Mobile Ubiquity: Understanding the Relationship between Cognitive Absorption, Smartphone Addiction and Social Network Services

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Abstract

The purpose of the present study is to examine the differences between user addiction to smartphone devices versus addiction to social network services (SNS), and the role of user perceptions. While a growing corpus of work has demonstrated the potentially deleterious effects of smartphone usage, relatively few studies have differentiated between addiction to the device versus addiction to social network services or measured the influence of user perceptions on smartphone addiction. To contribute to knowledge on this subject, the present study had three key aims. The first was to examine the differences between smartphone addiction and social network services addiction. The second aim was to understand the influence of user perceptions on addiction (measured through cognitive absorption to examine users' state of involvement and engagement with software and technology). Our final aim was to examine differences for demographic factors for smartphone and social networking services addiction and user perceptions. Based on a survey of business students at a university in the Mid-Atlantic region of United States, the results showed that addiction to smartphone devices is greater than addiction to social networking services and varies by educational attainment, while social networking services usage does not vary by gender, age or education. Further, users addicted to smartphones and social networking services experience higher levels of cognitive absorption, particularly by females when using social networking services and greater for social networking services than smartphones. Finally, we find that the impact of cognitive absorption on smartphone addiction is mediated by addiction to SNS services.

Keywords: mobile ubiquity; technology addiction; problematic smartphone usage; user perceptions; demographic factors.

Introduction

Smartphones are ubiquitous in modern society; evidence suggests that there were 3.9 billion smartphones globally in 2016, which is estimated to rise to 6.8 billion by 2022 (Ericsson, 2017). Smartphone technology, however, is a prime example of what Mick and Fournier (1998) refer to as a 'paradox of technology', which can be both emancipating and enslaving simultaneously. Smartphones afford us the liberty to communicate, socialize and search for information in ways almost unthinkable two decades ago; smartphone technology can also result in user dependency and deleterious user outcomes and behaviors.

Traditionally the Internet has been the chief subject of focus for studies of technology addiction and problematic behavioral outcomes (De-Sola Gutiérrez *et al*. 2016). In recent years, however, cell phone technology – and particularly the advent of the smartphone – has begun to supplant the Internet as a potential source of addictive behavior (Lane and Manner, 2011; Lin *et al*. 2015). Further, smartphone addiction may arguably be more important to study than problematic Internet use as smartphones offer a mobile computing platform (with Web browsers and GPS navigational services) with greater portability than other computing devices such as laptops and tablets and addiction hence may be more acute (Jeong *et al*. 2016; Demirci *et al*. 2014; Kwon *et al*. 2013).

A debate that is currently emerging in the literature is the distinction between addiction to a device versus addiction to applications and contents, and the relationship between the two (De-Sola Gutiérrez *et al*. 2016), reminiscent of earlier deliberations concerning the Internet (Griffiths, 1999). While a number of studies have examined smartphone addiction, very few have considered addiction to the device versus addiction to certain services, particularly social network services (SNS), which provide online platforms for building relationships based on shared personal dimensions. While a small corpus of scholarship has examined addiction to

various types of content (e.g. news, entertainment, social networking) (Bian and Leung, 2015; van Deursen *et al*. 2015; Rosen *et al*. 2013), with the exception of Jeong *et al*. (2016), no prior study has compared different types of content in any detail, or, further, differentiated between addiction to the device versus addiction to particular applications. This subtle difference is important as it helps us to better comprehend smartphone addiction, particularly as certain cell phone activities may be more significantly associated with addiction than others (Roberts *et al*. 2014).

In a departure from previous empirical studies, the present study examines the two different arguments beginning to appear in the literature, namely addiction to the device versus addiction to SNS, in a single study. Further, we examine users' levels of cognitive absorption – their state of involvement and engagement with software and technology – with smartphone and SNS addiction, to help understand the role of user perceptions in computer-mediated environments. Finally, we consider the potential influence of demographic factors on smartphone and SNS addiction.

The research design was based on a single cross-sectional sample and a self-report survey. Scales were adopted from previous studies, but were adapted and extended for the context of this study. The survey was implemented online and distributed to business students at a university in the Mid-Atlantic region of the United States. Hypothesis testing was conducted via t-tests, analysis of variance (ANOVA), regression, and a Sobel test.

The study is structured in the following way. Following this introduction, we consider the subject of technology addiction and research examining problematic smartphone usage. Next we examine the subject of user perceptions through the concept of cognitive absorption. We then turn to the development of a series of hypotheses. The remainder of the study empirically examines the hypothesis based on data obtained via a survey, including a discussion, conclusions and implications of the study's findings.

Definitions and Literature Review

The aims of this study are threefold: to examine the differences between smartphone addiction and SNS addiction; to understand the influence of user perceptions on addiction (measured through cognitive absorption to examine users' state of involvement and engagement with software and technology); and to examine differences for demographic factors for smartphone and SNS addiction and user perceptions. This section explores the background literature on these topics, focusing on technology addiction, problematic smartphone usage and cognitive absorption.

Technology Addiction

Merriam-Webster's Medical Dictionary (1995: 273) defines addiction as "...an acquired mode of behavior that has become nearly or completely involuntary," while the *Gale Encyclopedia of Medicine* (1999) considers addiction as "…a dependence, on a behavior or substance that a person is powerless to stop." Traditionally, addiction was regarded as relating only to substances (such as alcohol and drugs), but latterly was broadened to include problematic behaviors (including excessive sexual intercourse and pathological gambling). Further, some have argued that any uncontrollable or overused behavior or activity should be regarded as an addiction (Peele, 1985).

The American Psychiatric Association's *Diagnostic and Statistical Manual of Mental Disorders* (DSM), currently in its fifth edition (DSM-V, 2013), captures commonly agreed upon mental conditions. Clinicians have deliberated at some length on the possible existence of technology addiction, although the DSM does not currently recognize it as a condition, maintaining instead that it manifests as a consequence of other preceding mental conditions, such as reduced impulse control (Yellowlees and Marks, 2007). This said, however, addictions

to various facets of technology have attracted some research attention across a broad range of scholarly disciplines for some time, and there have been calls for its formal recognition (Block, 2008).

In the context of the information systems discipline, Carillo *et al.* 2017 points out that psychological dependency (addiction) to information and communication technologies should not be confused with goal-oriented dependency. While the two concepts may be related and may influence individuals' reasoned IT usage decisions, goal-oriented dependency captures the extent to which an individual's capacity to reach his or her objectives depends on the use of specific technology. It also tends to focus on the more positive consequences of the use of technology. On the other hand, addiction tends to focus on the more negative effects of technology use as it relates to a psychological state of maladaptive dependency on the use of a technology to such a degree that typical obsessive-compulsive behavioral symptoms arise. This paper focuses on this facet of the phenomenon.

A growing body of research has pointed to the presence of addiction to several forms of information technology (Carillo *et al.* 2017; Griffiths, 2001; Lin, 2004; Turel and Serenko, 2010; Turel *et al*. 2011; Barnes and Pressey, 2014). Turel *et al*. (2011) report that neurobehavioral support has been offered for the existence of behavioral addictions, including technology addictions, and points to the similarities between substance and behavioral addictions (Helmuth, 2001). One study employing functional magnetic resonance imaging in online gaming found that urge/craving in substance addiction and urge/craving in online gaming addiction have analogous neurobiological mechanisms (Ko *et al*. 2009). Hence Turel *et al*. (2011: 1045) conclude that "It is, therefore, reasonable to apply concepts, models and theories from the substance addiction area to the fairly new field of behavioral addictions".

