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Problematic Technology Use: The impact of personality and continued use

Brandis Phillips

North Carolina A&T State University, bphillip@ncat.edu

Belinda Shipps

North Carolina A&T State University, bpshipps@ncat.edu

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ABSTRACT

As technology becomes more pervasive, it is more accessible to use anytime, anywhere. Although technology has been a savior in many respects, there is a need for awareness of the potential for excessive and problematic technology use (PTU). Prompted by an increase in anxiety, stress, and feelings of isolation, some individuals may be more prone to PTU than others. If not recognized, PTU may become associated with obesity, sleeplessness, a decline in social skills, and deficient performance at school and work. The information systems literature has indicated that a variety of information technology artifacts can lead to PTU. The focus of this research will be to examine the antecedents of PTU, with an emphasis on IS continued use and personality traits. The value of this study is in addressing awareness, recognition, and prevention of PTU and proposing possible factors to consider in regulating the use of technology. The results suggest a significant and positive association between PTU and Information Systems continuance, habit, and personality traits of introversion and neuroticism.

Keywords

Problematic technology use, addiction, neuroticism, extroversion/introversion, five-factor model, habit, IS continuance

INTRODUCTION

The ubiquitous nature of technological artifacts has begun to lead to problematic behaviors throughout society. In and of itself, technology is a productivity tool as well as a means of spending leisure time. However, unintended consequences of overuse suggest the presence of problematic technology use (PTU) (Turel et al. 2008). Examples of problematic use include gaming for days on end to the exclusion of basic human functions such as eating or sleeping, or social media posting multiple times per hour every day. As a result of such societal trends, emerging research streams are now exploring the “dark side” of technology (Tarafdar et al. 2015).

There is much debate about whether PTU is an addiction. Many of the previous discussions and studies in the IS literature focus on PTU as an addiction without proper adherence to the psychological definition of addiction. As such, in this study, we take an alternative, unique view in our focus on not addressing PTU as an addiction in the clinical sense. We define PTU as a controllable/manageable condition characterized by excessive use of Internet-based technology which is not necessarily characterized as addiction. Furthermore, excessive use has been defined as “obsessive, uncontrolled, excessive and problematic behavior arising from use of digital technologies” (Lobe et al. 2011). Excessive use relates to frequency of use over an extended period, but also diminishing control over online technology use along with negative outcomes. The degree of negative effects can vary based upon time spent on the Internet, the purpose and intention and excessive and uncontrolled use (Filiz 2015).

PTU excessive use is evaluated as loneliness, diminished impulse control, and social comfort. Several examples illustrate the uncertain definition and debatable nature of technology addiction. For instance, although American psychologists have stopped short of identifying excessive technology use as a true addiction (Edition 2013), the Chinese government has specifically identified Internet addiction as a public health problem (Medalia and Shlam 2013; Tang et al. 2014). According to Medalia and Shlam (2013), there is an extensive network of Internet/gaming detoxification centers spread across China. Furthermore, organizations such as the American Academy of Pediatrics have shifted from addressing “screen time” purely in terms of television to encompassing all forms of screen technology, including computers, tablets, phones, video games, and so on. Even Silicon Valley technology entrepreneurs are voicing moderation as they are seeing the detrimental signs of overuse, which include stress and possible addiction leading to poor health outcomes (Richtel 2012). The World Health Organization (WHO), as of 2019, has deemed that excessive time spent playing electronic games is indeed an addiction (World Health Organization 2019). Another example of institutions addressing technology use is the French government, which has banned in-school cell phone use for all students aged 15 years or younger (Shaban 2018). As such, the focus of our inquiry is PTU, which we define as excessive and abusive/harmful use of technology that may be associated

with potential negative outcomes. We distinguish PTU from addiction by defining PTU as not being an involuntarily uncontrollable disease that focuses on psychological conditions.

Furthermore, as the COVID-19 pandemic continues to spread rapidly throughout the world, there are increasing concerns about technology dependency and the harmful effects on individuals (Drouin et al. 2020; Goh and Sandars 2020). Many people, both young and old, are isolated at home and have become more dependent upon multiple types of technology for school, work, communication, entertainment, shopping, and much more (Drouin et al. 2020; Goh and Sandars 2020; King et al. 2020; Kitchen et al. 2020). In a recent study by the Centers for Disease Control and Prevention (CDC) conducted during the Pandemic, 60% of young adults stated that they were experiencing anxiety and depression (Rettner). Previous research studies have shown an association between mental health conditions and problematic technology use (PTU) and technology addiction (Amendola et al. 2020; Brooks et al. 2020). Previous research has also shown how individual differences such as personality and self-efficacy may be factors associated with addiction (Thatcher and Perrewe 2002). We argue that individual differences such as IS self-efficacy and personality may also be factors in PTU.

The value of this study is in addressing awareness, recognition, and prevention of PTU and proposing possible factors to consider in regulating the use of technology. A theory-based model is presented that examines possible factors associated with PTU in considering multiple technological artifacts from a psychosocial perspective. The model encompasses not only psychological/personal traits but also social and technical dimensions from a social cognitive perspective.

The recognition of PTU factors can help in identifying and addressing actual and/or potential problematic technology users having the potential for negative outcomes in personal, social, professional, and academic environments (World Health Organization 2021). The focus of this research will be to examine the antecedents of PTU regarding continued use and personality traits in the overarching context of the presence of ubiquitous technology. We present a research model that addresses the following question:

How do personality and IS continued use impact problematic technology use?

The research model examines independent variables that focus on the personality traits of introversion and neuroticism along with the presence of habit and IS continuance. We take a unique approach in combining these independent variables with support from SCT to explore the technical environment (computer efficacy, ease of use) along with the social and individual personality (psychosocial) aspects of PTU.

The focus on two (introversion and neuroticism) of the big five personality traits is based on previous research that reported positive, significant associations with increased online technology use and introversion (Amichai-Hamburger and Etgar 2019; Hamburger and Ben-Artzi 2000; Harbaugh 2010; Liu and Larose 2009; Spradlin et al. 2019) and positive associations with neuroticism and online social media (Hamburger and Ben-Artzi 2000).

We suggest IS continuance supports PTU in the following way: IS continuance focuses on computer self-efficacy and is driven by initial, conscious intentions and rational decisions about IS use where it acts as a necessary condition of PTU's excessive use (i.e., use that is not initial and less intentional, occurs later with repeated use over time and is associated with negative outcomes). The initial IS continued use relates more to areas such as ease of use of technology or computer efficacy. We suggest habit as more automatic behavior, not requiring conscious choice, that is learned behavior, with repeated use over time (De Guinea and Markus 2009a). Habit thus must be present in situations where PTU exists due to its repeated use over time.

