



## Review

## Neuroticism and internet addiction: What is next? A systematic conceptual review

Laura Marciano<sup>a,\*</sup>, Anne-Linda Camerini<sup>a</sup>, Peter J. Schulz<sup>b</sup>
<sup>a</sup> Institute of Public Health, USI Università della Svizzera italiana, Via Buffi 13, 6900 Lugano, Switzerland

<sup>b</sup> Faculty of Communication, Culture, and Society, USI Università della Svizzera italiana, Via Giuseppe Buffi 13, 6900 Lugano, Switzerland

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## ABSTRACT

The personality trait of neuroticism (N) has consistently shown to be a risk factor for Internet Addiction (IA). Review literature, however, looked at this in bivariate analyses only. To the best of our knowledge, we conducted the first review that systematically and conceptually summarized results based on the inclusion of additional factors, thus coming closer to the complex nature of the relationship of N with IA. Through a systematic search, we identified 56 studies investigating the relationship between N, IA, and other variables. We grouped the latter in: (i) internalizing problems, (ii) externalizing problems, (iii) coping style, (iv) well-being, and (v) other factors. Based on our findings, we propose a theoretical model, which would move a step forward towards the understanding of long-term consequences of IA. Hence, in the proposed model, N (predictor) would predict IA, which, in turn, would predict health-related consequences (outcome) – including internalizing and externalizing symptoms, general well-being, and low academic/cognitive performance. Coping style, maladaptive cognitions, and low cognitive control would partially mediate the link between N and IA, whereas gender, age, and social context would moderate the hypothesized relationships. The proposed theoretical model should pave the way to longitudinal research on the role of IA in neurotic (N) people to eventually inform public health policies.

## 1. Introduction

In January 2021, 4.66 billion people actively used the Internet, with social media apps like WhatsApp, Facebook messenger, WeChat, QQ, Telegram, and Snapchat being used most (Statista, 2021). Internet Addiction (IA) has been widely discussed as a consequence of Internet pervasiveness, with different definitions aiming to describe its core components. A recent review (Bowden-Green et al., 2021) and a meta-analysis (Marciano et al., 2020) focused on the personality trait of Neuroticism (N) in the context of (problematic) media use, including IA. N is characterized by the tendency to frequently experience negative emotions, abnormal reactions to stressors, poor coping abilities, negative bias towards experiences, and interpersonal problems due to high sensitivity to others' critics (Costa Jr. & McCrae, 2008). The results of both syntheses showed a consistent link between N and problematic media use. This is not surprising since N has been related to media addiction and health-related and psychological problems as well, leading experts to consider N of major "public health significance" (Lahey, 2009). To the best of our knowledge, a comprehensive conceptual overview including additional factors explaining the link of N and IA is

still missing. The present review wants to fill this gap by focusing on other explicative constructs that may additionally explain the above-mentioned link such as internalizing, i.e. over-inhibited or internally-focused symptoms, and externalizing problems, i.e. disinhibited or externally-focused behavioral conducts. By doing so, the present conceptual review adds important theoretical considerations and posits the basis for a theoretical model aiming to understand the long-term consequences of the link between N and IA, to guide future research and develop effective interventions.

## 1.1. Internet addiction

The first case of IA, and its detrimental consequences, was described by Young (1998), who coined the term "Internet addiction" and compared it to substance addictions and impulse control disorders (Young, 1998). The concept of IA can be described as a "behavioral addiction", since it resembles other no-substance related disorders like Internet gaming disorder (American Psychiatric Association, 2013), although IA is not a standalone diagnosis yet. People addicted to the Internet show a constant preoccupation with online contents ("cognitive

<sup>\*</sup> Corresponding author at: Lab (Level 2), Via Buffi 13, Lab, 6900 Lugano, Switzerland.

E-mail address: [laura.marciano@usi.ch](mailto:laura.marciano@usi.ch) (L. Marciano).

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salience”), withdrawal symptoms (e.g., irritability, distress) when one cannot be online, tolerance (i.e., the need to spend an increasing amount of time online to achieve the same gratification previously experienced), difficulty in regulating the use with unsuccessful attempts to control the time spent online, obstinate use despite being aware of the negative consequences, use of the Internet to escape from problems or relieve a negative mood, loss of interest for other activities previously perceived as entertaining (“behavioral salience”), and social conflicts including loss of a significant relationship with others and problems at work/school due to excessive Internet use (Jo et al., 2019; Petry, 2015).

The prevalence of IA (together with other media addictions) has increased over time (Pan et al., 2020), especially among younger populations (Sohn et al., 2019). It is related to general psychopathology and poor physical, mental, and social functioning, especially in younger generations (Petry, 2015). With the aim of explaining the underlying processes of addictive behaviors involving Internet use, Brand et al. (2016, 2019) developed the Person-Affect-Cognition-Execution (I-PACE) model, according to which psychological and neurobiological dynamics are responsible for the development and maintenance of diverse behavioral addictions. The model gives a particular focus on predisposing variables, including psychopathological features and dysfunctional personality traits. In association with certain Internet-use expectancies and problematic coping styles, and by interacting with specific aspects of the medium, these predispositions eventually lead to IA. The use of specific online applications ultimately resulted in a gratifying experience, fueling a vicious cycle of reward expectancies, thus reinforcing a dysfunctional coping style. Additionally, deficits in executive control processes would further promote compulsive behavior. At the same time, digital media use can also relieve from stress as it may act as a compensatory tool enhancing social communication, especially in depressed people. However, this positive effect is likely to be only temporary (Stanković et al., 2021). In line with the I-PACE model, Montag et al. (2021) suggested that the preferred online activity is assumed to be independent of the means used (e.g., smartphone, PC). However, devices are characterized by specific technological features, which may further promote certain behavioral usage patterns. Hence, the disorder should be further classified as “predominantly mobile” or “predominantly non-mobile”. A similar taxonomy has been proposed by Wu et al. (2021), in their two-dimensional taxonomy of IA, which includes the device and the content. This is particularly important considering that higher levels of Internet use are not immediately related to more frequent smartphone use which goes beyond internet browsing (Stanković et al., 2021). Also, the ICD-11 (World Health Organization, 2019) suggests that the environment where a behavioral addiction takes place should be specified as either predominantly offline or online.