Studies examining the problematic usage of technology have a considerable lineage; for example, Hadley Cantril and Gordon W. Allport questioned the potentially addictive nature of

radio programs in their text *The Psychology of Radio* published in 1935. Later scholarship addressed dependencies on certain technologies such as excessive television viewing (Horvath, 2004; Mcllwraith, 1998), excessive video game playing (Keepers, 1990), 'computer addiction' (Shotton, 1991), and the addictive potential of the Internet (Brenner, 1997; Griffiths, 1997, 1996; Young, 1998), with the latter topic having attracted significant empirical attention (Pontes and Griffiths, 2016; Demirer and Bozoglan, 2016; Lehenbauer-Baum *et al*. 2015; Bozoglan *et al*. 2014; Kuss *et al*. 2013; Turel *et al*. 2011; Bridges and Florsheim, 2008; Charlton and Danforth, 2007; Morahan-Martin and Schumacher, 2000). A subset of Internet addiction research has also examined specific online activities, including addiction to online auctions (Turel *et al*. 2011) and virtual worlds (Barnes and Pressey, 2014). One natural extension of this line of scholarly enquiry that has received scholarly attention is problematic smartphone usage.

Problematic Smartphone Usage

The first study to empirically examine mobile phone addiction is attributed to a master's thesis (Jang, 2002), conducted in South Korea. Various facets of smartphone addiction have been examined and published in recent years (see Table 1 below), with an emphasis on the drivers of problematic smartphone usage. Smartphone addiction may arguably be more important to study than Internet or computer addiction as smartphones offer a mobile computing platform and thus offer greater portability than other computing devices such as laptops and tablets, and addiction may be more acute (Jeong *et al*. 2016; Demirci *et al*. 2014; Kwon *et al*., 2013), resulting in the habitual checking of a device (Lee, 2015; Oulasvirta *et al*. 2012). Some commentators have speculated that smartphones may represent the preeminent technological device encouraging addiction for our time (Shambare *et al*. 2012).

Table 1: The Growing Corpus of Empirical Research Examining Mobile Phone Addiction

Author(s)	Focus	Academic Field
Lin *et al*. (2017)	Diagnosing smartphone addiction through application (app)-recorded data.	Clinical psychiatry
Jeong *et al*. (2016)	Users' psychological characteristics and the content types that are used.	Computer studies
Sapacz, Rockman and Clark (2016)	Personality and problematic mobile phone use.	Computer studies
Samaha and Hawi (2016)	Relationships among smartphone addiction, stress, academic performance, and satisfaction with life.	Computer studies
Cho and Lee (2015)	The experiences of student nurses in terms of distractions by smartphones in clinical settings and their opinions regarding use policies for smartphones.	Medical (nursing) informatics
Jeong and Lee (2015)	Smartphone addiction and empathy among nursing students.	Scientific, technical and medical studies
Al-Barashdi *et al.* (2015)	Smartphone addiction among undergraduate university students.	General science
Kibona and Mgaya (2015)	Smartphone addiction and academic performance.	Engineering and technology
Pearson and Hussain (2015)	Smartphone use, addiction, narcissism and personality.	Cyber-psychology and learning
Wang *et al*. (2015)	The role of stress and motivation in problematic smartphone use among college students.	Computer studies
Demirci *et al*. (2015)	Smartphone use severity, sleep quality, depression and anxiety.	Behavioral addictions
van Deursen *et al*. (2015)	Smartphone usage types, emotional intelligence, social stress and self-regulation.	Computer studies
Bernroider *et al*. (2014)	Impact of smartphone addiction on smartphone usage.	Information systems
Bian and Leung (2014)	The relationship between loneliness, shyness, smartphone addiction symptoms and social capital.	Computer studies
Davey and Davey (2014)	Smartphone addiction among Indian adolescents.	Preventative medicine

Demirci *et al*. (2014)	Smartphone addiction among Turkish university students.	Clinical psychopharmacology
Kim *et al*. (2014)	Smartphone addiction among Korean adolescents.	Science and medicine
Lee *at al*. (2014)	Smartphone addiction management system.	Computer studies
Mok *et al*. (2014)	Internet and smartphone addiction among Korean college students.	Neuropsychiatry
Park and Park (2014)	Smartphone addiction in early childhood.	Social sciences and humanity studies
Zhang *et al*. (2014)	Motives for smartphone addiction.	Information systems
Shin and Dey (2013)	Assessing problematic smartphone usage.	software engineering and computer science (ubiquitous computing)
Kwon *et al*. (2013)	Smartphone addiction among Korean adolescents.	Science and medicine
Kwon *et al*. (2013b)	A self-diagnostic scale to determine smartphone addiction.	Science and medicine
Takao *et al*. (2009)	Personality and problematic mobile phone use.	Cyber-psychology
Ehrenberg *et al*. (2008)	Personality, self-esteem and mobile phone addiction.	Cyber-psychology
Bianchi and Phillips (2005)	Psychological predictors of problem mobile phone use.	Cyber-psychology

Collectively, these studies represent diverse academic fields including information systems, computer studies, healthcare, education, and psychology, among others. Only a handful of studies, however, have empirically examined the motives, drivers or user perceptions towards smartphone usage and addiction (Pearson and Hussain, 2015; Jeong and Lee, 2015; van Deursen *et al*. 2015; Bian and Leung, 2014; Zhang *et al*. 2014; Takao *et al*. 2009; Ehrenberg *et al*. 2008; Bianchi and Phillips, 2005). Of this subset of papers, user perceptions towards smartphone usage and addiction have been looked at from a standpoint of personality drivers (e.g. low self-esteem, neuroticism, extraversion) (Zhang *et al*. 2014;

Pearson and Hussain, 2015; Takao *et al*. 2009; Ehrenberg *et al*. 2008; Bianchi and Phillips, 2005), influencing factors (e.g. number of friends, academic achievement, and reading quantity) (Jeong and Lee, 2015), process and social orientation (e.g. smartphone usage types, emotional intelligence, social stress, and self-regulation) (van Deursen *et al*. 2015), and hybrid studies (e.g. research examining personality characteristics and patterns of smartphone use) (Bian and Leung, 2014).

The effect of user perceptions and the link to smartphone addiction is a pertinent area of enquiry as it relates to how users engage with technology and can become deeply immersed with it – sometimes to a problematic extent. Understanding user perceptions or beliefs are important as they influence user behavior, and help explain how users become absorbed with technology. Further, understanding what motivates users to harbor certain beliefs helps us to understand why they hold those beliefs; while prior research on mobile phone addiction has focused heavily on usage and attitudes, less attention has been placed on belief formation. This is the subject to which we now turn, particularly through introducing the concept of cognitive absorption.

Cognitive Absorption

While a number of theories help to illuminate user adoption and acceptance of information technologies – including diffusion of innovations theory, the theory of planned behavior, theory of reasoned action, and the technology acceptance model (TAM) (Rogers, 1985; Brancheau and Wetherbe, 1990; Ajzen, 1991, 1985; Fishbein and Ajzen, 1975; Davis, 1989) – they have limited power in explaining *how* beliefs around information technologies are shaped (Agarwal and Karahanna, 2000). Agarwal and Karahanna (2000) introduced the concept of cognitive absorption (CA) in order to help overcome this conceptual shortfall. CA shares a conceptual root with some of the first major IT user-acceptance theories including TAM by emphasizing

instrumentality as a core driver of user beliefs, and where usage behavior is motivated by "…cognitive complexity beliefs" (Agarwal and Karahanna, 2000: 666).

