 2022).

Undoubtedly, it is considered a public health issue across all countries and age groups and its prevalence ranges from 20% to 44.6% globally (Cai et al., 2023; Endomba et al., 2022), with particularly high rates after the onset of the COVID-19 disease (Alheneidi et al., 2021). More specifically, findings indicate that PIU increased 1.5 times during the COVID-19 pandemic, especially in the vulnerable population of young adults, since social isolation led them to use Internet excessively as a coping mechanism for negative psychosocial outcomes caused by lockdown (Oka et al., 2021; Sun et al., 2020). Under the umbrella of the term PIU are included, among others, the problematic use of social media and networking sites, online games, gambling, viewing pornography and online shopping (Fineberg et al., 2018; Ioannidis et al., 2018). Consequently, everyday activities can easily become uncontrollable as Internet features such as anonymity, convenience, private communication, and escapism can result in PIU (Young, 2001) and this in turn, in a series of physical and mental problems (memory loss, emotional problems, insomnia etc.) (Goto, 2017; Mahamid et al., 2022; Sun et al., 2017).

Even though PIU is a relatively new phenomenon, it is widely discussed and its association with psychosocial wellbeing has caused a great debate in the academic literature (El Asam et al., 2019). Loneliness is one of the most common psychosocial dysfunctions found to strongly predict excessive, addictive, or problematic Internet use with consistently moderate to high effect sizes (Ceyhan & Ceyhan, 2008; Ostovar et al., 2016; Reed et al., 2023). It is defined as ''an unpleasant emotional experience caused by a person's lack of interpersonal relationships both quantitatively and qualitatively'' (Perlman & Peplau, 1981; Zhao et al., 2016). Some researchers have demonstrated that loneliness may have a direct or an indirect effect on PIU mediated by variables such as depression, shyness, family support and interpersonal problems (Huan et al. 2014; Kim et al., 2017; Wongpakaran et al., 2021). This can be explained by the Social Needs theory, which states that individuals with high levels of loneliness use Internet problematically to compensate for the absence of actual relationships and avoid coping with adverse emotions caused by social isolation (Zhen et al., 2019). It is also widely proven that people who experience loneliness are more susceptible to excessive use of Internet (Fan et al., 2022; Harlendea & Kartasasmita, 2021; Musetti et al., 2020; Simcharoen et al., 2018; Whang et al., 2003), as it provides them with an ideal social environment to develop their lacking social skills without inhibitions, which according to the Social Skills Account Model is the main characteristic of lonely individuals that leads them to avoid face-to-face interaction and ultimately, to overuse Internet for companionship and communication (Caplan, 2005). However, numerous studies have shown that Internet-dependent engagement in online communication in an effort to seek validation and social bonding does not solve the problem of loneliness, but instead leads to a vicious cycle of poorer interpersonal relationships, deeper loneliness, and, therefore, elevated levels of PIU mainly due to its lack of intimacy and emotional depth (Huan et al., 2014; Milani et al., 2009; Shi et al., 2017). Consequently, while online

communications may provide a temporary sense of social connection, in reality they are superficial and weak and create unrealistic expectations of social interactions in lonely individuals, while increasing feelings of social comparison and inadequacy (Kavaklı & Ünal, 2021).

Besides online communication, lonely individuals engage in Internet activities problematically (watching videos/movies, playing online games, online shopping) with a bidirectional relationship, where loneliness can be both the cause and the result of PIU (Kim et al., 2009; Moretta & Buodo, 2020). This implies that the Internet can either isolate individuals by fostering a hypocritical and delicate web of connections that undermines real-world relationships, or it can attract lonely individuals seeking interactive online social activities that offer a feeling of belonging and companionship (Zhang et al., 2018). A large meta-analysis of 26 articles made evident the significant moderate relationship of loneliness and PIU since individuals who made an excessive use of Internet, had high rates of loneliness (Saadati et al., 2021). Similarly, Costa et al. (2019), using a sample of young adults, ascertained that problematic Internet use was predicted by loneliness in both males and females with a particular preference for social networks and chatting. This was also observed during COVID-19 lockdown as research noted a dose-response relationship (biological gradient phenomenon) between loneliness and PIU (Alheneidi et al., 2021). However, findings showed that high Internet use resulted in low levels of loneliness and increased social support in a sample of much older adults (Heo et al., 2015). Indeed, some studies indicate that loneliness can have a positive effect on PIU, as lonely adults might manage to meet interpersonal needs by engaging in Internet activities and significantly reduce their loneliness (Boylu & Günay, 2019; Hasmujaj, 2016). Hence, unsurprisingly, Internet has been repeatedly used as a therapeutic intervention (e.g., iCBT, iMBSR, iPDT etc.) to deal with loneliness, since activities such as sending e-mails, searching for information, and playing online games can serve as social supports and distract individuals' attention from the lonely situation they are in (Choi et al., 2012; Käll et al., 2020; Stuart et al., 2023). On the contrary, there are studies that do not agree with the above findings, indicating that loneliness has a not statistically significant effect on PIU (Eldeleklioğlu, 2008; Eldeleklioğlu & Vural, 2013). The observed discrepancies in the findings may stem from variations in individuals' Internet use, the purposes behind their usage, and the specific nature of the Internet services accessed (Li, O'Brien, Snyder, & Howard, 2015). Therefore, the above inconsistent results combined with the lack of empirical studies do not make clear the relationship between the two variables, which should be further examined.

