An Investigation of the Dark Side of Information Technology Use: Three Essays on IT Addiction

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Thesis Abstract

Despite the overwhelming number of studies on Information Technology (IT) use and adoption, there is a growing concern among researchers in psychology, health, and IS that problematic IT usage can create serious challenges for individuals, organizations, and even society. Hence, there is a need to devote additional research efforts to better understand the dark side of IT use and to identify undesired forms of IT use, especially in regard to excessive and compulsive use behaviors. From this perspective, this dissertation adopts a multi-method, multi-essay approach to investigate issues related to IT addiction.

Accordingly, the first essay investigates *users' liability to IT addiction* and looks at its variations among IT users. Based on data collected from in-depth interviews and exploratory open-ended surveys from smartphone users, the results allow the identification of five main types of user liability with unique usage behaviors: Addict, Fanatic, Highly Engaged, Regular, and Thoughtful.

The second essay proposes a process model to explain *the development of IT addiction*. Using qualitative data collected from both smartphones and social network users and following a grounded theory approach, we propose a three-phase model to explain how IT addiction develops through interactions between users, technology, and environment (using technology affordances).

Finally, the third essay focuses on *technology craving*. More precisely, we aim at explaining technology craving by discussing users' motivations and the needs that are being fulfilled by technology use. From a review of the literature, we develop a conceptual model that highlights the role of key users' needs in relation to craving *in the context of social networks* and the interactions between the structural features of technology and users' needs as a way to predict social network craving.

Résumé de la Thèse

Malgré le nombre impressionnant d'études sur l'utilisation et l'adoption des technologies de l'information (TI), il y a une préoccupation croissante pour les chercheurs en psychologie, en santé et en SI sur le fait que l'utilisation des TIs peut apporter des problèmes graves pour les individus, les organisations et même la société. Par conséquent, il est nécessaire de faire des efforts de recherche supplémentaire pour mieux comprendre le côté obscur de l'utilisation de TI et d'identifier les formes indésirables de cette utilisation, en particulier en ce qui concerne les comportements excessifs et compulsifs qui y sont liés. Dans cette perspective, cette thèse adopte une approche multi-méthode et multi-article pour étudier les questions liées à la dépendance aux TIs.

Le premier article présente une étude sur la susceptibilité des utilisateurs à la dépendance aux TIs. L'étude permet d'identifier les variations de ce potentiel chez les utilisateurs de téléphones intelligents. Basé sur des données recueillies lors d'entretiens et des résultats d'une enquête exploratoire avec questions ouvertes auprès d'utilisateurs de téléphones intelligents, cette étude a permis d'identifier les cinq types principaux d'utilisateurs au regard de leur potentiel de dépendance, chacun présentant des comportements d'utilisation uniques: Les utilisateurs dépendants, les fanatiques, les engagés, les réguliers et les prudents.

Le deuxième essai propose un modèle de processus pour expliquer la formation des comportements addictifs reliés aux TIs. En utilisant des données qualitatives recueillies par le biais d'entrevues avec des utilisateurs de téléphones intelligents et de réseaux sociaux et suivant une approche de type *grounded theory*, l'étude a permis de proposer un modèle en trois phases pour expliquer comment la dépendance informatique se développe à travers les interactions entre les utilisateurs, la technologie et l'environnement.

Enfin, le troisième essai se concentre sur les « fringales d'utilisation » dans le contexte des TIs. Plus précisément, nous visons à expliquer les « fringales d'utilisation » des médias sociaux par le biais des fonctionnalités de la technologie et leur effet sur les besoins des utilisateurs, qui sont ainsi comblés par l'utilisation de la technologie. En nous basant sur une revue de la littérature, nous avons développé un modèle conceptuel qui met en évidence le rôle clé des besoins des utilisateurs et de leurs relations avec les caractéristiques structurelles de la technologie pour prédire les « fringales d'utilisation » des réseaux sociaux.

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Contribution of Authors

This dissertation is original, unpublished, independent work by the authors. All of the essays were co-authored by Isaac Vaghefi (first author) and Liette Lapointe (second author). The majority of the work was conducted by the first author, while the second author provided critical feedback and review of the work, which was necessary for improving the dissertation. The first essay was also co-authored by Camille Boudreau-Pinsonneault (third author), who helped to conduct the qualitative interviews and frame the first essay draft that was presented at HICSS 2013. This essay is currently under review at an IS journal. A preliminary draft of the second paper was presented at HICSS 2014.

Chapter I: Introduction

In its various forms, technology has penetrated into practically all aspects of our lives and its use is on the rise. Accordingly, information systems (IS) research has spent significant scholarly attention on understanding the nature of IT use and identifying the several factors that contribute to its usage (Davis et al., 1992; Venkatesh et al., 2003; Jasperson et al., 2005; Schwarz & Chin, 2007). Despite this established body of knowledge on information technology (IT) use and adoption, little attention has been paid to understanding the dark side of IT use (Tarafdar et al., 2015; D'Arcy et al., 2014) and, in particular, the excessive and obsessive use of IT. From a traditional research perspective, increasing the level of IT use is a positive phenomenon, desired by most managers and IT implementers. Hence, continued IT use has been seen as one of the most common indicators of IT implementation success (DeLone & McLean, 2003).

As shown in Figures 1 and 2 below, the adoption and use of technology has dramatically increased during the last few years (Alexander, 2011) and can even be labeled a social phenomenon (Turel & Serenko, 2010; Brus, 2013). Arguably, as expected, the use of technology in most cases leads to productivity gains and economic benefits for organizations and enhances the well-being of individuals (Jasperson et al., 2005). However, the growing use of technology in its various forms can have a double-edged effect. Recent research and anecdotal evidence tend to indicate that the increasing use of technology has a negative side when it gets out of control (Turel et al., 2011). That is, excessive IT usage is likely to have some adverse consequences for individuals, organizations, and even for society (LaRose et al., 2003; Seah & Cairns, 2008).

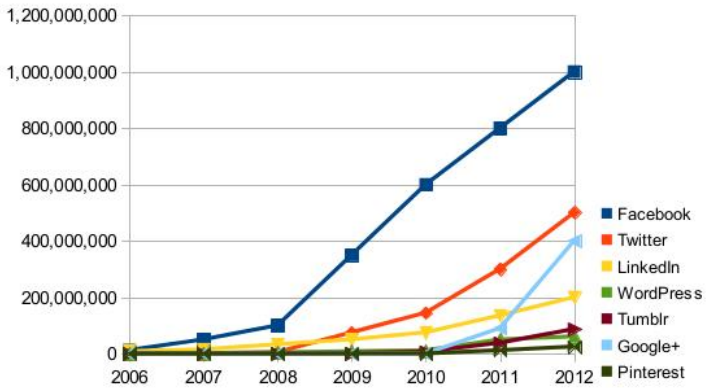

Figure 1: User base growth of social networks from 2006-2012 (dstevenwhite.com)

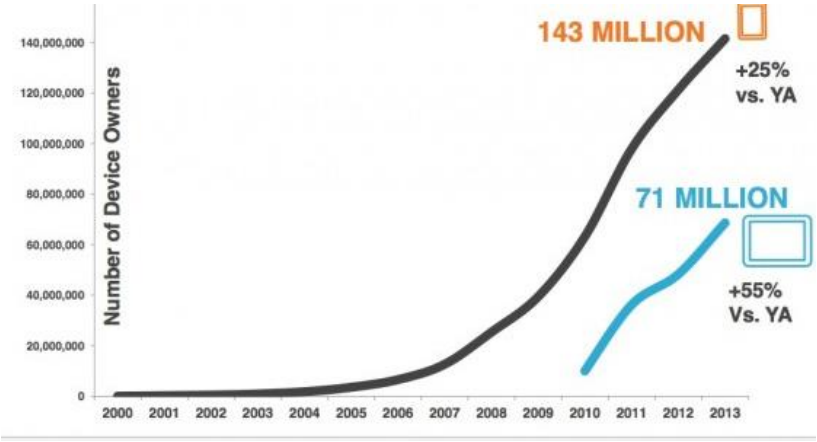

Figure 2: User base growth of smartphones and tablets from 2000-2013

Emerging as a common thread, there is a growing concern among researchers in psychology, health, and IS that IT addiction can result in serious challenges that have previously been overlooked (Serenko et al., 2007). As an example, pathological use of the internet was found to undermine academic performance, create social difficulties, and cause several psychological problems, such as depression and loneliness (Caplan, 2002; Billieux et al., 2008). Despite recognizing the existence of addictive behaviors related to technology use and the worrying levels of IT use recently reported (Gibbs, 2012), and recent scholarly attention to the topic (Turel et al., 2011; Turel & Serenko 2012; Xu et al., 2011; Soror et al., 2015), there is a need for more research in the IS discipline and further theorizing to understand the susceptibility of users to addiction, the factors contributing to it, and the mechanisms underlying its development. To this end, this dissertation is composed of three essays to answer three theoretically and practically important research questions:

1) What is user liability to IT addiction? What are the variations in IT addiction liability among users?

2) What is the process of development of IT addiction? What is the role of technology in this process?

3) What is technology craving? What are the factors contributing to technology craving and addiction?

Accordingly, the first essay investigates *users' liability to IT addiction* and looks at its variations among IT users. In this essay, we first review the literature in different disciplines (e.g. health, psychology, IS) to conceptualize IT addiction, to identify its antecedents and consequences, and to introduce liability in IS research. Then, building on the analysis of 15 in-depth interviews and 182 exploratory open-ended surveys collected from smartphone users, and using hierarchical and K-means cluster analysis techniques, we determine liability on the basis of four characteristics of IT addiction and propose a typological theory of user liability to IT addiction. Our typology reveals five ideal types; each can be associated with a user profile (addict, fanatic, highly engaged, regular, and thoughtful). Building upon both the extant literature and our results, we set forth propositions to extend the theoretical contributions of the study. We finally discuss the research contributions and practical implications of the typology and the propositions.

The second essay proposes a process model to explain *the development of IT addiction* and its underlying mechanisms. It also examines the specific role of technology in the IT addiction development process by focusing on technology features as well as on affordances. Using qualitative data collected from 38 smartphones and social network users, and following a grounded theory approach, we first identify the building blocks of the process related to the user, the technology, and the environment. Then, building on these results, we propose a process theory of addiction that explains how IT addiction develops through the three phases of Initiation, Transition, and Persistence. As in the first essay, the implications for both theory and practice are discussed at the end.

Finally, the third essay focuses on *technology craving*. More precisely, we aim at explaining craving (in the context of social networks) by focusing on technology features. From a review of the literature, we develop a motivational model of social network craving that highlights the key role of user needs and their relationships with the structural features of technology to predict users' craving.

Essay #1: A Typology of User Liability to IT Addiction

The main premise of this essay is that there are meaningful differences between behaviors of users and the risks of developing an addiction. Understanding these risks is crucial for going above and beyond the existing diagnostic criteria for addiction that provide a dichotomous classification of users (i.e. addicts versus non-addicts) and important for designing precise preventive and intervening mechanisms to control addiction. Our approach to studying such risks is to examine liability in the context of IT addiction.

Literature Review: In this essay, we first provide a review of existing conceptualizations and definitions of substance and non-substance addiction, and a conceptualization of IT addiction as a behavior that embeds four essential characteristics: 1) a feeling of dependency 2) excessive usage, 3) difficulty in stopping, and 4) negative outcomes. Building on this conceptualization, we define IT addiction as a psychological dependency on IT that involves excessive and compulsive use and is associated with negative consequences.

In addition, we introduce the concept of liability, which is associated with disorders, or more precisely with the risks of developing disorders. Introduced in human genetic research by Falconer (1965) to study the development of a disease, liability is a complex construct that, when assessed, allows taking into account the extent to which an individual either is affected by a disease or risks being affected by it. Accordingly, we focus on the two dimensions of liability: propensity and severity. Propensity refers to the probability of addiction being developed, while severity refers to the degree of obsessive and compulsive behaviors exhibited by an individual. By focusing on variation of these dimensions (from very low to very high), it becomes possible to define the various levels of liability to addiction exhibited by a population.

Finally, we provide a review of antecedents and consequences of IT addiction (see Table 1). First, antecedents of addiction can be related to the individuals who use technology and the differences among users, including demographics and personality types. In addition, appealing to existing research evidence that hints at the role of technology (Turel & Serenko, 2012), we focus on various technology features that could make IT appealing to users. Second, IT addiction has

been found to bring challenges to users' lives and to exacerbate existing problems. We focus on three categories of consequences that influence users' social, professional, and personal lives.

Category/Variable		Sample of Factors
Antecedents	Demographics	Gender; Age; Education; Race
	Individual Differences	Personality traits (e.g. impulsivity, shyness, low-self-esteem); Dysphoric moods (e.g. anxiety, depression)
	Technology Features	Communicative capacity; Speed; Stimulation potency; Graphics
Consequences	Social Life	Relationship conflicts; Social isolation; Technology-Family conflict
	Professional Life	Academic failure; Reduced productivity
	Well-Being	Mood disorders; Fatigue; Lack of sleep

Table 1: A review of antecedents and consequences of IT addiction

Method: We first used an exploratory, multi-method approach. We conducted 15 interviews with smartphone users in order to better understand user liability to IT addiction and to identify its underlying dimensions and sub-dimensions. Then, to develop a typology of user liability to IT addiction that reflects the existing variations in users' susceptibility to develop such addiction, we used both qualitative (content analysis) and quantitative techniques (cluster analysis) to analyze data gathered in 182 open-ended surveys. Finally, we conducted additional multi-method analyses to identify the user profiles associated with different types of liability to IT addiction, including antecedents, behaviors, and consequences.

Findings: We found that a level of propensity can be defined on the basis of the dependency and self-regulation levels associated with a behavior. Furthermore, severity can be determined on the basis of magnitude of negative consequences and intensity of IT use. Considering these dimensions and doing rounds of qualitative data analysis, hierarchical cluster analysis, and k-means cluster analysis, we developed a typology of IT user liability types that consists of five ideal types, namely, ADDICT, FANATIC, HIGHLY ENGAGED, REGULAR and THOUGHTFUL (see Table 2).

Propensity		Very high		High- Very high		Medium		Low		Very low	
Dependency	**Self-Regulation**	High	Low	High	Medium-Low	Medium	Medium	Low	High	Very Low	Very High
Severity		Very High		Medium-High		Medium		Low		Very low	
Magnitude of Negative consequences	**Intensity of IT use (hours)**	High	Very High	High	Medium-High	Medium	Medium	Very Low	Low	Very Low	Very Low
		↓		↓		↓		↓		↓	
Liability		Type I Very High		Type II High		Type III Medium		Type IV Low		Type V Very low	

Table 2: User liability to IT addiction types

For each type of user liability to IT addiction, we conducted additional analysis of the survey data to identify the nature of the behaviors, antecedents, and consequences associated with each user profile, and we developed propositions that can be tested in future studies.

Contribution: The main contribution of this essay is to extend the contemporary theories of addiction by introducing to IS research the concept of "liability" and empirically conceptualizing it in the context of IT addiction. The typology developed in this essay is useful in providing a rich and detailed explanation of the variations in user liability to addiction and extending our theoretical understanding of IT addiction to the entire population of users (i.e. not just addicts). Finally, to further our theoretical contributions to this stream of research, we developed propositions for each user liability type. These propositions can be used as a baseline to formulate the relationship between the associated constructs and to ground hypotheses that can be tested using large data sets in addiction-related contexts. In terms of the practical implications of the study, different strategies are discussed to prevent or limit the negative outcomes associated with the use of technology for each liability type.

Essay #2: When Too Much Usage Is Too Much: Investigating IT Addiction Development and the Role of Technology

The second essay investigates the IT addiction development process and the mechanisms involved, with special attention paid to the role of technology in the emergence of IT addictive behaviors. IT addiction has recently received some attention in the IS discipline (Turel et al., 2011; Turel & Serenko, 2012; Soror et al., 2015) and some of the antecedents have been

identified. While the explanations provided have been helpful to provide some insights about what causes technology addiction, the accumulation of knowledge mostly provides a *static view* of technology addiction, narrowing the focus onto the causal relationships between these factors. There is a lack of knowledge about the dynamics and mechanisms through which an individual's behavior is transformed over time from an initial IT adoption to problematic IT use and addiction. Understanding this is important, for it can provide a rich temporal view of the development of addiction. In addition, scholars who have studied technology addiction (e.g. pathological internet use) believe that addiction originates mainly from the *individual*. However, new findings in the gambling and gaming addiction literature hint that considering the role of the *object of addiction* (e.g. technology features) during development of the addiction is critical. In order to fill these gaps, we employ in this essay a set of interviews collected from smartphone and social media users to propose a process model of IT addiction that illustrates the interaction between user, technology, and the environment in three phases: initiation, transition to addiction, and persistence (see Figure 3).

Literature Review:

The review of the addiction literature across disciplines (IS, psychology, health, etc.) reveals that individual differences appear to be fundamental in the addiction development process. These differences could be related to the psychological factors and personality traits of users (Davis et al., 2002, Young, 1996, 1999, 2004, Kim et al 2009) or their motivation to use technology (Wan & Chiou, 2006; West, 2005; Goodman, 2007; Wu & Lu, 2013). Furthermore, we found evidence hinting that the characteristics of the technology can play a role in addiction. While there is no systematic research on the role of technology (e.g. Turel et al. 2010), the concept of technology affordances is useful to study user-technology interactions in the context of addiction. By definition, affordances are the "action possibilities and opportunities that emerge from actors engaging with a focal technology" (Faraj & Azad, 2012, p. 238).

Method: Given the need for a longitudinal understanding of IT addiction to add to the understanding provided by prior variance studies, a qualitative methodology, which enables us to take into account the temporal and processual characteristics of the phenomenon under study (here, IT addiction) (Vaast & Walsham, 2011), was used. To analyze our data, we followed a

grounded theory approach (Glaser & Strauss, 1967) to make sense of the dynamics that underlie IT addiction development. Using a theoretical sampling strategy to select the interviewees (Patton, 2002), we collected data in two rounds. In the first round, we conducted 12 face-to-face interviews with users of smartphones, with the aim of identifying key concepts and providing a draft of the IT addiction process. The interview guide was first constructed on the basis of the evidence in the extant literature and was further refined through pilot interviews with three heavy technology users and four IS experts. The second round of data collection involved 26 additional interviews, using a revised questionnaire based on the preliminary analysis of the data. This second round of data collection aimed at investigating further the preliminary findings and identifying other key mechanisms that could underlie the formation of addictive behaviors. On average, the interviews lasted 45 minutes. Following guidelines by Corbin and Strauss (1990) and Charmaz (2003), we analyzed our data using grounded theory standard coding practices (open, axial, and selective).

Findings: From our analysis, we found that the characteristics of users play a critical role in the development of addiction. They were found to be the first building block of the IT addiction development process. Our results show that the users' personality types, emotional states, and motivations are important at different stages of IT use and addiction. With respect to the role of technology (which was identified as the second building block of the process), we found that both the physical and technical features of technology enable the transition of regular behaviors to IT use. Furthermore, the affordances of technology that enable communication, entertainment, association, and information sharing also contribute to addiction development. Finally, the analysis of the interviews revealed the critical role of the use environment, which represents the third building block involved in the IT addiction development process.

Building on these results and taking into account the mechanisms that underlie the process, we propose that addiction development typically starts with what would be considered regular use. Environment-related factors (e.g. peer pressure) and technology-related factors (e.g. IT capabilities, design) in addition to the expected benefits seem to trigger the adoption of technology for most individuals. With time, the adoption and use of a smartphone provides an opportunity for users to connect to technology, evaluate the gains, and realize the potential benefits associated with use. To get more benefits from the technology, some users appear to

increase their level of engagement and the time spent on different tasks and activities. Users with specific personality traits, emotions, and motivations were found to further increase their interaction with technology, while experiencing a deficient assessment of the gains/losses from the system (e.g. undermining the negative consequences). Increased and unregulated IT-use behaviors will be followed by feeling an urge to use the technology. The persistence of problematic behaviors could bring challenges to addicts' lives. Such behaviors can limit the amount of time and effort spent on productive tasks, inhibit social relationships, and cause psychological issues for users. The negative cycle appears to persist unless there are changes in the conditions of the user, the technology, or the environment (e.g. introduction of controlling mechanisms).

Contribution: Overall, given the dearth of theories on IT addiction in the IS discipline, this essay contributes to the extant theorizations of the phenomenon. It sheds light on the process leading to IT addiction and clearly identifies the phases and the mechanisms that underlie this process. The results provide novel insights for understanding the development of addictive behaviors through an interaction between the user, the technology, and the environment surrounding the usage. It also provides support for the unique role of technology during the development of addiction by focusing on technology features and affordances. Finally, we identify four key affordances of technology that enable development of addiction over time. Our results call for further research on the changing and evolving nature of the elements and mechanisms that underlie IT-related addiction and an examination of their importance over time.

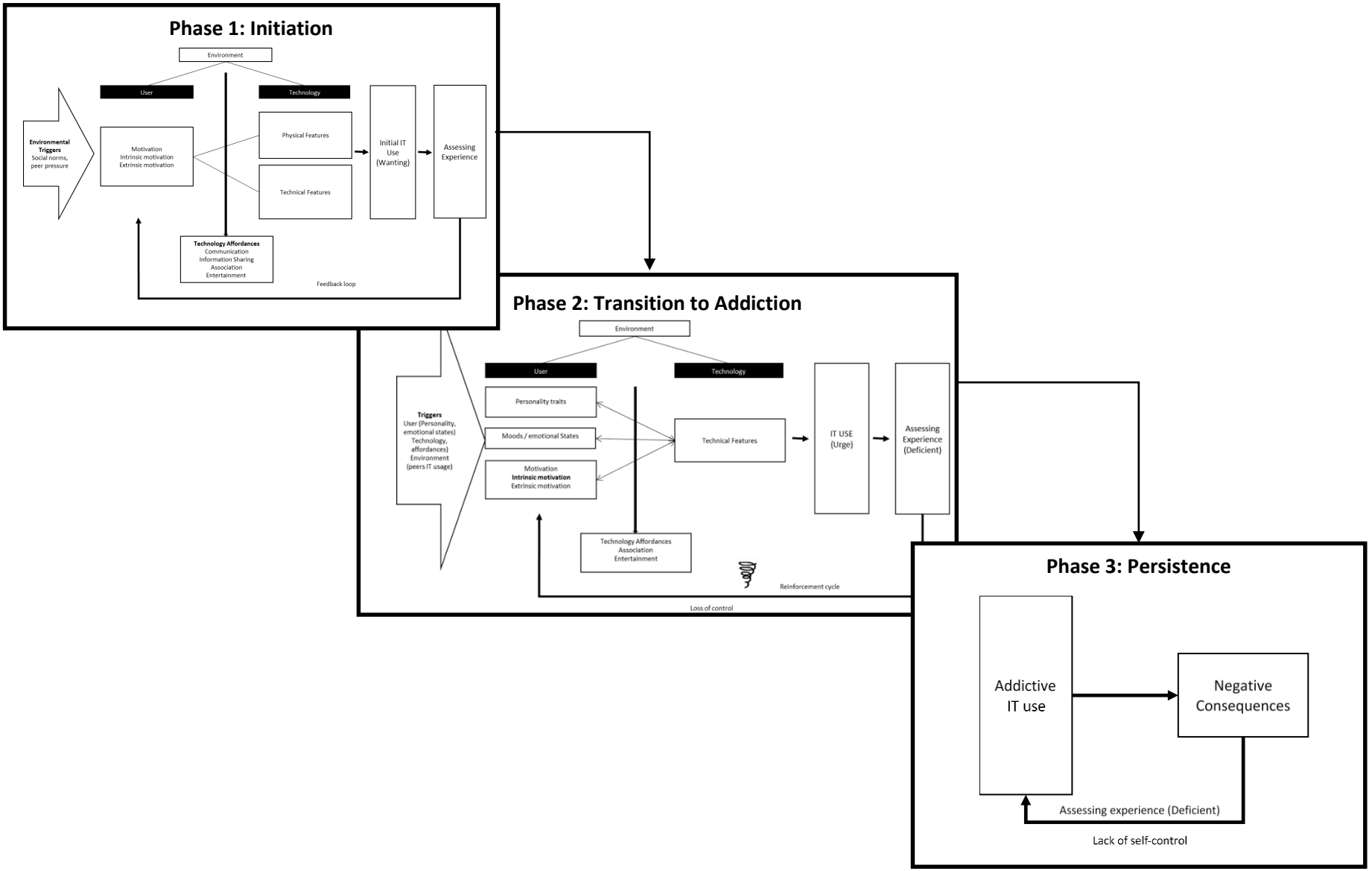

Figure 3: The process model of IT addiction development

Essay #3: An Examination of User Craving for Social Networks

The third essay focuses on technology craving and seeks to examine its antecedents, especially those that are related to technology, in the context of social networks. Defined as strong memories linked to the pleasant effect of an addictive substance, craving has been deemed a key driver of addiction and relapse, especially after a period of abstinence. From a review of the relevant literature, we propose a model of technology craving that shows the effect of the structural features of technology (Wood et al., 2004; King et al 2010) on users' needs (Verheul et al., 1999) and how interactions between these two elements lead to social network craving as well as to addiction.