These classifications mirror the actual inconsistency in the definition of IA (Billieux et al., 2015). In the present review, the term “IA” is used to capture different online addictions, including Facebook, social media, and smartphone addiction measured with self-reported scales in the general population. Importantly, although we use the term “addiction”, we acknowledge that it is challenging to delimit *problematic* use from *excessive enthusiasm* (Griffiths, 2005) as people are increasingly online.

### 1.2. Neuroticism and internet addiction

Personality has been widely reported as a risk/protective factor in relation to IA (Kayış et al., 2016; Mark & Ganzach, 2014) with the Five-Factor Model of personality (or the “Big Five”) as one of the most used frameworks. The model includes the traits of N or emotional instability, extraversion, openness to experience, agreeableness, and conscientiousness. Previous reviews and meta-analyses (e.g., Carvalho et al., 2018; Kayış et al., 2016; Liu & Campbell, 2017) focused on all “Big Five” traits and consistently found that N individuals were related to high levels of IA. Measures of N include items tackling negative affectivity, such as anxiety, irritability, anger, reactivity, sensitivity to criticism,

worry, and vulnerability (Costa Jr. & McCrae, 2008). N people are more likely to be impulsive, get angry quickly, and perceive life negatively, especially when threatened or frustrated (McCrae & John, 1992). Therefore, it is unsurprising that they have difficulties in social relationships and when coping with stress. The positive association between N and IA was further evidenced by a systematic review (Bowden-Green et al., 2021) and a meta-analysis (Marciano et al., 2020). They found that N people are not motivated to enlarge their social connections and have a medium number of friends/followers, they use the Internet for leisure and selected social media activities, like passive social media use. N people tend to create and fuel an online ideal or false self and express themselves through social media since the online world reduces the distress related to real (offline) social situations. Furthermore, they are concerned about others' comments and reactions to their posts and pictures (e.g., selfies) due to their sensitivity to rejection and need of peer acceptance (Bowden-Green et al., 2021). In addition, high levels of N significantly correlated with all measures of IA, including social media, Facebook, smartphone, and online gaming addiction (Marciano et al., 2020). However, the dynamics explaining why N people are more addicted to the Internet are still little explored and the complex relationships between N, IA, and other (health-) related concepts have not been systematically summarized, yet.

### 1.3. Neuroticism and well-being

The focus on N in the media effects agenda is not unexpected since N has been described as a public health concern. N is strongly associated with common mental disorders (Lahey, 2009; Ormel et al., 2013), in particular, to anxiety, mood, and substance use disorders (for a meta-analysis, see Kotov et al., 2010). Controlling for baseline symptoms and psychiatric history, N is still the strongest longitudinal predictor of internalizing and, to a lesser extent, externalizing symptomatology (Jeronimus et al., 2016). A study following participants from adolescence to young adulthood found that N changed over ten years, reaching a peak around the age of 20. People with high levels of N showed a 14-fold and a 7-fold increased risk of developing depression and anxiety disorders, respectively, over time (Aldinger et al., 2014). N is also strongly associated with persistent low subjective well-being (Vittersø & Nilsen, 2002), across countries (Lynn & Steel, 2006), and at different ages (Gomez et al., 2012). Moreover, high levels of N also predict greater comorbidity among mental disorders (both internalizing and externalizing; Brandes & Tackett, 2019; Hink et al., 2013). From a public health perspective, this is no small matter because persons suffering from comorbid mental disorders have more persistent and disabling health-related problems and are more likely to use high-cost mental health services and experience occupational problems (Friedman, 2019; Lahey, 2009).

### 1.4. Study aim

Considering the past evidence on the link between N and IA as well as N and poor well-being, it is pivotal extending previous reviews and meta-analyses by considering the role of additional factors. Hence, the present study aims to explore the complex dynamics linking N to IA (and other media addictions) via a systematic and conceptual literature review. The results should guide future studies focusing on the long-term consequences of IA in N people, help the development of interventions to prevent adverse outcomes, and complement existing theoretical models such as the I-PACE model.

## 2. Methodology

A systematic review was performed according to the PRISMA guidelines (Shamseer et al., 2015). In September 2020, all studies investigating N and IA were searched through nine academic databases. All entries were imported in Zotero to remove duplicates, after which

titles and abstracts were screened independently by two coders, according to predefined eligibility criteria. Cohen's kappa statistic (McHugh, 2012) was calculated as a measure of inter-coder reliability. The full description of the methodology is reported in the Appendix. Due to the high heterogeneity of the included studies, a meta-analytic summary of the findings was not feasible. For a detailed overview of effect sizes linking N to IA only, see Marciano et al. (2020).