While the literature has mainly focused on the relationship between problematic Internet use and loneliness, limited research has examined its association with other psychosocial vulnerabilities including life satisfaction (Bozoglan et al., 2013). Life satisfaction is a measure of well-being, which includes both an emotional and cognitive dimension (subjective well-being) (Çapan, 2010; Dorahy et al., 2000) and is assessed by factors such as achieved goals in life, economic safety, social relationships, positive self-concept and self-perceived abilities (Keser, 2005). Numerous studies have observed a positive relationship between Internet use and life satisfaction since Internet has been repeatedly shown to provide resources and opportunities for greater well-being (promoting social status, professional activity, and education etc.) as well as, building social relations, which result in better social and economic life, psychological empowerment, self-sufficiency, a better quality of life in general (Fowler et al., 2015; Lissitsa & Chachashvili-Bolotin, 2016; Zillien & Hargittai, 2009) but also sometimes in problematic Internet use (Cao et al., 2011). Notably, studies revealed that individuals who were satisfied with their lives, especially in terms of friend

satisfaction (Idriyani et al., 2021; Wang et al., 2010), had used Internet problematically in order to stay socially connected, create or maintain relationships and avoid feeling left out. This is called fear of missing out (FOMO), which mediates the relationship between life satisfaction and PIU (Elhai et al., 2018), and to which satisfied individuals appear to be more susceptible as they may have high expectations for their social experiences and feel more pressure to maintain their social status (Baker & Oswald, 2010). However, contradicting findings indicate that high levels of life satisfaction can act as a protective factor against PIU as they are usually associated with less problematic behavior (Sun & Shek, 2012) and elevated levels of social support, self-esteem and social skills (Rezaei & Jeddi, 2020). Therefore, although there is a positive relationship between these two variables (Cao et al., 2011), in the long run it seems that individuals who spend all their time on the Internet will prefer the virtual environment, become lonelier and ultimately, their life satisfaction will be significantly reduced (Narci, 2022).

As a matter of fact, problematic Internet use has been linked to lower levels of life satisfaction in numerous studies (Błachnio et al., 2019; Cai et al., 2023; Cao et al., 2011; Çelik & Odacı, 2013; Dočkalová et al., 2021; Kabasakal, 2015; Mohamid et al., 2022; Telef, 2016) and are associated with significant psychosocial problems, such as anxiety and interpersonal issues (Wongpakaran et al., 2021; Xie et al., 2021). Shanaz & Karim (2014) concluded that adults with low levels of self-esteem and life satisfaction, due to high availability and accessibility of the Internet, had higher levels of problematic Internet use. It was also noted that individuals who are dissatisfied with their lives may turn to Internet as a means of escaping negative emotions and fulfilling unmet social needs (e.g., self-expression), which is in accordance with Baumeister's Self-Escape Theory (Baumeister 1990). It is quite interesting that males tend to exhibit more problematic Internet use than females

(Mei et al., 2016), as they are more inclined to engage in online gaming, which is strongly associated with addictive behaviors and low life satisfaction (Király et al., 2014) compared to Internet pornography (Pawlikowski et al., 2014) or social networking sites (Kuss & Griffiths, 2017). This behavioral addiction leads dissatisfied with life individuals to devote more time to the Internet and neglect beneficial to well-being activities (e.g., pursuing hobbies, spending time with friends, being physically active etc.) which in turn, results to decline in academic performance, deterioration in interpersonal relationships, and avoidance of problems (Al-Menayes, 2015; Li et al., 2021). Nevertheless, Bozoglan et al. (2013) found that life satisfaction was the final factor that affected problematic Internet use, suggesting that low life satisfaction may lead to increased Internet use as a way of coping with loneliness, low self-esteem or other negative emotions. Correspondingly, previous research has indicated an absence of a direct relation between Internet and social media addiction with life satisfaction (Apaolaza et al., 2013; Hawi & Samaha, 2017; Valkenburg et al., 2006), suggesting that additional factors such as individual differences in personality or social support should be also considered. Likewise, Alqahtani et al. (2020) found no significant relationship between PIU and life satisfaction in young adults, which findings may have been influenced by cultural and contextual differences. Consequently, these mixed results highlight the complexity of the relationship between problematic Internet use and life satisfaction and indicate that there may be other factors at play that need to be investigated.