Literature Review: In this essay, we first provide a review of the literature on craving and its semantics. Several definitions have been provided for craving, for instance, as a strong appetitive quality of an individual, a type of psychological attachment to a substance, or a subjective desire for the positive outcomes of a substance use (Marlatt, 1987; Gendall et al., 1997; Volkow et al., 2006; Young, 2013). Borrowing from extant definitions of craving in the general addiction literature, we define technology craving as a psychological attachment to technology and an urge to pursue technology use. Furthermore, we discuss four types of models that have been used to model craving (conditioning-based, cognitive, psychobiological, and motivational models). In this essay, we use a motivational model of craving because of its relevance to the technology use context. Finally, we review the literature on users' motivations for IT use and particularly those that are related to craving, such as the need for rewards or the need for relief, as well as the technology-related factors, especially those that are important in the context of IT addiction.

Theoretical Development: The context of the study is social networks, an aspect of technology that has experienced exponential growth during last few years. As explained in the essay, a social network refers to any web-based virtual community that "allows users to (1) construct a public or semi-public profile within a bounded system, (2) articulate a list of other users with whom they share a connection, and (3) view their list of connections and those made by others within the system" (boyd & Ellison, 2007, p. 211).

Building on our review of the literature, we propose a motivational model of craving to explain the role of users' needs in craving, in social network craving, and in addiction. In addition, the model explains how the interactions between the structural features of technology and users' needs lead to craving and addiction to social networks (see Figure 4).

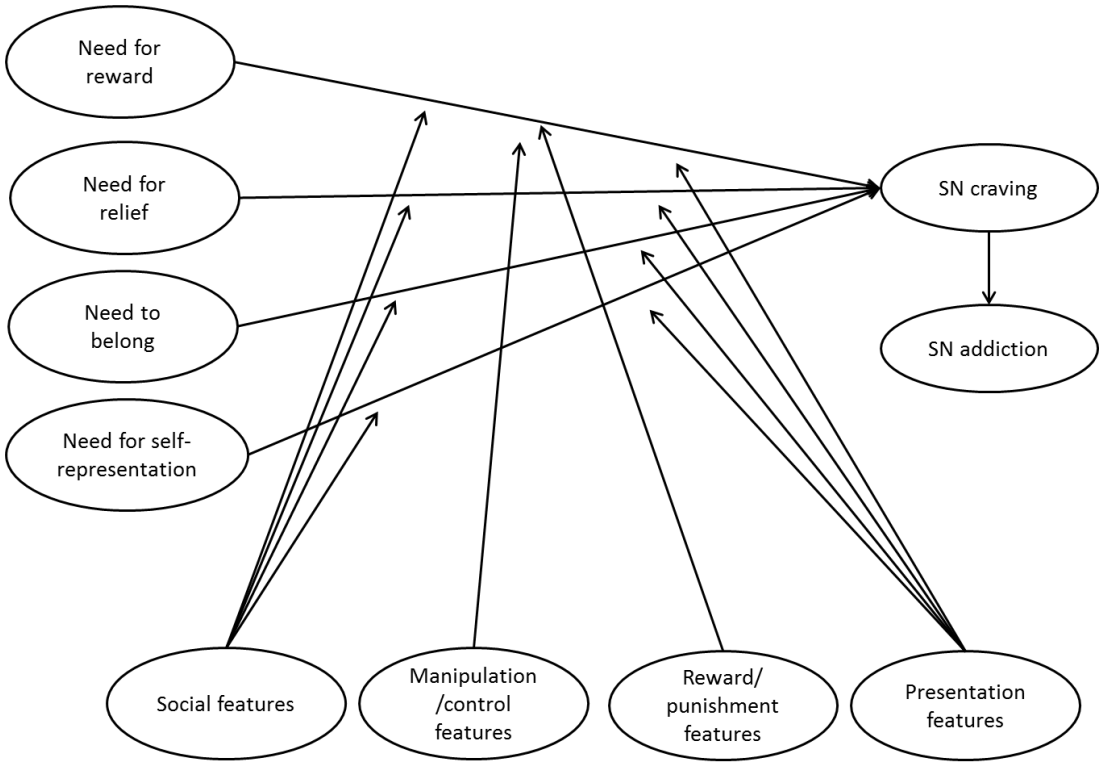

Figure 4: The proposed model of social network craving

Contribution: The paper provides a unique contribution to IS research by introducing technology craving, which is an important concept that can exacerbate addiction or cause relapses in cases where users decide to stop a problematic behavior. It also proposes a motivation-based model to study the antecedents of craving as they relate to users' needs and IT artifacts (i.e. structural technology features). For practitioners, the model highlights the importance of craving in the context of technology and social network use and shows how it may lead to addiction (and other negative consequences), which should be taken into account during decision making about adopting a new technology (such as internal social networks) in organizations.

Expected Contributions and Dissertation Structure

Since IS research on addiction is a new, though progressing field, this dissertation is expected to contribute to this emerging research stream and help establish the groundwork for future studies in this area. Overall, the dissertation contributes to the emerging literature on IT addiction by conducting multiple qualitative and quantitative studies that shed light on different issues related to IT addiction. Specifically, the thesis provides a conceptualization of IT addiction and two related concepts: liability to addiction and technology craving. It also, discusses the development of IT addictive behavior by theoretically taking both a process-based (essay #2) and a variance-based approach (essay #3) for studying IT addiction. The dissertation also enhances our knowledge of IT addiction, by specifically looking at the role of technology's characteristics and how they function in developing addictions. In each essay, we provide different ways of looking at the technology factor. For instance, essay #1 looks at different smartphone-related features that increase liability to addiction, while essay #2 uses the concept of technology affordances to discuss the opportunities provided for users, which may foster addictive IT use. The third essay also discusses the technology factor by hypothesizing the role of the structural features of technology in relation to craving and addiction. In this way, we add to the existing understanding of IT addiction that puts most of the emphasis on the role of user characteristics as the sole determinant of addictive behaviors. For managers and firms, the findings will be helpful in understanding the nature of addictive IT use and the development of such unwanted behaviors. Our results will enable practitioners to develop guidelines to prevent excessive and compulsive technology use in different contexts as well as mechanisms to lessen the problems they cause for employees' professional and personal life.

The rest of this dissertation is structured as follows: The second, third, and fourth chapters constitute the essays in detail. Each chapter includes an introduction to the problem, a literature review, a methods section, findings, and a discussion/conclusion (except essay #3, which is a theoretical paper). Finally, chapter five provides the concluding remarks of the dissertation.

Chapter II (Essay #1): A Typology of User Liability to IT Addiction

Abstract

To date, Information Systems (IS) research mainly has provided a monolithic view of IT use, considering it to be a desired behavior with positive outcomes. However, given the dramatic raise in the use of technology during the last few years, susceptibility to IT addiction is increasingly becoming an important issue for technology users and IS researchers. In this paper, we report the results of a study that focuses on user liability to IT addiction. We first review the literature in different disciplines (e.g. health, psychology, IS) to better understand IT addiction, to identify its antecedents and consequences, and to introduce liability. Then, building on the analysis of 15 in-depth interviews and 182 exploratory open-ended surveys collected from smartphone users, we conceptualize liability in the IS use context and propose a typological theory of user liability to IT addiction. Our typology reveals five ideal types; each can be associated to a user profile (ADDICT, FANATIC, HIGHLY ENGAGED, REGULAR, and THOUGHTFUL). Building upon both the extant literature and our results, we put forth propositions to extend the theoretical contributions of the study. We finally discuss the contributions and implications of our paper for research and practice.

Introduction

Despite the significant number of studies on information technology (IT) usage (Davis, 1989; Venkatesh *et al*., 2003), little attention has been paid to identifying and understanding excessive and problematic forms of IT usage. The extant literature mostly provides a monolithic view of the IT use phenomenon, treating all users' behavioral manifestations equally (Bagayogo *et al*., 2014). In most cases, IT use is considered a type of desirable behavior, which is typically the ultimate goal of system designers and implementers. Accordingly, from an information systems (IS) research perspective, IT usage is referred to as a common indicator of IS success (Delone & McLean, 2003). Although in most cases continued and intense IT usage helps individuals improve their productivity and results in significant economic benefits for organizations

(Jasperson *et al*., 2005), the use of technology—in its various forms—can have a flip-side and lead to undesired outcomes especially when it is excessive, compulsive, and uncontrolled. In fact, anecdotal and research evidence from psychology, health and IS research hints that excessive and compulsive technology use tends to cause serious challenges for individuals, organizations, and even for societies (LaRose *et al*., 2003; Block, 2008; Turel *et al*., 2011b). As an example, pathological use of the Internet was found to undermine academic performance, create social difficulties, and cause several psychological problems such as depression and loneliness (Caplan, 2002; Billieux *et al*., 2008).

The adoption and use of technology has dramatically increased during the last few years (Alexander, 2011), and has become a social phenomenon (Turel & Serenko, 2010; Brus, 2013). Recent statistics (Internet World Statistics, 2014) show that more than three billion people now have access to Internet, which is a 30 percent growth since 2010. In addition, the use of social media and mobile devices are at an all-time high. For example, almost three-quarters of online adults have a profile on at least one social networking site (Brenner & Smith, 2013; Davenport *et al*., 2014). The growing ubiquity and immediate accessibility to the Internet and social world, especially provided by mobile technologies, has expanded users' opportunities for constant use and long-term engagement with technology (Lundquist *et al*., 2014). For instance, a survey of more than 5,000 users in eight industrialized countries showed that most individuals (84%) cannot spend a day without using their phones and one fifth of them check their phones every 20 minutes (Gibbs, 2012), even when there is no sound or notification.

Despite the worrying levels of technology use recently reported (Gibbs, 2012), with the exception of some recent efforts (e.g. Turel & Serenko, 2010; Turel *et al*., 2011b; Lee *et al*., 2014; Xue *et al*., 2012; Turel, 2014), there is little research in the extant IS literature on the excessive and compulsive use of technology and there is no study that specifically looks at the susceptibility of users to develop IT addiction. Given the increase in the use of technology and the potentially disturbing effects associated with IT addiction, understanding the risks of developing IT addiction and its associated impacts is timely and critical. Hence, in this study, we borrow from human genetics and drug addiction literature to introduce the concept of *liability to addiction* (Falconer, 1965; Dawes *et al.*, 2000; Vanyukov *et al.*, 2003; Conway *et al*., 2010; Vanyukov *et al*., 2012), which corresponds to the state of being prone to addiction. Assuming

that every user is susceptible to develop IT addiction, we extend and empirically examine liability to addiction in the context of IT usage. In this study, we thus aim to answer these three important research questions: 1) What is user liability to IT addiction? 2) What are the variations in IT addiction liability among users? 3) What is the nature of the antecedents, behaviors and consequences associated with each type of IT addiction liability?

To answer these questions, we conducted a study to identify what is the user liability to IT addiction. Our study involved interviews and a qualitative written questionnaire (open-ended survey). The qualitative analysis of the interviews first allowed us to conceptualize the construct of user liability to IT addiction and identify its underlying dimensions and sub-dimensions. Then, building on this analysis, we proceeded to qualitative and quantitative analyses of the survey data to develop a typology that reflects the variations in user susceptibility to IT addiction. For each type of user liability to IT addiction, we conducted further analyses to identify the associated user profile.

This study has interesting contributions to and implications for the IS field. First, it introduces in IS research the concept of liability to addiction, which is critical to better understand the susceptibility of users to develop IT addiction and identifies its underlying dimensions. Second, this study extends the theoretical insights on IT addiction by developing a typology of user liability to IT addiction that includes five ideal types. Third, for each type, we identify the associated user profile, including antecedents, usage behaviors, and consequences. We extend further our theory development by putting forth a proposition for each type of user liability to IT addiction. These propositions provide a base for further investigation of addiction-driven IT use. Our results hence contribute to the emerging field of IT addiction that seeks to portray a more balanced picture of IT use, one that takes into account both normal and problematic IT usage. From a managerial standpoint, the findings of our study could be used to identify users' level of liability to IT addiction and even design mechanisms that effectively detect, prevent, or treat users who show higher levels of liability to IT addiction.

The remainder of this paper is structured as follows. In the next section, we review the literature and provide a foundation for studying user liability to IT addiction. Then, we describe and explain the methodology used in this study. The results section presents our conceptualizing of

user liability to IT addiction, and the typology resulting from our qualitative and quantitative analyses of the open survey. Next, we develop propositions for each type of user liability to IT addiction. Finally, we discuss the implications of our study for research and practice and identify avenues for future research.

Literature Review

Conceptualization of IT addiction

The concept of addiction is rooted in the psychology literature where it has been referred to as a loss of control over a behavior that either serves to produce pleasure or to escape from internal discomforts (Potenza, 2006) and that is typically associated with negative consequences (Goodman, 1990). For example, addiction to illegal drugs and alcohol has been found to cause cancer, mental illness and social dysfunctions, and/or to result in convictions (Cartwright, 2000; Volkow & Li, 2005; Potenza, 2006). Despite the focus on *substance dependency* in classic addiction research, this concept also has been used to describe *non-substance dependency* such as gambling addiction, compulsive shopping, and eating disorders (Becona *et al*., 1996; Blaszczynski & Nower, 2002; Davis & Claridge, 1998).

In recent years, IT has been found to be a source of addiction. In spite of clear advantages of using technology to facilitate tasks and speed up communications, it recently has been shown that the dramatic increase in adoption and use of IT and communicative tools such as computers, mobile devices, and social media may cause some difficulties for users (Chóliz, 2010).

IT addiction is a broad concept that has been extended to many excessive IT use behaviors such as online game addiction (Xu *et al*., 2012), Internet addiction (Young, 1996; Armstrong *et al*., 2000; Byun *et al*., 2009), media consumption addiction (LaRose, 2010), and online auction addiction (Turel *et al*.,2011b). In order to conceptualize IT addiction, we looked at the existing definitions of addiction in previous research (Table 1), and identified the elements that were repeatedly mentioned in different conceptualizations of IT addiction. Drawing from our review, we argue that IT addiction is a type of behavior that embeds four essential characteristics: 1) feelings of dependency; 2) excessive use; 3) failure to stop; and 4) significant negative outcomes. Building upon these elements and drawing upon the existing conceptualization of addiction, in

this study, we define IT addiction as *a psychological dependency on IT that involves excessive and compulsive use despite significant negative consequences*.

Study	Context	Definition of addiction
Ng & Wiemer-Hastings (2005)	Internet and online gaming	An obsessive and compulsive behavior with symptoms such as tolerance, withdrawal, craving, and negative life consequences.
Kandell (1998)	Internet addiction	"A psychological dependence on the Internet, characterized by an increasing investment of resources on Internet-related activities, unpleasant feelings when off-line, an increasing tolerance to the effects of being online, and denial of the problematic behaviors" (p. 11).
Young (1998)	Pathological Internet use (PIU)	"An impulse-control disorder which does not involve an intoxicant" (p. 1).
Caplan (2006)	Problematic Internet use (PIU)	"A multidimensional syndrome consisting of cognitive and behavioral symptoms that result in negative social, academic, and professional consequences" (p. 721).
Lemmens *et al.* (2009)	Game addiction	"Excessive and compulsive use of computer or video games that results in social and/or emotional problems; despite these problems, the gamer is unable to control this excessive use" (p. 78).
Young & Rodgers (1998)	Internet addiction	"Problematic Internet use associated with significant social, psychological, and occupational impairment" (p. 25).
Shapira *et al.* (2000)	Problematic Internet use	"An individual's inability to control his or her use of the Internet causes marked distress and/or functional impairment" (p. 267).
Wang (2001)	Internet dependency	A psychological dependence on the Internet that should have three key characteristics, namely compulsion, tolerance, and withdrawal.
LaRose *et al.* (2003)	Media addictions	"Addicted consumers feel compelled to consume media despite potentially negative consequences that make continued use appear irrational or out of control, even in their own eyes" (p. 226).
Byun *et al.* (2009)	Internet addiction	"An individual is addicted when an individual's psychological state, which includes both mental and emotional states, as well as scholastic, occupational and social interactions, is impaired by the overuse of the medium" (p. 204).
Turel & Serenko (2010)	Mobile email addiction	"A form of non-substance addiction that involves excessive interaction with both a mobile technology (mobile device) and the content (electronic communication) under conditions of psychological dependency" (p. 41).
Turel *et al.* (2011b)	Technology addiction	"A psychological state of dependency on the use of a technology to such a degree that the following typical behavioral addiction symptoms may arise: salience, withdrawal, conflict, relapse and reinstatement, tolerance, mood modification" (p. 1044).
Xu *et al.* (2012)	Online game addiction	"A state of maladaptive psychological dependency on online games that is manifested through the obsessive-compulsive pattern of seeking and use behaviors that take place at the expense of other important activities" (p. 322).

Table 1: Definitions of IT addiction in existing literature

Liability to Addiction

Early on, scholars have measured addiction using lean measures and classifying addicts versus non-addicts, based on diagnostic criteria (e.g. certain number of symptoms reported) (Shaffer 1996; Larose 2003; Yang and Tung 2007). In this dichotomous view of addiction, there is an underlying assumption stating that the characteristics and behaviors are similar within the two groups, i.e. for non-addicts (individuals below a given diagnostic threshold) or addicts (beyond this threshold) (Conway *et al*., 2010). Based on such view of addiction, there is no distinction between a user who falls slightly over the threshold and someone who experiences severe addiction. At the same time, all users who are below the threshold of addiction will be considered the same. For example, no action is usually taken by clinicians and policy makers for non-addicts (Conway *et al*., 2010; Vanyukov 2013) even though some of these users may carry a high risk of becoming addicts in the future.

Despite the popularity of this approach in addiction research (Murali & George, 2007; Beard, 2005), there could be meaningful differences between individuals in each group of users, whether below or above the diagnostic threshold. In other words, while we understand the differences between these two groups, little is known - above and beyond this addict/non-addict dichotomy - about the differences among users and their behaviors. While a few recent papers have addressed such variations among individuals within the cohort of addicts or non-addicts in the general addiction literature (Conway *et al*., 2010; Porter Kakabadse 2005), there is a need for to investigate the variations between users in IS research. Understanding such distinctions could inform and advance extant IT addiction theories and have important practical value.

To study these variations, the concept of "liability" is highly relevant. Indeed, liability to addiction refers to the degree to which an individual is prone to addictive behaviors. In extant addiction literature, liability has been used as a multifactorial concept representing the property of a behavior that is associated with the development of disorders (Vanyukov, 2012). More specifically, the concept is intended "to express not only the individual innate tendency to develop or contract the disease, i.e. his or her susceptibility in the usual sense, but also the whole combination of external circumstances that make him more or less likely to develop the disease'' (Falconer 1965; p. 52). Based on this conceptualization, liability is perceived as a multi-factorial

(non-substance-specific) construct that takes into account the combined effect of different factors (e.g. social, psychological, etc) related to the individual and the environmental condition around usage (Dawes *et al*., 2000; Vanyukov, 2012). While in the psychology, neuroscience and mental health literatures, different labels have been used to discuss the development of disorders concepts (such as susceptibility, vulnerability or resilience), liability has been accepted as a more heuristic, consistent and parsimonious construct to represent and manifest the addiction-proneness property of a behavior (Vanyukov et al., 2003).

Extending liability to the IT use context allows us at have a more granular view of users' behaviors and understand the heterogeneity among users in their susceptibility in developing and exhibiting IT addiction. Compared to the core concept of addiction that by definition deals with users who show excessive and compulsive behaviors (i.e. addicts who fall above the threshold of diagnostic criteria), liability is a much more inclusive concept that pertains to the entire course of development of a disorder or a socially undesirable or restricted behavior (Vanyukov 2012; Iacono 2008), including those who show no sign of the disorder and those who exhibit severe ones (Vanyukov et al., 2012In other words, in the IT addiction context, liability applies to the entire user population and their IT use behaviors, rather than just those who suffer from addiction at a given point in time.

In the general addiction literature, the liability construct has been used to investigate the likely development of several addiction types, including drug abuse (Collins et al., 1984), work addiction (Robinson & Post, 1997), and stimulants addiction (Foltin & Fischman, 1991). Despite the theoretical advances to understand liability in different contexts (Hicks 2012; Conway et al 2006; Neale et al., 2006), due to the complex, latent, and multi-factorial nature of the construct, the assessment of liability has been shown to be a methodological challenge (Dawes et al., 2000; Vanyukov et al., 2003; 2012). As Falconer (1965) argues, liability, once measured, can provide us a graded scale for the degree of normality or of affectedness, with these two categories divided by a threshold. Accordingly, to overcome the challenges in quantifying liability, some researchers have focused on the gradations of normality or of affectedness and identified two underlying dimensions that help assess liability (Conway et al., 2010; Vanyukov et al., 2012). First the gradation of normality shows the expected variations that exist in risk (also referred as *propensity*) of a behaviors turning into severe addiction. Second, the gradation of affectedness

(also referred as *severity*) corresponds to the various degrees of severity of addiction manifested by an individual (Robinson & Post, 1997; Conway *et al*., 2010; Vanyukov et al., 2012). While propensity refers to the probability or the risk of addiction being developed below the threshold of addiction (the subthreshold phenotypes), severity, refers to the degree of obsessive and compulsive behaviors exhibited by an individual (the suprathreshold phenotypes), when such behaviors fall above the threshold of addiction.

For each dimension (i.e. severity and propensity), several measure instruments were developed in general addiction research. For example, in the case of severity, the addiction severity index (ASI) (McLellan et al., 1980) evaluates the need for addiction treatment within the key areas of functioning (e.g. medical, legal, and employment). Another instrument (substance problem scale-SPS) was developed by Dennis et al (2003). The scale consists of items for diagnosis of substance addiction in addition to other screening items such as the amount of weekly usage, complaints from peers, and continued use despite confrontations. Other examples of exiting scales for severity are drug use screening inventory, global appraisal of individual needs, severity of alcohol dependence questionnaire, and substance dependence severity scale (Baillie & Mattick, 1996; Kirisci et al., 1995; Miele et al., 2000; Stockwell et al., 1979). In the case of propensity, the instruments for measuring the risks of developing addiction are few and far apart (Conway *et al*., 2010). Still, an instrument (transmissible liability index-TLI) was put together by the Center for education and drug abuse research (CEDAR), using items from numerous psychological and psychiatric scales to characterize users' behaviors/personalities and their likelihood of substance use disorder (Vanyukov et al., 2009; Kirisci et al., 2009).