### 3. Results

From 4238 studies identified through the initial research, 345 remained after excluding duplicates, conference papers, and book chapters. After title and abstract screening, 56 articles were included in the present study (PRISMA flowchart is reported in Fig. 1). Cohen's kappa was 0.836, indicating a very good inter-coder reliability.

The concepts studied in relation to N and IA were summarized in (i) internalizing problems ( $n = 50$  studies), (ii) externalizing problems ( $n = 9$  studies), (iii) coping style ( $n = 9$  studies), (iv) well-being ( $n = 8$  studies), and (v) other factors ( $n = 37$  studies, additionally divided into (S) social, (A) academic, (T) time, and (M) miscellaneous). Fig. 2 displays a summary of the concepts. The results will be discussed considering IA as the outcome and then as the predictor. Importantly, although we may use causal-like terms in describing the results, the reader should keep in mind that all the studies (with the exception of two) made use of a cross-sectional design.

#### 3.1. Internet addiction as outcome

##### 3.1.1. Internalizing problems

Twenty-eight studies included a measure of internalizing problems and N as predictors and IA as the outcome. Internalizing problems included depression ( $n = 8$ ), anxiety ( $n = 7$ ), loneliness ( $n = 5$ ), Fear of Missing Out (FoMO) ( $n = 5$ ), self-esteem ( $n = 4$ ), and stress ( $n = 4$ ). In general, N was a significant and positive predictor of IA together with

levels of depression (Dalbudak & Evren, 2014; Senormancı et al., 2014), negative affect and anxiety (Dalbudak & Evren, 2014), loneliness (Anam-ul-Malik & Rafiq, 2016; Tesi, 2018), shyness (Ozturk & Kaymak Ozmen, 2011), type-D personality (characterized by higher levels of negative affectivity and social inhibition) (Holdoş, 2017), and low self-esteem (Hawi & Samaha, 2019; Yao et al., 2014).

Other studies, focusing on smartphone addiction, found that it was associated with increased levels of emotional distress (e.g., depression, anxiety), poor sleep quality, and loneliness (Volungis et al., 2019), alongside high levels of N. In one case, after controlling for N, anxiety did not show any effect on the outcome (Hussain et al., 2017). In a longitudinal study, participants who experienced a decrease in social support and high levels of smartphone addiction showed also higher levels of depressive mood and N over time (Herrero et al., 2019).

Regarding social media addiction, two studies found that type-D personality significantly predicted Facebook addiction, controlling for N (Blachnio et al., 2017; Nie et al., 2019). Low self-esteem and N positively predicted social media addiction, whereas having an independent self-construal acted as a protective factor (Hawi & Samaha, 2019). To note, people with higher independent self-construal perceived themselves as detached from others, as they are more individualistic and have a weaker sense of social connectedness and belonging to groups. On the other hand, FoMO was the only significant and positive predictor of social media addiction after controlling for N and other covariates (Blackwell et al., 2017). Other specific social media platforms were investigated by Hou et al. (2018), who found that N people use both Weibo and WeChat similarly. However, lonely individuals tended to use Weibo more than WeChat, probably because Weibo is a half-open platform where one can experiment with diverse identities. Together with N, loneliness was also a significant predictor of social media addiction, which, in turn, was related to IA (Tesi, 2018). These results reflect that the Internet is often used for the management of negative emotions, and this could be applied to persons with high negative affectivity who use the online environment to improve their mood and

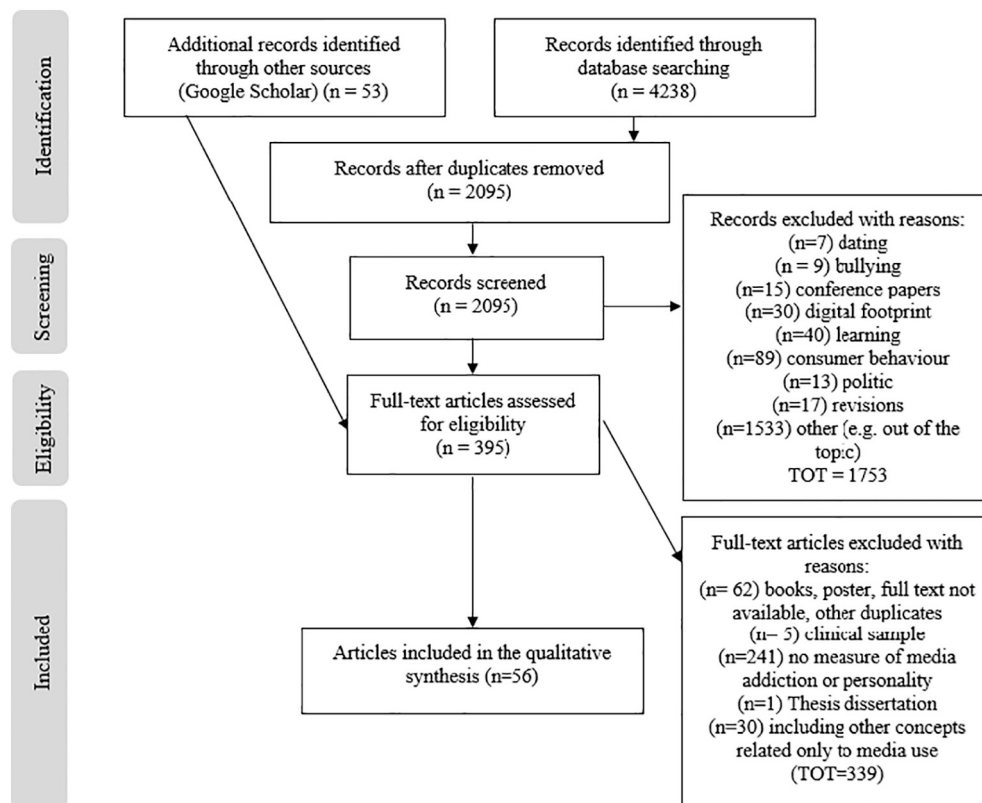


Fig. 1. PRISMA flowchart of study selection.

