Computers in Human Behavior 39 (2014) 331–338

Contents lists available at ScienceDirect

Computers in Human Behavior

journal homepage: www.elsevier.com/locate/comphumbeh

Genetic and environmental influences on problematic Internet use: A twin study

Deniz Deryakulu [a,*], Ömer Faruk Ursavaş [b]

[a] Ankara University, Faculty of Educational Sciences, Department of Computer & Instructional Technologies Education, Ankara, Turkey
[b] Recep Tayyip Erdoğan University, Faculty of Education, Department of Computer & Instructional Technologies Education, Rize, Turkey

ARTICLE INFO

Article history:
Available online 12 August 2014

Keywords:
Problematic Internet use
Internet addiction
Twin study
Behavioral genetics
Genetic influence
Environmental influence

ABSTRACT

Despite many studies on the prevalence and correlates of problematic Internet use (PIU), we know little about its etiological components. Our main aim is to find out to what extent PIU is influenced by genetic and environmental factors using the classic twin design. A total of 237 Turkish twin-pairs aged 10–25 participated in the study. PIU was measured using the 'Problematic Internet Use Scale' (PIUS) developed by Ceyhan, Ceyhan and Gürcan. For male twin-pairs, the monozygotic (MZ) twin correlations were larger than the dizygotic (DZ) twin correlations, indicating that genetic factors influenced scores on the PIUS. However, for female twin-pairs, the MZ correlations were smaller than the DZ correlations for the PIUS, showing that genetic factors did not play a role in female twin-pairs. The influence of both genetic and environmental factors was explored with model-fitting analysis. Results showed that both for the "*social comfort/benefit*" and "*negative consequences associated with the Internet use*" sub-dimensions, the best-fitting models were the ADE models whereas both for the "*excessive use*" sub-dimension and "*PIUS-Total*", the best-fittings models were the ACE models. The key result of this study is that the genetic and non-shared environmental effects are equally influential on the overall PIU in male twin-pairs.

1. Introduction

Computers, mobile-phones, and the Internet are inevitable information and communication vehicles in our daily lives. However, some individuals demonstrate problematic or addictive behaviors related to use of such technologies. Problematic Internet use (PIU) has been described as a multidimensional syndrome consisting of cognitive and behavioral symptoms that result in negative social, academic, professional, or health consequences (Caplan, 2002, 2005; Caplan & High, 2006; Davis, 2001; Davis, Flett, & Besser, 2002). This phenomenon is also labeled by researchers with various terms like *Internet addiction* (Young, 1998), *pathological Internet use* (Davis, 2001; Young & Rogers, 1998), *compulsive Internet use* (Greenfield, 1999), *excessive Internet use* (Hansen, 2002), *Internet abuse* (Morahan-Martin, 2005, 2008) and other similar terms.

PIU or Internet addiction (IA) is characterized by an individual's inability to control his/her use of the Internet, leading to feelings of distress and functional impairment of daily activities (Shapira, Goldsmith, Keck, Khosla, & McElroy, 2000). However, we now know well that the Internet itself (as a medium) is not addictive, but some content and/or interactive applications such as online shopping, gaming, chatting, gambling, social networking or cybersex appeared to play a significant role in the development of PIU/IA. Furthermore, because the classical concept of addiction used to describe a physical dependence on a substance, this type of addiction has been conceptualized as a form of behavioral (non-chemical) addiction. Some other examples of the behavioral addiction include pathological gambling, video-game playing, television viewing, and physical exercise. Shaffer et al. (2004) have expressed that their analysis of extant literature reveals that the specific objects of addiction play a less central role in the development of addiction than previously thought, and this situation identifies the need for a more comprehensive philosophy of addiction. LaRose, Lin, and Eastin (2003) highlight that genetics and family history may predispose experimentation and initial reactions to addictive behaviors, while Shaffer et al. (2004) consider genetic risk and psychosocial elements as distal antecedents of the addiction syndrome.