Despite the existence of separate measures for propensity and severity, there is no single instrument that combines the measurement of both propensity and severity, for example to generate a total score for liability of each user. As mentioned above, in extant conceptualizations of liability, the propensity and severity dimensions are seen as two independent constructs that are divided by a threshold (Conway *et al*., 2010; Vanyukov et al., 2012). Such a conceptualization of liability perpetuates the dichotomous view of addiction where severity only applies to users who fall above the diagnostic threshold (i.e. addicts) and propensity to those above the diagnostic threshold (i.e. non-addicts). Therefore, only looking at either propensity or severity will not be sufficient to investigate the variation between users' behaviors. The need for

such a finer-grained understanding of liability is further justified by existing research in IS discipline that has treated addiction as a continuous variable, and thus, did not specify a threshold for problematic IT use (e.g. Turel & Serenko, 2012; Soror et al., 2015).

Accordingly, in this study, we extend propensity and severity to the IT use context by considering them as continuous indices that could vary from low to high (see Figure 1 for an illustration of our conceptualization of liability). We argue that, in the context of IT addiction, propensity will refer to the risk of developing extreme addiction. Accordingly, a higher degree of propensity means a higher point along the X axis. At the same time, severity corresponds to the intensity of the compulsive behaviors that is manifested by any user, and higher severity translates into a higher point along the Y axis. Compared to the traditional dichotomous view, in this conceptualization, a degree propensity and severity can be attributed to any type of usage whether above or below a theoretical threshold.

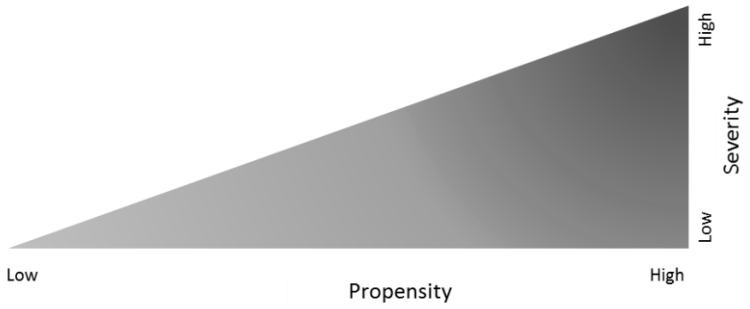

Figure 1: Liability to addiction and its dimensions

Extending the propensity and severity dimensions above the diagnostic threshold can be helpful in providing an in-depth understanding of users' behaviors and their liability to addiction. Although we expect addicts to have a high level of severity associated with their IT use, a more granular level of propensity can also be specified for these users. At the same time, for normal users who exhibit lower propensity, it is possible to the level of severity of their behaviors; although, this level of severity is expected to be lower compared to that of addicts. Hence, our study focuses on the liability of users to IT addiction by studying the meaningful variations that exist in users' liability levels, by examining both the propensity and severity levels of their usage.

Given that extant research on IT addiction has revealed the importance of several factors associated with excessive and compulsive use, we further reviewed the existing literature that has addressed these factors to see how they are linked to liability. In the following section, we provide an overview of the key antecedents and consequences that have been associated with IT addiction.

Antecedents and Consequences of IT Addiction

In the last few years, research on technology addiction has increased in the IS discipline. Some efforts have been made to integrate the addiction construct into mainstream IS theory and to examine some of the antecedents and consequences that are associated with it. Using the Technology Acceptance Model (TAM), Turel, Serenko and Giles (2011) showed how addiction may alter the belief system of users and increase their intention to use IT by changing perceptions about usefulness, ease of use, and enjoyment of IT. In another study, perceived enjoyment and prior use of social networks were found to facilitate the development of IT habits, which can eventually lead to addiction (Turel & Serenko, 2012). Xu *et al*. (2012) proposed a model that illustrates the key functional needs that encourage online game addiction (such as the need for relationships and advancement), as well as mechanisms that could counterbalance them (such as parental monitoring and increasing the perceived costs of online games). Turel and Serenko (2010) also suggested that some characteristics of mobile phones (e.g. ubiquity and convenience of email access) represent possible reasons for their widespread usage and even addiction, but they did not test these effects in their study. In terms of consequences, IS research has shown that IT addiction may increase the perception of work overload and decrease the commitment of employees, leading to technology-family and work-family conflict (Turel *et al*., 2011a), technostress (Lee *et al*., 2014), and burnout (MacCormick *et al*., 2012).

Despite the recent attention in the literature on the causes and consequences of IT addiction, this research stream is still developing and there are several calls to further investigate the factors associated with problematic technology use (Byun *et al*., 2009; Turel *et al*., 2011; Xu *et al*., 2012). In this study, we aim to broaden the pool of potential antecedents and consequences of smartphone addiction by integrating research in the psychology, health, and computer science literature. Based on our review of the literature across disciplines, we discuss three types of

antecedents (demographics, individual differences, technology features) and three types of consequences (social, professional, well-being) associated with IT addiction (see Table 2).

Antecedents: Early studies focused on the *demographics* of users and tried to establish links between technology addiction and factors such as gender, age, education, race, and economic status (Shotton, 1991; Young, 1996; Young, 1998; Griffiths *et al*., 2004). For instance, early results showed that computer and Internet addicts were usually young male introverts (Brenner, 1997; Griffiths *et al*., 1999; Morahan-Martin & Schumacher, 2000) who were computer savvy and educated (Shotton, 1991). Additional studies resulted in contradictory findings. For instance, it was found that women could be 20% more addicted to the Internet than men (Young, 1998) while other studies showed no specific distinction between different demographic groups (OReilly, 1996; Armstrong *et al*., 2000). Such inconsistencies motivated researchers to look for other drivers of technology addiction, i.e. beyond socio-demographic factors.

Researchers further scrutinized the *individual differences* between users and their role in the development of addiction. In this stream of research, many examined the role of personality traits and dysphoric moods on the development of Internet and computer addiction (e.g. Marlatt *et al*., 1988; Kreek, 1992; DeJong *et al*., 1993; Nelson-Zlupko *et al*., 1995; Caplan, 2002). For example, Griffiths and Dancaster (1995) argued that high-strung users with Type A personalities are more susceptible to addiction. Other studies linked depression, loneliness, shyness, self-esteem, social anxiety, and impulsivity to problematic Internet use (Caplan, 2002, 2006; Armstrong *et al*., 2000; Ha *et al*., 2007). Despite the abundance of studies on personality types, a review of the literature shows that, except for loneliness, there is no evidence that establishes a clear link between the personality of users and technology addiction (Byun *et al*., 2009). This calls for further investigation of these factors, especially in new technology-use contexts.

It should be noted that "not all IT artifacts are equally addictive" (Turel & Serenko, 2012). There has been growing interest in the role of the technology itself on addiction, meaning that specific *technology features* could make IT attractive and addictive. As Greenfield (1999) argued, the combination of features available in a technology (e.g. speed and stimulation potency) can provide a "highly psychoactive experience" that can change users' moods and influence their behaviors (Morahan-Martin & Schumacher, 2000). Depending on its characteristics and features,

users tend to engage with a technology and become dependent as long as it remains interesting (Chóliz, 2010). For instance, the communicative capacity of the Internet and the high level of accessibility to information and services have been found to accelerate the subjective passage of time and provide a potential for addiction (Shaffer, 1996; Griffiths *et al*., 1999). Also, online gambling addiction was found to exist at a higher level compared to real gambling due to the anonymity and accessibility provided by the technology (Griffiths & Parke, 2002). In addition, the results of a study by Ng and Wiemer-Hastings (2005) showed that advances in 3D graphics and virtual representation are reasons why game players exhibit dependency toward some games.

Consequences: As discussed above, IT addiction generally causes new difficulties or exacerbates existing problems (Beard, 2005). First, a visible consequence of technology addiction is the effect it has on the *social life* of users when IT use brings difficulties such as a lack of communication with others, relationship conflicts, and marital discord (OReilly, 1996; Goldberg, 1996; Young, 2004). As users spend most of their time using technology and connecting to people in the online environment, they have less time and a decreased tendency to have real-life social interactions (Beard, 2005). This may limit their interpersonal relationships substantially. Similar effects have been seen in different contexts such as video gaming (Lo *et al*., 2005), instant messaging (Huang & Leung, 2009), and cybersex (Cavaglion, 2009).

Second, depending on the intensity and purpose of use, IT can have negative effects on users' *professional life*. In the case of technology addiction, excessive use of IT for non-work-related purposes (e.g. personal email, chat, and online games) can have adverse effects on the productivity and performance of users (Yellowlees & Marks, 2007) and increase the likelihood of job turnover for professionals and academic failure for students (Davis *et al*., 2002; Porter & Kakabadse, 2006; Peters & Bodkin, 2007). The amount of time and effort spent on non-productive IT use, and the resulting distractions usually take away from the time users should spend on valuable tasks and is likely to lead to professional problems over time (Young, 2004).

Finally, previous research has shown that long-term stimulation resulting from technology addiction can undermine both the mental and physical *well-being* of users. As users become more dependent on technology, the resulting positive emotions (e.g. excitement, enjoyment) become entangled with technology use. However, when emotions become saturated, increasing

IT usage will no longer satisfy the addict's desire (Beard, 2005). The associated frustration may lead to mood disorders, loneliness, and depression (Young & Rodgers, 1998; Goodman, 2008; Murali & George, 2007). Also, disconnection from family and friends—caused by the overuse of technology—can result in similar disorders such as loneliness (Kraut *et al*., 1998). In addition, prolonged use of technology and lack of physical activity leads to physical problems such as fatigue or lack of sleep (Douglas *et al*., 2008). Long-term patterns of sleep disorder and fatigue may increase the chances of other severe impairments such as backache, neck pain, eyestrain, and carpal/radial tunnel syndromes (Young, 1999).

Category/Variable		Sample of Factors	Selected References
Antecedents	Demographics	Gender; Age; Education; Race	Shotton, 1991; Young 1996; Brenner, 1997; Griffiths *et al*., 1999
	Individual Differences	Personality traits (e.g. impulsivity, shyness, low-self-esteem); Dysphoric moods (e.g. anxiety, depression)	Nelson-Zlupko *et al*., 1995; Armstrong *et al*., 2000; Caplan, 2002; Ha *et al*., 2007; Young & Rodgers 1998
	Technology Features	Communicative capacity; Speed; Stimulation potency; Graphics	Greenfield, 1999; Griffiths & Parke, 2002; Ng & Wiemer-Hastings, 2005
Consequences	Social Life	Relationship conflicts; Social isolation; Technology-Family conflict	Beard, 2005; Goldberg, 1996; Turel *et al*., 2011a
	Professional Life	Academic failure; Reduced productivity	Nalwa & Anand, 2003; Yellowlees & Marks, 2007
	Well-Being (Mental And Physical)	Mood disorders; Fatigue; Lack of sleep	James & Drennan, 2005; Young, 1998

Table 2: A review of antecedents and consequences of IT addiction

Research Methodology

Given the aims of our study and in light of our literature review, we first used an exploratory approach and conducted interviews in order to conceptualize user liability to IT addiction and to identify its underlying dimensions and sub-dimensions. Then, to develop a typology of user liability to IT addiction that reflects the existing variations in users' susceptibility to develop such addiction, we used both qualitative and quantitative techniques to analyze data gathered using an open-ended survey. Finally, we conducted additional analyses to identify the user profiles associated with different types of liability to IT addiction, including antecedents, behaviors and consequences.

Context of the Study

Data for this study were collected from smartphone users. Smartphones are portable tools that combine a mobile phone with a collection of software applications, which were traditionally accessed via computers (e.g. email, web browser, and social networks), as well as other novel applications solely designed for this device (e.g. location-based apps) (Wei, 2008). In line with the general technology trends, smartphone adoption has recently experienced rapid global growth. Statistics show that more than 1.75 billion people worldwide own smartphones (Emarketer.com, 2014). The average daily use of the smartphone can be intense and ranges from 10-200 times with a mean length-of-use between 10 and 250 seconds (Falaki *et al*., 2010). Popular media also stressed the excessive use and dependency to smartphone and its embedded applications by coining terms such as crackberry (constant checking of Blackberry email) and nomophobia (extreme anxiety and fear of losing a phone). Given the global growth in smartphone usage, using smartphone as a context for our study on IT addiction was deemed timely and relevant. Moreover, smartphone use is a valuable phenomenon to study as it captures the interactions of users with a large range of different applications and information services, some of which have been found to be addictive (e.g. emails, social networks) (MacCormick *et al*., 2012; Lundquist *et al*., 2014; Lee *et al*., 2014).

Data Collection

In this study, we relied on two rounds of data collection. In the first round, we used a theoretical sampling strategy (Patton, 2002) to select eight female and seven male heavy smartphone users for face-to-face, semi-structured interviews. The interviewees were selected from faculty members and graduate students between the ages of 26 and 38 in a large North American University. To conduct our interviews, we used an interview guide (see Appendix I) that was developed based on the extant literature. This interview guide was further refined in the field through three pilot interviews with two users, and with a qualitative IS researcher who is an expert on the subject. The final interview guide included 21 open-ended questions (with some probes and prompts that could be used as needed). It began with a very general question about smartphone usage and then moved on to more specific questions. The interview guide ended with an open question that allowed interviewees to provide additional insights on smartphone

usage and addiction. Each interview took between 20 and 40 minutes, was recorded in its entirety, and transcribed verbatim. At the end of the interview, we also used a short questionnaire adapted from Young (1996) to assess the user's level of IT dependency. As mentioned in prior studies, dependency is consistently a central theme in evaluating addiction (Murali & George, 2007). Overall, interview data were analyzed and used to better delineate liability to IT addiction in the context of smartphone use by conceptualizing propensity and severity.

Given our goal of identifying variations in user liability to IT addiction, we then proceeded to the development of an exploratory written questionnaire that was based on both the insights derived from the extant literature and the findings from the analysis of the interviews. Although they are not typically used in IS research, an open-ended survey was particularly useful in the context of our study because it allowed users to reflect on their perceptions of their own behaviors in a less intrusive way (Lewis-Beck *et al*., 2004). The survey also helped us obtain rich and detailed qualitative data from a large sample of users. Hence, since we are studying a phenomenon that may not be perceived as socially desirable, such a qualitative survey was deemed effective for collecting more honest responses from a large sample by maintaining full anonymity of the respondents.

The first version of the questionnaire comprised five open-ended questions about smartphone usage and its associated outcomes. Nine additional questions allowed us to probe the respondents in order to identify their relevant individual characteristics and perceptions about smartphone features and capabilities. As we did for the interviews, we added the dependency questionnaire (Young 1996) at the end of the survey. To check for content and face validities, we pre-tested the questionnaire with two senior researchers and then with six smartphone users who had profiles similar to those of our respondents (university students). The pilot group was asked to reflect on the questions and comment on their readability, clarity, and relevance. Some items were reworded based on the pilot results (see Appendix II for the survey questions).

The survey was administered to all 275 students that were enrolled in an undergraduate-level class at a large North American university. 182 questionnaires were returned (for a response rate of 66.2%). Respondents were between 17 and 29 years old; 43.4% were male and 54.9% female (three respondents did not specify their gender). On average, it took 30 minutes to fill out the

questionnaire. Students voluntarily participated in the survey; no incentive was given. We chose the student population because it is typical of the fastest-growing smartphone-user segment (Test Kitchen, 2010) and represents a large proportion of current smartphone users (Smith *et al*., 2010). Indeed, based on Google statistics for the U.S., Germany, France, U.K., and Japan, it represents between a quarter and one third of smartphone users in developed countries (Google Think, 2013). A recent survey indicates that more than two thirds of U.S. college students currently own smartphones, which should increase to 90% by 2016 (Fredricksen, 2012).

Data Coding and Analysis

We first focused on the interview data and used NVivo9 to support the content analysis of the transcripts. Data were coded using the standardized methods of qualitative thematic analysis (Patton, 2002). We relied on the interviews to achieve a meaningful conceptualization of liability and a richer understanding of its dimensions (propensity and severity) in the context of smartphone use. First, we devised codes for each of the elements that appeared salient (e.g. personality traits, dependency, use behaviors, intensity of use, technology characteristics). A second round of coding involved grouping and combining the coding categories with the same content and meaning and developing new categories that were, as appropriate, associated with user liability to IT addiction. The analytical process was repeated until saturation was achieved (Patton, 2002), at which point additional analysis repeatedly supported previously made interpretations. In reporting the analysis, the most revealing quotes were selected to illustrate the results. We made sure that the quoted interviewees remained anonymous by assigning a single code to each interviewee. Overall, the analysis of interviews revealed that liability can be identified by mapping the characteristics of IT addiction to its underlying dimensions.

Once we had developed a conceptualization of liability in the context of IT addiction, we proceeded with a qualitative analysis of the survey data to build a typology (Doty & Glick, 1994) that would reflect the different types of user liability to IT addiction. The use of typologies is not uncommon in IS research. For example, a similar approach has been pursued to investigate multi-dimensional and interdependent phenomenon in different contexts such as types of trust in e-commerce relationships (McKnight et al., 2002), or types of control in IS development projects (Cram & Brohman, 2013). As defined by Doty and Glick, a typology is composed of "a

conceptually derived, interrelated set of ideal types", "each of which represents configurations of a set of dimensions" (Doty & Glick, 1994, p. 232). In this way, a typology is different from a classification, which is simply "an exhaustive set of mutually exclusive categories" (Shaw et al., 2005, p. 10). Typologies allow researchers to organize complex relationships that exist between factors and associated outcomes (Doty & Glick, 1994). It also integrates the findings into coherent theoretical accounts in a parsimonious manner (Fiss, 2011).

In a typology, ideal types are constructed based on a unique combination of dimensions. In general, there are three ways to specify ideal types (Doty & Glick, 1994). First, ideal types can be modeled based on the theoretical specification of dimensions made by expert raters. Second, the extremes of the dimensions (low versus high) can be used to theoretically model ideal types. In both methods, the researcher will first deductively construct ideal types, and then, use empirical data to assess the fit between the conceptualization of the ideal types and the observations (Bailey, 1994). The third method is to empirically specify ideal types based on the qualitative assessment of the data. In this case, the aim is to first empirically construct ideal types, and then, to conceptualize its theoretical specifications.

Given the nature of the study, we followed the third suggested approach. Hence, in order to identify the variations in user liability to IT addiction (i.e. ideal types), we first engaged in the data to examine the different liability dimensions and sub-dimensions. Given the results of our qualitative analysis of the interviews, for propensity, we focused on dependency and self-regulation. For severity, we considered the intensity of usage and the magnitude of negative consequences. Then, through a qualitative assessment of our survey data, we empirically developed a typology of user liability to IT addiction that embeds a unique combination of these dimensions along five different user types.

Afterwards, in order to validate this typology and refine our assessment of the ideal types, we used cluster analysis techniques (using SPSS) to quantitatively determine the groups (corresponding to user liability types) that could be identified in our dataset. Cluster analysis is a technique that aims to assign observations into distinct groups, based on high homogeneity within a group and high heterogeneity between groups (Romesburg, 2004). We used the identified liability dimensions to form the clusters. To serve the exploratory nature of the

analysis, we did not specify the number of expected clusters at the beginning of the analysis. Following guidelines by Hair *et al*. (2006) and Kaufman and Rousseeuw (2009), we first conducted a hierarchical agglomerative clustering and Ward minimum variance method to define the number of clusters that best fit our data. At this stage, we looked at the change in clustering coefficients and used the elbow criterion to define the optimum number of profiles. In this method, lower coefficients show the degree to which data observations tend to be closer to each other in each cluster. Once the number of clusters was determined, we used k-means clustering to form the actual clusters and build our typology (Burns & Burns, 2008) (please see Appendix III for more details on the cluster analysis). We also used ANOVA to check the null hypothesis that "there are no significant differences between the cluster centroids". Once the clusters were identified, we compared the quantitative results with the ideal types identified through a qualitative assessment of the dimensions.

Finally, for each ideal type, we also identified the associated user profile (nature of antecedents, behaviors, and consequences). Where appropriate, we again used thematic qualitative analysis techniques to analyze the qualitative data collected using the open-ended survey to complement the descriptive statistics (see Appendix IV).

Study Findings

Conceptualizing liability to IT addiction: propensity and severity

The interview data analysis gave us some insights on user liability and how it can be defined in the context of IT addiction. To clearly conceptualize user liability to IT addiction, we focused on the two known underlying dimensions of liability i.e. severity and propensity. As explained in the literature review section, propensity refers to the risk of developing an addiction, and severity refers to the degree of obsessive and compulsive use exhibited (Conway *et al*., 2010). Based on our analysis, it appears that in the context of IT addiction, propensity can be conceptualized using "dependency" and "self-regulation" and that severity depends on the "intensity of IT usage" and the "magnitude of negative consequences" experienced by users.

With regards to user propensity to IT addiction, our qualitative data analysis first suggests that it is associated with a user's *dependency* to technology, which can be defined as a need that is so strong that it becomes necessary to have access to that technology in order to function properly:

> *I guess there are different components to smartphone addiction. One part would be you are reliant on it, reliant on it in a behavioral sense that you feel an urge to have it … like a companion, right. You rely on it more and more and that thing becomes an unhealthy relationship with the device, in which case it's just like a person to person interaction where you depend on someone and it becomes unhealthy. (Interviewee B)*

Consistent with the extant literature, we used attributes of IT addiction (e.g. preoccupation, mood, tolerance) in defining the level of dependency of the interviewees (Young, 1996, 2004). An interviewee was considered highly dependent on IT if s/he had several "yes" answers to the diagnostic criteria. The lower the number of attributes reported, the lower the extent of dependency on technology.

A second insight that emerged from the interview analysis is that the level of *self-regulation* regarding IT use is also related to propensity. By self-regulation, we mean the capacity to control one's impulses to behave in a certain way. On the one hand, we found that individuals with low self-regulation tend to ignore or deny problems or disorders that they might experience due to their smartphone usage. Our analysis indeed revealed that some interviewees never made an effort to reduce their use, despite the high levels of use and long hours of engagement per day they reported. On the other hand, individuals with high self-regulation appear to assess their behaviors regularly and to have a high degree of control over their behaviors, as illustrated in the following interview excerpt:

> *I know that I can get addicted to things, but I know how to control. For example, TV watching became a big addiction for me when I was younger. From the morning until the evening or until night, I would watch TV- every program. So, once I started watching it wasn't difficult for me to kind of just keep watching. I did that for a couple of months, or maybe three or four months -- and then I realized "I'm not doing anything else". So, then I took a resolution that I'm not going to watch the TV for one year and then I did not. I think that for me obviously to avoid doing something in excess –I limit it or I just don't do it. I tend – because I know that I can get addicted to that. (Interviewee A)*

With regards to severity, we found that it is possible to conceptualize the severity of IT addictions by examining the intensity of use and the magnitude of negative consequences. First,

our results show that intensity of usage, that is the amount of time spent interacting with the technology, is critical to understand severity. For example, our results indicate that when users spend long hours using a technology, the severity of their problematic use behaviors is more salient:

> *Waking up to text things on your phone, or just constantly having your phone on you…Constantly checking things on your phone -- even if you don't need to have your phone, just constantly checking the time. Even doing that or constantly checking your e-mails, even though nothing new has come -- But just having it on you in your hand at all times… That is when I say you have a problem (Interview K).*

Also, our analysis indicates that the magnitude of negative consequences – i.e. the degree to which technology use affects a user's personal, social, and professional life – appears to be linked to severity. Indeed, in line with our literature review, interview data show that the severity of addiction is associated to the amount of negative consequences that are experienced. When users suffer no or very few negative consequences from their smartphone usage, the degree of affectedness (i.e. the importance of the impingement of the behavior) is low. In contrast, when users report higher levels of negative personal, social, and/or professional consequences (i.e. high magnitude of negative outcomes), they appear to have high degree of affectedness:

> *Like people have told me before when I had my Blackberry that, "Look, you're addicted to your Blackberry"…That was like being scolded, right, and that was when I was checking something when we were out at a dinner or something, or when it's pure family time (Interviewee J)*

In summary, our analysis indicates, as expected from our literature review, that user liability to IT addiction is associated with propensity and severity. Our analysis further reveals that in the specific context of IT addiction, propensity is associated with *dependency* and *self-regulation* and that severity is associated with *intensity of use* and *magnitude of negative consequences*.

