



Internet addiction and its facets: The role of genetics and the relation to self-directedness



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HIGHLIGHTS

- We examined Internet addiction and its facets in a twin-sibling design.
- Focus on adults to explore the role of age and developmental processes
- Use of different measurements to capture Internet addiction components
- Results showed considerable variation in heritability estimates.
- Heritability of Internet addiction facets was partly shared with self-Directedness.

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ABSTRACT

A growing body of research focuses on problematic behavior patterns related to the use of the Internet to identify contextual as well as individual risk factors of this new phenomenon called Internet addiction (IA). IA can be described as a multidimensional syndrome comprising aspects such as craving, development of tolerance, loss of control and negative consequences. Given that previous research on other addictive behaviors showed substantial heritability, it can be expected that the vulnerability to IA may also be due to a person's genetic predisposition. However, it is questionable whether distinct components of IA have different etiologies. Using data from a sample of adult monozygotic and dizygotic twins and non-twin siblings ($N = 784$ individuals, $N = 355$ complete pairs, $M = 30.30$ years), we investigated the magnitude of genetic and environmental influences on generalized IA as well as on specific facets such as excessive use, self-regulation, preference for online social interaction or negative consequences. To explain the heritability in IA, we further examined the relation to Self-Directedness as potential mediating source. Results showed that relative contributions of genetic influences vary considerable for different components of IA. For generalized IA factors, individual differences could be explained by shared and non-shared environmental influences while genetic influences did not play a role. For specific facets of IA and private Internet use in hours per week, heritability estimates ranged between 21% and 44%. Bivariate analysis indicated that Self-Directedness accounted for 20% to 65% of the genetic variance in specific IA facets through overlapping genetic pathways. Implications for future research are discussed.

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1. Introduction

Since their invention in the 80s and 90s, computers, mobile-phones, and the Internet itself have developed rapidly and nowadays they are inevitable information and communication vehicles in our daily lives.

Despite the fact that the Internet offers many opportunities and makes our life more convenient some individuals have difficulties dealing with the omnipresence of these technologies. As a consequence, a variety of problems in different areas of life emerge.

Internet addiction (IA) is a relatively new phenomenon and an increasing problem worldwide (Ko, Yen, Yen, Chen, & Chen, 2012). A rising number of humans spend more and more time both for leisure and business activities on the Internet, whereas an overuse of the Internet could have potential bad outcomes for one's own personal health (e.g., Kim & Chun, 2005; Xiuqin et al., 2010), well-being (Lachmann,

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Sariyska, Kannen, Cooper, & Montag, 2016) as well as social and work life (e. g., Nalwa & Anand, 2003; Young, 2004). To identify individual and contextual causes, correlates and negative consequences of these behavioral problems, a growing body of research focuses on problematic or addictive behaviors related to the use of the Internet. Although IA is not an official diagnosis in DSM-V, a specific form – namely Internet Gaming Disorder – has been included as an emerging disorder in section III in the latest version of the manual to highlight the importance for further research in this area. In the present paper, the main research question is to what extent genetic and environmental differences between individuals can explain why some individuals have more problems caused by their Internet usage than others. We focused on generalized Internet addiction and its specific behavioral facets (but not on distinct forms such as Internet Gaming or Internet Pornography Addiction). Furthermore, we investigated the extent to which the personality trait Self-Directedness mediates the heritability of IA and its facets.

Of note, scientists still argue over the definition and how to best name IA (e.g., Yellowlees & Marks, 2007). There is a consensus about key components of IA such as excessive use, mostly represented in many (private) hours per day, preoccupation with the using behavior, unsuccessful attempts to stop or reduce time online, as well as negative consequences in different life domains. Thus, there is also an ongoing debate on how this phenomenon should be labeled, diagnosed accurately and if it is a unidimensional or multidimensional disorder differentiated through subdomains and specific behaviors. In detail, it is still not clear if IA is actually best represented by being an addiction or linked to an existing other psychopathology such as depression, impulsive-control disorder or ADHD (co-morbidities in these areas have been observed with IA; e. g. Yen, Ko, Yen, Wu, & Yang, 2007a; Young & Rogers, 1998; Treuer, Fábíán, & Füredi, 2001; Sariyska, Reuter, Lachmann, & Montag, 2015). Although the use of the terms problematic, compulsive or excessive use of the Internet might be less critical, we use the term IA throughout this paper, because it is well established in the literature (see also a general overview by Montag & Reuter, 2015e).

Years after the first description of a IA patient by Kimberly Young (1996, 1998a, 1998b), Tao et al. (2010) recently proposed a so called “2 + 1” rule encompassing both preoccupation with the Internet and withdrawal symptoms as prerequisite for IA together with one out of a list of several symptoms such as development of tolerance to diagnose IA. Of note, as a course criterion they also ask for a minimum of 6 h of daily private use of IA for a minimum of three months. The prevalence of IA differs strongly around the globe (depending among others on cultural differences, different methodologies used to diagnose IA and different sociodemographic variables of the samples under investigation; e.g. Shaw & Black, 2008; Spada, 2014). In Germany, where the present study took place, recent evidence points to a prevalence of about 1% in the population for IA (Rumpf, Meyer, Kreuzer, John, & Merkekerk, 2011).