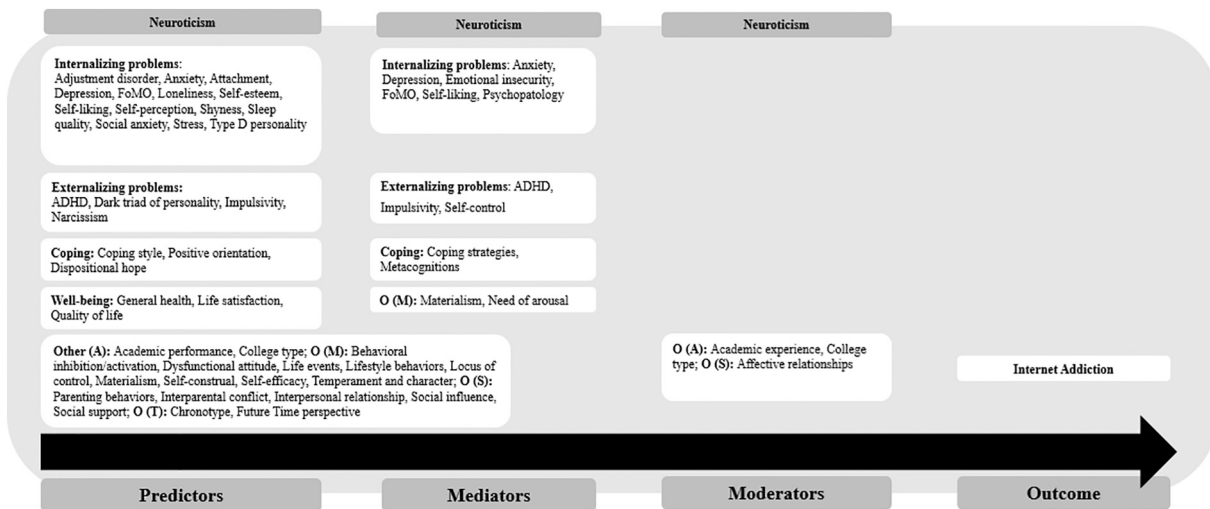


Fig. 2. Summary of the concepts studied in relation to N and IA.

cope with their feelings. Similarly, socially inhibited persons tend to use the Internet more excessively.

With respect to mediating variables, (social) anxiety (Chang et al., 2019; Peterka-Bonetta et al., 2019), self-liking (Kircaburun & Griffiths, 2018), emotional insecurity (Zhou, Li, Jia, et al., 2017), and FoMO (Alt & Boniel-Nissim, 2018) positively mediated the relationship between N and IA. In another case, trait-FoMO was related to state-FoMO, and in turn, state-FoMO was related to Instagram addiction; however, the latter did not mediate the relationship between N and the outcome (Balta et al., 2020). Koronczai et al. (2019) tested a mediation model to predict IA from personality traits through psychopathological symptoms. They found that higher levels of N were related to greater symptom severity, with only depression and obsessive-compulsive problems significantly and positively predicting IA. Importantly, the presence of symptomatology fully mediated the relationship between N and IA, and the association between specific psychopathological symptoms and IA was similar to the ones obtained with other addictive behaviors (Petry, 2015). This result sustained, again, that individuals with high levels of N cope with negative emotions by using the Internet intensively as a compensatory tool, and the level of psychological distress, especially internalizing symptoms, mediates this relationship. The results are in line with the Compensatory Internet Use Theory (Kardefelt-Winther, 2014), stating that individuals increment Internet use to fulfil their psychological needs for social interaction or other satisfying experiences.

Few studies considered N as a mediator or a moderator. In particular, N not only predicted IA and smartphone addiction together with levels of depression (Chang et al., 2019), stress (Cho et al., 2017; Müller et al., 2018), and adjustment disorders (Müller et al., 2018), but it was also a significant and positive moderator of these relationships. However, in one case, N did not moderate the relationship between emotional distress, poor sleep quality, and smartphone addiction (Volungis et al., 2019). Although preliminary, these results are mainly congruent with the diathesis-stress model (Swearer & Hymel, 2015), suggesting that personality may serve as a vulnerability factor that exacerbate the impact of stressors on adjustment behaviors (e.g., IA).

These findings show that internalizing problems and N are important predictors of IA. Furthermore, internalizing symptoms explain additional variability in IA with respect to N. Hence, although the two dimensions may share common determinants, they convey separate information on the person's well-being. However, the results are mainly based on studies using a cross-sectional design, thus limiting the interpretation of cause-effect mechanisms. Similarly, the effects of internalizing symptoms as mediators and N as moderator are still little explored.