Examining loneliness and life satisfaction separately with problematic Internet use appears to be complex and multifaceted, which makes it even harder to fully understand their underlying mechanisms and create a clear picture of how these variables interact and cooperatively affect PIU as they can be influenced or mediated by various factors, with findings once again being

puzzling. For instance, Deutrom et al. (2022) found that loneliness and life satisfaction significantly predicted problematic Internet use among workers during the COVID-19 pandemic. However, life satisfaction did not have a direct effect on PIU, indicating that loneliness fully mediated their relationship, which may have been also affected by the unique circumstances of working from home. These results are in line with Bozoglan et al. (2013), since they demonstrated a significant relationship between loneliness, self-esteem, life satisfaction and Internet overuse and which were also found to be predictors of interpersonal and health problems. Of great interest is that loneliness was the most influential factor associated with compulsive Internet use on young adults while, life satisfaction had an indirect effect on PIU via self-esteem. Moreover, Idriyani & Hidayatullah (2021) observed a significant interaction effect of life satisfaction and loneliness on PIU, with higher levels of loneliness and lower levels of life satisfaction associated with greater PIU, to a magnitude proportionate of 57.2%; whereas Owodunni (2022) noticed a joint contribution of 84.1% variance from both loneliness and life satisfaction to PIU. The importance of addressing loneliness and promoting positive life satisfaction through the cultivation of social support and positive relationships from the offline environment is underscored in endeavors to prevent PIU (Prievara et al., 2019). The cyclical nature of this relationship implies that those experiencing loneliness may turn to the Internet for relief, only to find themselves caught in a pattern of excessive use that further deepens their feelings of isolation and negatively impacts their overall life satisfaction. However, contrary findings contend that there is no significant correlation among students' Internet addiction, loneliness, and life satisfaction (Turan et al., 2020). This observation can be attributed to the literature's common assertion that loneliness and life satisfaction typically exert a direct impact on the Internet, rather than mutually interacting to shape the outcome. In a similar study conducted among college students, no significant relationship was identified between excessive Internet use, loneliness, and life satisfaction ($p > 0.01$), which may not be representative due to the exclusive inclusion of females in the sample and the limited cultural context (Alqahtani et al., 2020).

Undoubtedly the relationship between loneliness, life satisfaction and problematic Internet use is intricate and challenging and requires careful examination of various external factors. The current study, by shedding lights on the factors influencing PIU, will provide a valuable insight as well as, it will significantly contribute to the scarce material of PIU. Although PIU is a widespread phenomenon and has received a lot of attention in the last decades, the amount of research remains limited, especially regarding its relationship with life satisfaction, and the findings seem to be inconsistent. Moreover, apart from an attempt to resolve some contradictions in the literature and bridge the research gap, this study will reveal the effect of these two variables on PIU and not simply assess their relationship, which is common in the majority of related studies. Finally, the effect of loneliness and life satisfaction on problematic internet use was thoroughly examined during the COVID-19 pandemic and was greatly affected by the lockdown and social isolation (Alheneidi et al., 2021; Deutrom et al., 2021; Reed et al., 2023). For this reason, it would be of great interest to observe their cooperatively impact on PIU immediately after the COVID-19 period, as research suggests, in order to explore longitudinal post-pandemic patterns. Therefore, the (two-tailed) experimental hypotheses are: (H1) There is a significant main effect of loneliness on problematic use of Internet. (H2) There is a significant main effect of life satisfaction on problematic use of Internet. (H3) There is a significant interaction effect between loneliness and life satisfaction on problematic use of Internet.

MATERIALS & METHODS

Design

In the present study, a factorial 2x2 independent measures ANOVA was used consisting of two interval independent variables (Loneliness- Life Satisfaction) and a dependent variable (Problematic use of Internet). The participants, based on their responses, were divided into 2 groups on each condition; namely, High Loneliness-Low Loneliness and High Life Satisfaction-Low Life Satisfaction.