CA also has the advantage of being grounded in a large corpus of scholarship in the cognitive and social psychology literatures, where CA draws its theoretical basis from three related strands of literature: the personality trait dimension of absorption (Tellegen and Atkinson, 1974; Tellegen 1981, 1982), the state of flow (Csikszentmihalyi, 1990; Trevino and Webster, 1992), and the notion of cognitive engagement (Webster and Ho, 1997; Webster and Hackley, 1997).

Defined as "…a state of deep involvement with software" (Agarwal and Karahanna, 2000: 673), cognitive absorption can act as a powerful motivating factor towards beliefs related to IT, where highly engaging and engrossing experiences result in users' 'deep attention' and complete immersion and engagement with an activity (Csikszentmihalyi, 1990; Deci and Ryan, 1985; Vallerand, 1997; Tellegen and Atkinson, 1974).

Agarwal and Karahanna (2000) proposed CA as a powerful motivating factor towards beliefs related to IT, where highly engaging and engrossing experiences result in 'deep attention'. CA is driven by an *intrinsic* motivation (i.e. the enjoyment, satisfaction and pleasure as a result of an experience) as opposed to *extrinsic* motivation (i.e. the expectation of a reward associated with a certain behavior). As "…an end in themselves" (Csikszentmihalyi, 1990), intrinsic motivators have greater explanatory power in usage intentions than extrinsic motivators (Davis *et al*. 1992). Cognitive absorption is a multidimensional construct across five dimensions:

i. Temporal dissociation ("the inability to register the passage of time while engaged in interaction");

ii. Focused immersion ("the experience of total engagement where other attentional demands are, in essence, ignored");
iii. Heightened enjoyment ("the pleasurable aspects of the interaction");
iv. Control ("the user's perception of being in charge of the interaction"); and
v. Curiosity ("the extent the experience arouses an individual's sensory and cognitive curiosity").

We would expect that individuals with high levels of problematic smartphone and SNS service usage, or addiction, will experience higher levels of CA, as this provides some explanation of the deep state of involvement, engagement and attention that may be experienced by some individuals when interacting with computer-mediated environments, which may foster problematic behaviors among some users. Thus, addicted users will most likely have some form of perceptual distortion.

There is some evidence to support this assertion. The relationship between addiction and perceptual distortion may result in higher levels of CA, particularly as addiction may produce a framing effect that results in users perceiving websites more positively than non-addicted users (Turel *et al*. 2011; Barnes and Pressey, 2017). Addiction results in the modification of cognitive processes and the intensification of a particular experience. Hence, users who exhibit higher levels of addiction hold positive perceptions of a system (even if such perceptions are illogical), thus resulting in higher levels of absorption in a system. For example, Turel *et al*. (2011) found evidence that users with an addiction to online auctions reported higher levels of perceived usefulness, enjoyment and ease of use of an auction site, while Barnes and Pressey (2017) report that addiction to virtual worlds has a positive impact on cognitive absorption.

In sum, examining the relationship between CA and addiction affords us the capacity to understand the routes via which behaviors concerning technology are manifested and what

drives individuals to harbor particular beliefs concerning IT, and "serves as a key antecedent to salient beliefs about an information technology" (Agarwal and Karahanna, 2000: 666). This would seem both valuable and timely given the ubiquity of smartphone technology and reports of problematic usage, and would help us to understand why some users experience a deeper state of involvement with a particular technology than others. In the following section we outline our hypotheses related to addiction to smartphone technology.

Hypothesis Development

This section is organized into six areas. Initially, we examine smartphone addiction versus addiction to SNS, and this followed by the impact of cognitive absorption on addiction, and the demographic factors related to smartphone addiction. Next, we consider the impact of cognitive absorption on smartphone addiction, and finally the impact of cognitive absorption by gender, age and education.

Smartphone addiction versus addiction to SNS

The majority of studies examining problematic technology usage focus on the apparatus or device itself (radio, TV, computer, cell phone), rather than the content the technology provides (a particular program, software, website, or application). As Roberts and Pirog (2012: 308) note: "research must dig beneath the technology being used to the activities that draw the user to the particular technology." There is a current debate in the literature as to whether addiction is to the phone or to the services provided upon it; as Pearson and Hussain (2015: 19) have observed: "With so many addictive applications available on the smartphone, it is difficult to decipher the cause and effect relationship of problematic use. The smartphones multi-faceted functionality may be addictive or it may be that users are addicted to a certain media." Further,

it may be a case of co-occurrence, where a user is addicted to both their smartphone and SNS sites.

As De-Sola Gutiérrez *et al*. (2016: 2) note: "There is evidence that the smartphone, with its breadth of applications and uses, tends to induce greater abuse than regular cell phones" (see also Taneja, 2014). However, is it a case of an addiction to the device (e.g. smartphone) or addiction to contents and applications? This line of enquiry chimes with earlier discussions around addiction to the Internet where it is recognized that there is "a fundamental difference between addictions *to* the Internet and addictions *on* the Internet" (Griffiths, 2012: 519). As Griffiths (2000) argues, online activities will differ in their capacity to be habit forming (see also Young, 1999).

To-date, however, no study has distinguished between addiction to the smartphone or addiction to the activities they afford users or has integrated these two perspectives, despite being alluded to in earlier research. De-Sola Gutiérrez *et al*. (2016: 1) mention: "Research in this field has generally evolved from a global view of the cell phone as a device to its analysis *via* applications and contents." Central to this debate – and germane to the present study – is whether the problem is the smartphone or its applications and contents (De-Sola Gutiérrez *et al*. 2016).

Roberts *et al*. (2014) assert that owing to the expanding variety of activities that can be performed on cell phones, it is crucial that we comprehend which activities are more likely to be habit forming than others. Before undertaking such research it would seem a pertinent starting point to establish if there is a difference in addiction to the smartphone versus addiction to a set of core applications (such as SNS). SNS use has been shown to be a strong predictor of smartphone addiction, and stronger than other favored smartphone uses such as gaming (Jeong *et al*. 2016), and is the basis for its inclusion in the present study. Is it a case of addiction to one important aspect of smartphone usage, SNS, or is it a case of addiction more broadly or

globally? We maintain that addiction to the device more generally will be more acute than addiction to SNS more specifically; therefore no single application may be more addictive generally than the device in totality. Consequently we propose the following:

H1: Addiction to the Smartphone will be greater than addiction to SNS.

The impact of cognitive absorption on smartphone and SNS addiction

We now consider the impact of cognitive absorption on addiction to SNS and smartphones separately. The most popular choice of app used on smartphones is widely reported as SNS, driven by the social relations they afford (Pearson and Hussain, 2015; Salehan and Negahban, 2013; Barhuus and Polichar, 2011), and SNS use is reported as an antecedent of smartphone addiction (Salehan and Negahban, 2013). On this latter point, one explanation for the relationship between SNS availability and usage and smartphone adoption and addiction would be the level of cognitive absorption experienced by users and the highly engaging and engrossing experiences that result in users' 'deep attention' and complete immersion (Csikszentmihalyi, 1990; Deci and Ryan, 1985; Vallerand, 1997; Tellegen and Atkinson, 1974), particularly as SNS expand and grow in sophistication. Hence, we posit that cognitive absorption will be greater for SNS than smartphones, as one of the outcomes of high levels of cognitive absorption is an inability to self-regulate potentially harmful or damaging behaviors, particularly those driven through the popularity of SNS.

H2: The direct impact of cognitive absorption on addiction will be greater for SNS than smartphones.