A Typology of User Liability to IT Addiction

In developing our typology, drawing from our review of the literature and in light with the results of the interview data, we considered the two underlying dimensions of liability i.e. propensity and severity. Following the guidelines for typological theory (Bailey, 1994; Doty & Glick, 1994), we used these to uniquely identify each ideal type's configuration. In this study, *ideal types* refers to the variations of user liability to IT addiction. Based on a qualitative

assessment of our data, as well as the aforementioned dimensions and sub-dimensions, we developed a typology with five ideal types with a unique combination of these dimensions/sub-dimensions for each.

In order to validate and refine this typology, we proceeded with two rounds of cluster analysis. First, we ran hierarchical agglomerate clustering and used the Ward method to see how many clusters exist in the data. Table 3 shows the results of the hierarchical cluster analysis and coefficients calculated at each round. Then, we used the Elbow criterion to decide on the number of actual clusters, which is based on the change percentage of the coefficients. Using this method, we calculated the marginal gain in coefficients caused by adding an additional cluster to the analysis. We chose the number of clusters so that adding an extra cluster did not improve the cluster coefficient, meaning that any additional cluster would not provide sufficient information (Norusis, 2012). At this point, marginal improvement in the coefficients resulting from the extra cluster drops, which gives an angle in the elbow plot (Figure 2). The results of hierarchical cluster analysis confirmed that, indeed, there are five clusters in the data.

Stage	Cluster Combined		Coefficients	Change in Coefficients	Number of Clusters
	Cluster 1	Cluster 2			
1	15	182	0.000	0.000	181
2	180	181	0.000	0.000	180
…..					
172	58	65	65.990	29.10	10
173	66	76	80.597	29.81	9
174	3	39	96.722	36.48	8
175	66	75	115.410	41.56	7
176	2	3	134.897	57.18	6
177	32	58	165.721	68.26	5
178	26	32	196.836	161.64	4
179	1	2	282.117	265.98	3
180	26	66	444.842	794.14	2
181	1	26	988.264		1

Table 3: Hierarchical agglomerative clustering results

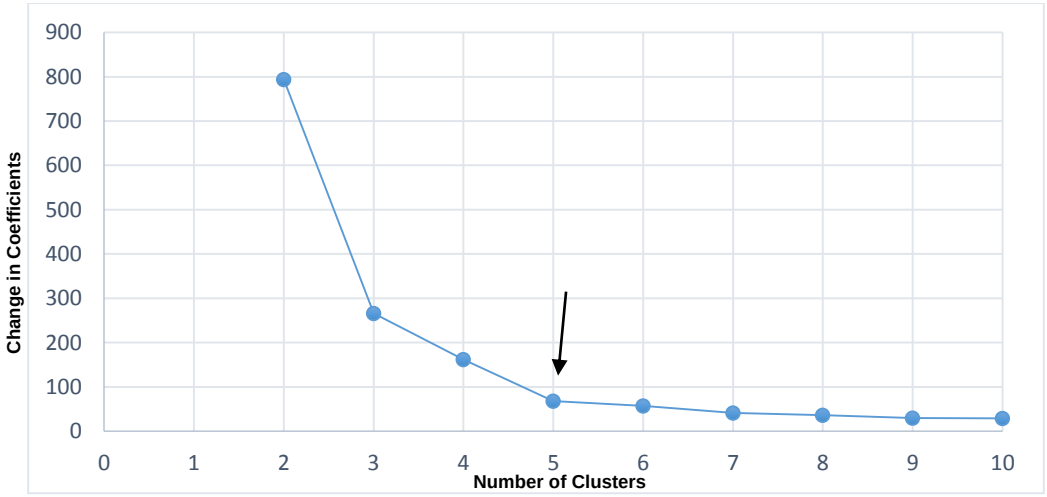

Figure 2: The elbow plot

Knowing that there are five clusters (types of user liability to IT addiction) in our data, we performed k-means clustering to assign data observations to the clusters. Table 4 contains the results of the final clustering and the cluster centroids for each dimension. The centroids show how data observations are grouped together, based on a unique mean value for each dimension.

	Cluster				
	1	**2**	**3**	**4**	**5**
Dependency (0-8)	5.96	5.60	3.63	2.10	.88
Intensity of IT use (hours)	6.95	4.35	3.47	2.51	1.10
Self-Regulation (1-3)	1.69	1.90	2.22	2.74	2.95
Magnitude of Negative Consequences (0-3)	2.12	2.28	1.49	.77	.54

Table 4: K-means clustering results

Finally, we used ANOVA to test the null hypothesis regarding the differences in the cluster centroid (see Table 5). Based on the results, we rejected the null hypothesis that objects were randomly assigned to clusters. Although all dimensions are shown to be important in discriminating between clusters, a comparison of F-values indicated that dependency has the greatest influence in formation of clusters.

	Mean Square Cluster	**Mean Square Error**	**F-value**	**Significance**
Dependency	143.218	.843	169.972	.000
Intensity of IT use	152.073	1.025	148.348	.000
Self-Regulation	17.158	.466	36.811	.000
Magnitude of Negative consequences	8.512	.404	21.075	.000

Table 5: ANOVA results

Overall, the cluster analysis results supported the results of our qualitative data analysis. In most clusters, we found similar assignment of data observations to ideal types, as well as similar trends between mean values across dimensions and clusters. In the few cases where there was discrepancy between the two analyses, we double-checked the data observations and manually

assigned the problematic ones (e.g. outliers) to the most appropriate category. The resulting typology of user liability to IT addiction, presented in Table 6, comprises five distinct types of user liability that differ based on the dependency, self-regulation, intensity of IT use, and magnitude of negative consequences associated with their behaviors. The descriptive statistics associated with each profile can be found in Appendix IV.

Propensity		Very high		High- Very high		Medium		Low		Very low	
Dependency	**Self-Regulation**	High 5.96	Low 1.69	High 5.60	Medium - Low 1.90	Medium 3.63	Medium 2.22	Low 2.10	High 2.74	Very Low .88	Very High 2.95
Severity		Very High		Medium-High		Medium		Low		Very low	
Magnitude of Negative consequences	**Intensity of IT use (hours)**	High 2.12	Very High 6.95	High 2.28	Medium-High 4.35	Medium 1.49	Medium 3.47	Very Low .77	Low 2.51	Very Low .54	Very Low 1.10
		↓		↓		↓		↓		↓	
Liability		Type I Very High		Type II High		Type III Medium		Type IV Low		Type V Very low	

Table 6: User liability to IT addiction types

Identifying Profiles Associated with User Liability Types

For each type of user liability to IT addiction, we analyzed the survey data to identify the associated user profile. This analysis was conducted using descriptive statistics (Appendix IV) and qualitative thematic analysis. It revealed the nature of the behaviors (e.g. texting while driving, checking emails), antecedents (e.g. individual traits or technology features) and consequences (social, professional and/or personal) found in each user profile.

ADDICT: For the first type of user liability to IT addiction (Type I – very high liability), the associated user profile was labelled ADDICT. These users are highly dependent on smartphones and exhibit very high intensity of usage. Our results also show that, in most cases, ADDICT users do not feel they have to control or reduce their smartphone use, or that they failed to regulate it,

despite the very significant magnitude of negative consequences it has on their personal, social and professional lives.

An analysis of the user characteristics associated with this liability type indicate that these users perceive themselves as conformist (83%), obsessed (50%), are in need of approval (67%), afraid of rejection (75%), and less optimistic than other users (58%). Also, ADDICTS are most likely to use smartphones when they are bored (86%), anxious (58%), and emotional (50%). ADDICTs are inclined to use smartphones because they are useful (92%), easy to use (75%), easily accessible (75%), portable (92%), convenient (83%), fast (92%), and efficient (83%). Other smartphone characteristics deemed important are nice design (75%), access to the Internet (83%), email (83%), Facebook (85%), text messages (83%), and various applications (67%). In terms of consequences, ADDICTs reported that their smartphone use causes conflicts regarding their social interactions with other people (50%) and inhibits them from doing the tasks they are responsible for (75%). They also reported feelings of frustration (58%), stress (67%), and being uncomfortable (92%) when they are away from their phone. The following quotations provide some additional evidence for the consequences of ADDICTs' smartphone use:

> *I get distracted very easily. If my phone flashes, I will have the urge to look at it even if I'm studying. (ADDICT user)*

> *I understand that people are busy. But on BBM (BlackBerry Messenger), it says someone read the message and If I don't answer quick, people get upset. Now we know people have their phones with them at all times, it gives me stress (ADDICT user)*

We also identified several disturbing usage behaviors in ADDICTs' behaviors. Most ADDICTs check their phone immediately when they wake up (92%), and use it when eating or socializing (92%), or in class (92%). To a lesser extent, ADDICT users admit to playing mobile games in inappropriate situations (42%) and to texting while driving (42%). Two ADDICTs clearly mentioned using their smartphone in almost all occasions: "*The only time I don't use my smartphone is in the shower*!" and "*I never leave home without it. I even sleep with it in my hand*!".

FANATIC: For the second type of user liability to IT addiction (Type II – high liability), the associated user profile was labelled FANATIC. FANATIC users have a high dependency to technology (lower than addicts), and medium-low self-regulation (higher than ADDICTs).

Although their intensity of use is at a medium level (lower than ADDICTs), there is a high magnitude of negative consequences that even exceeds that of ADDICTs. While FANATICs have hence a different profile than that of ADDICTs, their IT usage is problematic and results in significant negative impacts on their lives. Our results show that despite spending a significant amount of time per day using their smartphone, FANATIC users tend to be unconcerned about the intensity of their usage. They generally deny having a problem and believe that they do not need to control their behaviors.

Further analysis of the characteristics of FANATICs reveals that they are self-reliant (90%) individuals with active social life (86%), and high need for approval (76%). They use their phone very often throughout the day, especially when feeling bored (95%), lonely (81%), anxious (76%), emotional (48%), or shy (48%). Similar to ADDICTs, FANATICs mentioned that smartphone characteristics such as usefulness (90%), ease of use (90%), portability (90%), access to the Internet (86%), email (81%), text messages (90%), and Facebook (86%), fast (71%), fun (67%), and nice design (81%) are the reasons underlying their very high level of usage. In terms of negative consequences, FANATIC users reported conflicts between their use of the technology and the completion of their tasks (81%), or sometimes, their interaction with others (19%). When they are away from the device, FANATIC users feel stressed (76%), frustrated (67%) and uncomfortable (90%). In the words of two FANATIC users:

> *People get mad sometimes when you do not give them your full attention because you're on your phone. (FANATIC user)*
>
> *It definitely has an impact on studying as it is a constant source of distraction. (FANATIC user)*
>
> *I feel like I lack some social skills because of it [smartphone] (FANATIC user)*

FANATICs use their phones on most occasions such as in class (100%), during meetings (81%) socializing or eating (100%), when they just woke up (95%), or while driving (76%), as illustrated in the following quotes:

> *When I go to a restaurant with my family and I stay on the phone, not talking but texting, and my mother is upset. (FANATIC user)*
>
> *Even with others around, if I had a text conversation going on, I have the urge to check my phone. (FANATIC user)*

HIGHLY ENGAGED: For the third type of user liability to IT addiction (Type III – medium liability), we labelled the associated user profile as HIGHLY ENGAGED. These users have medium dependency and medium self-regulation regarding their smartphone usage. Also, their intensity of use is medium and they experience a medium magnitude of negative consequences. HIGHLY ENGAGED users use smartphone very often during the day, but are able to regulate it in a way that it brings less negative consequences on their lives overall.

Our data analysis of the characteristics of HIGHLY ENGAGED users shows that they are users with high-perceived self-esteem (71%), who use IT especially when they feel bored (94%), anxious (59%), lonely (68%) and, to a lesser degree, shy (50%). Similar to ADDICTs and FANATICs, these individuals use a smartphone because they perceive it to be a useful (97%), easy to use (85%), easily accessible (71%), portable (82%), convenient (85%), and fast (59%) device. Other technology features such as nice design (59%), access to email (59%), Facebook (79%) text messaging services (88%) and connectivity (65%) may influence their usage. As one user mentioned:

> *It replaces a watch. It replaces an alarm clock. It replaces a camera. It replaces TV for consuming, or to get the forecast. It's a replacement of all that stuff right handy (Highly engaged user)*

HIGHLY ENGAGED users' interaction with smartphones is usually task-oriented. Their smartphone use facilitates communication and makes their co-workers available at all times. They experience lower adverse consequences associated with their behaviors. For these users, smartphone use rarely conflicts with their social life (6%), causes less stress (29%) or frustration (26%). Yet, at times, the fairly high level of usage may actually conflict with their tasks (56%) while it can also have positive effects, as further evidenced in the following quotes:

> *I think it definitely increases productivity. It probably also hurts productivity, because you can get easily distracted with stuff and you can end up searching something that you shouldn't be. (HIGHLY ENGAGED user)*

> *I use my smartphone in group work. I want to use it for work even if I am not sitting with my team and make the best use of my time. (HIGHLY ENGAGED user)*

> *Technology is so important today and everyone has their phone on them always, so you are always connected, but maybe it could disconnect you from friends. (HIGHLY ENGAGED user)*

Looking at their usage behaviors, we found that HIGHLY ENGAGED users use their phones at almost any time, e.g. during class (94%) and meetings (59%), while eating or socializing (94%), and right after they wake up (91%). As mentioned by one user:

> *I may use it in class because the teacher is really boring, and you want to text your friends, play a game, or do other things to pass the time. (HIGHLY ENGAGED user)*

REGULAR: The fourth type of user liability to IT addiction (Type IV – low liability) is associated with a profile of users that was labelled REGULAR. This profile encompasses the largest number of users. REGULAR users exhibit low dependency and high self-regulation. In most cases, when these users try to reduce their smartphone use, their efforts are successful. The intensity of use for this profile is low and these users experience very low magnitude of negative consequences. REGULAR users have a reasonable level of interaction with smartphones, typically using them only when required (e.g. occasionally sending text/email, making a phone call here and there or using applications at times).

REGULAR users are generally upbeat (86%), and optimistic (75%) individuals, who use their smartphone especially when they are bored (95%). Looking at the technology-related antecedents associated with use, REGULAR users are inclined to use smartphones because they are useful (88%), easy to use (84%), easily accessible (77%), portable (91%), convenient (92%), fast (61%), and efficient (69%). Also, connectivity (72%), as well as access to emails (69%), text messages (95%), and Facebook (64%) are important smartphone characteristics for this type. REGULAR users generally did not report negative consequences associated with their smartphone use, except some being uncomfortable when away from their phone (66%). However in some cases, smartphone use may conflict with their daily life tasks (39%). In terms of usage behavior, some tend to text while driving (41%) and they generally use their phones during classes (97%), while eating or socializing (88%), and when they just woke up (86%). As explained by one user:

> *I use it, because it's necessary in today's society…it is nothing unusual. It's in my pocket. I use it when I am free (REGULAR user)*

THOUGHTFUL: Finally, the last type of user liability to IT addiction (Type V – very low liability) corresponds to what we labelled the thoughtful profile. THOUGHTFUL users have the lowest dependency and highest self-regulation. Our results show that for this type of users, the intensity is at the lowest level and the magnitude of negative consequences is very low. Based on our

analysis, the THOUGHTFUL users are very cautious and extremely watchful of their smartphone usage, and proactively limit any extended interaction with this technology. For most users falling in this type, having a smartphone was equal to having a regular cellphone, and, therefore was being used minimally (e.g. calling, or texting occasionally).

Our data analysis shows that THOUGHTFUL users are highly upbeat (84%), optimistic (84%), have high self-esteem (80%), and use their smartphone most often when they are bored (78%). In terms of technology features, THOUGHTFUL users use smartphones because they are useful (94%), easy to use (78%), portable (78%), convenient (84%), efficient (63%) devices that provide access to the Internet (69%) and text messages (92%). In terms of consequences, being away from their phone may bring an uncomfortable feeling to some users (43%).

THOUGHTFUL users closely monitor their own usage behaviors, though they do tend to check their phones in class (86%), during social events (76%), and when they wake up from bed (84%). However, all levels of these behaviors are below average when compared to other user types. The following quote provide additional insights in reference to the THOUGHTFUL user's view of smartphone use:

> *I do not really like my smartphone because it's destroying humanity's definition of social life, connectedness between people and our world around us. A phone and virtual doing is not the same as actually doing things.*
>
> *I hate when people are texting or using their phone while we're talking or hanging out, I find it impolite. (THOUGHTFUL user)*

Developing Theoretical Propositions

Following Doty and Glick's (1994) guidelines, we proceeded with our theory development by first constructing a typology of user liability to IT addiction based on propensity and severity, with five types ranging from very high to very low. For each type, we also identified an associated user profile ADDICT, FANATIC, HIGHLY ENGAGED, REGULAR and THOUGHTFUL. To extend our theory development, based on our data and in light of the literature, we develop a proposition for each type of user liability to IT addiction.

Looking at the first profile, the ADDICT, we found that 7% of smartphone users have very high liability to IT addiction. For these users, not only the propensity or risk of addiction (to

smartphone or other technological innovations) is high, but also the severity of addiction at the moment is very significant. Although, there is no study that looks at the rates of low to high user liability, our results are consistent with previous research on technology addiction, which has generally reported a 5-10% severe addiction rate (Young, 1998; Armstrong *et al*., 2000; Turel & Serenko, 2010).

By comparing and contrasting important factors across profiles (i.e. addressing those that have variability across ideal types), we found that some individual differences stand out, especially when user liability is very high. Indeed, users who belong to the ADDICT profile are IT users who are conformist, obsessed, and generally have high needs for approval and fear of rejection. Such traits are typically associated with depression, and may increase the probability of addiction to other technology types, such as Internet or online games (Chou *et al*., 2005; Young & Rodgers, 1998). We also found that ADDICT users tend to interact with IT excessively, especially when they feel lonely, anxious, and emotional. Earlier research suggested that technology-based communication allows such users to conceal their personalities through anonymous or carefully-devised interactions, and thus, evade social discomfort in the presence of others (Caplan, 2002; Chak & Leung, 2004; Beard, 2005; Byun *et al*., 2009). Therefore, users with depressive personality types (e.g. fear of rejection, need for approval, and lonely) tend to become dependent on technology for communication.

Beyond individual differences, our results show that technology features can explain variations between users' liability to IT addiction. Consistent with technology acceptance models (Davis, 1989; Venkatesh *et al*., 2003), usefulness and ease of use (and other related factors such as portability, convenience, and easy access to the Internet and text messages) were deemed critical factors by all types of users. ADDICTs in particular reported the speed, efficiency, design, and access to emails and Facebook as reasons for their excessive and compulsive IT usage. These results are in line with previous findings that hint the importance of technology in related contexts such as video game addiction (Ng & Wiemer-Hastings, 2005). In addition, the users who belong to the ADDICT profile tend to use a smartphone because it is fun and entertaining. Perceived enjoyment has been found to be associated with long-term and sometimes excessive IT usage in other contexts such as in Internet and mobile phone usage (Turel & Serenko, 2012; Park & Lee, 2011). Based on the theoretical insight in intrinsic motivations, hedonic motivations

are critical in forming IT habits (Van der Heijden, 2004). Also, extant literature indicates that gaining experience and increasing the level of habitual usage may lead to addiction (Turel & Serenko, 2012; Turel, 2014).

In terms of consequences, our results indicated that users who belong to the ADDICT profile hence have very high liability to IT addiction. They spend significant time per day on smartphone use, which causes conflicts with other productive tasks. This is akin to previous findings in IT addiction research that showed that the loss of time, plus distractions associated with the excessive use of technology, may cause work impairments and reduced commitment (Turel & Serenko, 2010) as well as academic failure and job termination (Davis *et al*., 2002; Beard, 2005; Nalwa & Anand, 2003; Byun *et al*., 2009). We also found that the excessive use of smartphones exhibited by users in this profile may cause negative consequences regarding users' psychological well-being, causing, for example, frustration and stress when they are deprived of their smartphones. Despite a few comments mentioning a lack of sleep and fatigue, we did not find any other significant effect of excessive smartphone use on the physical well-being of users. Finally, the users in the ADDICT profile are highly dependent on smartphones. These users declared using the device in almost all situations, such as when they are in meetings, classes, or at social gatherings, when eating, or in bed and just waking up, and playing online games in inappropriate situations. Based on our analysis of the data (see table 7), and in light of the extant literature, we propose that:

Proposition 1: User liability to IT addiction is very high when propensity and severity are very high. This type of liability is associated with the ADDICT profile.

Liability Type/ User Profile	Individual Differences	Technology Features	User Behaviors	Negative Consequences
Very High/ ADDICT	Obsessed, Conformist, High fear of rejection, High need for approval	Nice design, Access to all communication channels, Fun and Entertaining	Excessive and compulsive IT usage	Social Professional Psychological

Table 7: Characteristics of users with very high liability to IT addiction

In the second profile (see Table 8), the FANATICs, users have high liability to IT addiction. In terms of personality, FANATIC users have high need for approval. In contrast to ADDICTs, they

have an active social life. FANATICs, appear to increase smartphone usage when they are lonely, anxious, emotional, or shy. They tend to use a nicely-designed technology that is fast, fun, and provides easy access to different communication channels (email, text, social networks). Overall, the usage behaviors of FANATICs are problematic, but FANATICs have lower liability to IT addiction than ADDICTs:

Proposition 2: User liability to IT addiction is high when propensity is high to very high and severity is medium-high. This type of liability is associated with the FANATIC profile.

Liability Type/ User Profile	Individual Differences	Technology Features	User Behaviors	Negative Consequences
High/ FANATICs	High need for approval, Active social life	Nice design, Access to all communication channels, Fast, Fun and Entertaining	Excessive IT usage	Social Professional Psychological

Table 8: Characteristics of users with high liability to IT addiction

The third type, medium degree of liability to IT addiction, corresponds to the HIGHLY ENGAGED profile (see Table 9). As we do here, previous research has distinguished between high engagement IT use behaviors that are non-pathological and addiction (Charlton & Danforth, 2007). As Turel and Serenko (2012) argued, high engagement with technology refers to a high degree of psychological involvement with IT that should be seen as low apathy toward IT use. Consistent with the definition of high engagement, which emphasizes the non-problematic aspect of such behavior, we found that users that belong to this profile have lower liability level compared to users who belong to the ADDICT or FANATIC profiles.