Indeed, whether internalizing symptoms are primary or secondary to IA is still an open question.

### 3.1.2. Externalizing problems

Eight studies included externalizing problems together with N in explaining IA. Controlling for N and other covariates, ADHD positively and significantly predicted IA (Dalbudak & Evren, 2014; Shi & Du, 2019), with the severity of hyperactivity/impulsivity symptoms showing the stronger effect (Dalbudak & Evren, 2014). Also, attention impulsiveness was found to predict smartphone addiction (Roberts et al., 2015). ADHD symptoms were also a significant mediator between N and IA (Shi & Du, 2019), suggesting that core features of N, such as the feeling of anxiety and nervousness, may interfere with ongoing cognitive functioning, thus contributing to ADHD symptomatology. In general, these findings highlight that, when bored or frustrated, participants with attentional and impulsivity problems may find distraction online. Over and above levels of N, young people with ADHD enjoy the online world as it provides them with an unreal life in which they can go and act without inhibition. It appears that one's inability to focus on a particular task is a pivotal element to consider in investigating media addictive behaviors. Billieux et al. (2007) suggested that less perseverant people are overwhelmed with irrelevant thoughts, and the media contents allowed them to distract or even rid themselves of such feelings. Similarly, Cho et al. (2017) found that as stress increased, N also increased, while self-control faltered, thus augmenting levels of IA. In general, when self-control is low, IA and smartphone addiction are high.

Together with N, and controlling for covariates, also the personality trait of narcissism predicted smartphone addiction (Pearson & Hussain, 2015). However, another study did not replicate such an effect (Hussain et al., 2017; Lee, 2019). Psychopathy was found to increase vulnerability towards social media addiction, whereas, in the same study, N did not have an effect (Lee, 2019). The psychopathy measured in the latter study tackled aspects of risky decision-making, poor inhibition, and high impulsivity, which facilitate excessive use of social media.

To summarize, it is likely that N and externalizing problems, especially concepts related to inattention, low self-control, and impulsivity, have distinct effects in predicting IA. To note, in some cases, externalizing concepts showed a larger predictive power, which annulled the effect of N. With respect to the internalizing component, externalizing symptoms have been less studied, hence, future studies should include more these measures, also in terms of mediators between N and IA.

### 3.1.3. Coping style

Eight studies investigated how coping strategies were associated



with IA. Making use of emotion- and avoidance-oriented coping strategies was positively associated with Facebook addiction, and N failed to predict the outcome when coping strategies were entered in the equation (Blachnio et al., 2017). It is likely that people addicted to social media have a tendency to use emotion-oriented strategies, such as tension, blame, or anger, thus turning this strategy into a maladaptive behavior. In addition, avoidance strategies allow engaging in alternative activities. In this case, findings support the compensatory perspective (Kardefelt-Winther, 2014) by emphasizing the role of online activities to escape from everyday problems.

On the contrary, Blachnio and Przepiorka (2016), in their first study, reported that positive orientation – the tendency to see positive aspects of life, including optimism – predicted IA, but the relationship became non-significant when N was added as a covariate. Moreover, in the second study, the authors found that addicted Facebook users reported lower levels of positive orientation and higher levels of N. Similarly, the authentic contribution of dispositional hope failed to be meaningful. In contrast, N still positively predicted IA (Cetin Gudunz et al., 2017).

Coping has been frequently included as a mediator variable. In a sample of adolescents, type-D personality (including N) directly and indirectly predicted Facebook addiction through restorative outcomes, defined as the feeling of recovery from mental fatigue when engaging in Facebook activities (Nie et al., 2019). Zhou et al. (2018) found that maladaptive cognitions over Internet use positively and significantly mediated the relationship between N and IA over time. Similarly, N positively predicted Facebook addiction via two metacognitions: negative beliefs about thoughts (a concept similar to rumination) and lack of cognitive confidence (which reflects cognitive inattention and memory problems) (Marino et al., 2016). Similarly, N and emotion-focused coping positively predicted IA, with emotion-focused strategies also mediating the relationship between N and IA (Zhou, Li, Li, et al., 2017). Chwaszcz et al. (2018) reported that N impacted IA both directly and indirectly through the mediation of the emotion-focused coping strategy of helplessness - including substance use, behavioral disengagement, and self-blame. The authors suggested that N makes individuals more helpless, which, in turn, increases the risk of developing IA.

In general, it is not surprising that emotion-focused and avoidant strategies are associated with both N and media addictions. N is grounded in an avoidance temperament with the tendency to experience fear, sadness, and distress. Emotion-focused coping may lead individuals to indulge in the online environment to escape from negative feelings, which would further trigger negative emotions. In addition, results also supported theoretical propositions from the cognitive-behavioral model of IA, stating that maladaptive cognitions over the Internet are antecedent of IA, which would, in turn, lead to a variety of maladaptive outcomes.

### 3.1.4. Well-being

Controlling for N, life satisfaction did not predict IA or social media addiction (Hawi & Samaha, 2019). In another study, participants with unhealthy lifestyle behaviors (e.g., smoking habits, drinking habits, inappropriate daily duration of sleep and work, insufficient physical activity, unbalanced diet) had greater levels of smartphone addiction after controlling for N (Ezoe et al., 2009). Indeed, people high in N are more likely to engage in unhealthy behaviors (Mroczek et al., 2009). Furthermore, N did not predict smartphone addiction in the study by Panda and Jain (2018), although the latter affected individuals both emotionally (through interpersonal and family relationships) and physically (by lowering the quality of sleep and physical well-being).