Demographic factors and smartphone addiction

Younger people and females may be more at risk of smartphone addiction, while the evidence regarding the impact of education is more mixed. Initially, women tend to spend more daily time on their phones than males (Roberts, Yaya and Manolis, 2014), and there is compelling evidence to suggest that females experience a greater degree of cell phone dependence and problematic usage than males (Jenaro *et al*. 2007; Sanchez Martinez and Otero, 2009; Beranuy *et al*. 2009; Lopez-Fernandez, Honrubia-Serrano, and Freixa-Blanxart, 2012; Hakoama and Hakoyama, 2011; Jackson *et al*. 2008; Leung, 2008; Geser, 2006). Women (particularly those with low self-esteem) are deemed the most vulnerable group regarding smartphone addiction (Pedrero *et al*. 2012), and may rely more on smartphones than males in order to reduce social anxiety (Lee *et al*. 2014). Evidence also suggests that females send more text messages than their male counterparts and also tend to compose lengthier texts than males (Pawłowska and Potembska, 2012). Notwithstanding, some studies have found little or no differences in cell phone dependence by gender (Pearson and Hussain, 2015; Junco *et al*. 2010; Bianchi and Phillips, 2005).

There is evidence to suggest that males and females use their phones in distinct and different ways. Geser (2006: 3) asserts that "the motivations and goals of cell phone usage mirror rather conventional gender roles." While females tend to favour the emotional and personal exchange that phones allow, and hence value the social functionality of a device more than males – particularly social networking sites (such as Facebook) (De-Sola Gutiérrez *et al*. 2016; Lenhart *et al*. 2010; Geser, 2006; Bianchi and Phillips, 2005) – males tend to value professional networking sites (such as LinkedIn) (Lenhart *et al*. 2010). Further, in their study of college students in the US, Roberts, Yaya and Manolis (2014) found that females spent significantly more time on Facebook than their male colleagues, and that certain social networking sites were significant drivers of cell phone addiction. Hence we may argue that social motives are a prime driver in females' use of smartphones.

Younger people, particularly adolescents, are prone to compulsive phone usage, while the total time spent on mobile phones decreases with age (De-Sola Gutiérrez *et al*. 2016), attributed to a reduced capacity for self-control (Bianchi and Phillips, 2005). Research has also pointed to the age one first obtains a cell phone and the increased likelihood of problematic usage in the future (Sahin, Ozdemir, Unsal, and Temiz, 2013).

Evidence regarding the relationship between educational attainment and problematic cell phone usage is equivocal. While some studies point to a link between problematic cell phone usage and level of education (particularly among those undertaking extended periods of study) (Tavakolizadeh, Atarodi, Ahmadpour, Pourgheisar, 2014), others refute this (Billieux, 2012), and even report a link between low educational levels and problematic cell phone usage (Leung, 2007). Hence explanations that have been made concerning a link between problematic cell phone usage and educational attainment have not been particularly compelling.

We hypothesize the following:

H3: SNS service addiction will vary by: (a) gender; (b) age; and (c) education.

H4: Smartphone addiction will vary by: (a) gender; (b) age; and (c) education.

The impact of cognitive absorption on smartphone addiction

Since SNS can be considered as a subset of the functionality and services provided on smartphones, and a dominant aspect of time spent on the device, the impact of cognitive absorption on phone addiction per se should (logically) be mediated by SNS addiction. In other words, addiction to SNS (such as Facebook, Instagram, Pinterest, etc.) will act as a draw or enticement for overall addiction to the device and a conduit for processing cognitive absorption.

There is support for this relationship in the related literature. As noted earlier, by far the most popular choice of smartphone app is SNS (Pearson and Hussain, 2015; Salehan and Negahban, 2013; Barhuus and Polichar, 2011), and evidence points to a positive relationship between mobile phone addiction and SNS. Therefore, the rapid rise in smartphone adoption and usage corresponds with the significant proliferation of SNS, where SNS use drives smartphone addiction (Salehan and Negahban, 2013). Hence, the greater the pull of SNS, the greater the overall level of addiction to the device. Given that we would anticipate the direct impact of cognitive absorption on addiction will be greater for SNS than smartphones, as argued earlier we would expect addiction to SNS to mediate the relationship between cognitive absorption and smartphone addiction. Thus, we posit:

H5: The impact of cognitive absorption on smartphone addiction will be mediated by addiction to SNS.

The impact of cognitive absorption by gender, age and education

Some evidence suggests that different genders perceive and identify with technology in different ways. Females are thought to emphasize people-oriented and socially-driven usage motives, while males are regarded as more task-oriented (Claisse and Rowe, 1987). Pertinent to the present study, differences have been reported between male and female users for certain psychological traits and compulsive smartphone usage. Lee *et al*. (2014) found that three psychological traits (need for touch, locus of control, and social interaction anxiety) differed between male and female smartphone users.

As noted earlier, compared to males, females tend to favor the emotional and personal exchange that phones allow, and hence value the social functionality of a device, particularly social networking sites (De-Sola Gutiérrez *et al*. 2016; Lenhart *et al*. 2010; Geser, 2006;

Bianchi and Phillips, 2005). Further, females tend to use smartphones for communal reasons, while males favor agentic purposes (Lenhart *et al*. 2010). Hence, could females experience a deeper state of engrossment (or cognitive absorption) with SNS than males?

While Agarwal and Karahanna's (2000) study of cognitive absorption experienced via the Internet found no differences according to gender, their study was conducted in a pre-SNS world. If, as assumed earlier, female users will experience higher levels of SNS addiction than males due to their predilection for the personal and emotional exchange that smartphones allow and their social functionality, then we can posit that female users will experience greater levels of cognitive absorption than male users.

In terms of age and education, there is no evidence to suggest that either factor plays a role in the levels of cognitive absorption experienced by users. We would therefore expect no differences in cognitive absorption by age or educational attainment.

Given the above, we hypothesize:

H6a: The effect of cognitive absorption will be stronger for females than males when using SNS.

H6b: The effect of cognitive absorption when using SNS will not differ by age.

H6c: The effect of cognitive absorption when using SNS will not differ by educational attainment.

Cognitive absorption and user addiction

Our final series of hypotheses relate to user smartphone and SNS addiction and the levels of cognitive absorption experienced. As noted, we would anticipate that users experiencing high levels of problematic smartphone and SNS service usage, or addiction, will exhibit higher levels of CA. This would explain why some users experience a deep state of involvement,

engagement and attention when interacting with computer-mediated environments while other users do not. Hence a heightened degree of CA is driving addiction and fostering problematic behaviors among some users, and acting as a form of perceptual distortion. Thus, we posit:

H7: Users with addiction to a smartphone will have higher levels of CA.

H8: Users with addiction to SNS will have higher levels of CA.

Research Methodology

Research design

The research design adopted involved a single cross-sectional convenience sample using a self-report survey. The study employed scales from previous research to measure the constructs in the study, although these were adapted and extended for the context of the study – social network applications and smartphones. The measure of *cognitive absorption* was adapted from Agarwal and Karahanna (2000) and comprises five factors: *temporal dissociation* ("the inability to register the passage of time while engaged in interaction"), *focused immersion* ("the experience of total engagement where other attentional demands are, in essence, ignored"), *heightened enjoyment* ("the pleasurable aspects of the interaction"), *control* ("the user's perception of being in charge of the interaction"), and *curiosity* ("the extent the experience arouses an individual's sensory and cognitive curiosity"). The wording of the cognitive absorption questions focused on the focal activity of "using social networking apps on my smartphone". The measures for *addiction to the smartphone* and *addiction to social networking services* were adapted from Charlton and Danforth (2007). The measure for each was identical in content but differed in terms of focus on "my smartphone" or "social networking apps". Five items were included from Charlton and Danforth (2007), supplemented with a further two items to better fit the context of the study "I feel lost without [social networking apps/my

smartphone]" and "I tend to get easily distracted by [social networking apps/my smartphone]." All construct items were measured on seven-point Likert scales from 1=Strong Disagree to 7=Strongly Agree, where 4=Neither Agree Nor Disagree. The scales items used in the survey are provided in the Appendix. Demographic and background information was collected for gender, age, highest level of educational achievement, daily SNS usage, and daily smartphone usage.