The dependent variable of problematic technology use is conceptualized as a second-order factor comprised of diminished impulse control, loneliness, and social comfort. To gain more insight into PTU, the study is organized as follows. The second section provides a theoretical overview and literature review revolving around social

cognitive theory, personality characteristics, continual use, and habit. The third section presents the research model and hypotheses; the fourth section presents the results, and the last section provides a discussion and conclusion.

THEORY AND LITERATURE REVIEW

In reviewing the literature, we have organized this section to support the PTU model from a wider lens. The information systems (IS) and psychology literatures, as well as the uses and gratifications theory (UGT) and social cognitive theory (SCT) literatures serve as a foundation for inquiry. We look at PTU beyond the stereotypical user, single personality, or single artifact. The theory and literature review section discusses IS, communication, and psychology literature. It examines the individual user in relation to PTU using social cognitive theory and its three focal areas: personal, social environment, and behavior. In terms of individual need and personality we also draw support for PTU behavior in an online environment from the uses and gratifications theory. We explore how the intersection between the individual and the online environment may relate to IS computer efficacy/continuous use of technology and problematic use. First, we discuss the social/technical environment with supportive literature from information systems. Second, we discuss the individual personal perspective with support from psychology and communication literature, and third, we introduce SCT and how it connects the personal, social/technical environments, and PTU behavior. Within the IS literature, computer self-efficacy (CSE) and technology use form the basis of inquiry, supported by SCT (Bandura 1986). These theoretical lenses serve as a basis for PTU, in that a user must have the ability and motivation to use a particular technology that is dependent in part on a potential user's behavior and his or her environment (Compeau and Higgins 1995). CSE is also affected by "attribution of cause" (i.e., recent performance using technology most likely affects future use), "feedback" (i.e., computer anxiety), "emotion-focused coping" (i.e., goal setting/goal attainment), commitment, and demographic factors (age, gender, etc.) (Marakas et al. 1998). In developing the model, we draw support from SCT and UGT as well as previous research studies.

IS literature— addiction-like behavior (social/technical environment)

In the next two sections, we discuss the broad focus in prior research on technology use as an addiction in IS and psychology literature. In contrast to previous views on addiction and technology use, our unique focus in this study is on technology use as a problem that is not an addictive clinical disorder. Later in the section on Uses and gratifications theory, we discuss support for PTU in terms of personal communication and human interaction needs. Our assumption in focusing on PTU, continued usage, and personality is that it is a condition that can be modified given limits. Problematic technology use emphasizes factors associated with negative outcomes and consequences associated with loneliness, social comfort, diminished self-regulation (Caplan and High 2011), or abusive behavior and the idea that it is not a disease or clinical disorder (Morahan-Martin and Schumacher 2003). Examples of negative outcomes include gaming for days on end to the exclusion of basic human functions such as eating or sleeping, or social media posting multiple times per hour every day

In reviewing problematic technology use in relation to the information systems literature, there is a heavy focus on examining negative use from an addictive perspective using single artifacts. Many of the previous studies regarding technology use focus on the problem as an addiction and/or from a stereotypical perspective. In the following paragraphs, we present several examples of IS research focusing on technology use as an addiction and with stereotypes.

Most notably, Turel et al (2011), in their study of eBay use, find that online auction addiction is preceded by perceived enjoyment (Davis, F. D. et al. 1992) as well as technology acceptance (Davis, F. D. 1989). Furthermore, Turel et al. (2011) defines technology addiction as "a psychological state of maladaptive dependency on the use of a technology to such a degree that the following typical behavioral addiction symptoms arise—salience, withdrawal, conflict, relapse and reinstatement, and tolerance, as well as mood modification." Other researchers such as Thadani and Cheung (2011) define technology addiction in the context of social networking, stating that it is "a deficiency in self-regulation with which an individual is unable to effectively regulate one's dependency on the social networking sites." Other researchers state the formation of habit (Limayem and Hirt 2003; Limayem et al. 2007) as

a precursor to addiction. According to Wang et al. (2015), stress moderates the relationship between escapism motivation and problematic smartphone use. Rosen et al. (2014) find excessive media and technology use leads to diminished health levels in adolescents, and Xu et al. (2012) find that using online gaming as an artifact to fit a functional need for the actor, such as relationships with others and escapism, drives tendencies toward addiction. Adding to the arguments in the IS literature, in the field of communications, LaRose (2003) examines maladaptive technology use through the lens of media consumption patterns, suggesting that self-regulation is weakened for users who exhibit addictive tendencies to television. Finally, Vaghefi and Qahri-Saremi (2018) examine how personality affects addiction and find that two of the big five personality traits—neuroticism and conscientiousness—significantly affect social network addiction. In summary, although the IS literature states that technology usage has become detrimental to the user, the results of the studies cannot necessarily claim that users are truly addicted in the clinical sense of a diagnosis.

Examples of other research assume that problematic technology use only affects certain types of individuals. In this study we address this assumption by exploring a unique group of students at a Minority Serving Institution (MSI) in the southeast as well as students at majority institutions. Early research in this literature stream by Soule et al. (2003) suggests that stereotypes such as the young white male American video game player or the middle-aged female Internet shopper are representative of those most prone to unhealthy Internet use, but in many cases, this characterization does not fit current reality. This is especially true with the increasing reliance on technology use due to COVID-19 social distancing and isolation requirements (King et al. 2020). D’Arcy and colleagues (2012) further dismiss these stereotypes by synthesizing the existing literature and suggesting a singular theme for problematic use that is, in effect, the so-called “dark side.” This dark side of technology may quite possibly lead to stress, interruptions, misuse, or addiction regardless of gender, race, age, or other traits. Behavior that is deemed to be excessive has been identified as a possible antecedent to addiction in many different cases, such as alcoholism or drug abuse (Turel and Serenko 2011). Internet addiction or PTU is similar, in those excessive behaviors revolving around technology usage and media consumption lead to negative outcomes. Thus, IS and psychology literature serve as a foundation for inquiry.

Psychology literature—PTU and addiction (individual personal perspective)

Similar to the IS literature in the previous section, many of the previous discussions and studies in the psychology literature have debated about the possibility of heavy technology use as an addiction but have not formally labeled excessive technology use as an addiction. In this study, PTU is viewed as a controllable and modifiable condition and not an addiction. We argue that, with awareness and understanding, PTU behavior may be manageable with modification of individual behavior. The PTU model looks at PTU from a multidimensional approach. We examine online communication and psychological aspects of PTU as dimensions associated with individual users. We argue that, in combination with other factors, individual differences can influence the problematic use of technology, not necessarily as an addiction.