* Corresponding author. Address: Ankara University, Faculty of Educational Sciences, Department of Computer & Instructional Technologies Education, Cebeci Campus, 06590 Ankara, Turkey. Tel.: +90 (312) 363 3350x3203; fax: +90 (312) 363 6145.
E-mail addresses: deryakulu@ankara.edu.tr, deniz.deryakulu@gmail.com (D. Deryakulu).

http://dx.doi.org/10.1016/j.chb.2014.07.038
0747-5632/

Davis (2001) introduces a cognitive-behavioral model of PIU that defines two distinct types of PIU as specific and generalized PIU. According to this distinction, specific PIU includes those people that are dependent on a specific function of the Internet whereas generalized PIU involves a multidimensional overuse of the Internet (Davis, 2001). This model also hypothesizes that maladaptive cognitions and psychosocial pathology predisposes some Internet users to develop PIU/IA. Indeed, PIU/IA is associated with various psychosocial correlates or psychiatric comorbidities. Some of the variables that have been linked to PIU/IA include depression (Caplan, 2002; Ceyhan & Ceyhan, 2008; Davis et al., 2002; Yen, Ko, Yen, Wu, & Yang, 2007; Young & Rogers, 1998), anxiety disorder (Bernardi & Pallanti, 2009; Shapira et al., 2000), social phobia (Yen et al., 2007), attention deficit hyperactivity disorder (Bernardi & Pallanti, 2009; Yen et al., 2007), obsessive–compulsive personality disorder (Bernardi & Pallanti, 2009), impulsivity (Meerkerk, van den Eijden, Franken, & Garretsen, 2010), loneliness (Caplan, 2002; Ceyhan & Ceyhan, 2008; Davis et al., 2002; Morahan-Martin & Schumacher, 2000), low self-esteem (Caplan, 2002; Kim & Davis, 2009; Niemz, Griffiths, & Banyard, 2005), shyness (Odacı & Çelik, 2013), external locus of control (Chak & Leung, 2004), higher novelty seeking and lower reward dependence (Ko et al., 2010), aggressive behaviors (Ko, Yen, Liu, Huang, & Yen, 2009; Odacı & Çelik, 2013), hostility (Yen, Yen, Wu, Huang, & Ko, 2011; Yen et al., 2007), substance use (Ko et al., 2006), and problematic alcohol use (Ko et al., 2008). Besides, some researchers have been argued that comorbidity of two disorders may indicate the casual relationship and/or common etiology shared by them (e.g., Mueser, Drake, & Wallach, 1998).

Although PIU/IA has been identified as a potential mental health issue, until now it is not included as a psychiatric disorder or a mental illness in the revised fourth edition of the *Diagnostic and Statistical Manual of Mental Disorders-IV Text Revision* (DSM-IV-TR) (American Psychiatric Association [APA], 2000) or in the tenth edition of the *International Classification of Diseases* (ICD-10). Besides, PIU/IA was considered for the DSM-V 'behavioral addiction' category but was rejected due to a lack of sufficient research evidence, however, APA decided to include it in the appendix of the DSM-V in order to stimulate future research (APA, 2010).

Some researchers, on the other hand, have suggested that PIU can be defined as an impulse-control disorder (Shapira et al., 2003; Young, 1998) or another form of an obsessive–compulsive spectrum disorder (Shapira et al., 2000). In fact, studies have shown that problematic Internet users' use of the Internet met the DSM-IV criteria for an impulse-control disorder not otherwise specified (Shapira et al., 2000), and the diminished impulse-control is an indicator of more severe PIU (Davis et al., 2002). According to Yellowlees and Marks (2007), the existence of such a relationship has caused some researchers to postulate a role of brain chemistry in addictive Internet use because many other impulse-control disorders and behavioral addictions are thought to operate dopaminergically. Indeed, more recent evidences showed that PIU/IA is associated with dysfunctions in the dopaminergic brain systems (e.g., Hou et al., 2012; Kim et al., 2011).