Data collection and analysis

The survey was implemented online via Qualtrics, and was distributed to students studying business at a university in the Mid-Atlantic region of the United States in February 2015. A total of 140 valid responses were collected. The sample was 68.6% female and 31.4% male. A total of 75% of the sample were 34 years of age or under, whilst 42.9% had a Bachelor's degree and 13.6% a Master's degree.

We examined the reliability of the measures using Cronbach's Alpha; the scales for addiction to the smartphone and addiction to social networking apps had Cronbach's Alphas of 0.835 and 0.890 respectively, well above the 0.7 threshold recommended by Nunnally (2010). The Cronbach's Alpha for the cognitive absorption measure was 0.909, whilst those for its subcomponents ranged from 0.722 to 0.949, all of which are considered acceptable. Discriminant validity was also examined through variance inflation factors. Examining the Variance Inflation Factor (VIF) for the measured variables in our study, we find that all VIF values are well below 10, ranging from 1.032 to 1.404, indicating that multicollinearity is not a problem (Hair *et al*. 2014). Common method bias was examined using Harman's single factor test. The first factor explained only 35% of the variance for the sample and thus common method bias did not appear to be present.

In order to assess the levels of addiction for the ANOVA used for testing H7 and H8, we created three addiction groups using a method similar to Morahan-Martin and Schumacher (2000). Our addiction groups were assessed in terms of the number of "active" symptoms from the seven-item addiction scale. For a symptom to be "active", the Likert scale response should be in excess of the mid-point, 4 (Charlton and Danforth, 2007; Morahan-Martin and Schumacher, 2000). The three addiction groups were: no addiction (no symptoms), low addiction (one or two symptoms) and high addiction (three or more symptoms).

The majority of the statistical analysis was conducted in SPSS 22. The hypothesis testing process utilized a number of statistical procedures: t-tests, analysis of variance (ANOVA), regression and a Sobel test calculated using the method of Baron and Kenny (1986).

Results

Smartphone addiction versus addiction to SNS

Our first series of tests sought to identify any difference between user addiction to the smartphone and addiction to SNS by means of a paired samples t-test between the summary variables for smartphone addiction and SNS addiction (see Table 2). The results indicate that there is a significant difference between these two forms of addiction, with a mean difference of 3.44 and t-value of 7.303 ($p<.001$, $M_{smartphone\_addiction}=25.43$, $M_{SNS\_addiction}=21.99$). Hence *H1* – addiction to the smartphone will be greater than addiction to SNS – is supported.

The impact of cognitive absorption on addiction

In order to examine the impact of cognitive absorption (CA) on the two forms of addiction, we ran two bivariate regression models: one examining the impact of CA on smartphone addiction and the other testing the impact of CA on SNS addiction. The results are shown in Table 3. As we can see, SNS use addiction is more strongly influenced by CA than smartphone use

addiction, with a larger beta coefficients and a higher F-value (SNS use addiction: R^2=0.254; F=47.061; p<.001; β=.746, p<.001; smartphone use addiction: R^2=0.240; F=43.444, p<.001; β=.683, p<.001).

Table 2: Test for Differences in Addiction

Variable	Mean	SD	SE	Mean Difference	SD (Difference)	SE (Difference)	t	df	p
Smartphone Use Addiction	25.43	9.19	0.78	3.44	5.57	0.47	7.303	139	<.001
SNS Use Addiction	21.99	9.75	0.82						

Table 3: Regression Models for SNS and Smartphone Addiction

	Independent Variable	β	SE	β (Std.)	t-value	p
Model 1. DV: SNS Use Addiction R^2=0.254 (F=47.061, p<.001, $df_{regression}$=1, $df_{residual}$=138, df_{total}=139)	Cognitive Absorption	.746	.109	.504	6.860	<.001
Model 2. DV: Smartphone Use Addiction R^2=0.240 (F=43.444, p<.001, $df_{regression}$=1, $df_{residual}$=138, df_{total}=139)	Cognitive Absorption	.683	.103	.490	6.599	<.001

To test whether the difference in the beta values is statistically significant we use the test of Paternoster *et al.* (1998) and the following formula:

$$Z = \frac{\beta_1 - \beta_2}{\sqrt{SE_{\beta 1}^2 - SE_{\beta 2}^2}}$$

The result is Z=1.766, which is significant at the 5% level, confirming that CA has a more significant impact on SNS addiction than on smartphone addiction. Therefore, *H2* – the direct impact of cognitive absorption on addiction will be greater for SNS than smartphones – is supported.

Demographic factors and addiction

We turn now to demographic facets of smartphone addiction. In order to test for differences according to gender, education and age, we use ANOVA to examine differences between groups for the summary addiction variables for both smartphones and SNS. In order to examine addiction by age group it was necessary to recode the older age groups into a single group for 35+ years due to inadequate data. We therefore had three age groups: 18-24 years, 25-34 years and 35+ years. Similarly, educational attainment was recoded into three groups due to inadequate data: High School Graduate or Below, Bachelor's degree or Equivalent, and Master's Degree or Equivalent.

The ANOVA tests for SNS service addiction revealed no significant differences according to age (F=1.368; p=.258), gender (F=.327, p=.568) or educational attainment (F=1.488, p=.229). Hence, H3 – SNS service addiction will vary by: (a) gender; (b) age; and (c) education – is rejected.

In terms of smartphone addiction and demographic factors, the ANOVA tests find significant differences between groups for educational attainment (F=3.098, p=.048). A post-hoc test using the Bonferroni procedure found that the lowest educational group, High School Graduate or Below, had significantly higher addiction than Bachelor's Degree or Equivalent (difference=4.093, $M_{HighSchool}$=27.462, $M_{Bachelors}$=23.333, p=.042). No significant differences are revealed according to gender (F=0.102, p=.750) or age (F=1.008, p=.368). Hence, *H4* – smartphone addiction will vary by: (a) gender; (b) age; and (c) education – is partially accepted, with evidence for smartphone addiction differences for education.

The impact of cognitive absorption on smartphone addiction

The mediating effect of addiction to SNS on the relationship between cognitive absorption and smartphone addiction was examined using the Sobel test (Baron and Kenny 1986; Sobel 1986).

The results of this test are shown in Table 4, indicating that cognitive absorption is indeed significantly mediated by addiction to SNS (Z=6.865, SE=0.063, p<.001). This shows that cognitive absorption is amplified by addiction to SNS and carried through to addiction to the smartphone. Thus, *H5* – the impact of cognitive absorption on smartphone addiction will be mediated by addiction to SNS – is supported.

Table 4: Test of the Mediating Effect of SNS Use Addiction

Relationship tested	a	SE_a	b	SE_b	Sobel	SE	p
Cognitive Absorption → SNS Use Addiction → Phone Use Addiction	0.573	0.072	0.760	0.056	6.865	0.063	<.001

Note: Path a: Cognitive Absorption → SNS Use Addiction; path b: SNS Use Addiction → Phone Use Addiction.