Participants

A G*Power analysis was conducted to determine the minimum sample size to achieve a moderate effect size consistent with previous related research (Alheneidi et al., 2021; Deutrom et al., 2021), which was found to be at least 196 participants. The minimum threshold was exceeded and a total of 200 participants took part in the research, of which 125 were females and 75 were males, from 18 to 49 years old with a mean age of 25.7 years (SD= 7.27). Sampling was opportunistic (non-probability-based sampling), and participants were recruited from Greece and selected based on their availability. The inclusion criteria were Internet users aged 18 to 49 years old. Participants over the age of 50 were excluded since research has shown that the cognitive functions of this age group decrease (Pliatsikas et al., 2019), risking to negatively affect the results of the present study, while at the same time people over 50 are less associated with Internet surfing and problematic Internet use (Ioannidis et al., 2018). Other exclusion criteria were people under the age of 18, individuals who have been diagnosed with Internet Addiction, who are under medication or suffer from physio-psychological conditions.

Materials

Three Likert scale questionnaires were used to conduct this study. The first questionnaire used was the UCLA Loneliness Scale (Version 3) (Russell, 1996), a 20-item questionnaire that measures feelings of social isolation and loneliness. This scale includes questions including: 'How often do you feel that you are no longer close to anyone?' or 'How often do you feel alone?' but also, 9 reverse questions such as 'How often do you feel that you are "in tune" with the people around you?', as a way of addressing potential response bias. Participants answer on a scale from 1 (Never) to 4 (Often) and therefore, a possible minimum total score of 20 and a maximum of 80, where higher scores indicate higher levels of loneliness. The UCLA Loneliness Scale (Version 3), according to Cohen (1988), has a moderate effect size (α= 0.72) and was chosen due to the fact that it has been widely tested and supported as it is considered a reliable and robust questionnaire (Zarei et al., 2016). The questionnaire assessing life satisfaction is the Satisfaction With Life Scale (SWLS) (Diener et al., 1985), which contains 5 items and measures cognitive judgments of life satisfaction on a 7-point scale ranging from 1 (Strongly Disagree) to 7 (Strongly Agree). The total score can reach a minimum of 5 points and a maximum of 35 points, of which higher scores equate to greater life satisfaction. Some items included in the scale are: "In most ways my life is close to my ideal", "So far, I have gotten the important things I want in life" and "If I could live my life over again, I would change almost nothing". This questionnaire is reported to have strong internal consistency with a large effect size (α = 0.87) and was selected for its documented validity and reliability as well as its time-saving brevity (Magyar-Moe, 2009; Maroufizadeh et al., 2016). The last questionnaire used was the Problematic Internet Use Questionnaire (PIUQ) (Demetrovics et al., 2008), which consists of 18 items and was created to assess the problematic and excessive Internet use, without however implying or diagnosing individuals with any type of Internet addiction. Participants rated the questionnaire statements with a 5-point Likert scale (never, rarely, sometimes, often, always) and the overall scores ranged from 18 to 90 points, with higher scores indicating

an increased risk of problematic Internet use. According to a study by Kelly & Gruber (2010), the PIUQ is governed by three factors: Obsession (obsessive thinking about the Internet) (α=0.85), Neglect of offline and daily activities (α=0.74) and Control disorder (i.e. inability to control Internet use) (α=0.76). Some examples of questions included in PIUQ are: "How often do you feel tense, irritated or anxious if you cannot use the Internet for as long as you want?" or "How often does using the Internet impair your work or your efficiency?". This questionnaire was used as it has been proven to be a reliable and valid measurement tool with a large effect size (α= 0.87) (Becker, 2000) in samples of different age groups and ethnicities (Koronczai et al., 2011; Mazhari, 2012; Lin & Kim, 2020). Finally, the calculation and summation of the total scores of each questionnaire was done using IBM SPSS Statistics 27.

PROCEDURE
The procedure began with the provision of an information sheet to the participants, which detailed the purpose, procedure and duration of the research (approximately 10 minutes) as well as, data use conduct and participant's rights to confidentiality and privacy (GDPR). Furthermore, participants were informed of their right to withdraw their data, up to two weeks, after conducting the research without having to give any explanation. The current study was conducted in accordance with the standards of the BPS Code of Human Research Ethics and the ethics form was approved by the academic supervisor. Participants were then presented with a consent form and after agreeing to participate freely and voluntarily in the study, they were asked to successively answer three different questionnaires. They additionally filled in their personal code (last 3 letters of their surname and last three digits of their phone number) to preserve their anonymity. After completion, participants were given a debrief sheet, which included further information

about the study and the contact details (emails) of the researcher and her supervisor in order to answer any questions or withdraw any participation.