### 3.1.5. Social, academic, time-related, and miscellaneous factors

This category includes social-, academic-, and time-related variables. A final subcategory, called miscellaneous (see Appendix), contains factors that cannot be classified in any of the previous categories.

**3.1.5.1. Social factors.** Collecting data from adolescents, Marino et al. (2016) reported that the more adolescents felt that people important to them thought they had to use Facebook (subjective norms), and the more they shared values with their group about the importance of using it (group norms), the more they used Facebook in an addictive way. This result was significant alongside the significant detrimental effect of N. Another study on adolescents found that low levels of affective relationships with friends - together with higher N - were associated with restorative outcomes, which, in turn, augmented social media addiction (Nie et al., 2019). The results were in line with the affective relationships model (Takahashi & Sakamoto, 2000), according to which, when social support from friends is lacking, it fuels an unpleasant feeling - especially in adolescents with high levels of N. Thus, youths may compensate by looking for online social interactions (Valkenburg et al., 2005).

Similarly, behaviors aiming to maintain relationships both online and offline (like self-disclosure and intimacy) and receiving online social support (in terms of information, affection, and companionship), together with N, significantly and positively predicted IA and Facebook addiction in young adults (Anam-ul-Malik & Rafiq, 2016; Tang et al., 2016). Hou et al. (2018) found that young people who lacked social support and spent less time socializing in real life interacted more often online. Poor interpersonal relationships were associated with smartphone addiction, although N did not moderate this relationship (Volungis et al., 2019). The predictive role of social support in relation to smartphone addiction was also investigated (Herrero et al., 2019): using a cross-lagged model, the authors found that levels of social support decreased smartphone addiction over time, and vice versa, especially among participants with higher levels of N. This reinforces the idea that stable aspects of personality could exert a substantial impact on smartphone addictive behaviors, with consequences for psychosocial well-being.

Family relationships and conflicts also contribute to IA. In young adults, N, together with father overprotection and rejection and mother rejection, positively predicted IA (Yao et al., 2014). In the same study, parental emotional support augmented children's self-esteem, which, in turn, reduced IA. To note, parental behaviors had different effects on males and females. In another study on adolescents, interparental conflict interacted with N in predicting emotional insecurity - i.e. the lack of the child's sense of safety (Zhou, Li, Jia, et al., 2017), with a stronger association in adolescents with higher N. Also in this case, N was a vulnerability factor that exacerbates the impact of stressors (e.g., interparental conflict) on behavioral adjustment (e.g., IA). In one case (Yan et al., 2014), only N, but not family functioning, predicted IA. The authors concluded that families with high-quality functioning have a better parent-child relationship, thus preventing adolescents from engaging in anti-social and addictive behaviors (Hawkins et al., 1992).

In general, the results implied that both individual personality and social factors might play a critical role in shaping media addictive behaviors. In line with the "Poor-Get-Richer" hypothesis (Valkenburg et al., 2005), young people who experience a lack of social relationships and low social support in real life choose to seek online interactions to obtain reassurance in affective relationships. Additionally, according to the diathesis-stress model, people with high N perceive more threat from social stresses like conflicts, which would positively affect IA.

**3.1.5.2. Academic factors.** Only two studies used academic-related concepts to predict media addiction together with N. In particular, Öztürk and Özmen (2016) reported that technical high school students had significantly higher levels of IA than students in other types of high schools. Whereas, Jaradat and Atyeh (2017) found the opposite, with humanitarian college students showing higher levels of social media addiction.

**3.1.5.3. Chronotype.** Chronotype refers to the endogenous circadian clock and it is also known as "morningness-eveningness" preference,

indicating the preference for morning or evening hours for intellectual and/or physical peak performance (Adan et al., 2012). Differences in chronotype are linked to personality and lifestyle aspects. For instance, evening types seem to be more inclined to make addictive use of substances such as alcohol, cigarette, and illegal drugs (Giannotti et al., 2002; Prat & Adan, 2011) and online gaming disorder (Vollmer et al., 2014). In contrast, morningness is usually associated with a healthier lifestyle, especially in youth (Kauderer & Randler, 2013). This might explain results from two included studies (Demirhan et al., 2016; Randler et al., 2014) linking chronotype and IA. In particular, Demirhan et al. (2016) found that emotional stability and morningness negatively predicted smartphone addiction, also controlling for other factors. Furthermore, evening types (who spend more time in front of screens) were more prone to develop IA. Similarly, Randler et al. (2014) reported that, controlling for other factors including N, only evening orientation was related to higher levels of IA, with evening-type participants generally reporting more emotional and learning problems.

To summarize, morningness-eveningness was the best predictor of IA when considering other personality factors. Since previous studies showed that eveningness was related to substance abuse, IA may be just another type of addictive conduct related to eveningness. However, whether IA is a coping mechanism due to misalignment to social times or whether sitting in front of the screen shifts chronotype towards eveningness is still an open question, which should be further addressed with longitudinal and experimental data.

**3.1.5.4. Miscellaneous.** Other factors related to IA and N were self-directedness, dysfunctional attitudes, behavioral inhibition, behavioral activation-fun seeking, sense of belonging, stressful life events, and locus of control. For a complete description of these results, see Section 3 in the Appendix.