Beginning with Young (1998), from a psychological perspective, psychology literature labels negative Internet-related behavior as an addiction. Young states that actors susceptible to Internet addiction exhibit greater usage, which is often associated with personal problems that are related to work and/or family conflict. Concerning psychology and technology addiction across artifacts, research has investigated the identification of the antecedents of usage on social networking websites (Grüsser et al. 2006; Wilson et al. 2010), the ability to identify problematic Internet use before employment (Davis, R. A. et al. 2002), and game addiction, as well as general Internet addiction (Lin 2004; Whang et al. 2003). Notwithstanding the existing literature, the psychology community has yet to formally acknowledge the existence of a distinct technology dependence or addiction that an individual can or should be diagnosed with in the *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition* (DSM-5) (Block 2008; Edition 2013). Nevertheless, Turel and Serenko (2011) suggest that the poor habits that mark other addictions, such as substance abuse and alcoholism, are similar to the poor habits that are signs of what could be termed Internet addiction. Caplan (2002) and Morahan-Martin and Schumacher (2003) find that consequences associated with loneliness, social comfort, and self-regulation, as well as abusive behavior, do not necessarily invoke disease or clinical disorders.

Uses and Gratifications theory and PTU

In contrast to the psychology literature on addiction, we draw support for the psychological and social dimension of PTU with the uses and gratifications theory, which helps to explain PTU as a personal desire motivated by the need for communication and interpersonal interaction. This theory has been used to help explain personality style and human interactive relationships in online environments (Harbaugh 2010; LaRose et al. 2001). The theory emphasizes the fulfillment of individual needs as a motivator toward continuous use of online interactive technology. We argue that individual behavior associated with PTU and the specific need for human interactivity may elicit habit forming behavior which may not necessarily be addiction. Uses and gratifications theory indicate that different people have different social and psychological needs. The needs contribute to the reasons why some people may spend more time using technology than others (Harbaugh 2010). Harbaugh (2010) is guided by uses and gratifications theory in research that highlights eight reasons or gratification factors for Internet use which include: to stay informed, diversion and entertainment, peer identity, good feelings, communication, sights and sounds, career, and “coolness”).

In this study, our research focuses on two personality styles and PTU. Our focus on examining two personality styles (neuroticism and introversion) is based on previous research which indicated an association between heavy technology use, need, and specific personality styles (Harbaugh 2010; McKenna and Bargh 2000). Similar to other researchers, we did not focus on the other three big five personality traits (openness, agreeableness, and conscientiousness). Previous research indicates that certain individuals that are lonely, depressed or have low psychological well-being (Bargh and McKenna 2004; Caplan 2003) may become heavy users of the Internet. Harbaugh (2010) found a positive association between time spent using the Internet and introversion/extroversion personality styles. Introverts may prefer online technology interaction and may become heavy Internet users because of the opportunity for social interactions that may not be available in face-to-face environments (Liu and Larose 2009; Spradlin et al. 2019). The Internet allows the introvert to have more time to think before responding and thus may allow them an opportunity to recreate themselves as more of an extrovert (Liu and Larose 2009; Spradlin et al. 2019). Neuroticism is another personality trait that appears to have an association with excessive technology usage (Amichai-Hamburger and Etgar 2019; Hamburger and Ben-Artzi 2000; Harbaugh 2010). We focus on studying two specific personality traits that have been shown from previous research to be heavy users of the Internet and therefore may be more prone to PTU due to their personality and need for social interaction.

SOCIAL COGNITIVE THEORY

Social cognitive theory (SCT) provides support for the PTU model and its focus on the problematic use of various technology artifacts in relation to an individual’s personal and environmental characteristics and behavior. SCT states there is a triangular relationship between personal attributes, environment, and behavior. In this study, we use this concept to help understand the interplay between technology behavior, the individual and their personal attributes, and the Internet environment and possible susceptibility to PTU. SCT focuses on understanding behavior and the reciprocal interplay between behavior and personal and environmental considerations (Bandura 1986). SCT also addresses self-efficacy, and we relate it to continual use, computer self-efficacy (CSE), and satisfaction. People learn how to behave by observing and acting on their personal characteristics, abilities, and behavior, as well as by observing the behavior of others. In this study, we use SCT and its dimensions (personal, social, and behavioral) to help understand possible factors associated with the behavior of PTU.

The personal and behavioral dimensions of SCT focus on the individual’s characteristics and the reciprocal interaction and effect of both. Personal characteristics include traits that have been associated with PTU, such as stress, anxiety, anger, depression, loneliness, introversion, and escapism (LaRose et al. 2003; Turel et al. 2011). The personal dimension addresses the individual characteristics in relation to personality, self-efficacy and the person’s beliefs regarding behavior. In relation to PTU, an individual’s beliefs about his or her technological use and self-efficacy regarding the use of technology guides his or her behavior toward excessive use. As actors continue to engage with artifacts, confidence increases with use (i.e., CSE) and thus becomes habit-forming. The social

dimension drives use as the artifact is a conduit to interactions with others. As such, in examining the personal dimension of an individual user, we focus on two of the five personality traits, neuroticism and introversion, due to previous research that showed an association between these traits and technology addiction (Andreassen et al. 2013).

PTU MODEL

In this section, we describe the factors in the PTU model. The model addresses PTU as a controllable condition that is not considered an addiction that is driven solely by a reliance on an individual's psychological state. The model looks at the user from a triad perspective in terms of their individual person, their environment, and their behavior. We will attempt to test excessive use in the context of personality traits and usage. This model does not test if there is a psychological dependency (Turel et al. 2011) on technology.

Problematic technology use

The IS literature has begun to coalesce around a singular dependent variable of inquiry (i.e., PTU). PTU is an alternative label for what is perceived to be an addiction-like behavior. In the past, this addiction-like behavior has been described in many ways such as including an intense preoccupation with technology use (Chou 2001), poor impulse control (Soule et al. 2003; Tang et al. 2014), or excessive or compulsive amounts of time using technology (Chou et al. 2005; Whang et al. 2003). The focus of this study is on examining PTU not as an addiction but through a behavioral lens where we examine the psychosocial behavior that is associated with the negative use of technological artifacts in professional, academic, and personal environments. We consider problematic behavior such as loss of job or failure in courses due to overindulgence in some form of online technology. Problematic behavior is captured with the use of the second-order reflective construct, PTU (Jia and Jia 2008). The social psychological states that comprise PTU—diminished impulse control, loneliness, and social comfort (in that the use of technology helps the actor avoid situations that may lead to social anxiety)—combine to capture users' technological artifact consumption that may be excessive or quite possibly, psychologically damaging. Specific maladaptive behaviors include excessive microblogging (Li et al. 2012) or cyberloafing (Zwanenburg 2013). Furthermore, we conceptualize PTU, not as a single artifact as an object of inquiry like other IS studies of problematic use, but as many artifacts that include smartphones (Soror et al. 2015; Zhang et al. 2014), social media such as Facebook and Myspace (Thadani and Cheung 2011; Turel 2015), mobile email usage (e.g., BlackBerry) (Turel et al. 2008), and gaming (Charlton and Danforth 2010; Sepehr and Head 2012; Xu et al. 2012).