RESULT
Before conducting the statistical analysis, it was first necessary to examine whether the parametric assumptions were met. By calculating skewness and kurtosis, it was shown that there is skewness both in high loneliness and life satisfaction after it exceeded the limit of +/- 1.96. Moreover, the z scores did not exceed the +/-3 limit, and no outliers were found. Graphs were also checked. Specifically, in Q-Q plots the points are relatively close to the line, histograms seem to be bell-shaped and have a normal curve and the boxplots, even though it appears to be an outlier in the low-loneliness and high-life satisfaction condition, for the most part they are proportional around the median and thus, symmetrically distributed. In addition, from the Kolmogorov-Smirnov test it was observed that low loneliness and high life satisfaction were normally distributed however, in the conditions of high loneliness and low life satisfaction it was found that $p<0.05$, which indicates a not normal distribution. Therefore, the parametric assumption of normal distribution is not met. For this reason, according to Field (2018), if some parametric assumption is not met, the level α can be adjusted to a stricter significance limit (e.g., 0.01) and continue the research with the parametric test, which was done in this case. Finally, Leven's Test showed that there was homogeneity of variance since $p>\alpha$ (p= 0.090).

After the appropriate changes were made (α= 0.01) the parametric test 'Factorial Independent Measures (between subjects) ANOVA' was conducted. This design was used to examine the effect of loneliness and life satisfaction on problematic Internet use. The mean number of problematic Internet use in each group is shown in Table 1.

Table 1. Mean (Std. Deviation) scores of Problematic Internet use in each experimental setting.

	High-Loneliness	Low-Loneliness	Total
High-Life Satisfaction	45.22 (10.60)	39.71 (11.00)	40.71 (11.08)
Low-Life Satisfaction	57.85 (14.06)	43.77 (13.15)	55.32 (14.87)
Total	55.58 (14.31)	40.45 (11.45)	

By examining Table 1, it appears that individuals with high loneliness and low life satisfaction score higher on problematic Internet use (M=57.85; SD=14.06) than individuals with high loneliness and high levels of life satisfaction (M=45.22; SD=10.60). In addition, individuals with low loneliness and low life satisfaction have greater problematic Internet use scores (M= 43.77; SD=13.15) compared to individuals with low loneliness and high life satisfaction (M=39.71, SD=11.00), who seem to have the lowest rates of problematic Internet use than all other conditions. Conversely, the highest problematic use scores were obtained in the high loneliness and low life satisfaction condition.

Data were analyzed using a 2 (loneliness) × 2 (life satisfaction) Factorial Independent measures ANOVA. There was a significant main effect of loneliness ($F_{(1,196)}=18.05$, $p<0.001$, $\eta2 = 0.063$) on problematic Internet use, demonstrating that high-loneliness participants experience greater problematic use of Internet, compared to individuals with low levels of loneliness. Similarly, there was a significant main effect of life satisfaction ($F_{(1,196)}=13.1$, $p<0.001$, $\eta2 = 0.045$) on problematic Internet use, indicating that high-life satisfaction participants have lower problematic Internet use scores, than low-life satisfaction participants. However, there was no significant interaction between loneliness and life satisfaction on problematic Internet use ($F_{(1,96)}=3.46$, $p=0.064$).

DISCUSSION

The present study examined the potential impact of loneliness and life satisfaction on problematic Internet use (PIU). The findings partially supported the research hypotheses, with results indicating a significant effect of loneliness on PIU with a medium effect size, providing support for hypothesis 1. Moreover, the analysis revealed a significant main effect of life satisfaction on PIU on a moderate level, thus confirming hypothesis 2. This suggests that both loneliness and life satisfaction have a moderate impact on PIU. However, the interaction effect of loneliness and life satisfaction on PIU was found to be non-significant, leading to the rejection of hypothesis 3.

Indeed, loneliness not only had a significant effect on problematic Internet use, but it was noticed that the higher the loneliness, the higher the rates of PIU. The findings of the current study are consistent with most of the previous literature research, indicating a positive relationship between them (Ceyhan & Ceyhan, 2008; Musetti et al., 2020; Ostovar et al., 2016; Simcharoen et al., 2018; Whang et al., 2003). More specifically, Harlendea & Kartasasmita (2021) and Reed et al. (2023), although they used a different statistical method, ascertained that lonely people aged between 18 and 51 had high levels of problematic Internet use, which fully agrees with the findings of this study. One possible explanation is that individuals who experience loneliness may use the Internet as a means of coping with feelings of social isolation. Online activities such as social media, gaming, and online communities provide a sense of belonging and social interaction that may be lacking in offline social relationships (Zhen et al., 2019). Hence, problematic Internet use, according to Social Needs theory, can become a substitute for actual social interactions which unfortunately, instead of relieving loneliness, can lead to further withdrawal from face-to-face interactions and loneliness exacerbation (Papacharissi and Rubin, 2000).