In contrast to the first two types, HIGHLY ENGAGED users are individuals with high self-esteem. These users however tend to use their smartphones throughout the day, especially when they are lonely, shy or anxious. Technology features such as design and access to Internet and Facebook were deemed very important for this type of user. HIGHLY ENGAGED users generally have a positive experience with regards to their smartphone use and, compared to users from the first two profiles, do not experience all potential negative consequences of IT use. However, the extent of their usage may sometimes cause conflicts with life's daily tasks and activities or minor psychological issues:

Proposition 3: User liability to IT addiction is medium when the propensity and severity are medium. This type of liability is associated with the HIGHLY ENGAGED profile.

Liability Type/ User Profile	Individual Differences	Technology Features	User Behaviors	Negative Consequences
Medium/ HIGHLY ENGAGED	High self-esteem, Lonely, Shy, Anxious	Nice design, Access to Internet and Facebook	High IT usage	Professional Psychological

Table 9: Characteristics of users with medium liability to IT addiction

Our results (see Table 10) further indicate that most smartphone users belong to the REGULAR profile, which is associated to the Type IV of user liability to IT addiction. These users have "normal" interactions with IT and, as expected, have low liability to IT addiction. As such, REGULAR type of users can be characterized as upbeat, optimistic individuals, who tend to engage with a technology that is efficient in doing the required tasks, and that provides connectivity and access to text messages. These findings are comparable to those of Sarker and Wells's study (2003), in which they found that network capabilities and communication capacity of mobile devices influence users' exploration of and experimentation with the device. Such usage behaviors were generally found to have positive impacts on social interactions (e.g. facilitating communication and establishing relationships), performance at work (improving productivity), and psychological well-being (e.g. improving self-confidence) (Clark *et al*., 2004; Murali & George, 2007). Thus, we propose that:

Proposition 4: User liability to IT addiction is low when there is low propensity and low severity. This liability type is associated with the REGULAR profile.

Liability Type/ User Profile	Individual Differences	Technology Features	User Behaviors	Negative Consequences
Low / REGULAR	Upbeat and Optimistic	Connectivity	Controlled IT usage	Rare psychological or professional consequences

Table 10: Characteristics of users with low liability to IT addiction

Finally, our results reveal that the fifth user profile, labelled as THOUGHTFUL, are extremely watchful of their smartphone use behaviors and are unwilling to extend their interaction with it. These users show very low liability to IT addiction. THOUGHTFUL users are generally upbeat,

optimistic individuals with a high degree of self-esteem. The technology factors that influence their behaviors are mostly related to access to text messages. The conscious attempts made by this type not to engage with IT result in having experiences with the device that have none or almost no negative consequences.

Although more than a quarter of users in our sample were classified as Type V, their profile generally has not been recognized in the extant IS literature. One way to explain these users' behaviors is to employ self-determination theory (Ryan & Deci, 2000). As MacCormick *et al*. (2012) explained, depending on the type of motivation that drives one's behavior, some individuals may exhibit under-engaged behavior, which is characterized by the low duration, low direction, and low intensity of an effort (Ryan & Deci, 2000). Through "controlled motivation," a user may choose not to engage in an activity beyond a certain point (e.g. unwillingness to engage at certain periods of time or in certain ways). In the context of our study, we suggest that THOUGHTFUL type of users are individuals with controlled motivation who actively choose not to use a smartphone beyond necessity. Their usage behaviors, at best, will be carried out to the point of efficiency:

Proposition 5: User liability to IT addiction is very low when the propensity and severity are very low. This liability type is associated with the THOUGHTFUL profile.

Liability Type/ User Profile	Individual Differences	Technology Features	User Behaviors	Negative Consequences
Very Low/ THOUGHTFUL	Optimistic, upbeat, High self-esteem	Access to text messages	Minimal IT usage	Rare psychological or none

Table 11: Characteristics of users with very low liability to IT addiction

Discussion and Conclusion

Extant IS research has largely focused on IT use as a positive and desired behavior and hence spent significant efforts to find ways to increase acceptance and usage of technology (Venkatesh *et al*., 2003), assuming that more usage would help reap more benefits (Delone & McLean 2003; Jasperson *et al*., 2005). More recently, there has been several calls to better understand the "dark side of technology use" (D'Arcy *et al.*, 2014), especially with regards to the IT addiction phenomenon (Turel *et al*., 2011b; Xu *et al*., 2012). With this study, we aimed to contribute to

this growing stream of literature by introducing the concept of user liability, which allows investigating the susceptibility of users to IT addiction, and by developing a typology that illustrates variations in liability to IT addiction.

Based on the analysis of our interviews, we first were able to conceptualize liability and identified its dimensions (propensity and severity) and sub-dimensions (dependency, self-regulation, intensity of use, and magnitude of negative consequences). Although liability and its underlying dimensions have not been previously studied in IS research as such, their importance in understanding problematic IT usage has been recognized indirectly. In the case of propensity, dependency has been used repeatedly in distinguishing between normal usage behaviors and addiction (Young, 1996; Armstrong *et al*., 2000; Byun *et al*., 2009). In some cases, dependency even has been used as a proxy for addiction-driven behaviors (Fazel *et al*., 2006; Goodman, 2008). In addition, our results revealed that self-regulation also appears to play a role in user liability. It has been found that a deficiency in self-regulation, "a state in which conscious self-control is relatively diminished" (LaRose *et al*., 2003; p. 232), can lead to development of bad habits and, at times, to addiction (Bandura 1999; Heatherton & Baumeister, 1991). Such addiction may occur due to the failure to sufficiently monitor the intensity of use, adequately judge usage behaviors, and properly react and adjust it to normal levels (LaRose *et al*., 2003; Caplan 2006). Conversely, other users implement self-regulatory mechanisms in order to limit and control their usage of technology (Peters & Bodkin, 2007), which limits the risk of developing IT addiction.

In the case of severity, the intensity of usage was found to be an important factor. In some studies, intensity of use was found to be associated to future usage intensity (Marlatt *et al.,* 1988) and can be used to estimate the likelihood of developing problematic behaviors. In the context of technology addiction, intensity of use has been used to monitor the level of daily engagement required with technology usage, which can be used to assess the level of chronic, repetitive behavior (Ferraro et al 2007). In our study, we found that intensity of use can be used to assess the severity of IT addiction. Finally, magnitude of negative consequences also has been recognized in recent literature as a critical element in the study of addiction. Indeed, in contrast to the view that assumes addiction simply to be equal to dependency, some researchers have argued that for a behavior to be called an addiction, negative consequences must be exhibited

(Morahan-Martin & Schumacher, 2000; Caplan, 2002). As Charlton and Danforth (2007) put it, even a high degree of technology usage is non-pathological unless is it associated with negative consequences.

In this study, through an analysis of the survey data based on typology theory, we identified five types of user liability. Our results showed that while all types of users might be susceptible to develop IT addiction, only a small proportion of users fall into the types that have high or very high liability to IT addiction. Consistent with the literature (Xu *et al*., 2012), most users were found to have regulated interactions with technology that does not interfere with important life functions. To further our understanding of the user liability types, we used survey data to specify the profiles of users associated with each liability type. Our results expand our knowledge of the potential behaviors, antecedents and consequences associated with different types of liability to IT addiction. The findings were mostly consistent with previous claims that individual differences (e.g. personality traits or moods during usage) could help discriminate between addiction and non-addiction (Armstrong *et al*., 2000; Caplan, 2002, 2006; Byun *et al*., 2009). For instance, we found that having a fear of rejection or need for approval is more common in high liability types (ADDICT & FANATIC profile). In addition, our study reveals that some technology features appear to be associated with high liability. For example, while in the ADDICT profile, users emphasized the importance of being able to use communication and social media, users belonging to the THOUGHTFUL profile emphasized text messaging as the key feature of smartphones.

We understand that this study has some limitations. Our data was primarily collected from students in a large North American university. Even though the sample was deemed suitable given the context of our study, it is important for our results to be replicated in other contexts and with populations of different ages, education, professions, and background. This would advance our understanding of user liability to IT addiction and improve the generalizability of our findings. Future research should also aim at providing an instrument that would provide a more precise measure of user liability to addiction (e.g. a user liability to IT addiction scale).

Despite its limitations, our study makes important contributions to theory and practice. First, we introduce to IS research the concept of "liability to addiction" and empirically conceptualize it in

the context of IT addiction. In this way, we contribute to the understanding of IT addiction, by investigating the susceptibility of users to develop IT addiction and the risks of excessive IT usage. Our findings can be useful for researchers to better distinguish between pathological and non-pathological IT use behaviors (Charlton & Danforth, 2007; Turel & Serenko, 2012), and improve the capacity and precision in assessing problematic behaviors, based on a measure of liability (Conway *et al.*, 2010). For instance, rather than focusing only on dependency or intensity of use to understand IT addiction, a combined assessment of dependency, intensity of use, self-regulation and magnitude of negative consequences is recommended.

Second, we used typology theory (Doty & Glick, 1994) to provide a rich and detailed explanation of user liability to addiction and extend our theoretical understanding of the IT addiction phenomenon. The typology was developed and validated through qualitative and quantitative analyses. Based on this typology, we can argue that while some users were found to have very low liability to IT addiction and seem wary of technology (Type V), others show very high or high levels of liability to IT addiction (Type I and II).

Third, we identified the profiles associated with each type of user liability to IT addiction by distinguishing the distinct antecedents, behaviors, and negative consequences associated with each profile. Despite significant research on addiction in other research disciplines (e.g. psychology, mental health), past IS research has mentioned the limited knowledge and the need to further explore the potential antecedents and consequences of IT addiction (Turel *et al.*, 2011b; Xu *et al.*, 2012). Our study hence extends research on these factors. Finally, to further our theoretical contributions to this stream of research, we developed propositions for each user liability type. These propositions can be used as a baseline to formulate the relationship between the associated constructs and to ground hypotheses that can be tested using large data set in addiction-related contexts.

Practical implications should be considered with caution, as further research in organization contexts will be needed to truly allow for generalization of our findings. But, assuming that the student population is representative of organizational users, these findings could be used to better understand the differences between users in terms of susceptibility and risks of developing IT addiction. This is becoming increasingly important since many companies are using new

technologies, for example to improve business communications. Many of these technologies could prove to be addictive. Examples are internal social media networks or providing BlackBerry phones for employees (Turel & Serenko 2010; Xu *et al*., 2012). Depending on the level of user liability to IT addiction (i.e. propensity and severity), different strategies could be suggested to avoid or limit the negative outcomes associated with excessive and compulsive technology use.

For Type I (associated with the ADDICT profile), liability was found to be very high. Since the behaviors of users associated with this profile are already problematic and are tied to significant negative consequences, intervention programs are likely necessary. In extreme cases, treatments should be offered to reduce IT addiction liability to lower, healthier levels. Users belonging to Type II (i.e. the FANATIC profile), also require interventions in order to control their usage, as there is a risk of falling into the ADDICT profile, where dependency and usage intensity are very high. This can be done for example by limiting, in all or in part, their access to technology, increasing their self-regulation (e.g. usage reports, reminders), and controlling their level of dependency (e.g. monitoring usage behaviors). Type III users (belonging to the HIGHLY ENGAGED profile) do not fall in the threshold of high liability (i.e. addiction) but still exhibit fairly high intensity of usage. Since HIGHLY ENGAGED users mentioned experiencing some drawbacks, due to their high IT usage, it would be important to design preventive mechanisms to ensure that their usage will not progress to more problematic levels, where they may experience additional negative consequences from their IT use. Users with low liability to IT addiction (Type IV; REGULAR profile) maintain a non-problematic level of IT usage that is mostly beneficial, positive, and is generally not associated with negative consequences. As long as their IT usage remains as the same level, there is no need to intervene. Lastly, in the fifth type (very low liability; THOUGHTFUL profile), users exhibit a very low level of interaction with IT. However, THOUGHTFUL users' minimal IT usage inhibits them to take advantage of the many benefits associated with technology usage. Hence, in contrary to Type I, II and even III, further IT usage should be encouraged for this type through various promoting mechanisms, such as providing training, incentives, and rewards.

All in all, technology usage is undoubtedly on the rise. Given the potentially destructive effects of excessive and compulsive IT usage, there is a need for further investigation and theorizing of

addiction-related behaviors. This study contributes to a better understanding of the risks and dangers of developing addiction by users of technology. Depending on the user liability type, different antecedents, behaviors and consequences can be identified. Further theorization is needed to expand IS theories with regards to the dark side of IT use and IT addiction, and design intervention programs to reduce problematic IT usage, and to avoid unintended, non-beneficial consequences. For example, future work is needed in order to test and validate our typology and propositions, using large data sets, collected from IT users in different contexts (e.g. online gambling, online games, or social networks). Another interesting avenue for future research would be to look at the typology from a longitudinal perspective. For instance, one may seek to know whether a Type I user may fall into Type V category over time. Although our data does not allow for such analysis, future work is needed to study how the usage behavior of users may evolve with time, leading to change in liability level. We hope that our study serves as a platform for further research and theorization on IT addiction in IS research.

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Appendix I: The Interview Guide

1- General Question (Behavior):

To begin, can you tell me for what purpose you are using your smartphone?

- Work? Social?
- Type of applications (e-mail, calls, texts, social networks…)

How much time, on average, do you spend using your phone every day?

- Mostly when (morning, afternoon, evening, night?)
- Compared to other types of technology

2- Antecedents:

- Technology characteristics: What specific characteristics of the smartphone do you find appealing?

  - Ease and availability of access
  - Visual representation
  - Interactive
  - Speed
  - Accessibility
- What are the characteristics of the smartphone that make you use it more (or less) frequently compared to other types of technology such as computers?

- User characteristics: As an individual, how would you describe yourself in terms of your personality?

- Do you consider yourself an extravert or an introvert?
  - Risk-taking, impulsivity
    - Can you see any link with your use of smartphone?
- How would you characterize your social life, e.g. very active, quiet?
  - Social: Would you say that you often experience: loneliness, interpersonal anxiety, need of approval?
    - Can you see any link with your use of smartphone?
- How would you assess your level of stress in general?
    - Can you see any link with your use of smartphone?
- Though it is a sensitive question, because it may be related to technology use, I would need to ask you if you have ever suffered from depression

3- Consequences

Overall, what would you say are the most significant impacts of your smartphone use in your life?

-Work/Studies:

- What are the impacts of your smartphone use on your work/studies?
  - How does it impact your amount of work?
  - Do you sometimes use it to procrastinate?
  - How does it impact your general productivity?
  - How does it impact your performance (e.g. Academic failure, missing a deadline)?
  - How does it impact your satisfaction vis-à-vis your studies/work?
  - How does it impact your general level of stress for your studies/work?
  - Does it create spillovers between work/studies and family/friends? How so?

- Social:

- What are the impacts of smartphone use on your social life?
    - Interaction with family
    - Interaction with friends

- Well-being:

- Can you see any impacts from your smartphone use on your health or well-being?
    - Do you ever feel tired because of your use of your smartphone?
    - Do you experience headaches after long sessions?
- How do you feel when you do not have access to your smartphone?

4- Behavior:

- How do you perceive the use of smartphones at night?
    - Do you use it at night?
    - Does it keep you awake or wakes you up?
- How do you perceive the use of smartphones while driving?
    - Do you sometimes use it while driving?
    - Did you once get in an accident because of that?
- How do you perceive the use of smartphones in meetings or during class?
    - Do you sometimes use it during meetings or classes?
- How do you perceive the use of smartphones when out with family or friends?
    - Do you use it when out with family or friends?
- How do you perceive the use of smartphones in social settings (e.g. buses, movie theatre)?
    - Do you use it in social settings?
- Have you ever been admonished for your smartphone use?
    - At what occasion?
    - How did you react?

5- Conclusion:

Thank you for your participation. The time you have spent with us is greatly appreciated and your comments are very important for the success of our study.

- Is there anything else about smartphone use that we did not discuss and you think is important to understand the use of smartphones?

6- Young's questionnaire

1. Do you feel preoccupied with your smartphone (think about previous smartphone use or anticipate next smartphone use)? YES NO

2. Do you feel the need to use your smartphone over increasing periods of time to achieve satisfaction? YES NO

3. Have you repeatedly made unsuccessful efforts to control, cut back, or stop your smartphone use? YES NO

4. Do you feel restless, moody, depressed, or irritable when attempting to cut down or stop your smartphone use? YES NO

5. Do you use your smartphone longer than originally intended? YES NO

6. Have you lied to family members, therapists, or others to conceal the extent of involvement with your smartphone? YES NO

7. Have you jeopardized or risked the loss of a significant relationship, job, educational, or career opportunity because of your smartphone use? YES NO

8. Do you use your smartphone as a way of escaping from problems or feelings of helplessness, guilt, anxiety, depression, etc.? YES NO

7- **Socio demographic questions:**

Email address?
Age?
Student:
- Level?
- Program?
- Where?

Worker:
- Profession?
- Where?

For how long have you had a smartphone?

Appendix II: Exploratory Open-ended Smartphone Addiction Survey

A) What are the primary reasons for which you are using your smartphone?

B) What are the features and/or the applications of your smartphone that prompt or increase its usage?

C) Generally, is your smartphone with you at all times (e.g. even at night or in social situations)? Can you provide examples of using your smartphone in such situations?

D) Do people expect you to answer texts/Facebook messages/e-mails faster since you have a smartphone? ***Yes / No*** Do they get upset when you don't? ***Yes / No*** Do you expect people to answer you immediately? ***Yes / No*** Please explain.

E) Could you describe a situation(s) where the use of a smartphone had a negative impact on

1. *... your overall productivity (at university and/or work) Please explain briefly:*
2. *... your work in groups. Please explain briefly:*
3. *... your social life. Please explain briefly:*
4. *… any other negative impact? Please explain briefly:*

Overall, would you say that :

1. ***You are more ...*** (please clearly circle the appropriate descriptions):

1. Conformist OR Non-Conformist 2. Risk-adverse OR Risk-taking
3. Motivated OR Not motivated 4. Depressed OR Upbeat 5. Optimistic OR Pessimistic
6. Introvert OR Extrovert 7. with Low Self-Esteem or High self-esteem
8. Self-Reliant OR Dependent 9. Driven (Type A) OR a Laid back (Type B)

2. ***You have…*** (please mark all those that are relevant)

1. A fear of rejection? 2. A need for approval? 3. An active social life?
4. A quiet social life? 5. Any addiction problem?

3. ***Do you sometimes …*** (please check all those that are relevant)

1. Text and drive 2. Use your phone during class
3. Use your phone during meetings 4. Use your phone while eating or socializing

5. Play games when not appropriate 6. Check your phone when you just woke up

4. Do you sometimes use your smartphone because you feel… (please check all those that are relevant)=

1. Bored 2. Lonely 3. Anxious/Stressed 4. Vigilant 5. Aggressive 6. Emotional 7. Obsessed 8. Shy

5. Are these characteristics of your smartphone that play a role in your usage of this technology … (please check all those that are relevant)

1. Useful 2. Easy to use 3. Easily accessible 4. Portable 5. Convenient 6. Cheap
7. Anonymous 8. Powerful/Fast 9. Multi-faceted 10. Fun 11. Efficient

6. Do you use your smartphone in part because the technology provides or has… (please check all those that are relevant)

1. A visual interface 2. A nice design 3. A touch screen 4. Access to internet
5. Mobile Games 6. Network games 7. Various Applications 8. Access to Email
9. Access to text messages 10. Multi-faceted 11. Connectivity 12. Access to Facebook

7. When you use your smartphone, do you feel… (please check all those that are relevant)

1. Deeply involved 2. Relaxed 3. Preoccupied with excessive levels of use
4. Trying to escape problems 5. Trying to relieve helplessness, guilt, anxiety or depression
6. The need to use it more to feel positive emotions 7. That it results in conflicts with other people
8. That it conflicts with your tasks

8. When you cannot use your phone, do you feel… (please check all those that are relevant)***:***

1. Frustration 2. Stress 3. Depression 4. Anger 5. Uncomfortable

9. When you try reducing the use of your smartphone:

1. Your attempts fail
2. Your attempts succeed
3. You don't ever try
4. You don't need to do it

Young's questionnaire

1. Do you feel preoccupied with your smartphone (think about previous smartphone use or anticipate next smartphone use)? YES NO

2. Do you feel the need to use your smartphone over increasing periods of time to achieve satisfaction? YES NO

3. Have you repeatedly made unsuccessful efforts to control, cut back, or stop your smartphone use? YES NO

4. Do you feel restless, moody, depressed, or irritable when attempting to cut down or stop your smartphone use? YES NO

5. Do you use your smartphone longer than originally intended? YES NO

6. Have you lied to family members, therapists, or others to conceal the extent of involvement with your smartphone? YES NO

7. Have you jeopardized or risked the loss of a significant relationship, job, educational, or career opportunity because of your smartphone use? YES NO

8. Do you use your smartphone as a way of escaping from problems or feelings of helplessness, guilt, anxiety, depression, etc.? YES NO

Your gender: M ___ F____ **Your age: _____**

Appendix III: Cluster Analysis

Following suggestion by Hair et al. (2006) and Kaufman and Rousseeuw (2009), we used two common techniques to categorize and assign our observations to ideal types: hierarchical agglomerate clustering, and k-means clustering

Hierarchical agglomerate clustering (HAC): we first ran an exploratory analysis to find out the number of clusters in our data. Hierarchical clustering is a major statistical method that builds hierarchy of clusters based on the idea that data points that are close together in distance are more related to each other than others that are far. In HAC, the analysis starts at a point in which each observation is considered as one cluster. Following each step, data points merge to the closest pair of clusters to form new clusters (also known as bottom-up approach). The dissimilarities (distances) between observations were used in order to form the clusters (Burns & Burns, 2008). To merge data points into clusters, we used Ward minimum variance method (Loo, 2004; Hair *et al*., 2006). The Ward method is an efficient technique that uses ANOVA approach to evaluate the distances between clusters. In this method, cluster membership are calculated based on the total sum of squared deviations from the mean of a cluster, summed over all four dimensions (dependency, intensity of use, self-regulation and magnitude of negative consequences). Each data point joins a cluster that produces the smallest increase in the total sum of squared deviations. The algorithm stops when all data points are assigned to only one cluster. At each step, cluster coefficients are calculated.

K-means clustering: Although HAC is an efficient technique to get the number of clusters, it may not be precise in allocating the data points to clusters (Norusis, 2012). To overcome this, we used non-hierarchical k-means clustering to move users across profiles to reach convergence through maximizing between cluster distances and minimizing within cluster distances (Sireci *et al*., 1999; Loo, 2004). In k-means clustering, the number of clusters (initial clustering points) should be predefined, therefore it is not possible to perform this analysis before running HAC (Hair *et al*., 2006). Once we set the number of clusters at five, we ran k-means clustering to calculate each clusters' centroids (the average values for each dimension in each cluster) and the distances between data observations and each cluster centroid (intra-cluster distance). Through multiple iterations, we randomly assigned new cluster centroids and calculated clusters till the

convergence was reached; this means that randomly assigned cluster centroids do not change the allocation of data observations. At this point, the final clusters were formed, in which data points are nearest to the center of their clusters and farthest from other cluster centroids (Kaufman and Rousseeuw, 2009).

A review of cluster analysis techniques indicates that there is no consensus in extant research on what is the most suitable clustering technique for each study and context. However, the rejection of null hypothesis (assuming that all clusters are equal) using an ANOVA test, and the ability to provide meaningful interpretation of the results are two main ways to assess the "goodness" of cluster analysis (Bapna *et al*., 2004).