Problematic Technology Use is modeled as a second order factor in that it represents a multidimensional phenomenon. Researchers such as Edwards (2001) and Jarvis et al (2003) suggest that allowing for hierarchical constructs gives way to matching the phenomenon's level of abstraction. Furthermore, hierarchical constructs should be modeled as reflective when the first order factors are expected to be correlated (Freeze and Raschke 2007) and dropping a first order construct will not significantly alter the essence of the second order construct. In contrast formative second order factors maintain first order measures that do not necessarily need to be correlated but serve as causal (MacCallum and Browne 1993), composite (MacKenzie et al. 2005) factors of the second order factor. Finally to remain consistent with previously published research by Jia (2008), PTU is operationalized as a reflective second order factor. The following will discuss each first order factor.

Diminished Impulse Control

PTU (i.e., usage that leads to unintended consequences) may manifest itself in a variety of ways, including increased stress (Maier et al. 2013; Ragu-Nathan et al. 2008) or loss of impulse control (Jia and Jia 2008) where an individual cannot govern his or her behavior (Jia et al. 2007). Actors may find themselves energized by being online as well as thinking about getting online when they are engaged in offline activities. Actors are also perceived by others as engaging in and consuming too much Internet-related media.

Loneliness

The loneliness dimension (Jia 2008) of PTU suggests that actors engage in artifacts to combat isolation from others. Individuals not connected with viable real-world social networks turn to finding engagement through technology-enabled media to find and maintain relationships. This type of engagement becomes problematic when it comes at the expense of establishing and maintaining other types of relationships.

Social Comfort

Related to the effects of personality, actors feel more comfortable (Jia and Jia 2009) socializing in a technology-enabled environment as opposed to face-to-face. Real-time face-to-face interactions call for non-verbal cues and overall physical appearance, which for the most part is not technology-enabled. As such, actors find solace in technology-enabled environments as opposed to those in person. Actors are relieved of the burden of reacting to another human being in real time and thus do not have to be subject to any perceived or real negative feedback.

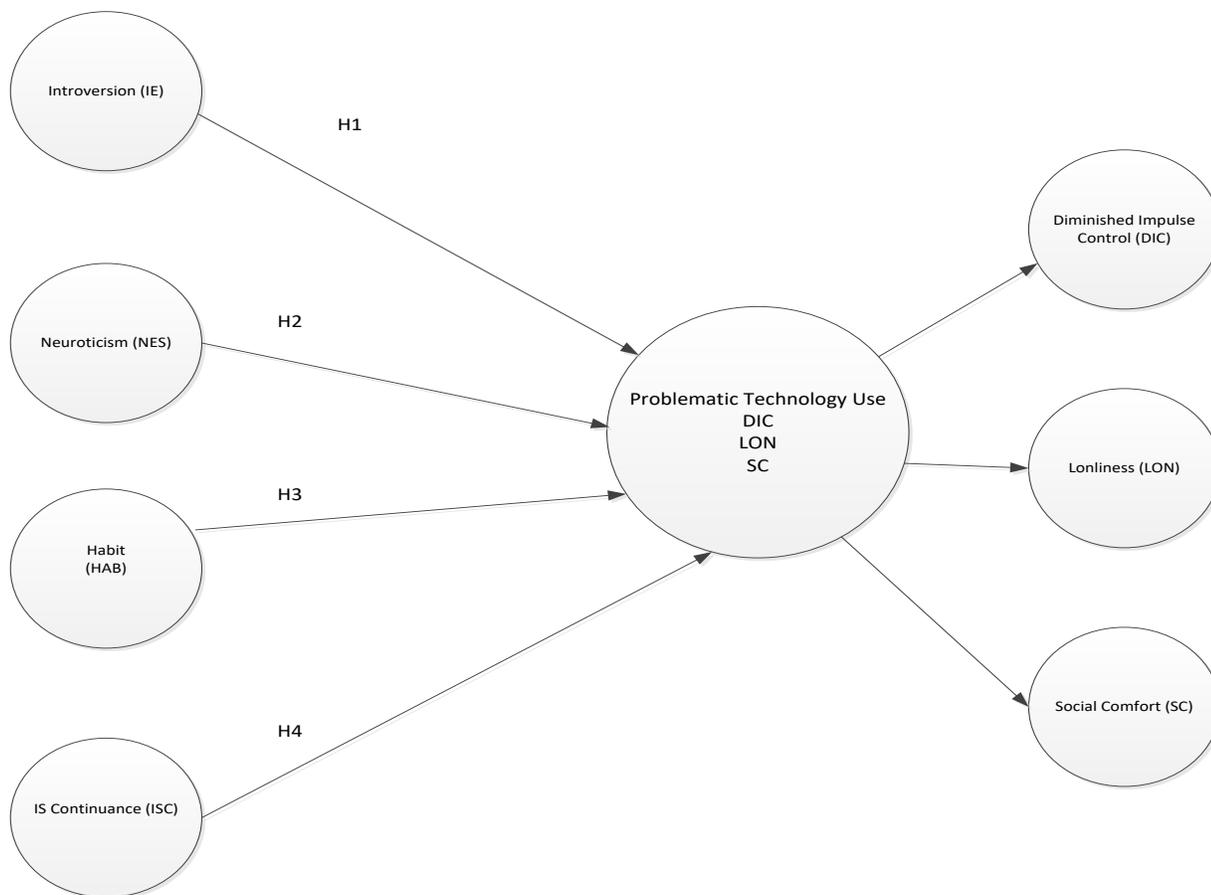
Model

In defining the model, we focus on the psychosocial and technical traits/characteristics and behaviors that are associated with negative or problematic behavior underpinned by personality. As such, introversion and neuroticism are independent variables in the model that have been linked in previous research to maladaptive and problematic behavior. Furthermore, an assumption is made regarding users' involvement with their artifacts. As such, constructs for habit and IS computer-efficacy continuance (Limayem et al. 2007) are incorporated in the model to properly capture the notion that artifact use has already been established.

We study the impact on PTU of the following variables: personality, initial, conscious/intentional use (IS continued use) and (Habit) which is defined as later occurring, repeated, learned, unconscious and unintentional. IS continued use differs from PTU use in the occurrence, frequency of use, and negative outcomes. IS continued use is driven by initial, conscious intentions and rational decisions about IS use whereas PTU is defined as excessive use (use that is not intentional, occurs later with repeated use over time and is associated with negative outcomes). The initial IS continued use may relate to ease of use of technology or computer efficacy. Using these constructs, our focus is on the psychosocial and technical traits/characteristics and behaviors that are associated with negative or problematic behavior underpinned by personality

In pursuit of that goal, the following research question is offered along with the research model:

How do personality and continued use impact problematic technology use?