Moreover, the current study came in agreement with the results of Costa et al. (2019) who indicated that young adults who made problematic use of Internet had high feelings of loneliness, with a preference up to 90.6% for social networking sites and chatting via email and Internet forums.

Studies have repeatedly shown that lonely people prefer to use social networking sites since they prefer online communication, which allows them to self-disclose easily, while reducing the anxiety and discomfort that can be associated with face-to-face social situations (Boursier et al., 2020; O'Day & Heimberg, 2021; Yuldashev, 2021). This further reinforces the idea that Internet and online communication has an inherent connection with feelings of loneliness (Sharabi & Margalit, 2011). A possible evolutionary explanation is that, as the ancient philosopher Aristotle pointed out, 'humans are social beings by nature' and have the innate need to co-exist in social groups in order to survive (Kraut, 2002). Thus, lonely individuals, who live socially excluded, turn to the Internet in an attempt to find the social interaction and communication they seek, and by extension, their belonging to a social community (Caplan, 2005). This use, due to anonymity and convenience, can easily become problematic; albeit the absence of sensorimotor information during online communication hinders the ability of lonely individuals to establish deep connections with others (Pezzulo et al., 2019). Consequently, they may find themselves trapped in a vicious cycle of using Internet excessively to alleviate their loneliness, only to end up feeling even more disconnected and isolated than before.

Researchers who claimed that loneliness had a significant effect on problematic Internet use, and which is consistent with the present results, took place during the duration of COVID-19 strict measures and lockdown (2020-2023) (Deutrom et al., 2022; Fernandes et al., 2021; Reed et al., 2023). For example, Alheneidi et al. (2021) observed that during the COVID-19 lockdown, the lonelier Arab participants (n= 593) aged 18–35 felt, the more likely they were to engage in PIU, with young single women reporting higher loneliness scores and PIU than men. It seems that pandemic has significantly affected loneliness with an increase of up to 22% in Europe (Baarck et al., 2022) since it led to social distancing measures, quarantines, and restrictions on social gatherings and face-to-face interactions as well as, to elevated levels of anxiety and depression, which can further aggravate feelings of loneliness and social isolation (Holt-Lunstad et al. 2015). Nonetheless, the current study proved that even after the end of the lockdown, the levels of loneliness remain high and its effect on problematic Internet use is strong. This may be due to the long-lasting impact of the COVID-19 lockdown, as people still feel hesitant to socialize or interact in person for fear of contamination, preferring to do necessary activities online (e.g., online shopping, online work, Internet entertainment, chatting etc.), which result in problematic and dependent Internet use (Krendl & Perry, 2021). A further possible explanation is that lonely people have other psychosocial predispositions, including anxiety, depression and low self-esteem, which may act as mediators for the development of PIU (Huan et al. 2014; Kim et al., 2017; Wongpakaran et al., 2021). This intricate relationship gains heightened relevance during and after COVID-19 pandemic and the associated social isolation measures, with detrimental consequences for individuals' physical and mental health, academic or work performance, and interpersonal relationships (Kożybska et al., 2022; Kwak et al., 2022).

On the other hand, Boylu & Günay (2019) and Hasmujaj (2016) detected that individuals with high levels of problematic Internet use have reduced levels of loneliness, which contradicts the findings of the present study. These outcomes indicate that Internet can serve as a means for socializing and reducing loneliness since people who experience social obstacles and struggle to form close relationships may turn to excessive online use as a way to meet their interpersonal needs and create alternative social connections (Kubey et al., 2001). Conversely, Eldeleklioglu & Vural-Batik (2013), in contrast to the statistically significant results of the current research,

found that loneliness had no significant effect on Internet overuse of young Turkish individuals. The implication of this data, as in the aforementioned studies, suggests that the results may be explained by the fact that lonely youth may use Internet excessively as a way to connect with others in order to alleviate feelings of loneliness or for different reasons, such as academic or recreational purposes. It should be noted that these studies used different questionnaires than the present study used to assess the problematic Internet use (e.g., Internet Addiction Scale (IAS), Internet Addiction Test (IAT) etc.) with a mostly small age sample and cultural differences, which may therefore, account for the non-concordance of the findings.