### 3.2. Internet addiction as predictor or mediator

Fourteen studies looked at IA as a predictor or a mediator, especially of well-being outcomes. For example, Floros et al. (2014) reported that N and defense style positively predicted IA, which, in turn, was related to overall psychopathology, rather than vice versa. In a similar vein, N predicted Facebook addiction, which, in turn, positively influenced the experience of negative affect (Abbasi & Drouin, 2019). In the latter case, Facebook use was a source of social stress, thus leading N people to experience negative emotions. IA also mediated the relationship between withdrawal (a sub-dimension of N) and poor sleep. Similarly, Facebook addiction negatively predicted general health and sleep quality and positively predicted stress, also controlling for N (Atroszko et al., 2018). Furthermore, N was indirectly associated with phubbing (i. e., ignoring the offline presence of others while using the smartphone), only via Instagram addiction (Balta et al., 2020). Also, controlling for external locus of control, and materialism, N positively predicted social media use, which, in turn, augmented levels of technostress (Hsiao, 2017). In adolescence, IA predicted higher loneliness, less self-esteem, higher depressive levels (van der Aa et al., 2009). N moderated the effect with least emotionally stable adolescents reporting higher IA. In accordance with the cognitive-behavioral model (Davis, 2001), vulnerable adolescents are likely to start a vicious cycle by incrementing IA, which, in turn, worsens their problems. In general, results support IA as a primary mental disorder that lead to the manifestation of psychological symptoms.

Another general well-being indicator was the quality of life. In one study (Gao et al., 2017), people with high levels of N were more likely to develop smartphone addiction, which, in turn, tended to result in a poorer quality of life. Subjective well-being was also predicted by N, together with IA and FoMO (Stead & Bibby, 2017). However, in this case, there was no evidence of a mediating relationship. Turel et al. (2018) reported that women with high levels of N and social media

addictive symptoms were more at-risk for low mood. It seems that women respond differently to stressors than men: They tend to avoid or use emotion-oriented strategies eliciting negative emotions, while men see stressors as challenges to overcome with problem-focused oriented strategies (Matud, 2004). Moreover, hormonal processes may contribute to the differences in expression of poor well-being in females versus males (Young & Korszun, 2010). These results supported the “telescoping effect” - the idea that women present a more severe clinical profile and faster progression in addictions. These differences are relevant also in technological addictions (Turel et al., 2018).

Finally, two studies used IA and N to predict academic achievement (Glass et al., 2014; Przepiorka et al., 2019). Glass et al. (2014) found that, although N did not predict social media addiction, the latter negatively impacted academic performance. Similarly, N did not predict IA, however, IA predicted lower grade point average (Przepiorka et al., 2019). Anam-ul-Malik and Rafiq (2016) found that N, low social support, and IA positively predicted procrastination.

## 4. Discussion

Personality traits received increasing attention in the understanding of risk and protective factors of IA (e.g., Kayış et al., 2016; Mark & Ganzach, 2014). Based on 56 studies, the present conceptual review revealed important results leading to theoretical considerations on the link between IA and N. The most important result is that IA has been generally included as an outcome, and all other concepts mainly as predictors, with few exceptions. Among the studied concepts, internalizing problems represent the most consistent portion. N and internalizing symptoms did not only positively correlate with each other, but they also independently predicted IA, smartphone, and social media addiction. The same picture emerged concerning externalizing problems, which were generally less investigated. The presence of symptoms such as inattention and impulsivity not only predicted IA but also diminished the effect of N, to the point that it appears that one's inability to focus on a particular task is an essential element to consider in investigating IA and similar concepts. The results of the present review also showed that the Internet offers N people a unique environment where they can cope with negative feelings, which matches the struggles that N people experience in regulating emotions. Additionally, low quality of social relationships augments the likelihood to develop IA and other technological addictions, especially in individuals with high levels of N. When IA was considered as a predictor or mediator, the picture was barer. In general, IA predicted negative well-being outcomes. As such, they were interpreted as a source of (social) stress and overload, which would augment the already experienced negative feelings of N people. By doing so, the problematic use of the Internet and of social media could be paramount with respect to the manifestation of other psychological problems.

Based on our findings, it is difficult to sustain if health-related problems are primary or secondary to IA. In other words, the question remains whether N people develop anxiety, depression, or sleep problems before or after using the Internet and Internet-enabled devices excessively. It is now well-established that N and IA are related to each other. Moving forward, we propose that IA should not only be seen as the final outcome but as the mediator through which psychological problems (which may be already present) are further worsened. Indeed, although in some cases IA can be the final diagnosed outcome (similar to other substance-based and behavioral addictions), the majority of the studies to date included samples from the general population and measures tackling IA and similar concepts in a broad way, without being specific to a particular use (e.g., pornography, online stock trading services, online shopping). It is more likely that general IA is akin to a coping mechanism to deal with negative emotions, sometimes also experienced as a stressful experience, which would trigger subsequent negative consequences.