Research Model. Figure 1
Hypothesis Development

Hypothesis 1 (Introversion & PTU)

The Big Five personality traits, first espoused by Tupes and Christal (1961) and then advanced by Digman (1990b), serve as the basis for understanding how individual differences affect behavior. In a meta-analysis of psychological disorder studies performed by Kotov et al. (2010), the results suggest many individuals with disorders were low on extraversion (i.e., high on introversion), as well as high on neuroticism and low on conscientiousness. These personality traits are generally present in a variety of substance abuse disorders, as well as in individuals who exhibit depressed moods or anxiety. Introversion is described as low levels of sociability assertiveness and enthusiasm (John and Srivastava 1999). Neuroticism, or emotional instability, is described as feelings such as sadness, anxiousness, insecurity, anger, and nervousness (John and Srivastava 1999). Introverts, who may be shy and uncomfortable interacting with others and prefer less face-to-face interaction, prefer interacting online (Digman 1990; Jia and Jia 2009). As a result, increased amounts of time spent interacting online reinforce habits of social media use, gaming, and so on as a way to connect with others. This has the potential to lead to excessive technological use. As such, SCT and UGT help us understand how personality affects PTU. As previously mentioned, although American psychologists have not specifically labeled overuse of technology as a disorder, technology researchers suggest otherwise (Turel 2011a). Furthermore, certain types of behavioral interactions may be rooted in certain personality factors. For instance, extraverted personality types may be less prone to retreat to technology use than introverts, who may generally prefer online interactions as easier to maintain than face-to-face ones. Thus, the following proposition is put forth:

H1. Higher levels of introversion will lead to higher levels of PTU.

Hypothesis 2 (Neuroticism & PTU)

An individual's personality may affect behavior such as technology use. Individuals with neurotic traits tend to have a lower level of stress tolerance and seek ways to reduce it. They may experience feelings of loneliness, anxiety, anger, or depression. Consistent with previous research, individuals who have difficulty dealing with stressful situations may have higher tendencies toward problematic technology use associated with addiction, as they may increasingly use technology to help reduce stress and feelings of loneliness, irritability, and social anxiety (LaRose et al. 2003; Tokunaga and Rains 2010; Vaghefi and Qahri-Saremi 2018). Neuroticism is one of the personality traits that appears to have an association with excessive technology usage (Hamburger and Ben-Artzi 2000; Harbaugh 2010). Neuroticism is defined as a tendency to experience distress and negative emotions such as anger, sadness, fear, depression, anxiety, irritability, loneliness, worry, self-consciousness, dissatisfaction, hostility, shyness, reduced self-confidence, and feelings of vulnerability (Krueger et al. 2008). In relation to Eysenck's (1963) theory of personality, neuroticism relates to a low tolerance for stressful or unpleasant situations. For example, individuals who are classified as neurotic and experience a low tolerance for stress and anxiety may use online social networks or gaming sites excessively to help them successfully manage their stress (Jia and Jia 2009). Therefore, we propose the following hypothesis:

H2. Higher levels of neuroticism will lead to higher levels of PTU.

Hypothesis 3 (Habit & PTU)

Ubiquitous technology allows actors to switch easily among IT artifacts regardless of location or time of day. In this way, routines are formed that incorporate technology into daily life. In the presence of habitual technology use, poor habits may be formed, leading to the possibility of PTU. Users may seek to meet basic behavioral needs through technology use, including the need to escape from the stressors of everyday life or the desire to build more appealing relationships via technology. As such, certain types of use may facilitate a higher sensitivity toward PTU. For instance, when an actor views their activity as always being necessary to advance his social centrality, this type of activity may exacerbate the behavior toward technology from merely habitual to problematic. Habit is a necessary but not sufficient antecedent in developing addictive behavior. Within IS literature, researchers such as Limayem et al. (2007) initially introduced habit to support the notion that continued usage is affected by habit. Regarding PTU, Turel and Serenko (2011) find that habits—specifically bad IS habits—lead to addiction to a social networking website. They also suggest that there are similarities between poor habits associated with deficient self-regulation (that contributes to habit formation—quite possibly bad) as well as addictions such as substance abuse and alcoholism and the poor habits that are signs of Internet addiction-like behavior. Given these findings, the argument can be made that habit can lead to PTU. Thus, the following hypothesis is put forth:

H3. Stronger habits will lead to higher levels of PTU.

Hypothesis 4 (IS Continuance and PTU)

IS continuance behavior relating to behavioral patterns where IS are associated with intentions for continued use. IS continued use differs from PTU use in the occurrence, frequency of use, and negative outcomes. IS continued use is driven by initial, conscious intentions and rational decisions about IS use whereas PTU is defined as excessive use (use that is not intentional, occurs later with repeated use over time and is associated with negative outcomes). The initial IS continued use may relate to ease of use of technology or computer efficacy. The more satisfaction the user feels in using technology, the higher the tendency to use the technology (Bhattacharjee 2001). From a social cognitive approach, self-efficacy and user satisfaction increase with effective use of technology, which develops into a self-reinforcing loop. The IS continuance variable draws support from SCT's personal dimension and an

individual's intention to continue to use information systems (IS). Research by Bhattacharjee (2001) revealed that a user's intention to continue to use information systems is determined by their perceived usefulness and satisfaction with the IS. In this study, we suggest that an individual who has continued satisfaction with an IS will continue to use it. The results of the study by Bhattacharjee indicate that the strongest predictor of a user's intention to continue to use the technology was satisfaction with its use. The second-highest predictor was the perceived usefulness of the device (Bhattacharjee 2001).

IS continuance (Bhattacharjee 2001) suggests a post-adoptive behavior that is temporally situated more closely to the time of developing problematic technology behaviors than the initial acceptance of such technology. In essence, continuing to engage with a particular technology is a fundamentally persistent intentional behavior (De Guinea and Markus 2009b). Over time, this intentional behavior becomes learned and then automatic. Addictive behaviors generally develop from an intentional act (i.e., habit) to an automatic behavior that has turned into a poor habit. Thus, the following proposition is put forth:

H4. Higher levels of IS continuance intention will lead to higher levels of PTU.

Control variables for gender and socioeconomic status are also entered into the model.

METHOD

A survey was conducted with students at three eastern universities in the United States. The characteristics of each university are as follows. The first is a large private institution in a large northeastern metropolitan area, the second is a large public university in a rural mid-Atlantic location, and the third is a mid-sized minority serving public college in the southeast. Business majors at all three institutions were surveyed utilizing the Qualtrics Internet-based survey tool. Students were recruited from professors at the three institutions with an inducement of course extra credit. Students were asked a variety of questions (see Appendix A for survey items) regarding their technology awareness and habits.