Likewise, the present study revealed a significant main effect of life satisfaction on problematic Internet use. Specifically, a mirroring effect is observed where the lower the levels of life satisfaction among adults, the higher the problematic Internet use scores. These results are in line with the relevant literature (Błachnio et al., 2019; Cai et al., 2023; Dočkalová et al., 2021; Kabasakal, 2015; Telef, 2016). Previous studies ascertained that individuals who reported lower levels of life satisfaction, as well as in specific domains including family and friendships, academic performance, and living environment, tended to have higher scores on measures of PIU with a medium to small effect size (Cao et al., 2011; Mohamid et al., 2022), which is in in correspondence with the current findings. One possible explanation is that, according to Baumeister's Self-Escape theory (Baumeister, 1990), life-dissatisfied individuals use online activities problematically (online games, gambling, online shopping) as a form of escape from the pressures and stressors of everyday life, providing a temporary relief from negative emotions and mental states (boredom, emptiness, inadequacy or lack of purpose in their lives). Simultaneously, it seems that their self-image and self-worth can be boosted by validation and approval from other Internet users through likes and comments on social media (Baumeister, 2016; Liu & Baumeister, 2016; Magner, 2018; Stefanone et al., 2011). However, the implications of the relationship between life satisfaction and PIU are concerning as they can create unrealistic expectations or comparisons with others on social networking sites (Hassim et al., 2020) and result in adverse consequences for individual's mental health, social relationships, and overall well-being (Caplan, 2003; Restrepo et al., 2020; Stead & Bibby, 2017; Wongpakaran et al., 2021; Xie et al., 2021).

From a societal perspective, the findings might suggest that promoting life satisfaction may be a valuable approach to prevent or reduce PIU. This could involve interventions at various levels, such as providing support for individuals at risk for low life satisfaction, promoting positive social and community environments, and creating policies and programs that address the underlying social and economic factors that contribute to life dissatisfaction (Görzig et al., 2023; Howley, 2017; Ruggeri et al., 2020). Social support may also play a critical role in mediating this relationship and reducing the negative effects of PIU, with research showing that individuals who have strong social support networks (close friends and family) are less likely to engage in PIU behaviors (Çelik & Odacı, 2013; Hinojo-Lucena et al., 2019; Senol-Durak & Durak, 2011; Serin, 2011). Therefore, social support can provide a sense of acceptance and connection, which can reduce the feelings of loneliness and life dissatisfaction that are responsible for PIU and for this reason, its integration into treatment programs is deemed essential (Blau et al., 2019; Emerson et al., 2021).

Conversely, several studies in a young adult sample have revealed that PIU is positively associated with life satisfaction, indicating that individuals with higher levels of life satisfaction tend to have higher levels of PIU, probably because they create interpersonal relationships and do not feel socially excluded, which once more contrasts with

the results of this study (Fowler et al., 2015; Idriyani & Azizah, 2021; Lissitsa & Chachashvili-Bolotin, 2016; Wang et al., 2010). However, these studies are not longitudinal and life satisfaction levels were studied over a short period of time and therefore, may not be representative as research has repeatedly shown that in the long-term excessive use of the Internet will make people increasingly lonely and dissatisfied with their lives (Cao et al., 2011; Narci, 2022). Furthermore, contrary to the present findings, Alqahtani et al. (2020) noticed a non-statistically significant relationship between life satisfaction and problematic Internet use, with further implications suggesting that this is due to cultural and gender differences that limit the generalizability of the research. Indeed, the perception and prioritization of life satisfaction may vary among cultures and individuals due to different morals, values, and social norms (Chapman et al., 2019). Therefore, it is important to consider cultural factors when interpreting findings and designing interventions for PIU and other related issues.

Nonetheless, the latter hypothesis was not confirmed since no significant interaction effect of loneliness and life satisfaction on problematic Internet use was produced. This finding is in agreement with those of Alqahtani et al. (2020) and Turan et al. (2020) as they found no interaction effect of loneliness and life satisfaction on PIU. Interestingly enough, it has generally been observed that loneliness and life satisfaction are more likely to have an independent direct effect on PIU, rather than interacting with each other to influence the outcome. This may happen because these variables operate with different mechanisms and while lonely people make increased use of the Internet as a means of seeking social connection, people who are dissatisfied with life use the Internet problematically as a means of escaping from real challenges, which can partially explain these results. However, the aforementioned studies have a number of limitations such as sample size and differences in culture and