The impact of cognitive absorption by gender, age and education

Our next set of tests looked at CA and the differences users experienced by gender, age and education. In terms of gender, we find that females experience greater levels of CA than men when using SNS (M_{CA_Male}=4.517; M_{CA_Female}=4.925; see Table 5a). Assuming equality of variances, an independent samples t-test for differences in CA between males and females was found to be significant (mean difference=0.408; t=2.421; p=.017). However, further tests by CA subcomponent found that this difference was driven by time dissociation, the only element of CA that displays a significant difference for gender, with a mean difference of 0.735 (t=2687; p=.008; see Table 5b). Thus, *H6a* – the effect of cognitive absorption will be stronger for females than males when using SNS – is supported.

Table 5a: Gender and CA – Descriptive Statistics

Variable	Gender	N	Mean	SD	SE
CA	***Male***	44	4.517	0.861	0.130
	Female	96	4.925	0.953	0.097
FI	***Male***	44	4.046	0.825	0.124
	Female	96	4.413	1.123	0.115
TD	***Male***	44	4.859	1.567	0.236

	Female	96	5.594	1.472	0.150
CU	***Male***	44	4.466	1.464	0.221
	Female	96	4.625	1.496	0.153
CO	***Male***	44	4.432	1.039	0.157
	Female	96	4.646	1.130	0.115
HE	***Male***	44	4.790	1.054	0.159
	Female	96	5.159	1.222	0.125

Table 5b: Independent Samples T-Test for Gender and CA

		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
CA	Equal variances assumed	.027	.870	-2.421	138	.017	-.40795	.16849
	Equal variances not assumed			-2.515	91.786	.014	-.40795	.16220
FI	Equal variances assumed	3.048	.083	-1.940	138	.054	-.36705	.18918
	Equal variances not assumed			-2.170	110.830	.032	-.36705	.16911
TD	Equal variances assumed	1.919	.168	-2.687	138	.008	-.73466	.27346
	Equal variances not assumed			-2.624	78.928	.010	-.73466	.27999
CU	Equal variances assumed	.000	.991	-.588	138	.557	-.15909	.27052
	Equal variances not assumed			-.593	85.141	.555	-.15909	.26839
CO	Equal variances assumed	.913	.341	-1.066	138	.288	-.21402	.20072
	Equal variances not assumed			-1.100	90.264	.274	-.21402	.19452
HE	Equal variances assumed	1.238	.268	-1.730	138	.086	-.36908	.21334
	Equal variances not assumed			-1.828	95.834	.071	-.36908	.20194

In order to examine cognitive absorption by age group it was necessary to recode the older age groups into a single group for 35+ years due to inadequate data (as mentioned above). We therefore had three age groups: 18-24 years, 25-34 years and 35+ years. Equal variances were assumed for the ANOVA tests. The ANOVA tests revealed a small number of significant differences between age groups, namely for Curiosity and Control (F=4.444, p=.013; and F=5.008, p=.008 respectively). Post-hoc tests using the Bonferroni procedure found that for Curiosity, the 18-24 years age group is significantly greater than the 25-34 years age group (mean difference=0.800, p=.016). For Control, the 35+ years age group was found to have levels significantly larger than the 25-34 years age group (mean difference=0.731, p=.006). There were no other significant differences in the data. Thus, we find that *H6b* – the effect of cognitive absorption when using SNS will not differ by age – is partially supported.

The ANOVA tests to ascertain differences in cognitive absorption according to educational attainment found no significant results. Therefore, *H6c* – the effect of cognitive absorption when using SNS will not differ by educational attainment – is supported.

Cognitive absorption and user addiction

Our final series of tests examine the relationship between level of addiction and the extent of CA experienced by users of smartphones and SNS. In order to conduct these tests we created groups of users with high, low and no addiction, as outlined in the methodology section.

Our initial ANOVA test examined CA differences and smartphone addiction (see Table 6), finding that CA is significantly different by group for level of smartphone addiction (F=19.572, p<.001). While the Control subcomponent of CA was not significant (F=2.359, p=.98), all other subcomponents of CA were significant, the largest effect being that of time distortion (F=35.229, p<.001), followed by focused immersion (F=7.514, p=.001), curiosity (F=5.255, p=.006), and heightened enjoyment (F=4.484, p=.009). Overall, users reporting high levels of smartphone addiction reported higher levels of CA than users reporting low levels of addiction, while users with low levels of smartphone addiction reported higher levels of CA than users with no level of smartphone addiction. Hence *H7* – users with addiction to a smartphone will have higher levels of cognitive absorption – is supported.

Table 6: Analysis of Variance of Cognitive Absorption and Phone Use Addiction

Characteristic	1. High addiction (n=67)	2. Low addiction (n=47)	3. No addiction (n=26)	P (F-value)	ANOVA
Cognitive Absorption	5.15	4.76	3.94	<.001 (19.572)	1>2**, 1>3***, 2>3*[b]
Focused Immersion	4.58	4.24	3.69	.001 (7.514)	1>3**[a]
Control	4.77	4.48	4.26	.098 (2.359)	Non-sig.[b]
Time Distortion	6.06	5.33	3.62	<.001 (35.229)	1>2**, 1>3***, 2>3**[b]

Curiosity	4.87	4.60	3.79	.006 (5.255)	1>3**[a]
Heightened Enjoyment	5.23	5.08	4.43	.009 (4.854)	1>3*[b]

Note: [a] Bonferroni; [b] Tamhane's T2 used due to heteroscedasticity; *** p<.001; ** p<.01; * p<.05; $df_{betweengroups}$=2, $df_{withingroups}$=137, df_{total}=139.

Next, we examined CA differences and users' levels of SNS addiction (see Table 7). We find that CA is significantly different by addiction group (p<.001). Users reporting high levels of SNS addiction reported higher levels of CA than users with low levels of SNS addiction and users with no levels of SNS addiction. Again, the Control subcomponent of CA was not significant, neither was the subcomponent Curiosity. Given these results, *H8* – users with addiction to SNS will have higher levels of cognitive absorption – is supported.

Table 7: Analysis of Variance of Cognitive Absorption and SNS Use Addiction

Characteristic	**1. High addiction (n=53)**	**2. Low addiction (n=37)**	**3. No addiction (n=50)**	**P (F-value)**	**ANOVA**
Cognitive Absorption	5.25	4.82	4.35	<.001 (13.902)	1>2*, 1>3***[b]
Focused Immersion	4.72	4.25	3.94	.001 (7.871)	1>3***[a]
Control	4.85	4.40	4.45	.092 (2.425)	Non-sig.[a]
Time Distortion	6.14	5.55	4.50	<.001 (18.777)	1>2**, 1>3***[b]
Curiosity	4.91	4.58	4.26	.080 (2.571)	Non-sig.[a]
Heightened Enjoyment	5.38	5.18	4.63	.004 (5.827)	1>3***[a]

Note: [a] Bonferroni; [b] Tamhane's T2 used due to heteroscedasticity; *** p<.001; ** p<.01; * p<.05 $df_{betweengroups}$=2, $df_{withingroups}$=137, df_{total}=139.

Table 8 provides a summary of the results of hypothesis testing. As we can see, of the ten hypotheses tested, the results of our study provide support for seven of them (H1, H2, H5, H6a, H6c, H7 and H8). We also find partial support for two further hypotheses (H4 and H6b); in particular, smartphone addiction was found to vary by education (supporting H4b), with addiction of high school respondents exceeding that of those with bachelor's degrees, while

cognitive absorption in SNS was found to differ between age groups for curiosity and control. One hypothesis is not supported by our data (H3).