RESULTS

Sample Characteristics

Five hundred and ten surveys were completed in Qualtrics across the three institutions, with 475 (93%) being usable. Of the usable surveys, there were 246 male respondents (approximately 52%) and 229 female respondents (approximately 48%). Four hundred and sixty of the 475 respondents (97%) chose to answer the racial identity question ("The ethnic identity of the respondent is ...") as follows: 191 (42%) white, 99 (22%) Asian, 93 (20%) African American, 32 (7%) Hispanic, 14 (3%) Native American, and 7 (1%) Middle Eastern; a further 24 (5%) chose "other" as a response. Regarding socioeconomic status (see Table 1), data for both income and parental education level were collected. The results indicate that 73% of the respondents' parents were college graduates, and 57% of the households had incomes above \$75,000. Socioeconomic status from a sociological point of view has implications for how individuals engage with technology, in that the more education and income they have, the more likely they are to engage with technology in ways that enhance themselves personally or professionally (Hargittai 2008), which suggests utilizing technology in a manner that is *not* problematic.

Table 1. Socioeconomic Status

Parental Educational Attainment	Number of Responses	Family Income Range	Number of Responses
No formal education	2	1: Less than \$25,000	103
Eighth grade	8	2: \$25,001–\$50,000	44

High school grad	51		3: \$50,001–\$75,000	59
Some college	65		4: \$75,001–\$100,000	57
College grad	167		5: Greater than \$100,000	212
Graduate school	180			
Total	473		Total	475

Measurement Model

We use partial least squares (PLS) as the statistical tool for our analysis because of its ability to evaluate second-order factors and because our research is exploratory. As such, an examination of the measurement model is conducted through confirmatory factor analysis (CFA). The CFA is conducted utilizing the method of Yi and Davis (2003). Table 2 shows the results of the CFA analysis, highlighting the factor loadings and cross-loadings.

Table 2. Construct Loadings/Cross Loadings

	DIC	Gender	HAB	ISC	IE	LON	NES	SC	SES
DIC1	0.78	-0.01	0.16	-0.11	0.01	0.51	0.24	0.425	0.08
DIC2	0.82	0.12	0.14	-0.16	0.10	0.52	0.30	0.42	0.01
DIC3	0.85	0.06	0.18	-0.38	0.09	0.60	0.33	0.42	-0.00
Gender	0.07	1.00	0.05	0.05	-0.04	0.07	0.11	0.05	0.016
HAB1	0.21	0.05	0.92	0.12	-0.18	0.15	-0.02	0.04	0.13
HAB2	0.14	0.08	0.89	0.24	-0.19	0.12	-0.07	0.05	0.15
HAB3	0.15	0.01	0.83	0.21	-0.15	0.13	-0.07	0.04	0.16
ISC3	-0.16	0.05	0.20	1.00	-0.23	-0.10	-0.17	-0.16	0.14
IE10	0.03	0.03	-0.07	-0.15	0.75	0.10	0.22	0.17	-0.03
IE6	0.02	-0.07	-0.18	-0.17	0.88	0.12	0.19	0.23	-0.11
IE7	0.00	-0.05	-0.21	-0.21	0.8	0.10	0.24	0.20	-0.1
IE8	0.15	-0.03	-0.19	-0.23	0.88	0.12	0.34	0.28	-0.14
IE9	-0.02	0.03	-0.21	-0.17	0.68	0.02	0.15	0.10	-0.04
LON1	0.60	0.06	0.07	-0.10	0.18	0.87	0.33	0.51	-0.07
LON2	0.55	0.06	0.21	-0.08	0.07	0.85	0.31	0.47	-0.06
NES10	0.28	0.04	-0.08	-0.18	0.34	0.30	0.77	0.31	-0.04
NES3	0.25	0.15	0.03	-0.14	0.16	0.23	0.68	0.17	-0.03
NES5	0.26	0.07	-0.05	-0.13	0.23	0.32	0.75	0.28	-0.04
NES6	0.27	0.12	-0.07	-0.12	0.20	0.30	0.83	0.28	-0.12
NES7	0.39	0.10	-0.05	-0.16	0.25	0.30	0.86	0.30	-0.11
NES8	0.37	0.11	-0.08	-0.18	0.2	0.35	0.89	0.37	-0.12
NES9	0.23	0.05	0.01	-0.07	0.20	0.25	0.77	0.22	-0.07
SC1	0.49	0.06	0.11	-0.09	0.21	0.55	0.29	0.89	-0.07
SC2	0.42	0.04	-0.08	-0.20	0.26	0.45	0.34	0.87	-0.15
SES	0.01	0.02	0.17	0.14	-0.13	-0.00	-0.10	-0.12	1.00

All survey items load on their construct at 0.75 or better, which is considered satisfactory. The items also load more on their associated constructs as opposed to other constructs in the model. Further testing of the measurement model evaluates the reliability and validity of the model by calculating the internal composite reliability (ICR) and average variance extracted (AVE). The ICR is interpreted in the same manner as Cronbach's alpha (Fornell and Larcker 1981), where an ICR of 0.7 is deemed to be sufficient. The ICRs shown in Table 3 suggest sufficient construct reliability because all the constructs' ICRs are above 0.88. The AVE measures variance relative to measurement error. A valid construct that consistently measures what is intended has an AVE above 0.5 (Chin 1998); the lowest value in our study is 0.52, suggesting sufficient convergent reliability. Discriminant reliability requires the constructs to be distinct from one another. The square roots of the AVEs (the bold data in the diagonal in Table 3) for two latent variables must each be greater than the correlation between those two variables (Fornell and Larcker 1981). An examination of the correlations among the constructs in Table 3 indicates that all of these relationships pass the discriminant validity test.

Table 3. Correlations, Average Variance Extracted, Internal Composite Reliability, Discriminant Validity

	Mean	STDEV	ICR	DIC	Gender	HAB	ISC	INT	LON	NEU	PTU	SES	SC
DIC	3.04	1.56	0.86	0.82									
Gender	1.48	0.50	1.00	0.07	1.00								
Hab	5.87	1.24	0.91	0.19	0.05	0.88							
ISC	3.09	1.69	1.00	-0.16	0.05	0.20	1.00						
INT	2.93	1.34	0.91	0.08	-0.03	-0.20	-0.23	0.82					
LON	3.21	1.65	0.85	0.66	0.07	0.16	-0.10	0.15	0.86				
NEU	2.92	1.37	0.92	0.36	0.12	-0.06	-0.18	0.31	0.38	0.80			
PTU	2.99	1.61	0.89	0.89	0.08	0.16	-0.17	0.18	0.87	0.43	0.72		
SES	4.96	1.08	1.00	0.01	0.02	0.17	0.14	-0.13	-0.08	-0.11	-0.07	1.00	
SC	2.70	1.61	0.88	0.52	0.06	0.02	-0.17	0.27	0.57	0.36	0.79	-0.13	0.89
Average Variance Extracted				0.67	1.00	0.78	1.00	0.67	0.74	0.64	0.52	1.00	0.79

Where DIC – diminished impulse control, HAB-habit, INT-introversion, LON-loneliness, NEU-neuroticism, PTU-problematic technology use, SES-socioeconomic status, SC-social comfort

Structural Model

PLS structural models are interpreted in the same manner as regression models. The path coefficients represent standard betas, while R^2 represents the variance explained. Thus, given the hypothesized research model, Figure 2 depicts the results of the hypothesis tests. The variance explained in the dependent variable, PTU, is $R^2 = 0.23$, suggesting a moderately significant result. A discussion of each hypothesis is as follows.