According to the vulnerability model of N (Lahey, 2009), N would

trigger mental processes and behaviors that lead to the development of mental health problems or boost the impact of risk factors such as stressful events (e.g., diathesis-stress scenario), like technological addictive behaviors. Considering that N people show an attention bias towards negative and threatening stimuli and negatively interpret ambiguous information, they anticipate aversive stimuli and do not well tolerate uncertainty. They, thus, experiencing higher levels of stress and increased negative feelings (Servaas et al., 2013), including negative thoughts and cognitions (the “diathesis” component). According to the Cognitive-Adaptive Theory of N (Matthews, 2004), distinct styles of self-regulation of individuals with high versus low levels of N represent different modalities of adaptation to a threat. Persons with high levels of N over-appraise threat and are prone to cope through emotion-focus and avoidance strategies, to maintain personal security and avoid tense situations. On the contrary, individuals with low levels of N prioritize other goals than personal safety, and, thus, engage in problem-focused coping and use a more active approach. If we adopt this model to media contents, it is possible that N people not only tend to consume media contents compulsively to cope with stress, but they also interpret media-based contents, especially social media content (e.g., through upward social comparison mechanisms; Buunk et al., 2001), in a way that triggers more negative than positive emotions (the “stress” component). Since people high in N are more prone to use negative coping styles and perceive the online contents as more threatening, it is now time to focus on the long-term consequences.

To sum up, it is likely that high N leads to higher levels of IA, which, in turn, triggers or increases negative health-related outcomes, and vice versa. We, thus, propose a theoretical model linking N (predictor) directly to IA – including smartphone, and social media addiction, (mediator) – and indirectly to Health-related consequences (outcome). We acknowledge that past literature focused on the link between health-related outcomes (predictor) and IA (outcome) and kept this direct link (see Fig. 3).

Furthermore, low levels of cognitive control – a crucial component of externalizing problems – may act as a risk factor mediating the relationship between N and Media addiction. To note, the proposed relationships not only depend on the levels of N, but are also moderated by gender, age, and social context (poor versus rich social environment). The outcomes of the model include both internalizing (e.g., depression, anxiety) and externalizing (e.g., ADHD) symptomatology, for which it is advisable to use standardized assessment tools including a broad spectrum of problems, since the two dimensions are usually correlated (Achenbach et al., 2016). Besides, we propose to go beyond the vastly applied ill-being model, which emphasized adverse health outcomes, by studying the broader concept of general well-being. For example, measures should include the hedonic and eudaimonic components of well-being (Ryan & Deci, 2001), together with the construct of flourishing (Huppert & So, 2013). In addition, health-related behaviors (e.g., sleep, physical activity, substance use, diet, smoking, etc.) should be

investigated more together with cognitive-related outcomes like academic achievement, work problems, and cognitive functioning.

This theoretical improvement complements the negative consequences in daily life postulated by the I-PACE model by Brand et al. (2016, 2019). The switch from functional/health-enhancing use to uncontrolled generalized overuse is caused by the interaction between a psychopathological vulnerability (e.g., N), dysfunctional coping style and cognitions, low self-control, and certain Internet-use expectancies (Brand et al., 2016). Hence, N may act as a psychological vulnerability and promotes an inadequate coping style and negative core cognitions, paving the way for the development of IA and media-related problematic behaviors. The proposed model also builds on the person-specific approach to the study of well-being in the media effects research (Beyens et al., 2020). This research stream states that every individual can experience null, positive, or negative effects when using social media, and these effects are consistent. In other words, the same person tends to experience always the same effect. Since some people experience consistently negative effects (“negative susceptibles”), we assume that N individuals belong to this category.

The present conceptual review shows some limitations. We included only studies published in peer-reviewed scientific journals. The lack of longitudinal studies limits the interpretation of the results in terms of cause-effect mechanisms. In addition, the generalizability of the findings is limited to younger populations in Asia, Europe, and North America. Despite these limitations, we hope that our proposed theoretical model can guide the investigation of long-term consequences of IA, and media addictions in general, in vulnerable populations. This would further allow implementing interventions, policies, prevention efforts, and clinical treatments.

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## CRediT authorship contribution statement

Conceptualization: LM, PJS. Data curation: LM. Funding acquisition: ALC. Investigation: LM. Methodology: LM, PJS. Supervision: ALC, PJS. Writing — original draft: LM. Writing — review and editing: LM, ALC, PJS.

## Declaration of competing interest

None.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.paid.2022.111260>.

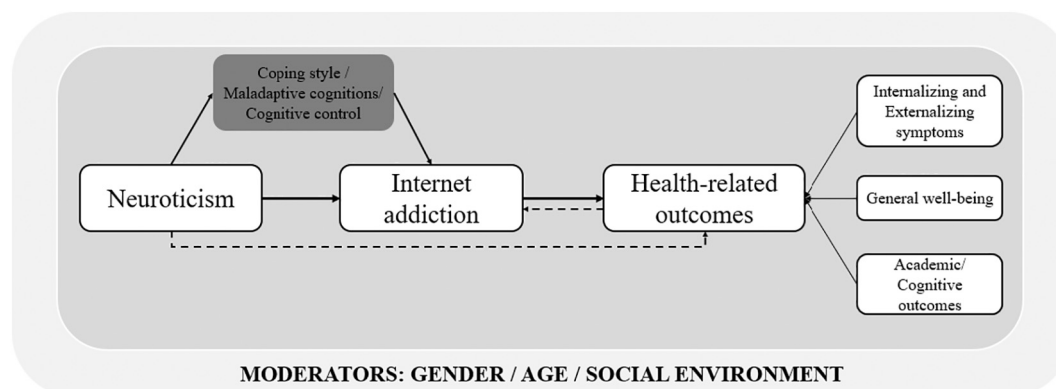


Fig. 3. A theoretical model of N and IA.



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<sup>1</sup> References of the studies included in the systematic conceptual review are reported in the Appendix



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