Appendix IV: Descriptive Statistics

Profiles			Addict	Fanatic	Highly Engaged	Regular	Thoughtful
Total = 182: Number (Percentage)			12 (7%)	21 (12%)	34 (19%)	64 (35%)	51 (28%)
Demographics	**Usage**	*Average time spent per day*	6.95 hrs	4.35 hrs	3.47 hrs	2.51 hrs	1.10 hrs
		Range	2-10 hrs	1-10 hrs	1-10 hrs	15min -6 hrs	5min to 6 hrs
	Gender	*Female*	8 (67%)	14 (67%)	20 (59%)	36 (56%)	22 (43 %)
		Male	4 (33%)	7 (33%)	14 (41%)	28 (44%)	26 (51 %)
		N/A	-	-	-	-	3 (6%)
	Age	*Average (years)*	19.7	19.6	19.6	19.8	20.1
		Range	18-21	18-22	18-23	18-29	17-29
Antecedents	**Individual differences**	*Risk-adverse*	58%	57%	56%	47%	55%
		Motivated	83%	86%	85%	84%	88%
		Conformist	83%	52%	62%	45%	45%
		Obsessed	50%	29%	26%	20%	4%
		Optimistic	58%	71%	68%	75%	84%
		A fear of rejection	75%	52%	56%	52%	27%
		A need for approval	67%	76%	47%	52%	22%
		Upbeat	79%	71%	79%	80%	84%
		Driven	67%	67%	65%	69%	67%
		Self-esteem (High)	57%	67%	71%	64%	80%
		Self-Reliant	75%	90%	71%	73%	78%
		An active social life	67%	86%	65%	69%	67%
		Use it when bored	83%	95%	94%	95%	78%
		Use it when lonely	58%	81%	68%	53%	31%
		Use it when anxious/stressed	58%	76%	59%	42%	20%
		Use it when shy	42%	48%	50%	33%	20%
		Use it when emotional	50%	48%	38%	28%	16%
	Technology characteristics	*Powerful/fast*	92%	71%	59%	61%	57%
		Multiple applications	67%	71%	47%	52%	47%
		Access to Internet	83%	86%	82%	83%	69%
		Access to Facebook	83%	86%	79%	64%	41%
		Access to text messages	83%	90%	88%	95%	92%
		Access to e-mail	83%	81%	59%	69%	55%
		Mobile games	42%	43%	35%	27%	24%
		Portable	92%	90%	82%	91%	78%
		Convenient	83%	90%	85%	92%	84%
		Useful	92%	90%	97%	88%	94%
		Easy to use	75%	90%	85%	84%	78%
		Easily accessible	75%	71%	71%	77%	65%
		Nice design	75%	81%	59%	55%	47%
		Fun	65%	67%	59%	51%	43%
		Efficient	83%	71%	56%	69%	63%
		Connectivity	58%	71%	65%	72%	57%
Consequences		*Conflicts with other people*	50%	19%	6%	3%	2%

	Conflicts with tasks	75%	81%	56%	39%	10%
	Stress when not at reach	67%	76%	29%	30%	6%
	Frustration when not at reach	58%	67%	26%	58%	6%
	Uncomfortable when not at reach	92%	90%	65%	66%	43%
	Depression when not at reach	0%	14%	3%	2%	0%
Behaviors	*Text and drive*	42%	76%	38%	41%	33%
	Use during class	92%	100%	94%	97%	86%
	Use during meetings	50%	81%	59%	61%	29%
	Use while eating or socializing	92%	100%	94%	88%	76%
	Play games when not appropriate	42%	48%	38%	42%	12%
	Just woke up	92%	95%	91%	86%	84%

Chapter III (Essay #2): When Too Much Usage Is Too Much: Investigating the Role of Technology in IT Addiction Development

Abstract

While IT addiction has recently received some attention in the IS discipline, little is known about the process through which regular IT use becomes problematic. This paper investigates the development of IT addiction and aims to identify the mechanisms underlying it. It also seeks to identify the specific role of technology in the development of IT addiction by focusing on technology affordances. Based on the analysis of 38 in-depth interviews with smartphone and social network users, a process theory of IT addiction was developed that explains the progression of IT use behaviors through three phases: namely, initiation, transition to addiction, and persistence. The model highlights the key elements and mechanisms of IT addiction development that are related to the user, technology, and the environment and sheds light on the mechanisms that exist in each phase of the process. Finally, the implications for both theory and practice are discussed.

Introduction

Information Technology (IT) addiction has been in the focus of IS research in the last few years, and the dark side of IT use has increasingly received scholarly attention (Tarafdar et al., 2015; D'Arcy et al., 2014). In contrast to the dominant view in IS research that usually encourages IT use (Venkatesh et al., 2003, Jasperson et al., 2005, Limayem et al., 2007), this emerging stream of research makes it clear that it is important sometimes to think of ways to prevent, intervene in and reduce IT use (Turel et al., 2011). This is mainly due to the difficulties and problems associated with undesired or unexpected IT behaviors, which have an impact on users and organizations. The extant research has primarily examined *internet addiction* and other internet-enabled pathological behaviors (e.g. online games and gambling). In these studies, researchers

have focused mainly on the antecedents of IT addiction and tried to establish a link between the factors related to the user and IT addiction (see Armstrong et al., 2000; Byun et al., 2009; Widyanto & Griffiths, 2006 for a review). While the explanations provided have been helpful to provide some insights about what causes technology addiction, the accumulation of knowledge for the most part provides a *static view* of technology addiction, narrowing the focus to the causal relationships among these factors. In other words, previous studies were generally designed to predict IT addiction (i.e. explain higher variance of the addiction variable) by looking at various demographical, psychological, or social factors associated with users. Little is known about the dynamics and mechanisms through which an individual's behavior is transformed over time from initial IT adoption to problematic IT use and then to addiction. Hence, although we may know, to some extent, what causes IT addiction, our knowledge of how addictive behaviors develop is very limited. Understanding this is important, for it can provide a rich and temporal view of the development of addiction. It can extend the existing literature that generally provides a variance-based understanding of addiction by uncovering the mechanisms that underlie addiction development. Ultimately, understanding this process can be useful in designing control and preventive mechanisms at different stages of the process.

In addition, scholars who studied technology addiction (e.g. pathological internet use) believed that addiction mainly originates from the *individual*. Especially in the psychology and mental health literature, researchers have conducted many studies that were focused on personality types, negative moods and/or cognitive/emotional states (Armstrong et al., 2000; Murali & George, 2007). Examples are depression, impulsivity, low self-esteem, loneliness, and lack of social skills (Caplan, 2002; Byun et al., 2009). The role of user-related factors has been the focus of researchers for years; some even argued that nothing beyond the individual is responsible for addiction and *no other factor should be considered important* in the development of addictive behaviors. For instance, Shaffer (1996) explicitly mentioned that *technology* does not represent a cause of addictive technology use. In this view, problematic internet use is "the result of shifts in subjective experience" of users and the technology merely provides a reliable and potent means to change their emotional states. Despite the breadth of research on the user-related factors, new findings in the gambling or gaming addiction literature hint that considering the role of the *object of addiction* (e.g. technology features) during the development of addiction is critical (Ng & Wiemer-Hastings 2005; Griffiths, 1998). Given the anecdotal evidence, recent research support

and the significant upsurge in usage of new technological innovations (e.g. smartphones, social media tools, tablets, smartwatches etc.) during last few years, a careful examination of the role of technology deserves scholarly attention (Turel et al., 2011), especially when we focus on the development of addiction-related behaviors over time.

In order to fill these gaps, we seek in this study to answer two main research questions: 1) What is the process of development of IT addiction? 2) What is the role of technology in this process? To answer these questions, we designed an exploratory study and adopted a grounded theory approach. First, we reviewed the literature to identify the building blocks of the IT addiction process. Then, building on an analysis of 38 interviews collected from smartphone and social media users, we developed a three-phase process model of IT addiction.

Our study makes important contributions to research and practice. First, it contributes to the emerging stream of research on addiction in the IS discipline by providing a longitudinal understanding of the phases that exist during IT addiction development. Since IS research on addiction is relatively new, we hope our study improves theorizing about IT addiction and helps establish a groundwork for future studies of this phenomenon. Second, the paper portrays the importance of the user, the technology and the environment in the development of addiction. Extant addiction research provides mostly a monolithic view of the antecedents of addiction, focusing on the role of users, and thus does not provide much information about the complex interactions between these elements. Third, we specifically contribute to this literature by identifying the technology affordances that are involved during the development of IT addiction. Furthermore, we show how users may take advantage of these affordances during different phases of IT addiction development.

For practitioners our results are helpful through providing a broader understanding of IT users' behaviors, especially those that become problematic. On the basis of our results, at each stage of development, different actions can be taken (e.g. changing the environment around technology use, blocking or limiting access to IT, boosting user's moods and morale) to make sure that users will not progress to the final stage when they will experience significant negative consequences of IT addiction.

Theoretical Foundations

In order to study the development of IT addiction, we delved into the literature (in IS, psychology, and other disciplines) to provide a definition of IT addiction and to identify the key building blocks of IT addiction development. Specifically, we discuss the roles of the *user* and *technology* as well as the interactions between these two components by looking at technology affordances. The literature review provides a basis for the data collection, data analysis and construction of the process theory of IT addiction development.

Addiction and IT Addiction

The concept of addiction has been the subject of much scrutiny over the years (West, 2005). Traditionally, addiction has referred to situations in which a user experiences dependency on a *substance* (drug, alcohol, nicotine) (Rachlin, 1990; Goodman 1990). For instance, an addiction to drugs was defined as a state of *physiological dependence* on a *substance* to the point at which lack of intake of the drug would result in unpleasant feelings and physical dysfunctions (Baler & Volkow, 2006). Further developments extended definitions of addiction to a broader context to describe non-substance-related addictive behaviors such as extreme gambling or compulsive shopping (Black, 2007; Rueisel & Lahtnesor, 1991).

With the rapid advancement of technology, introduction of new tools, and the overall increase in the use of technology, IT-related types of addiction have become an issue for researchers and practitioners (Turel & Serenko, 2010). Earlier studies focused mainly on behaviors that were primarily related to excessive internet use. For instance, Young (1996) studied internet addiction and defined it as the irregular and extreme use of the internet that leads to an unmanageable life for the user and the appearance of several control problems. Subsequent studies examined other relevant concepts, such as internet addiction disorder (Oreilly 1996; Pratarelli et al. 1999; Ferraro et al. 2007), pathological internet use (Griffiths et al. 1998; Young & Rogers 1998b), excessive and maladaptive internet use (Murali & George 2007) or problematic internet use (Caplan, 2006; Shapira & Goldsmith, 2000).

Although previous research mainly focused on internet addiction, other technologies have also received some scholarly attention. In some cases, the studied technology simply acts as a

medium that facilitates or increases the occurrence of existing addictions (Griffiths, 2000). For example, some studies have shown that the internet has re-shaped or magnified non-substance addiction types such as obsessive gambling (Griffiths 2003), adult content surfing (Waters 2005; Young, 2008), stock trading (Greenfield, 1999) and auctioning (Turel et al. 2011; Peters & Bodkin 2007). Yet the sophistication of new technologies and constant addition of new features and capabilities have resulted in new forms of addiction, which did not previously exist. They include online games addiction (Griffiths & Dancaster 1995; Ng & Wiemer-Hastings 2005; Lemmens et al. 2008; Mehroof & Griffiths 2010), addiction to virtual worlds (Greenfield 1999), smartphone addiction and social media addiction (Turel & Serenko, 2012; Lapointe et al. 2013).

While there are noticeable differences between the nature of IT addiction and general addiction types, IT addiction has some similarities to general types of addiction (LaRose et al. 2003; Byun et al. 2009). The similarities are in two essential elements that are present in general types and IT-related types of addiction: the first element is the *individual* who develops a form of psychological or disordered internal dependency, and the second element is the *substance* (in our case technology) that the dependency is based upon. By taking these elements into account, IT addiction can be defined as "a psychological dependency on information technology that involves excessive and compulsive use despite significant negative consequences" (Vaghefi & Lapointe, Paper 1).

The Building Blocks of IT Addiction Development

Over the last two decades, a significant body of research in psychology investigating addiction to different technologies, such as the internet, TV and online media, has emerged. This research has used the commonalities between addiction to substances and addiction to technology to extend theories from the former to the later (e.g. Young, 1996; LaRose et al., 2003). In recent years, researchers in computer science began to focus on the IT addiction phenomenon and investigate the technical aspect of this type of addiction. The existing body of knowledge has generally followed two main streams. First, for decades, the research in psychology and health focused on the *individuals* who become addicts and investigated a wide array of personality traits and psychological attributes that might increase the likelihood of addiction (Brody, 1996; Caplan, 2002, 2006; Davis et al 2002, Young, 1996, 1999, 2004, Kim et al., 2009). This literature

generally looks at the psychopathological traits and negative emotional states of users, such as mental distress and predisposed vulnerability that can cause addictions such as depression, loneliness and social anxiety (Caplan, 2002), or the *maladaptive traits*, especially negative thoughts about the self (such as low self-reliance or self-esteem) (Caplan, 2002).

In the last decade, especially in computer science, some researchers have paid attention to technology itself and how it may become a source of addiction for users. In these studies, the focus was on the characteristics of technology to examine how these may prompt addiction. For instance, in the context of online games (such as MMPORG—Massively multiplayer online role-playing games), Ng and Wiemer-Hastings (2005) found that advances in 3D graphics and virtual representation increase the interaction of players with online games as well as the likelihood of addiction.

As detailed in the next sections, our literature review first reveals that previous studies generally focused on testing and validating the causes and triggers of IT addiction rather than looking at the mechanisms that show the development of such behavior. Therefore, while these studies were able to portray a variance-based view of IT addiction (especially to explain the role of the individuals), our understanding of the process that leads to addiction is insufficient. Second, we found that these two streams of research have been studied mostly independently, i.e. researchers have investigated either the role of the user (assuming that individuals are the cause of addiction) or of the technology (assuming that technology is the cause of addiction). In this study, we aim to bridge these two research streams by looking at both the user and technology components in studying addiction. We argue that in order to study the development of IT addiction it is important to take both user and technology into consideration. To this end, we use the concept of technology affordances (Gaver, 1991; Majchrzak & Markus, 2012), which is useful for taking into account the interactions between user and technology.

The Role of the User

As mentioned, although IS research has just recently paid some attention to IT addiction, in other reference disciplines (e.g. psychology), addiction to various technological innovations has been studied for some years (Young, 1996; Caplan, 2002; LaRose et al., 2003). The existing literature mostly focused on *psychological factors* and *personality traits* of users and tried to establish a

link between the mental well-being of users and problematic technology use (Brody 1996; Caplan 2002, 2006; Davis et al., 2002, Young, 1996, 1999, 2004, Kim et al 2009). For instance, depression, which was found to be associated with dependency on substances (alcohol, drugs etc.) (Lysaught & Wodarski 1996), may produce a similar effect and increase dependency on technology (Young and Rogers, 1998). Related to depression, loneliness was linked to IT addiction (Morahan-Martin & Schumacher, 2000; Caplan, 2002). Technology use and internet-based communication can provide a medium for easy communication with others, boost moods and allow anonymous interactions, which help users to hide their personality and disorder symptoms during interpersonal communications. Further studies shed light on other traits that could relate to technology addiction, such as shyness, social anxiety, emotional sensitivity and reactivity, and discussed their role in increasing IT addiction (Pratarelli et al., 1999; Caplan, 2002; Caplan & High, 2006; Chak & Leung, 2004; Young & Rodgers, 1998).

In addition to these factors, individuals' *motivation* has received some attention in the addiction literature (West, 2005; Goodman, 2007). Motivation is the inner drive that forces people to do certain actions (Wan & Chiou, 2006). In general, the benefits gained through technology motivate individuals to use IT; this is why IT use is usually perceived as a goal-directed behavior that serves specific goals and states (Limayem et al., 2007). As Ryan and Deci (2000) discussed, there are two types of motivations underlying a behavior: extrinsic and intrinsic. *Extrinsic motivation* refers to the motivation to perform an action because it is instrumental in achieving benefits that serve an individual's goals. However, intrinsic motivation refers to the motivation to do an action because of a genuine personal interest in performing that action (Teo et al., 1999). In the context of technology use, Davis et al. (1992) showed that people are driven to use a technology mostly because of its usefulness, which is the extrinsic motivation in using technology. To a lesser degree, IT use behaviors are also driven by the perception of enjoyment, which forms the intrinsic motivation for using technology (see Wu & Lu, 2013). Similar results were found in the context of acceptance and use of microcomputer technologies (Igbaria, 1996). With regard to IT addiction, the extant research has shown that both extrinsic and intrinsic motivation (usefulness and enjoyment) are important issues that should be taken into account in studying IT addiction (Teo et al., 1999; Lin and Liu 2001; Turel & Serenko, 2012). Accordingly, we consider the roles of personality traits and motivation during the process of IT addiction development.

The Role of Technology

Although research on the role of users is predominant in addiction research, there is evidence hinting that the characteristics of the substance plays a role in individuals' dependence. Examples are the results showing the effect of nicotine on drug/smoking addiction, caffeine on excessive coffee consumption or ethanol on alcohol dependence (Mathers, 2006; Goodman, 2007; Volkow & Li 2005; Baler & Volkow 2006; West 2005). Similarly, in the context of IT addiction, there are a few studies (especially with regard to game addiction) that focus on the specific characteristics of technology (e.g. virtual worlds, graphics, social features), hinting that IT itself could be important in the emergence of problematic behaviors (Griffiths et al., 1999; Ng and Wiemer-Hastings, 2005; Cole & Griffiths, 2007; Turel et al., 2010).

In IS research, there is a long-standing body of knowledge about the perception of users about technology. As early as Davis et al. (1989), researchers looked at technology-related beliefs such as perceived usefulness and ease of use and identified them as the most salient factors explaining initial adoption and extended usage of IT in different contexts (Venkatesh et al., 2003). While the perceptive measure of IT use has received extensive attention and validation, these factors have diverted scholars' attention away from the design of IT artifacts and its criticality in behavioral outcomes of technology use (Benbasat & Barki, 2007). Accordingly, there have been several calls within IS research to put more emphasis on the IT artifact in studying IT-related phenomena (Benbasat & Zmud, 2003, Orlikowski & Iacono, 2001). As Markus and Silver (2008) put it, it is important to understand "what it is about IT that may contribute to the behavioral and social outcomes of IT use, when such effects occur. This is not to say that technology is the only, or even the most important, contributor to IT effects, but merely that it may matter" (p. 610). Despite such calls and the recent findings suggesting the role of technology, there is no study that systematically examines this complementary role in the context of addiction-driven IT use.

Overall, the investigation of IT artifacts has been found to be challenging within the IS environment, and there is no agreement on how to study technological innovations (Orlikowski & Iacono, 2001; Grange & Benbasat, 2010). The challenge is that to study IT, one might come up with a lengthy list of artifact features instead of a parsimonious set of meaningful dimensions

that truly reflect the nature of a technology. One way to overcome such challenges is suggested by DeSanctis and Poole's (1994) experimental work, which led to the development of Adaptive Structuration Theory (AST). In general, AST validates the role of technology along with the role of the user and suggests that looking at IT is necessary in studying technology. It also proposes that focusing on the structural features (resources and capabilities provided by the system) and the spirit (general system values and goals by design) can help scholars capture the effects of technology. Markus and Silver (2008) provided an updated view of AST and extended it by introducing the three concepts of technical objects (features), functional affordances (relationship between user and technology), and symbolic expressions (designated signs) that can be helpful in discussing IT as a source of individuals' behaviors. Building on this literature, in this study, we use the concept of technology affordance, which is established on the premise that users "assimilate and respond" to technology on the basis of what it enables, or "affords", them to do, rather than on the affixed features built into IT by design (Vaast & Kaganer, 2013). In the following section, we explain this concept, which provides an anchor for studying the role of technology in the development of IT addiction.

Technology Affordances

There has been growing research in IS to understand technology's impacts by looking at the interconnectedness between users' behaviors and IT through the lens of technology affordances (Treem & Leonardi, 2012; Leonardi, 2013; Majchrzak & Markus, 2012; Majchrzak et al., 2013; Volkoff & Strong, 2013; Vaast & Kaganer, 2013). Originated by the work of ecological psychologist James Gibson (1977), affordances have long been used to associate an object's (such as a rock or a door handle) physical properties with the ways it is being used by an actor. As defined by Norman (1988), "the term affordance refers to the perceived and actual properties of *the thing*, primarily those fundamental properties that determine just how the thing could possibly be used. A chair affords ('is for') support and, therefore, affords sitting" (p. 9, italics added). An a*ffordance* thus refers to the attributes of both the material and the actor (Gaver, 1991).

Introduced first to the human-computer interaction literature, technology affordance is a relational concept (Leonardi, 2011; Leonardi & Barley, 2010; Treem & Leonardi, 2012) that

represents what an individual can do with a technology (Majchrzak & Markus 2012). In another definition, technology affordances refer to the "action possibilities and opportunities that emerge from actors engaging with a focal technology" (Faraj & Azad, 2012, p. 238). For instance, ERP can integrate data in an organization and allow managers to organize and allocate tasks to department employees or team members. However, the efficient division of labor depends on a manager's experience and capability to work with ERP effectively.

Technology affordances highlight that although the material properties of technology are the same for all, the perception of users about technology could differ among users (Leonardi & Barley, 2010). Hence, a technology may be used differently, resulting in the emergence of different usage behaviors and outcomes. In the context of our study, we can expect that, in some cases, the interactions between user and technology lead to excessive and compulsive use. However, in most cases, individuals' interactions with IT may not develop this kind of dependence. The nature of these interactions could vary according to the context, user competency and objectives (Vaast & Kaganer, 2013), which can be captured via technology affordances.

With the focus on technology affordances (Gaver, 1991), there has been a growing interest in studies that look at the outcomes of technology use. For instance, Grange and Benbasat (2010) looked at technology features and affordances to examine the role of design artifacts on the attitude and belief system of the users in an online social shopping context. Treem and Leonardi (2012) proposed and discussed four major affordances of social media (visibility, persistence, editability and association) that can change the nature of established organizations' processes, such as socialization and power. In another study, Majchrzak et al. (2013) studied the ways that social media tools can influence online knowledge sharing; they introduced the four affordances of metavoicing, triggered attending, network-informed associating and generative role-taking.

Using the concept of technology affordances, we intend to investigate the dynamic interactions between users and technology during the transformation of usage behaviors. This approach is similar to recent efforts that have examined the IT artifact in relation to the users, especially to study the potential outcomes of IT use (e.g. Leonardi, 2011, 2013). While the recent studies looked at the positive side of IT use and investigated affordances that improve the experience of

users and organization (e.g. Mathiesen et al.'s study on IT affordances for business process improvement), to our knowledge, there is no study that uses the concept of technology affordance to understand the development of undesired and problematic IT use behaviors. Our goal is to contribute to this area by studying the interactions between user and technology and empirically finding their roles in the development of IT addiction over time.

The Development of Addiction

Despite the lack of attention to the addiction process in IS research, there have been some efforts in other disciplines to provide a longitudinal perspective on general addiction in other contexts (e.g. Baler & Volkow, 2006; Koob & Le Moal, 2008). For instance, Grover et al. (2011) discussed the transformation of consumption behavior (e.g. smoking, drinking or illegal drugs) from the pre-addiction stage (benign consumption) that is without any harmful consequences toward the addiction stage (excessive consumption). According to their framework, the decision to perform a behavior begins with a low engagement. Depending on the physical, environmental and physiological factors, an individual increases the time and involvement with an activity to the point at which excessive usage causes harm and dependence. As users progress toward excessive use, they increase the time spent on the behaviors and the perception of enjoyment from them, while losing some control over their behavior (Charlton, 2002). Building on Grover et al.'s model, Martin et al. (2013) developed a longitudinal model that shows how individuals move along different stages of consumption behaviors: non-use, non-addictive use, near-addiction and addiction. According to their model, a mixture of neurological, biological, psychological and social factors can initiate an individual's progression through different stages. In this model, usage behaviors are specified on the basis of four dimensions: time/frequency, degree of self-control, enjoyment and degree of negative consequences. Similar to Grover et al.'s model, this model posits that as individuals progress through the stages of addiction, the time and frequency of use, enjoyment and negative consequences increase while the degree of self-control diminishes.