Table 8: Summary of Hypothesis Tests

Hypotheses	Result
H1: Addiction to the smartphone will be greater than addiction to SNS.	Supported
H2: The direct impact of cognitive absorption on addiction will be greater for SNS than smartphones.	Supported
H3: SNS service addiction will vary by: (a) gender; (b) age; and (c) education.	Not supported
H4: Smartphone addiction will vary by: (a) gender; (b) age; and (c) education.	Partially supported
H5: The impact of cognitive absorption on smartphone addiction will be mediated by addiction to SNS.	Supported
H6a: The effect of cognitive absorption will be stronger for females than males when using SNS.	Supported
H6b: The effect of cognitive absorption when using SNS will not differ by age.	Partially supported
H6c: The effect of cognitive absorption when using SNS will not differ by educational attainment.	Supported
H7: Users with addiction to a smartphone will have higher levels of cognitive absorption.	Supported
H8: Users with addiction to SNS will have higher levels of cognitive absorption.	Supported

Findings and Discussion

The present paper contributes empirical evidence relating to addiction to smartphones versus addiction to social networking apps. While there are clearly related streams of research regarding addiction to a smartphone device and addiction to social networking sites these are not fully integrated, although the issue is alluded to in recent studies (De-Sola Gutiérrez *et al*. 2016; Jeong *et al*. 2016; Pearson and Hussain, 2015). No study to-date, however, has distinguished between addiction to smartphones versus addiction to the activities they afford users, or else attempted to integrate these two perspectives. We find that user addiction to

smartphones is greater than addiction to SNS; hence there is presently a greater level of addiction to the device in general than to each of the services provided upon it.

While we find that SNS service addiction does not vary by gender, age or education, we find that smartphone addiction does vary by education. Specifically we find that users with the lowest level of educational attainment exhibited the highest levels of smartphone addiction. Why smartphone users with relatively lower levels of educational attainment should experience higher levels of addiction is not entirely clear; perhaps this group has a reduced capacity to self-regulate their compulsive smartphone usage.

These findings emphasize the importance of a more nuanced understanding of smartphone addiction in future studies and theorizing on problematic smartphone usage, particularly as there are clearly crucial differences between addictions *to* smartphones versus addictions *on* smartphones. As Emanuel (2015) notes: we "are addicted to the information, entertainment, and personal connections [that a smartphone] delivers", but clearly problematic usage will relate to the task being undertaken. As smartphones become ever more complex – as well as the ubiquity of the tasks they can perform now and in the future – we need to understand the differences in the nature of addictions between smartphones and SNS (as well as many other tasks being performed).

A pertinent question to ask is how do addictions to smartphones and SNS form? Behavioral addictions (such as smartphone addiction) related to overuse or dependence are use disorders that are driven by substance abuse (e.g. drugs, alcohol, tobacco), or in the case of smartphones, the 'substance' is the social connections and entertainment services they provide. As a society, many people have an attraction to incessant entertainment and maintain social connections, and smartphones are arguably the most popular devices to achieve this. Yet despite how much mobile phones "…have transformed social practices and changed the way we do business … surprisingly we have little perception on their effect in our [lives]" (Katz and Akhus, 2002).

This is surprising given the growing reports of respondents claiming to use a smartphone to avoid social interactions, or else habitually using their device in a social setting (Belardi, 2012; Merlo *et al*. 2013). Connectivity has also become a key driver of social behavior change; at an extreme level, however, being flooded by messages, texts, emails, and updates may cause us to depersonalize those around us, treating them as digital entities (Turkle, 2017).

The habitual use of devices such as smartphones is also driven by the 'fear of missing out' (Baral, 2017). Habits are formed through a process of reinforcement learning around certain behaviors that have previously rewarded us; smartphones are helping to ensure that users do not miss events or updates, thus reducing social pressures. As Elliot Berkman – professor of psychology at the University of Oregon – notes, "smartphones can be an escape from boredom because they are a window into many worlds other than the one right in front of you" (Baral, 2017). Suppressing the habitual use of smartphones for some users may result in anxiety and irritability. User perceptions will also play a role in driving addiction, which we consider in more detail next.

The present study is the first extant study to emphasize the role of user perceptions (measured through level of cognitive absorption (Agarwal and Karahanna, 2000)) on smartphone addiction. We find that the direct impact of CA on addiction is greater for SNS than smartphones, probably owing to one of the outcomes of high levels of cognitive absorption – an inability to self-regulate potentially harmful or damaging behaviors, particularly those driven through the popularity of SNS. Further, we find that the impact of cognitive absorption on smartphone addiction is mediated by addiction to SNS. In other words, addiction to SNS (such as Facebook, Instagram, Pinterest, etc.) will act as an inducement or enticement for overall addiction to the device and a conduit for processing cognitive absorption. Hence, the rapid rise in smartphone adoption and usage corresponds with the significant proliferation of SNS, where SNS use drives smartphone addiction.

We find that users with addiction to a smartphone also exhibit higher levels of CA than users with low or no levels of smartphone addiction. Further, we also find that users with addiction to SNS have higher levels of CA. These findings provide strong evidence as to why some users become addicted while others do not exhibit problematic usage, although more research is needed to explore the drivers of user addiction to smartphone devices and SNS.

Turning to the demographic factors of cognitive absorption, we initially find that the effect of cognitive absorption is stronger for females than males when using SNS; the time dissociation subcomponent of CA was seen to be driving this, indicating that females experience an inability to register the passage of time while engaged in SNS usage compared to males. This manifests as time appearing to pass more quickly, losing track of time, and spending more time on social networking apps than intended. In terms of CA and age, some differences were observed but these were relatively minor and thus suggest no particularly clear findings. Finally, the effect of CA when using SNS does not differ by educational attainment.

In sum, this paper makes three theoretical contributions. Initially, we address the 'device versus content' debate of smartphone addiction, thus, responding to recent calls to investigate this phenomenon (De-Sola Gutiérrez *et al*. 2016; Jeong *et al*. 2016; Pearson and Hussain, 2015). No prior study has compared different types of content in any detail, or, further, differentiated between addiction to a device versus addiction to particular applications; this subtle difference is important as it helps us to better comprehend smartphone addiction (Jeong *et al*. 2016). Secondly, we analyzed gender differences and smartphone addiction including user perceptions. Thirdly, the present study extends our understanding of cognitive absorption and user perceptions related to smartphone addiction. Collectively, the present study contributes to the dark side of mobile phone technology and user addiction, and the role of user perceptions in computer-mediated environments.

Taken together, these findings emphasize the importance of taking into account the potential differences between any device with computer processing power and its applications or contents. Future research on smartphone addiction and problematic smartphone usage therefore needs to be more nuanced and take into account these potentially important differences, particularly given the ubiquity of contemporary computing devices. Related to this is the role of user perceptions; user perceptions when engaging with smartphones may differ depending on the task being undertaken, indicating that future research should take this into account when investigating different aspects of problematic smartphone usage.