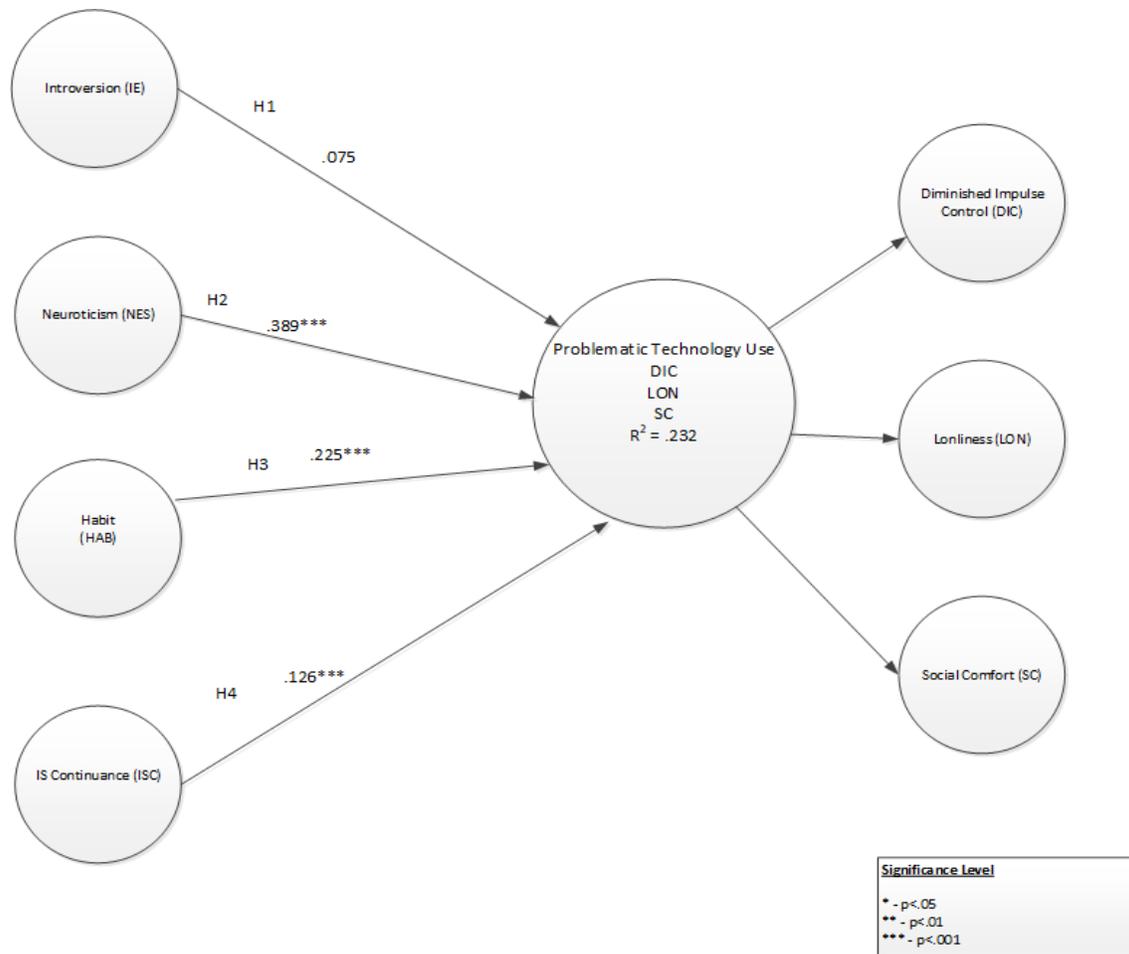


Figure 2. Research Results

Hypothesis results

Hypothesis 1 (Introversion/Extraversion)

The personality trait of introversion is found to have a mildly significant effect on PTU ($\beta = 0.075$; $p < 0.10$). This finding suggests that individuals with introversion have a higher tendency to use technology in a manner that may lead to problematic behavior. Consistent with the literature, more introverted individuals tend to be less talkative, shyer, and less comfortable around people. Therefore, they look at various forms of technology, such as the Internet, as a way to interact with others in a less confrontational manner.

Hypothesis 2 (Neuroticism)

The finding for hypothesis 2 is that the personality trait of neuroticism is found to significantly affect PTU ($\beta = 0.389$; $p < 0.001$). This finding suggests that individuals with neuroticism have a higher tendency to use technology in a manner that may lead to problematic behavior. Consistent with the literature, more neurotic individuals tend to exhibit feelings of anxiety, loneliness, guilt, worry, or fear. Therefore, they look at various forms of technology, such as the Internet, as a way to interact with others to avoid experiencing those psychological states.

Hypothesis 3 (Habit)

The hypothesis regarding habit is found to significantly impact PTU ($\beta = 0.225$; $p < 0.001$). This finding suggests that individuals who have a stronger habit of using technology (e.g., to reduce stress) may develop a stronger tendency to do so in a manner that may lead to problematic behavior. They may tend to rely on technology automatically for a variety of reasons, including enjoyment, companionship, and reduction of loneliness (Jia and Jia 2008). As individuals form habits that lead to an automatic and natural reliance on technology, the habitual use of technology may lead to problematic use (Limayem et al. 2007).

Hypothesis 4 (IS Continuance)

The hypothesis regarding IS continuance is found to significantly affect PTU ($\beta = 0.126$; $p < 0.001$). This finding confirms the hypothesis and suggests that individuals who have higher levels of IS continuance intention will have a higher tendency to use technology in a manner that may lead to problematic use. This supports the previous literature that suggests technology users in the post-adoptive phase will continue to use IS if they have high satisfaction with their use and perceived usefulness. Satisfaction with an artifact will encourage continued use, which can lead to problematic use of technology. Although originally put forth in the model as a three-item construct consistent with the construct's original conception, the reverse coded item (ISC3) is the only item to properly load on the construct. This may be due to the respondents not understanding the positively coded continued use questions (ISC1 & ISC2), which loaded at 0.259 and 0.358, respectively. ISC3 loaded at 0.783 on the ISC construct. The model was run with ISC1 and ISC2 both in and out of the model, as the ISC construct remained a significant predictor of PTU in both cases. The poorly loading items (ISC1 and ISC2) were culled from the model. Examining the items suggests respondents had a visceral reaction to the ISC3 question, suggesting they discontinue use. The construct item was able to stand on its own. Although using a single-item construct is less than optimal, authors such as Fuchs and Diamantopoulos (2009) state that using such a construct can add value to research models. Table 4 summarizes the results of the hypotheses.