Towards a fuller understanding of IA, Brand et al. (2016) proposed an Interaction of Person-Affect-Cognition-Execution (I-PACE) model to capture the processes underlying the development and maintenance of an addictive use of the Internet and its applications. The model explicitly distinguishes between predisposing factors making individuals vulnerable to an excessive use, and factors serving as moderators and mediators in the processes to and maintenance of addiction. Within the core predisposing characteristics of the person, personality (e.g. impulsivity, low self-esteem) as well as genetic factors together with other psychopathologies are specified while dysfunctional coping strategies or expectancies about the use and affective and cognitive responses are proposed as mediators and moderators. Most previous studies have focused on different presumed risk factors associated to IA, such as poor family functioning, low socio-economic status, and negative life events (Ni, Yan, Chen, & Liu, 2009; Park, Kim, & Cho, 2008; Yen, Yen, Chen, Chen, & Ko, 2007) or personality correlates (e.g. Müller, Beutel, Egloff, & Wölfling, 2014; Sariyska et al., 2014). However, it remains uncertain whether these factors exert their effect through an ‘environmental’ pathway, such as context, situation or family climate, or

through biological pathways such as genetic factors shared by family members. It is now well established that genes are somehow involved in all aspects of human behavior (Polderman et al., 2015) and that relationships, such as the relationship between certain personality measures and incidence of depression (Kendler & Myers, 2010), may also be due to shared genetic risk factors. Given that both, personality and IA have shown a heritable component and to be phenotypically linked, it is likely that personality traits represent a vulnerability factor for IA that could be mediated through genetic mechanisms (see Fig. 1).

While previous family, adoption and twin studies revealed substantial genetic influences on a broad range of other addictions (e.g., substance use, pathological gambling; for a review see Agrawal et al., 2012), only a few studies investigated IA in a behavior genetic research design. So far, studies indicated that both genetics and environmental influences play a role, but the results between studies show pronounced variation. The first study by Li, Chen, Li, and Li (2014) reported heritability estimates for generalized IA of 58% for females and 66% for males. The remaining variance in the total addiction score was explained by unique environmental influences. In the second study, Deryakulu and Ursavaş (2014) investigated not only Internet addiction in general but also different components of problematic Internet use such as the excessive use, social benefit through the Internet compared to real life interactions and negative consequences associated with Internet use. They found extremely varying estimates for genetic influences from 19% to 86% but only for male participants while for the female participant heritability estimates were zero. With respect to the environment, 19%, respectively 17% of the variance were explained by shared environmental influences while the remaining variance was non-shared environmental in nature. Using a large population-based sample of adolescent twins, Vink, van Beijsterveldt, Huppertz, Bartels, and Boomsma (2016) reported a heritability of 48% for generalized compulsive Internet use which is comparable to a recent study by Long et al. (2016) showing that frequency of Internet use was explained by genetic factors accounting for 41% of the variance. Altogether, previous studies revealed inconsistent results with respect to the extent genetic influences are involved as well as whether sex differences occur in heritability estimates. All previous studies focused on adolescent participants. Given that also older generations suffer from being addicted to the Internet, it is important to further investigate the pattern of genetic and environmental influences on IA and its components in adults.

Moreover, only the study by Li et al. (2014) also investigated how to explain the heritability in IA in relation to personality by examining effortful control, an important aspect of self-regulation. Analysis indicated a significant overlap between genetic influences on IA and effortful control (larger in boys than in girls) which provides insights into possible genetic pathways. However, common genetic factors explained only a part of the heritability in IA leaving the rest of the genetic variance unexplained. Given that associations between IA and other personality traits, such as (low) Self-Directedness (Montag, Jurkiewicz, & Reuter, 2010; Montag et al., 2011; Sariyska et al., 2014), (high) impulsivity (Cao, Su, Liu, & Gao, 2007), (high) sensation-seeking (Lin & Tsai, 2002), (low) self-control (Kim, Namkoong, Ku, & Kim, 2008), and (high) neuroticism (Dong, Wang, Yang, & Zhou, 2013; Tsai et al.,

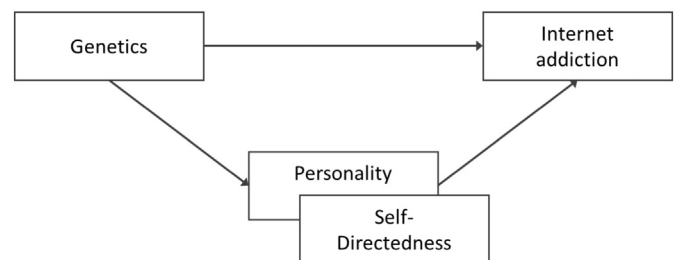


Fig. 1. Genetics could influence Internet addiction directly as well as mediated via personality characteristics such as Self-Directedness.

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