Conclusions

As Rudi Volti (1995) has observed "[our] inability to understand technology and perceive its effects on our society and on ourselves is one of the greatest, if most subtle, problems of an age that has been so heavily influenced by technological change." The paradox of smartphone technology is that it has the capacity of simultaneously liberating users and also subjugating them, which may result in problematic user behaviors and even addiction. As such, it would seem imperative to understand the effect that smartphone technology has on users and society, particularly the dark side of technology. This study extends the body of work on technology and smartphone addiction in a number of directions. The results of the present study demonstrate that there are significant differences between addiction to smartphone devices and SNS in terms of user addiction; addiction to smartphone devices is greater than addiction to SNS ($t=7.303$, $p<.001$), smartphone addiction varies by educational attainment ($F=3.098$, $p=.048$), while SNS usage does not vary by, gender, age or education. These results emphasize the importance of not limiting research to the study of users' behavior with a device itself in isolation, but also to pay credence to its use and the particular activities undertaken. We also find important differences in user perceptions; users addicted to smartphones and SNS

experience higher levels of cognitive absorption ($F=19.592$, $p<.001$; and $F=13.902$, $p<.001$ respectively), cognitive absorption is felt more strongly by females than males when using SNS ($t=2.421$, $p=.017$), the impact of cognitive absorption is greater for SNS than smartphones ($Z=1.766$, $p=.039$), and the impact of cognitive absorption on smartphone addiction is mediated by addiction to SNS ($Z=6.865$, $p<.001$).

Implications

This study makes a number of contributions to theory, policy and practice. While many studies have examined aspects of smartphone addiction (see, for example, Bian and Leung, 2015; van Deursen *et al*. 2015; Rosen *et al*. 2013) few have differentiated between devices and applications in order to better understand problematic smartphone usage. Further, while earlier research has examined personality characteristics and compulsive smartphone usage (Lee *et al*. 2014; Wang *et al*. 2015), user perceptions have been overlooked. Measured through cognitive absorption, we find that users addicted to smartphones experience a deeper state of engagement and involvement – what might be described as a 'cognitive corridor'. Therefore, to the best of our knowledge, this study is the first extant research project to draw a distinction between devices and applications in the context of problematic smartphone usage, as well as user perceptions.

A number of policy implications can also be drawn. Initially, we must show caution in describing an activity as 'addictive', particularly smartphone usage, which may actually be due to broader issues (e.g. impulse control disorders). This said, however, excessive smartphone usage may result in social withdrawal and damaged personal relationships. Similar to related debates around Internet addiction and its regulation (Barnes and Pressey, 2014), the regulation of smartphone usage is problematic and a subject of recent debate in the media, although beyond the remit of the present study. Whatever label may be ascribed to excessive use of

smartphone technology – dependency, compulsive and habitual use, or addiction – it is a subject of concern in most developed countries, particularly given smartphone usage is almost entirely self-regulated. As devices and platforms become increasingly sophisticated, they have a greater capacity to encourage user engagement and involvement, which, in turn, can result in excessive usage. Further, research has demonstrated that compulsive smartphone usage may cause 'technostress' (Lee *et al*. 2014) – the inability to cope with new computing technologies (Brod, 1984), and users experiencing feelings of anxiety owing to communication and information overload (Ragu-Nathan *et al*. 2008).

The results of the present study also have practical implications. Smartphones have become an indispensable aspect of everyday life for many people, and whilst this technology affords the capacity to engage in social networking, entertainment, and educational pursuits, it can also however, result in overdependence and compulsive usage, and ultimately psychological distress for some users (Lee *et al*. 2014; James and Drennan, 2005). The industry implications for devices that can facilitate ever higher levels of cognitive absorptive are stark, with media reports questioning whether smartphones should actually carry health warnings, and concerns of problematic smartphone usage among young people (Pells, 2017; Siddique, 2015). A further practical application to support individuals with problematic smartphone usage would be an informative mobile app which records the application usage to its user, which should help with self-regulation.

Limitations and future research

This study has several limitations. Regarding internal validity, the research is based on participants' self-reports, which may be vulnerable to common-method variance. This said, self-reports may be the most valid mechanism to assess individuals' psychological characteristics, as subjects are best placed to provide insights into their own beliefs than outside

observers. The problems associated with common-method variance, however, might be exaggerated (Spector, 2006). Secondly, regarding external validity, the study is based on a cross-sectional survey, administered to a US student sample, which may interfere with the detection of demographic relationships in the study. Future research might employ longitudinal research designs and broader sample profiles in an attempt to replicate the findings of the present study. In order to do so, further research should focus on specific services and seek a stratified sample that is more representative of the SNS population. Thirdly, given that two dimensions yielded nonsignificant results concerning the relationship between cognitive absorption and the two addictions, we may begin to question whether the current cognitive absorption construct is suitable in its present form for studies of addiction to social network services, and how immersion in social networks might differ from immersion in other potentially addictive behaviors. Scale development and refinement in this context provides another potential avenue for future research to improve internal validity.

There is considerable scope for future research on addiction to smartphones and their applications and the dark side of technology more generally, particularly among those members of society who are vulnerable including adolescents and those from younger age groups. One question that demands further attention is whether extended smartphone usage is actually increasing Internet addiction. Further, certain facets of problematic smartphone usage (for example, so-called smartphone zombies), are yet to receive detailed scrutiny. We must move on from studies of 'global' addiction to a device to more nuanced studies that distinguish between the device and its applications and user addictions, as well as an understanding of users' cognitive perceptions of technology. Finally, given the ubiquity of smartphone devices it is important to comprehend the paradox of technology both in its capacity to liberate and to subjugate.

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Appendix: Survey Items

Cognitive Absorption

Temporal Dissociation

- Time appears to go by very quickly when I am using social networking apps on my smartphone.
- Sometimes I lose track of time when I am using social networking apps on my smartphone.
- Time flies when I am using social networking apps on my smartphone.
- Most times when I use social networking apps on my smartphone, I end up spending more time that I had planned.
- I often spend more time using social networking apps on my smartphone than I had intended.

Focused Immersion

- While using social networking apps on my smartphone I am able to block out most other out-of-world distractions.
- While using social networking apps on my smartphone, I am absorbed in what I am doing.
- While using social networking apps on my smartphone, I am immersed in the task I am performing.
- When using social networking apps on my smartphone, I get distracted by other out-of-world attentions very easily
- While using social networking apps on my smartphone, my attention does not get diverted out-of-world very easily.

Heightened Enjoyment

- I have fun using social networking apps on my smartphone.
- Using social networking apps on my smartphone provides me with a lot of enjoyment.
- I enjoy using social networking apps on my smartphone.
- Using social networking apps on my smartphone bores me.

Control

- When using social networking apps on my smartphone I feel in control.
- I feel that I have no control over the use of social networking apps on my smartphone.
- Social networking apps on my smartphone allows me to control my computer interaction.

Curiosity

- Using social networking apps on my smartphone excites my curiosity.
- Using social networking apps on my smartphone makes me curious.
- Using social networking apps on my smartphone arouses my imagination.

Addiction to the Device

- I sometimes neglect important things because of my interest in my smartphone.
- My social life has sometimes suffered because of me interacting my smartphone.
- Using my smartphone sometimes interfered with other activities.
- When I am not use my smartphone, I often feel agitated.
- I have made unsuccessful attempts to reduce the time use my smartphone.
- I feel lost without my social networking apps.
- I tend to get easily distracted by social networking apps.

Addiction to the App

I sometimes neglect important things because of my interest in social networking apps.

- My social life has sometimes suffered because of me interacting with social networking apps.
- Using social networking apps sometimes interfered with other activities.
- When I am not using social networking apps, I often feel agitated.
- I have made unsuccessful attempts to reduce the time I interact with social networking apps.
- I feel lost without my smartphone.
- I tend to get easily distracted by smartphone.