Beard (2005) also proposes a model to conceptualize PIU integrating biochemical, genetic, psychological, familial, environmental, and cultural dynamics. The genetic component of Beard's model recognizes that perhaps a combination of genes makes a person prone to developing addictive behaviors whereas the biochemical component of this model acknowledges that the neurochemical changes (e.g., insufficient amount of dopamine) may force a person engaging in an addictive behavior to maintain the homeostasis of his/her body. The psychological component, on the other hand, recognizes the use of learning processes to initiate, maintain, or change addictive behaviors, whereas the social component highlights familial, social, or cultural dynamics that may incite addictive behaviors.

However, we still do not have a valid answer regarding whether PIU/IA is a separate disorder, a manifestation of an underlying psychiatric illness, or both (Mitchell, 2000; Morahan-Martin, 2005, 2008; Pies, 2009; Shapira et al., 2000). Besides, Pies (2009) has summarized that a syndrome and its symptoms may be understood as a specific disease entity when at least one of the following criteria are met: (1) a pattern of genetic transmission is discovered, sometimes leading to the identification of a specific genetic locus; (2) the syndrome's etiology, pathophysiology and/or pathologic anatomy become reasonably well understood; and (3) the syndrome's course, prognosis, stability, and response to treatment are seen to be relatively predictable and consistent across many different populations (p. 35).

In the literature, however, there are a small number of molecular genetics studies (DNA researches) associated with PIU/IA. According to the findings of these studies, the genetic polymorphisms of the dopamine D2 receptor gene (DRD2 Taq1A1) and G allele of the norepinephrine transporter gene (Net-8) were found more frequently in a group of male adolescents with Internet addiction tendency (Kim, Lee, Han, Suh, & Kee, 2006); the genetic polymorphisms of the serotonin transporter gene (SS-5HTTLPR), which was associated with depression, was also found more frequently in a group of male adolescents with excessive Internet use (Lee et al., 2008); similarly, the genetic polymorphisms of the dopamine D2 receptor gene (DRD2 Taq1A1) and low activity alleles (i.e., COMTL) in the Catecholamine-O-Methyltransferase (COMT) gene were found more prevalent in a group of male adolescents with excessive Internet video game play (Han et al., 2007); and more recently, the genetic polymorphisms of the nicotinic acetylcholine receptor gene (CHRNA4) was found more frequently in the problematic Internet users (Montag, Kirsch, Sauer, Markett, & Reuter, 2012). Taken together, these findings suggest that a biological or genetic predisposition to PIU/IA may exist. However, this predisposition seems more powerful especially in males. While above mentioned molecular genetic studies have shown that relationships do exist between some genetic polymorphisms and PIU/IA, the joint contribution of both genetic and environmental influences is still vague. Thus, it is necessary to expand research on PIU/IA behaviors to consider genetic influences as well as environmental ones. Besides, as emphasized by some researchers, no twin studies investigated the heritability of PIU/IA to date (Montag et al., 2012; Pezoa-Jares, Espinoza-Luna, & Vasquez-Medina, 2012). Therefore, the main purpose of this study is to quantify the relative importance of genetic and environmental influences on PIU, using the classical twin design.

2. Methods

2.1. Design: Rationale of behavioral genetics and the classical twin design

In the present study, we adopted a quantitative behavioral genetics approach, and used the classical twin design. Quantitative behavioral genetic approaches are designed to separate out genetic influences and environmental influences by apportioning the observed differences between people (phenotypic variance) into three subcomponents: *heritability* (h^2), *shared* (*common*) *environment* (c^2 or C), and *non-shared* (*unique*) *environment* (e^2 or E) (Plomin, DeFries, McClearn, & Rutter, 2001). Heritability is a statistic that describes the proportion of observed variance for a behavior that can be ascribed to genetic differences among individuals in a particular population (Plomin, 1989). It should be noted however that the effects of some genes may be independent of other genes