Although prior studies were not conducted in the context of IT use, they highlight the importance of considering different stages in the development of addiction. In the context of our study, this could mean that users go through stages and exhibit the transformation from healthy IT usage

behaviors to problematic ones. Hence, we can view IT addiction development as an evolutionary course of activities that represents the change in behavioral usage patterns over time, although the nature of this transformation and the mechanisms underlying it have yet to be explored. Using technology affordances and considering the evolutionary nature of IT addiction, we conducted our qualitative study in order to find the process underlying the development of IT addiction.

Methodology

The purpose of this study is to explore the *process* by which IT addiction behaviors are developed and, in particular, to study the role of technology in this process. It is important to note that process theories are essentially different from variance theories. While the latter provide an overview of the *casual relationships* among independent and dependent variables, the former explain the *patterns of events, choices and activities* that occur during a period of time (Langley, 2009). Given the lack of knowledge and theories of IT addiction in IS research and our objective to investigate the temporal and processual characteristics of an understudied and incompletely documented phenomenon, our study follows a qualitative methodology and adopts a grounded theory approach (Glaser & Strauss, 1967; Strauss & Corbin, 1990; Urquhart et al., 2010). In order to provide an in-depth understanding of the mechanisms that exist in this temporally evolving phenomenon, we develop theoretical accounts that are deeply rooted in the empirical data (Eisenhardt, 1989; Langley, 1999). In the following, we explain the steps taken during data collection and analysis.

Data Collection

To collect rich, real-life data, our study followed two rounds of data gathering. In the first round, we relied on semi-structured interviews with a convenient sample of 12 (eight male, four female) heavy users of smartphones. The initial interviews were aimed at identifying the key concepts of addiction development, providing descriptions of addiction-related behaviors, and developing a draft of the essential activities that occur during the IT addiction process (Patton, 2002). We used the concepts and elements found in the literature (e.g. elements related to IT addiction, users, and technology) to define the scope and boundaries of our research and develop our interview guide (Urquhart, 2001), yet we paid careful attention to avoid any preconception regarding the IT

addiction process. The guide included open questions along with probes and prompts that facilitated the interviews. The respondents were asked to describe their use of smartphones and explain how it progressed to the current state. At the end of the interview, they were asked to fill out an eight-item survey (Young, 1996) in order to report their technology dependency more objectively. The interview guide (see Appendix I) was refined using pilot interviews with two excessive smartphone users and an IS professor. Additional insights revealed during the pilot interviews were taken into account (Corbin & Strauss, 1990). The interviews lasted between 25-45 minutes. All interviews were recorded and transcribed verbatim.

Building on the results of the first interviews, which provided preliminary insights about the basic elements and the mechanisms involved in the process of IT addiction, we conducted the second round of interviews to further investigate the initial results and finalize our model. For this round, we revised our interview guide (see Appendix II) on the basis of the insights derived from the first round of interviews; we paid particular attention to the dimension of time and how interactions between the user and technology and the user's behaviors change during the course of IT addiction development. To better specify the role of technology, in this round we conducted interviews with heavy users of a social network (i.e. Facebook). The focus on social networks enabled us to compare and contrast our results across technologies. While social networks represent a type of software application that could be problematic for users, smartphones are a collection of several technologies and applications, some of which have been shown to be addictive. In addition, the second round of interviews helped us depart from a rather descriptive model of IT addiction and develop a process theory that provides a rich understanding of the mechanisms underlying the development of IT addiction.

To select interviewees, we followed theoretical sampling (Patton, 2002). We recruited interviewees through an online ad that was posted on the university's classified page and provided a short description of the study. All volunteers were asked to fill out Young's questionnaire and those who were above the diagnostic threshold (i.e. reported at least five symptoms) were selected for the interview. Our final sample consists of 26 interviews (11 male, 15 female; 19-34 years old). Incentives (10$ in cash or a Starbucks gift card) were given to all participants. The second round of interviews took between 35 and 75 minutes. As with the first round, all interviews were recorded and transcribed verbatim.

Data Coding and Analysis

Interview data were all recorded in NVivo9 for analysis. Specific codes (in the form of numbers) were assigned to interviewees to make sure that their identities would not be revealed in the analysis. In grounded theory, data collection is tightly linked with analysis and theory development (Patton, 2002). Following the guidelines of grounded theory, we started analyzing our data shortly after the first few interviews were conducted (Strauss & Corbin, 1990; Urquhart 2001). Standard coding practices based on guidelines suggested by Corbin and Strauss (2007) and Charmaz (2003) were used.

To analyze the transcripts, we proceeded with open, axial and selective coding. First, using open coding, we analyzed data content to determine classes of relevant concepts and recurring themes (e.g. personality traits, motivation and moods related to the user). Second, axial coding was performed to group codes with a similar meaning into categories (e.g. mechanisms and phases). For instance, at this stage we identified four types of affordances provided by technology (Communication, Entertainment, Association, and Information Sharing). Finally, selective coding allowed us to integrate the analysis of the categories, analyze the patterns of users' behaviors and arrange patterns into coherent core findings.

Consistent with the spirit of grounded theory, the theoretical model was developed gradually through numerous iterations between data collection, data analysis and reflection on the findings in the extant literature (Vaast, 2013). The analysis resulted in the development of a preliminary model[1] in the first round which was further refined in the second round. Our analysis continued until saturation was reached; that is, when no new elements (user or technology or context related), usage patterns or activity seemed to emerge from our analysis, and further analysis only confirmed the already existing understandings of the IT addiction process (Glaser & Strauss, 1967). Finally, we returned to the literature to make sense of and further clarify our findings and refine our understandings of the process of IT addiction.

We present the results in the next section. We first look at the building blocks (i.e. user and technology) and identify the entities related to them. Then, we discuss additional components (e.g. environment) and mechanisms (e.g. triggers, loss of control and the reinforcement cycle)

[1] The preliminary model was presented at 46th *Hawaii International Conference on System Sciences*-HICSS (2013).

that play a role in the studied process. Building on the provided insights, we develop a process model of IT addiction development.

Findings

The aim of process theory is to understand how things evolve through time and why they happen in a particular manner (Langley 1999; Pentland, 1999). In the context of our study, this translates into our goal of developing a model that shows how IT use can evolve into addiction. In this section, we first discuss the results of data analysis corresponding to the building blocks of the IT addiction process and discuss different entities and mechanisms involved in the process. Building on these findings, and through a longitudinal analysis of our data, we proceed to theory development and propose a process theory of IT addiction development.

A Process Model of IT Addiction Development

In this section, we first discuss the elements of the model (including the building blocks—see Appendix III for details and evidence) and the mechanisms that are critical in understanding IT addiction. Building on the elements and mechanisms identified in our data, we develop our model and describe the three phases that underlie the process of IT addiction. It is important to note that rather than focusing on cause-effect relationships between these factors and patterns, in our analysis we looked at the temporal sequence of events and the "probabilistic interaction between entities" (Langley, 1999) to see when and how obsessive and compulsive technology use may emerge from such interactions.

The Building Blocks of the Model

The User: First, our results showed that indeed users (also known as human agents in the technology literature) play a critical role in the development of IT addiction. As illustrated in Appendix III we found that in this process three issues should be considered: first, certain personality traits play a part in initiating the usage and also triggering problematic behaviors. Specifically, having a self-centered, shy, introvert or overly extrovert personality may trigger excessive usage of and dependency on IT. Also, negative emotional states and moods can initiate dependency on technology, followed by addiction. For instance, depressive moods or boredom

(proneness) may encourage excessive interaction (e.g. constant checking of phone or Facebook) followed by dependency.

Second, users' emotions and mental states appear to be important in extending usage. The results of our analysis show that users who feel insecure would constantly interact with social technologies to receive feedback and validation from others and overcome the unpleasant feeling associated with a lack of security. Another feeling that is associated with the development of IT addiction is boredom. Using technology seems to provide a gateway for users to escape from the boring moments. Those with higher boredom proneness reported high engagement and sometimes excessive usage.

Third, our analysis showed that the motivations of users are key in understanding IT addiction. We found that several motivations could help explain why individuals initiate and later increase IT usage. Extrinsic motivations were mostly related to the utilization of the benefits expected from technology, such as getting information and communicating with the peers in a network (mainly to stay in touch). In addition, intrinsic motivations were also at play during the process of addiction. Therefore, enjoyment was brought up as a key motivation for interaction with smartphones (e.g. online games) or social networks. While utilitarian usage and getting such benefits (e.g. having access to email, texting, connecting to people) were found to be related to any type of use (different intensity), hedonic usage was mentioned as a critical issue in initiating addictive usage when users extend their interaction to get a positive feeling (pleasure, excitement) from IT use. If a technology cannot provide such an experience for the user (e.g. accounting systems), it is less likely that the user will develop an addiction.

The Technology: Although looking at the user was clearly important in understanding addiction, IT addiction neither occurs in a vacuum nor is independent from technology. As illustrated and explained in Appendix III, we found that addiction would emerge partially, due to the characteristics of technology and the experience it provides for the user. First, physical attributes of technology (weight, size, design, etc.) were found to extend users' opportunity for excessive interaction. For instance, some mentioned that they are more likely to check Facebook on a smartphone device compared to using a desktop computer. This happens because of the portability of the technology (as explained further in the discussion of affordances). Also, the

technical features appear to be very important. Specifically, our results showed that the telecommunication features of technology are key as they motivate (frequent) IT usage. In addition, the use of these features is reinforced by alerts and notifications embedded in the technology by design that make users come back to the device and check for updates regularly. The integration of a wide range of services and applications provided through social networks and smartphones are reasons why users adopt and use them increasingly. For instance, one interviewee mentioned that it is easier to get addicted to a smartphone (as a tool to access many applications and services) than to a regular mobile phone.

The Environment: Besides the role of users and technology in the development of IT addiction, additional analysis of the interviews (see Appendix III) provided novel insights into the role of the environment and showed that the context in which users and technology interact with each other should be taken into account in studying IT addiction. First, the importance of peers was emphasized during adoption of technology. Users tend to initiate a technology that is being used by their friends, family, colleagues etc. Likewise, social norms and an increase in the popularity of a technology have a snowball effect and influence users' adoption (if they have not already adopted a technology). For instance, some interviewees stated that they joined Facebook since everyone is on Facebook. While these associations appear at the early stages of use, the influence of peers seems to extend to the advanced stages of addiction development. We found that users increase their technology usage gradually in order to keep up with their peers and social trends.

Technology affordances: While the user, the technology and the environment are important in understanding how IT addiction develops, it would be misleading to consider the effect of these elements independently from each other. From our analysis and as evidenced in Appendix III, we found four main affordances that appear to be key in developing addiction: namely, communication, entertainment, association, and information sharing. While they are all important in initiating the process, our analysis showed that IT for entertainment (fun, pleasure) and association (bonding and keeping connected) are key in the later stages of IT addiction development (see Appendix III for more details). Table 1 provides a summary of the affordances identified in the context of IT addiction.

Affordance	Definition	Example of Features
Communication	Ability to connect to others and receive updates about current events	Internet access, social network access, email app, text message service, news applications
Entertainment	Ability to provide enjoyment and thrilling experiences	Social networks, games, music and video player, chat service
Association	Ability to establish social connections	Friends network, open and closed groups
Information Sharing	Ability to broadcast or receive information to a group of people	Status update, sharing buttons, group messaging

Table 2: Affordances of technology associated with IT addiction

Considering affordances in our study means that addiction is not only rooted in the user, the technology and/or the environment, but also that the interactions between the user and technology in a specific environment is how addiction develops (see Figure 1). Also, while a technology may have features and characteristics that are equally available to all users that could influence usage behaviors, such effects only exist when users perceive the features and utilize them in agreement with their goals and motivations. As we explained above, the concept of technology affordance can be helpful to look at these interdependencies and interactions.

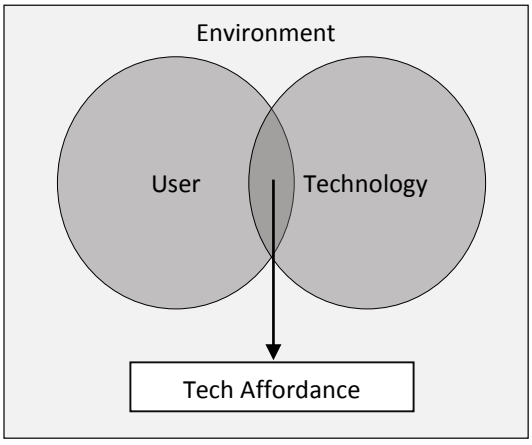

Figure 3: interaction between user, technology and environment

Overall, not only may the environment influence usage behaviors when users adopt a technology, but it can play a role at advanced stages of use, when they have gained experience

and begun to increase usage and enter the problematic stages of use. Further analysis of our data helped us go beyond these building blocks (user, technology and environment) and identify other elements and mechanisms common among the users' behaviors that led to the development of IT addiction.

The Key Mechanisms of the Model

From our analysis of the interviews, it became evident that there are some critical mechanisms that occur during the development of IT addiction. First, we explain these mechanisms in detail, and then we propose the process of IT addiction.

The increase in usage intensity: Our results showed that individuals may use technology at different degrees of intensity over a period of time. Many users mentioned that their IT usage was pretty low at the beginning and their interaction with features and services provided by technology was very limited. Some also mentioned that they had no or a minimum level of interaction with smartphone or social media technologies for a while. As time went on and individuals naturally advanced through the learning process, they expanded their usage of different features and increased their intensity of use. For normal users, the usage intensity usually grew to a point and then stabilized. This is an average point at which IT is mostly beneficial and usage behaviors are non-problematic. The time and speed of learning could be different for users, but we found that all the users went through this stage and experienced a similar progression of behaviors. Besides this general trend, some users tended to go beyond that (average) level and reach a point at which the intensity is high and the usage is excessive and compulsive (beyond the average) (see Figure 2 for a comparison between these behaviors).

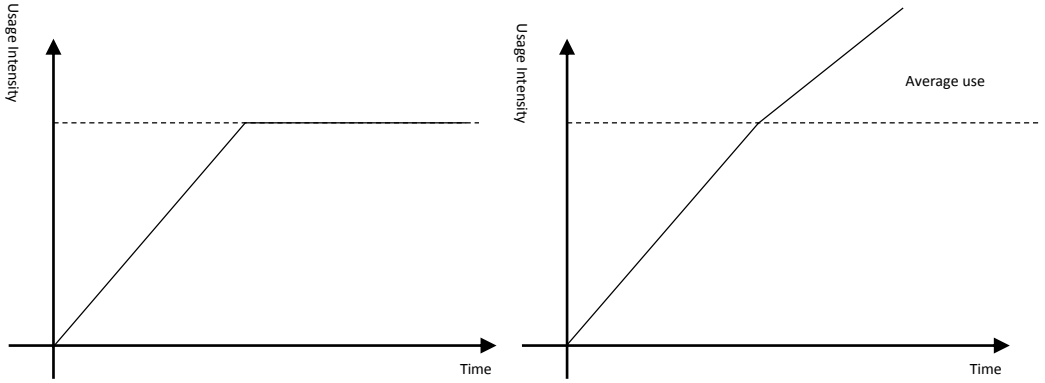

Figure 4: Normal (left) versus problematic (right) usage patterns

Moreover, we found that the intensity may increase because of changes in the user, technology and/or the environment. Therefore, it is important to consider change in these entities and how new IT behaviors form through changes in these elements. For example, many mentioned that they experienced growth in their usage as social network technology evolved and new features were added that provided new and additional benefits for the user. Similarly, the introduction of smartphones led to higher usage intensity, as Facebook is available at almost any moment and within arm's reach. Also, as the environment around users changed (e.g. a high school student living with parents becomes a college student living in a dorm) more benefits became clear (group work features) to them and more opportunities were provided for interaction with technology (e.g. no parental supervision).

Describing this as a case of imbrication of user, technology and the environment (Leonardi, 2011) could be useful. We can see IT use as an intersection of these factors. While these interactions can be studied at any moment, we need to consider them as an evolving ecosystem. Imagine that at t_1, a user might take advantage of a technology in a specific environment, and that the user establishes a specific pattern of IT use. With the progress of technology at t_2, the user feels the need to increase IT use in order to maximize the benefits. At t_3, s/he finds out that friends are using new features that allow them to connect and gain a collective benefit; for instance, everyone is now posting photos on Facebook. Again in order to be part of the community and catch up with this new trend, the user will adapt and increase usage intensity. Finally, at timet_4, when the user feels bored, s/he will increase usage of a system to boost his/her mood and get over the unpleasant feelings being experienced at that moment.

Triggers: From our analysis, we found that there are some triggers that are critical in progressing toward addiction. Hence, while the user, the technology and the environment are important, some specific circumstances (related to the user, technology or environment) can trigger the development of addiction or increase the speed of the transition. We explain these triggers in detail in the model.

Loss of control: We also found that users' degree of control is an important factor, especially during the development of problematic behaviors. As users go through the process, the degree of control and the amount of effort spent in regulating their IT use drops. While most users do not allow usage to go overboard and develop into addiction (high control), addicts admit that they experience difficulties in controlling their usage and reducing it back to normal levels (i.e. low control) (Figure 3).

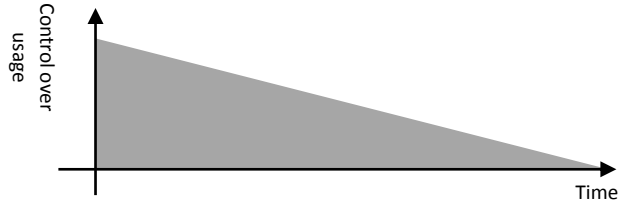

Figure 5: The control over usage behaviors over time

The reinforcement cycle: Another mechanism that was evident in our findings was the pairing of usage with the positive response and experience associated with usage behaviors. We noticed that during the development of IT addiction, users experience a situation in which the use of technology creates a pleasant and positive effect for the user (usually tied to the feelings of enjoyment, excitement and arousal). The positive experience and resulting satisfaction drive further technology. Therefore, to receive a similar positive experience, users will increase their usage intensity. This reinforcement (see Figure 4) may recur up to a point at which users experience significant negative outcomes due to their excessive and compulsive usage.

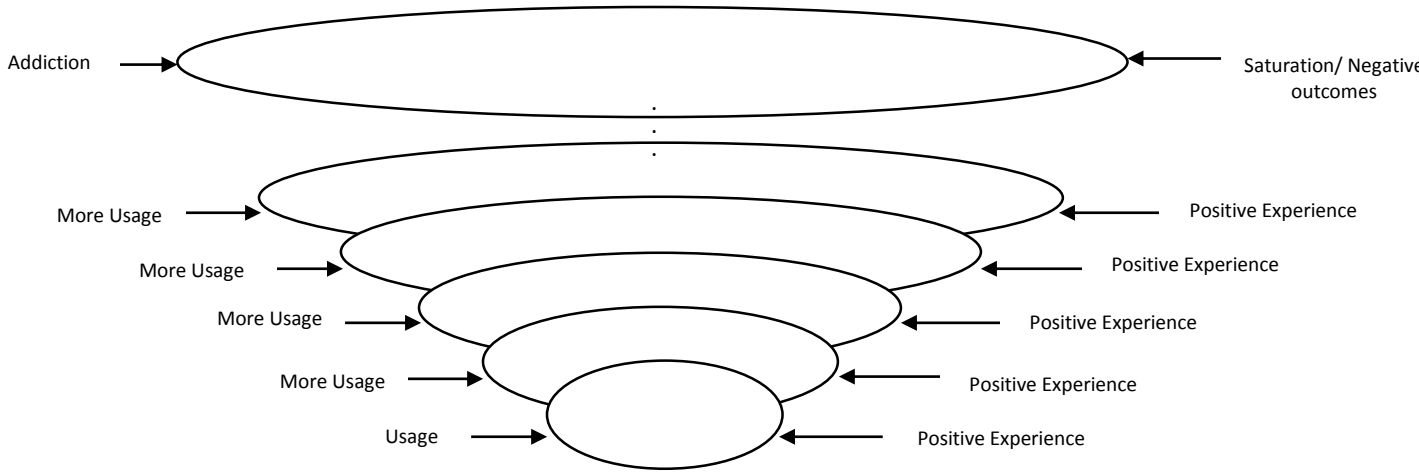

Figure 6: Transformation of usage behaviors

The change in the nature of usage: Our analysis also revealed that the nature of IT use behaviors may change over time. As we mentioned, individuals have different motivations for using IT. While average users may "want" to use a technology in order to answer a specific need (e.g. social connection, information sharing etc.), addicts feel an "urge" to use it. We found that the transformation of *wanting* something into the *urge* happens during the course of IT addiction development and can help distinguish between non-problematic and problematic usage (see Paper 3 for more details).

A Process Theory of IT Addiction Development

Using these insights, we further delved into our data to understand the patterns of actions and events related to IT addiction along time. On the basis of our analysis, we were able to distinguish three key phases underlying the development of IT addiction (see Figure 5): namely, initiation, transition to addiction, persistence. The mechanisms in these phases show how IT usage behaviors are transformed over a period of time and turn into undesired addictive usage. In the following section, we discuss our findings and explain how and why initial, ordinary IT behaviors progress to addictive ones over time.

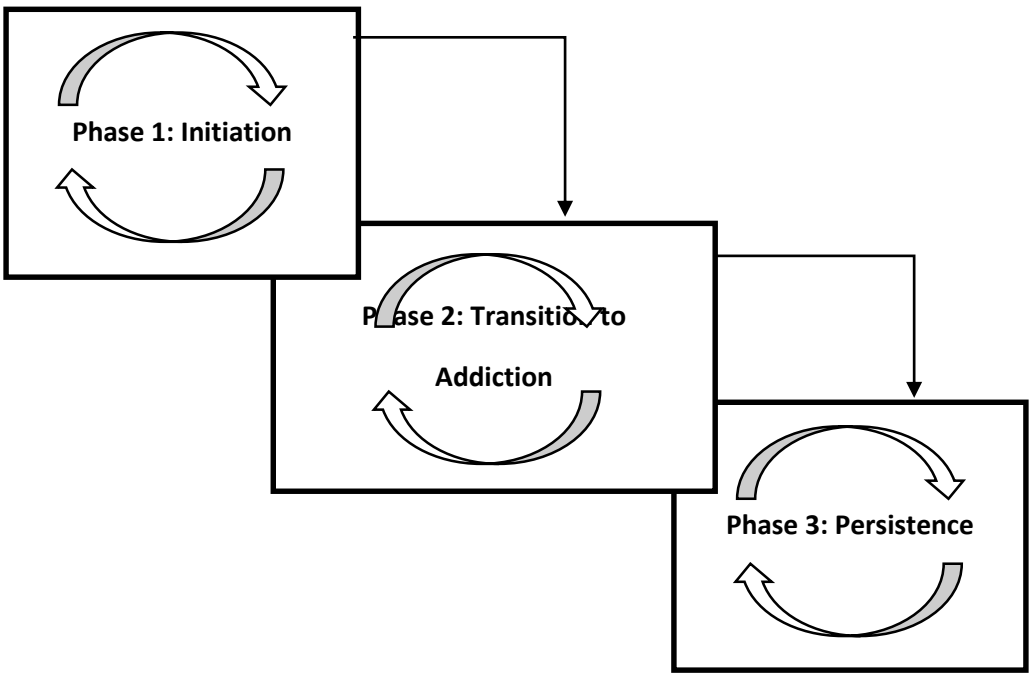

Figure 7: The phases of IT addiction process

Phase 1: Initiation

Our analysis revealed that the decision to adopt new technologies (e.g. smartphone and social network) and starting to use them is first triggered by the pressures coming from the environment. Some interviewees mentioned that smartphones have become more popular and affordable, and now everyone around them is using such tools. Many social network users also mentioned that they started to use this network after their friends or family members joined Facebook and encouraged them to use it. A few interviewees even mentioned that they were hesitant to join this network at the beginning and they only began using it after others created a profile for them. For instance, one user stated, *"I think my older siblings had it [Facebook profile] and my older sister said oh I'll make you an account, so she did and at that point not too many of my friends had it, so I didn't really use it too often then"* (23). Seeing others using a technology and trying to conform to social norms can create an early expectation about what a technology can do. This could further motivate users to adopt and use a specific technology at the early stages of use. A user may join Facebook in order to take advantage of the benefits provided by technology that s/he has heard about from his/her peers. For example, as illustrated by this quote, one user was expecting a photo sharing capability from Facebook before actually

using it: *"I was asking for photos of a party and my friend would say oh! They're on Facebook"* (23).