Table 4. Hypotheses and Results

Hypothesis	Hypothesized Linkage	Support
H1	Introversion \rightarrow Problematic Technology Use	No*
H2	Neuroticism \rightarrow Problematic Technology Use	Yes
H3	Habit \rightarrow Problematic Technology Use	Yes
H4	IS Continuance \rightarrow Problematic Technology Use	Yes

*Hypothesis approached significance at the .10 level

Impact of Control Variables

Of the two control variables tested, neither gender nor socioeconomic status were found to be significant predictors of PTU.

DISCUSSION AND CONCLUSION

The omnipresent nature of technology has made it easy for technology use to become an integral and important part of our existence. With this growing reliance on technology, there is a growing concern about its possible overuse. Previous research suggests psychosocial problems can affect technology use in a harmful way. The results of this study support and extend this research. This research looks at a broader range of factors and indicates individuals' personal traits, habits, and intentions for continual use and how they contribute to PTU. This research suggests that

individuals' habits and continual use are important considerations in understanding PTU. Also, this research emphasizes the importance of considering neuroticism and introversion. An individual with either of these two personality traits may experience anxiety, loneliness, or depression or have a low tolerance for stress and, thus, may have a stronger tendency to experience PTU.

Limitations

This study is limited in several ways. The survey was cross-sectional, conducted at a single point in time, thereby introducing the possibility of ambiguity in a causal direction. To test this, Harman's one-factor test (Podsakoff and Organ 1986) was performed to determine if common methods were a problem. Results suggest common methods bias was not a problem, as less than 50% of the variance was extracted from the first construct. Also, we focused only on the 18–24 age demographic, and PTU could be prevalent in other age groups, ranging from the very young to the elderly. Finally, as previously mentioned, the use of a single item for the IS continuance construct limited the variability of the construct. The other limitation in our study was the use of student respondents. Students may differ from the non-student 18–24 demographic regarding their orientation and use of technology, and our sample did not reflect other (non-student) populations.

Managerial Implications

As worker productivity becomes increasingly important, the need to understand how to recognize, manage, and prevent harmful use of technology becomes a crucial consideration for organizations in general and managers and workers in particular. This research can help in identifying and assigning specific types of jobs and work assignments in relation to specific individuals and their personality tendencies and habits. Workers who have a tendency toward PTU may not be suitable for some positions or may struggle to be productive in stressful work situations and resort to less time working and more time using technology for enjoyment or social reasons to relieve stress. This research can help in identifying factors early on and addressing them before they become a problem.

Research Implications

This study has demonstrated that PTU is associated with post-adoptive technology habits, IS continuance, and certain personality traits (neuroticism and introversion), which is supported by SCT. There has been discussion in the IS literature about the psychosocial aspects of PTU for particular technologies.

Future Research Directions

Future research directions should focus primarily on three areas. The first is incorporating the additional big five personality factors, openness, agreeableness and conscientiousness to determine if they have an inverse relationship with PTU. The second research area is to examine the impact of isolation and loneliness given the rise in mental health concerns during the COVID –19 pandemic. The acknowledgement of mental health concerns in general during the COVID-19 pandemic is worthy of examination to determine what role, if any, does technology play in facilitating an increase in poor mental health. Furthermore, an examination of the lasting effects of unhealthy technology use as a result of the pandemic is warranted as a longitudinal study. The final area of future inquiry may be the differential outcomes in problematic technology use among racial minorities in comparison to the majority population. Although the sample used in this study did not yield significant differences by race, going forward this topic deserves further inquiry.

Conclusion

This research has developed a model that draws support from SCT, uses and gratifications theory, as well as the IS literature, and psychology literature. We have determined that factors relating to neuroticism, introversion, habit, and intentions toward IS continuance can influence the problematic use of technology. Individual users who have higher levels of neurotic or introverted personalities may tend to experience more problematic use of technology.

There is a need to proactively recognize and manage factors that may contribute to PTU because of the potential harmful effect on individuals' personal and professional lives.

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Appendix A – Survey Items

HAB1	Using the Internet and social media in general has become automatic to me	Habit Limayem, M., Hirt, S., and Cheung, C. M.K. "How habit limits the predictive power of intentions: The case of IS continuance," <i>MIS Quarterly</i> (31:4) 2007, pp 705 - 73
HAB2	Using the Internet and social media in general is natural to me	
HAB3	When faced with a particular task, using the Internet is an obvious choice for me	
DIC1	When I am on the Internet/social media, I often feel a kind of "rush" or emotional high	Diminished Impulse Control (2 nd order factor - Dependency) ⁱ
DIC2	People complain that I use the Internet/social media too much	
DIC3	When I am not online, I often think about the Internet/social media	
LON1	I am less lonely when I am online	Loneliness 2 nd order factor – Jia, R., Jia, H. H. "Computer Playfulness, Personal

		Innovativeness, and Problematic Technology Use: A New Measure and Some Initial Evidence,” International Conference on Information Systems, Paris, 2008.
LON2	I feel helpless when I don’t have access to the Internet/social media	Social Inclusion – Jia & Jia 2008 see above
SI1	I am most comfortable online	
SI2	The Internet is more “real” than real life	
IE1	I am the life of the party (reverse)	Introversion/Extraversion Digman, J.M., Personality structure: Emergence of the Five Factor Model, Annual Review of Psychology, 1990, 41: 417-40
IE2	I feel comfortable around people (reverse)	
IE3	I start conversations (reverse)	
IE4	I talk to a lot of different people at parties (reverse)	
IE5	I don’t mind being the center of attention (reverse)	
IE6	I don’t talk a lot	
IE7	I keep in the background	
IE8	I have little to say	
IE9	I don’t like to draw attention to myself	
IE10	I am quiet around strangers	
NES1	I am relaxed most of the time (reverse)	Neuroticism/Emotional Stability Digman, J.M., Personality structure: Emergence of the Five Factor Model, Annual Review of Psychology, 1990, 41: 417-40
NES2	I seldom feel blue (reverse)	
NES3	I get stressed out easily	

NES4	I worry about things	
NES5	I am easily disturbed	
NES6	I get upset easily	
NES7	I change my mood a lot	
NES8	I have frequent mood swings	
NES9	I get irritated easily	
NES10	I often feel blue	

ISC1	I intend to continue using my Internet connected devices rather than discontinue their use	IS Continuance Bhattacharjee, A. "Understanding Information Systems Continuance: An Expectation-Confirmation Model," <i>MIS Quarterly</i> (25:3) 2001, pp 351 - 370
ISC2	My intentions are to continue using my Internet connected devices rather than using any alternative means	
ISC3	If I could like to discontinue my use of my Internet connected devices	

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