context. Inversely, the non-significant result is in disagreement with the conclusions of Bozoglan et al. (2013) who although they did not detect a direct effect of life satisfaction on PIU, they discovered that cooperatively loneliness and life satisfaction significantly affected problematic Internet use among adults. Correspondingly, Idriyani & Hidayatullah (2021) and Owodunni (2022) observed a significant interaction effect of life satisfaction and loneliness on PIU, with higher levels of loneliness and lower levels of life satisfaction associated with greater PIU. It was indicated that negative psychological state in individuals with high levels of loneliness and low life satisfaction, may intensify dependence on the Internet as a coping mechanism or source of validation. Contrary to the majority of related research, the current study did not find a statistically significant effect, which produces several potential implications. A possible explanation is that this finding may have been influenced by cultural differences, which may also be responsible for the inconsistent results of earlier literature. According to the Sociocultural theory of Vygotsky (Vygotsky & Cole, 1978), individuals develop within a cultural context and through social interactions with others. Therefore, the cultural and contextual differences of the participants, including different social and familial structures, different standards, and social norms, may have affected their perceptions and experiences of loneliness, life satisfaction, and PIU as well as, their coping mechanisms and use of the Internet for social interaction. For instance, Greek individuals regard close family ties, socializing, and communal living (Reher, 2005) and may cope with loneliness and low life satisfaction by seeking social support from family and friends (Kafetsios, 2006). These cultural values and coping mechanisms may have influenced the way participants responded to the measures of loneliness, life satisfaction, and PIU, and could result to cultural response bias, which in turn, may explain the non-significant interaction effect.

Another possible interpretation for the non-statistically significant hypothesis is the possibility of a type 2 error, that is, the failure to reject the null hypothesis when it is in fact false (Field, 2018). Although the power of this study is relatively high, there is still a possibility of a type 2 error. This may be due to the lower alpha level that was given in order to conduct the parametric ANOVA test ($\alpha = 0.01$), which although reduces the probability of type 1 error, i.e., rejecting the null hypothesis when it is actually true, concurrently increases the probability of a type 2 error. This could have been avoided with a larger sample size and higher effect size, making it more likely to detect a true effect. However, it does not necessarily mean that a mistake was made, as it is also possible that there are counter-effects, opposing influences or even compensatory mechanisms. Individuals with high levels of loneliness and low life satisfaction may find alternative ways to mitigate the negative impact of these variables on PIU for example, by building a strong social support network and developing offline interests and hobbies (Zhou et al., 2021). Moreover, it seems that other moderating variables (e.g., self-esteem, personality traits, attachment styles, etc.), which were not included in the present research, may contribute significantly to their interaction effect on PIU (Park et al., 2014; Shillair et al., 2020; Stead & Bibby, 2017). Therefore, a non-significant interaction effect should not be undervalued, but rather viewed as an opportunity for further exploration.

Looking at the overall study, it has many strong points, the main one being its contribution to the bibliography since the material on problematic Internet use is rare and the conclusions controversial. The current report goes beyond simply assessing the relationship between loneliness, life satisfaction, and PIU as it examines the effect of these variables on PIU, using valid and reliable questionnaires. Simultaneously, it is a timely study as it recognizes the impact of the COVID-19 pandemic, particularly containment and social isolation measures, on loneliness, life satisfaction and PIU. Nevertheless, limitations cannot be absent from the study. More specifically, participants were recruited based on availability (opportunistic sampling), which may introduce sampling bias and limit the generalizability of the findings. Adding to this, the study was conducted in Greece and therefore, may not be applicable to other cultural contexts due to different societal norms and Internet usage patterns, which reduces the external validity of the study. Moreover, the problematic use of Internet was assessed with the PIUQ scale, which, although it measures the general aspects of PIU, it does not quantitatively examine the use of the Internet and the time spent online. For this reason, an additional questionnaire that would quantitatively examine the Internet use, would offer valuable information about the actual patterns of Internet use, and would provide a clearer picture of the effect of loneliness and life satisfaction on PIU. Finally, regarding the statistical issues, although the alpha level was adjusted as a solution for the violation of the assumption of normal distribution, it could result in limitations and possible biases in the statistical analysis, thus significantly affecting the results.

Consequently, future research could focus on conducting longitudinal studies, which are limited in the literature of PIU, to examine causal relationships between loneliness, life satisfaction, and PIU over time, combining underlying mechanisms that mediate or moderate these relationships such as, social support, self-esteem, or coping strategies. Additionally, it would be of great importance to replicate the current study in different cultural contexts where it will shed light on the generalizability of the findings, identifying possible cultural differences or similarities. Finally, conducting quantitative and qualitative studies to test the effectiveness of interventions targeting loneliness and life satisfaction in reducing PIU, would be valuable.

CONCLUSION

In conclusion, this study revealed that both loneliness and life satisfaction had a main effect on problematic Internet use (PIU), indicating that higher levels of loneliness were associated with greater PIU, while higher life satisfaction was linked to lower PIU. These findings are consistent with previous research and highlight the importance of considering social and psychological factors in understanding PIU. However, the interaction effect between loneliness and life satisfaction on PIU was not significant due to possible limitations. The study also contributes to the existing literature on PIU and provides valuable insights into the complex nature of this phenomenon. Further research is needed to explore the longitudinal patterns of PIU, including the examination of additional influencing factors, in order to develop focused interventions and preventive measures.

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