At the beginning of usage, the intensity is typically low. Rather than actively seeking to engage in usage and getting benefits from technology use, users were found to have limited interactions with technology and to be solely experimenting with its features. However the interactions between user and technology may gradually increase over time. Although this can happen in many different ways, our analysis showed that it generally occurs through exchanges between motivations to use and technology features that can answer those needs. For example, in the context of social media use, some users mentioned that they wanted to *stay in touch* with their friends. Facebook allows the user to create a free profile, join a network of friends and be able to communicate with them. By using IT for this specific reason, the communication affordance of technology is being realized by a user. A long-term need associated with a positive experience will help repeat the usage, while a short-term need or a negative and unpleasant experience will not likely be repeated (the technology will be abandoned).

> *"Well when it first started there was something called Netbook or something and that's when all my friends joined that and it was very bad and then someone said Facebook and so I had to Google it and see like oh it's the new rage, everyone has Facebook accounts. I mean and I don't think I used it for a couple of months because I didn't really understand what it was and so people were saying that oh I sent you this and that on Facebook. So these things just started to get more and more, and I figured out how to use the different apps." (13)*

> *"My friends joined it, so it was like okay I'll like go with the crowd and do what they did and mainly sharing information even connecting with people that I have not seen in a long time. I realized later on that I could like add people in different countries and communicate with them." (36)*

Despite limited use at the beginning, users learn about a technology and expand their usage over time. As shown by the examples above, during this time motivations and technology play important roles in extending and increasing IT usage. Many interviewees also mentioned that the productivity gains (via using these technologies) became increasingly important for them. Also, some addressed both the physical (such as size and weight) and technical features of technology (e.g. applications and accessibility to the Internet for smartphones or private chats for Facebook) as reasons why they were interested in these technologies and maintained their interactions.

Respondent 2 mentioned such benefits in this quote: *"[Because] it replaces a watch. It replaces an alarm clock. It replaces a camera ... tells you what the weather is going to be like. So, it's a replacement of all that stuff right handy… and just so convenient and you feel plugged-in all the time."* During this period, additional advantages of technology become clear and are appropriately assessed by users, which is followed higher intensity of IT use (longer times, more frequency). As users spend more time using technology, they get to know the additional features of technology and more benefits will be revealed (illustrated by the feedback loop in phase 1). At the same time, the complexities of working with the system at the beginning will disappear.

> *"[Because] it's more accessible and smaller – it's very portable, you can put it in your pocket and take it anywhere; unlike a PC…. You have the entire Internet on a little single device so that is really useful." (8)*

Also, changes related to the technology can lead to an ongoing increase in technology use. As evident in our data analysis, the behavior of users might be influenced by the improvements in the technology and addition of new features. As an illustration, many users mentioned that Facebook has gone through many changes throughout the years. By regularly enhancing technology and adding new features, a technology provider makes sure that users maintain or increase their interactions with technology, since they always want to maximize their utility (Becker and Murphy 1988). It also helps users realize new affordances and receive more benefits from technology, which can give them a better experience and increase their IT use over time. As an example, one respondent explained how the technical capabilities of Facebook have improved over time and how this affected his/her behaviors: *"The photo sharing is a lot better now than before. I remember it used to be like one page and you could upload five photos manually and then you had to do it over and over again but now it's you just copy the entire file and it goes by itself. Yeah, so I use it more for photo sharing now!"* (16).

In addition to the improvements in technology, the growing number of peers who use a similar technology (network) appears to increase usage at this phase. The expansion of a network translates into more advantages for users (especially related to the social gains). These benefits can again be discussed in regard to the affordance of technology. For instance, more users in a network eventually lead to more content and information shared among the members. In addition, a bigger network will be a better environment to provide positive experience, support,

validation or a sense of self-worth for its members, as the opportunities for communication and feedback are extended. The following quote illustrates this point:

> *"…a little bit less earlier than I do now, because there was nothing to do on Facebook [at the time]. Now there's more people. Basically I just use it to check my news feed and chat with people. That would be it…. I use it a lot more and it got a lot more useful for everything too. Like once I started adding more people it just it's really it has so many different things that it just kind of puts into one space and that's for me an important part of Facebook." (17)*

> *"I was in grade 8 and I think it was more of just friends started to join it like most of my friends started originally just getting on Facebook and you hear about it and then I just one day decided to make an account and like start up with 5 friends I kind of told you about it not much activity going on your news feed." (23)*

> *When I joined it was just finding some old friends and [I was] having discussion in the groups with some new people. So after time passed the number of my friends increased you know. More friends joined Facebook, so I got into my Facebook. There are more news from people that I can follow, then people started to create different pages for everything in any field so I joined these pages and that again caused me to have more news to read, more things to follow. Also I think the apps and games they were not before but now they have them and that's how I got to spend my time with them…. Much more yeah, because it was just once a week now is too many hours a day." (14)*

While we found that different users' motivations are important in initiating technology use, no specific patterns in users' personality traits or emotional states were observed at the early stages of use; i.e. the use of technology does not start because of a specific personality or emotional state of the user, and any individual may adopt and start using the studied technologies. It is important to note that the outcome of phase 1 is an IT usage behavior that is higher than the initial use, while still normal and beneficial to the user. As we explained, in this phase although users might "want" to use technology for various reasons, they do not have a psychological dependence or urge to use technology. The mechanisms described in phase 1 are illustrated in Figure 6.

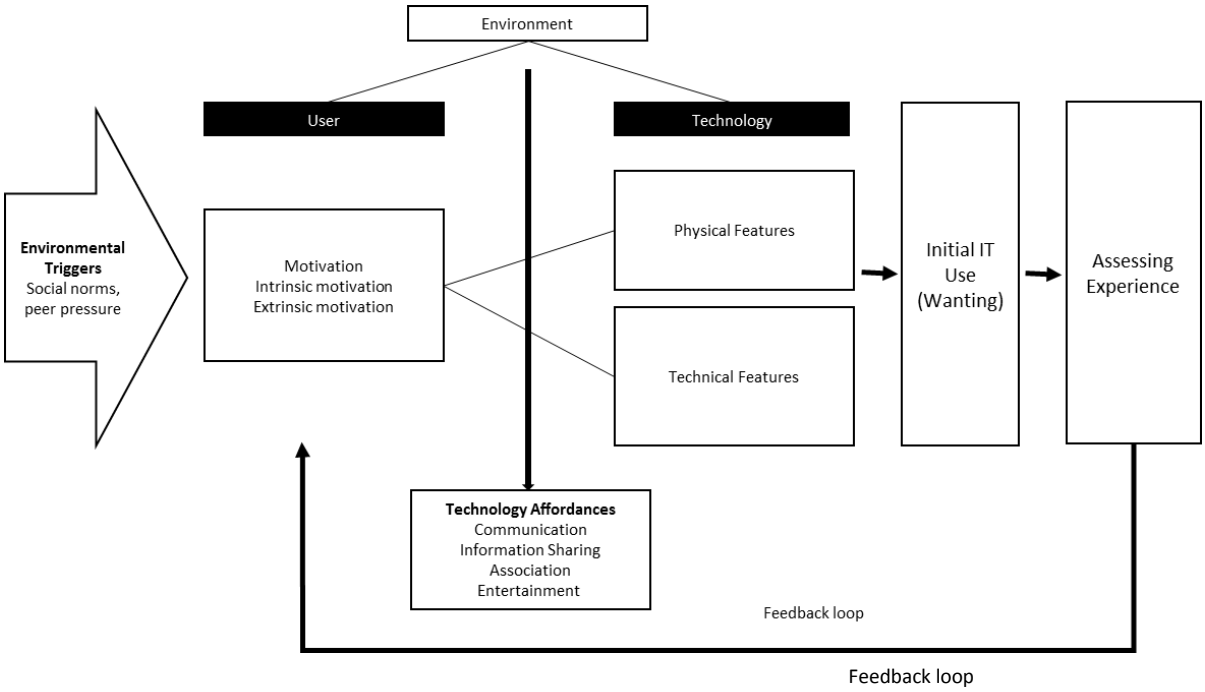

Figure 8: Phase 1 - Initiation

Phase 2: Transition to Addiction

By the beginning of phase 2, the functionality of the technology has been usually realized and users have established technology use patterns in order to take advantage of the benefits provided by technology. While most users may go through phase 1 and experience a change or increase in their IT usage behaviors, not all of them will develop an addiction. Our analysis showed that the addiction can be triggered by several factors that, again, are related to the user, the technology, and the environment. However, the nature of the factors contributing to the initial stages of usage are somehow different from those that play a role in the later stages of use and addiction.

First, we found that the use of technology may go beyond the average (non-problematic levels of usage) if the peers and friends in individuals' social networks are using technology at higher levels of intensity. As in the first phase, where peers could trigger a usage of technology, those who have excessive usage habits (and if there are many of them in a network) could influence the individuals around them. For example, we mentioned that many users are motivated to stay in touch with the others. If peers tend to make changes their social network very often (constantly chatting, sending photos, sending group messages, updaters their status etc.), the user has to further increase her/his usage to keep up with the others in the network, as illustrated by this comment:

> *"It started off as like normal because not a lot of people had it. It was more just connecting with friends that I wouldn't see very often and as most of my friends initially like would be school friends, but I went to college and everyone was using Facebook a lot more… things were coming and you had to check every hour or even sooner... so in that aspect definitely the use grew more." (26)*

Second, our results reveal that certain personality types and emotional states also tend to contribute to the development of excessive usage patterns. As we explain in Appendix III, shy, self-centered, and introvert/extrovert personality types were found to be related to excessive IT usage. Users with high depressive moods or boredom reported that they had higher interaction with technology. Also, an increase in IT usage is partly driven by different motivations that could be extrinsic (e.g. more information, better productivity) or intrinsic (e.g. more enjoyment). In order to reap more benefits, some users (especially those who have lower self-control) tend to go beyond the normal levels of usage.

Third, at this stage, the usage of features and services will increase. Our results showed that as long as technology features can support the needs of the user and technology affordances are being satisfactorily realized by users, the usage will continue to grow. Although both the utilitarian and hedonic uses of IT were important in phase 1, we found that the use of IT in this phase 2 was usually associated with a positive feeling, such as enjoyment, excitement or arousal. This means that in order to experience the transition from normal IT use to addictive IT use, the system has to provide such an experience for the user (i.e. serve users' intrinsic motivation).

> *"Some people just really enjoy seeing those photos and seeing what people are doing on Facebook, whereas other people it's just not as important to them I think." (17)*

> *"I always text, I guess I don't enjoy speaking on the phone. I like enjoying live conversation but I think there are a lot of phobias of phones and calling so they enjoy texting because it's a lot less stressful." (9)*

In regard to these factors, it was interesting to see that rather than having an independent effect on the transition of behaviors to IT addiction, they are interdependent and their effects during the process are compounded; hence, looking at such interactions is critical for understanding addiction development. For instance, we found that users with a self-centered personality appear to have higher interactions with technology. This may occur because of the technical characteristics of a technology (such as social network) that allow users to share information about themselves (e.g. post a status and share a photo) on their network (information sharing

affordance) and receive the attention of others (e.g. through comments or likes). This will eventually provide a positive experience for such users and satisfy their need for self-validation and sense of self-worth, as one respondent pinpointed:

> *"I think it's all for feeling popular and like in the loop. Like with Tumblr I don't really know exactly what it is but I'm pretty sure you like repost other people's stuff and you can look at other things and find interesting stuff and post it on yours. So like any of that it's just you expressing yourself somehow and then receiving validation for it and seeing what your friends are doing and like it's all a matter of connecting socially and somehow benefiting personally from that." (38)*

In another example, shy people were found to experience higher interaction with technology. The effect of this trait can also be explained through the technology features and affordance. Since technology can provide a convenient way to communicate with others through social media means and smartphone-enabled communication, individuals with a shy or introvert personality tend to engage highly in virtual communications (communication affordance) in order to overcome the difficulties of real life situations and compensate for lack of social interactions. In this case, again a continuous exchange between users and technology (traits, motivations, features and affordances) is what leads to IT addiction, as illustrated by one interviewee: "*It [excessive usage] also works for introverts, who like feel comfortable expressing themselves online but not in person. It gives them a voice to say what they want without going through awkward interactions with others"* (22).

The transition to addiction goes through loops, where users increase their usage of technology in order to get the maximum benefit out of IT use (e.g. validation, information etc.), while gradually losing control of their behavior. Our analysis shows that, over time, such IT usage generally produces positive feelings and pleasant experiences for users that are described by feelings of enjoyment, excitement, mood boosting, joy and relief from anxiety. The positive experience generally drives more usage, while the user develops a psychological dependency on IT. The dependency is visible through symptoms such as feeling deeply involved with technology and being preoccupied with its use.

> *"I will go crazy, if I leave it at home… no matter how far I am I'll go back to get my iPhone. I feel unsafe without it." (3)*

"It's a friend of mine…. I want it with me and I feel naked without it. I feel like I'm missing something." (2)

"I feel weird when I don't have it with me. I would panic if I leave home and I don't have it with me. I'd have to go back and get it or I feel lost." (5)

The loss of control together with the dependency impedes users from seeing the negative outcomes that begin to appear as a result of their excessive usage (such as taking time away from other productive tasks). Through repetition of this vicious cycle, the positive feelings experienced by users will become saturated, which means that additional usage will not produce the similar effect. For instance, some excessive users mentioned that they felt frustrated and anxious if they did not have their smartphones at hand or could not check their social networks. Although the experience of users could be unique and specific to them, the mechanisms we have discussed in this phase continue up to a point at which dependency becomes fully formed and "wanting" to use IT changes into the "urge" to use IT (see figure 7 for an illustration of phase 2).

"I guess like most of us do (use Facebook) loosely but I think a lot of people in our generation are slightly … have formed an addiction to it because of the fact that we're always checking it and we always have to…. I definitely think many people have the urge to look at Facebook all the time and be connected. So I definitely think in that sense it has created an addiction." (26)

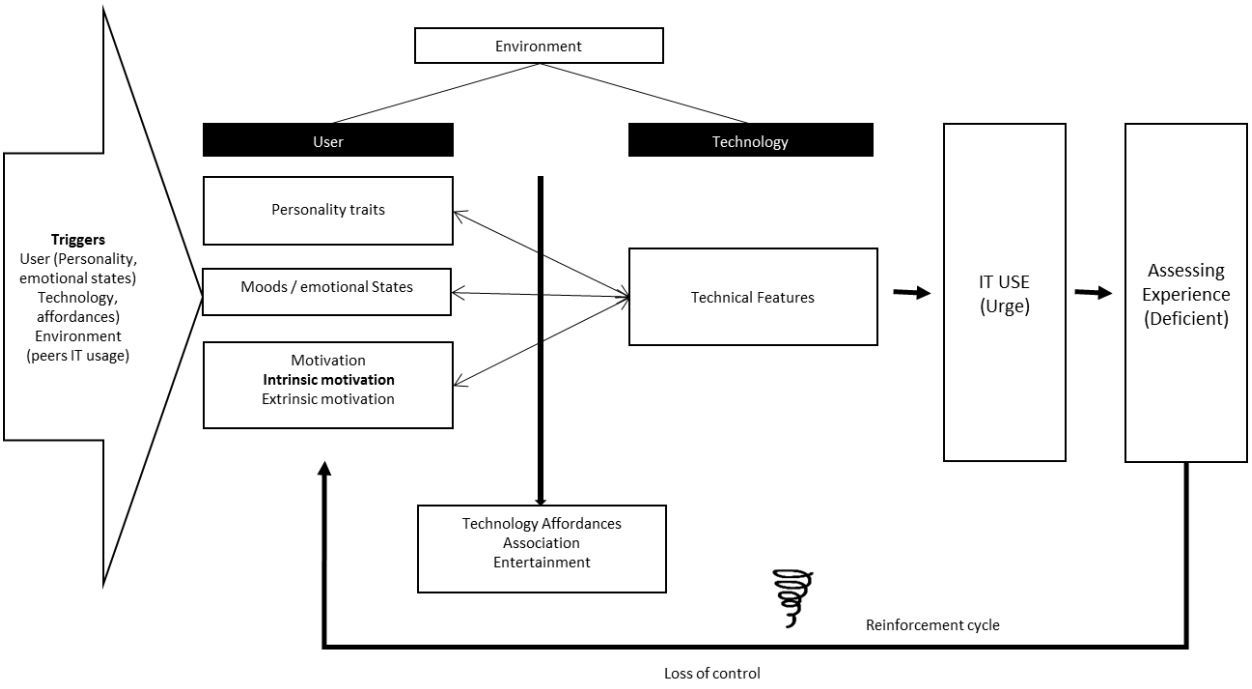

Figure 9: Phase 2 - Transition to Addiction

Phase 3: Persistence

Our analysis showed that, with time, excessive and compulsive IT use, once formed, could be followed by serious negative consequences that undermine users' work and personal life and, in the long term, may damage their physical well-being. At this phase, some users acknowledged that addictive use of IT can conflict with important tasks and life activities. The conflict was found to be rooted in the time taken away from other tasks either by excessive IT use or the distraction caused by the obsessive need to constantly interact with technology. For instance, one respondent mentioned that

> *"It distracts me from studying and sometimes a simple assignment can take twice as long because of that. I look at the notes and I'm thinking I have to check my email right now…. I go to check the email, I end up playing a game, reading news and it's like I totally forget I had to study for class." (5)*

> *"It can definitely be distracting during studying but I wouldn't say it's like a compulsive need to check Facebook, it's just like sort of a distraction I'm like oh I can't focus and I'm like oh I'll go on Facebook and you end up being on there like scrolling through the news feed for longer than you wanted. Never like hours or anything but just like you know 10 minutes here and there and then it adds up. And yeah like I said I don't really open it and like spend a lot of time like chatting to people." (23)*

In addition, we found that obsessive and compulsive IT use may have some negative effects on the social life of users. Excessive and compulsive use of technology (especially for communication) may hinder real-life communication and social interaction with peers, as illustrated by the following quotes:

> *"I think that it definitely kind of takes away from their experiences in the real world. Like I think that spending a lot of time kind of in a virtual world like takes away from like actual like personal development and like ability to deal with things that you have to deal with in the real world. I think that it would definitely interfere with like maybe even relationships or something at work." (25)*

> *"I know, I'm so used to it that [it] annoys my parents. When I'm at lunch or dinner with them, you know, I check the phone every 5-10 minutes, so does my sister. I can say, like, every time, there's a conflict." (6)*

Obsessive and compulsive usage patterns were also found to have some impact on the health status of some users. Spending long hours using smartphones or social networks (usually without

any break), could lead to sleep disruption, eye strain and back pains that undermine the overall well-being of users (see Figure 8).

> *"I usually go to bed with it. I keep checking my emails and Facebook or playing games with friends who are up and online on the network. If my girlfriend is staying over, I have to pay attention to her; otherwise I just play till I'm really tired, especially if I don't have to wake up early the next day." (6)*

Users' behaviors at this stage remain problematic and can produce negative impacts on their lives unless the users decide to control and decrease their usage or other preventive or intervening mechanisms are implemented. Such controlling actions can break the addiction cycle and reduce the usage to less problematic levels that are associated with fewer or no negative outcomes.

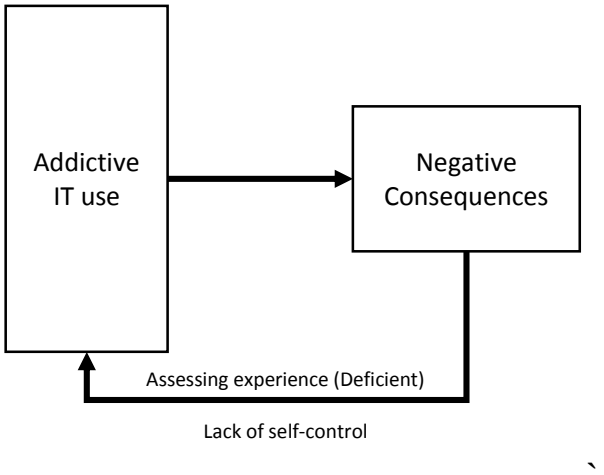

Figure 10: Phase 3 - Persistence

In summary, from our data, we found that the process starts with fairly regular use. The characteristics of the environment (e.g. peer pressure, social norms etc.) seem to trigger the adoption of technology for most individuals. The initial adoption and use of a technology for a period of time provides an opportunity for users to connect with the technology, evaluate it and check whether the technology's features and affordances satisfy their intrinsic and extrinsic needs. To get more benefits from the technology, some users increase their level of engagement and the time spent on different tasks and activities. Some individuals with specific personality traits, emotions and motivations were found to further increase their interaction with technology, while having a deficient assessment of the gains from the system (e.g. undermining the negative

consequences). Increased and unregulated IT-use behaviors appear to be followed by the feeling of an urge to use technology. The persistence of problematic behaviors will most probably bring challenges to IT addicts' lives. Such addictive behaviors can limit the amount of time and effort spent on productive tasks, inhibit social relationships and cause psychological issues for users. Despite these negative consequences, IT addicts persist in their excessive use of the technology. Figure 9 illustrates our findings and portrays the three phases in the process of IT addiction development.

Discussion and Conclusion

This study is a response to the recent calls in IS research to further investigate the negative side of IT use (D'Arcy et al., 2014; Tarafdar et al., 2015). Specifically, our aim was to develop a process model to understand the development of IT addiction. By reviewing the literature from various disciplines, we first identified the building blocks of IT addiction. Then, building on the analysis of 38 interviews collected from smartphone and social network users, we shed light on the mechanisms that underlie IT addiction development and proposed a process model. Our data analysis revealed three main phases in the course of IT addiction development. In the first phase, users get to know a technology and learn how to use its features in order to benefit from utilitarian and hedonic effects associated with IT use. In the second phase, depending on the triggers related to the user, the technology and/or the environment, some users may fall into problematic patterns of use and develop psychological dependency on the technology. Finally, in the third and last phase, the negative consequences of IT addiction will persist, which can undermine users' lives.

Our process model shows how user- and technology-related factors interact with each other in the context of IT addiction. While, to our knowledge, there is no study that examines the process of IT addiction development overall, our findings are consistent with previous models that focused on the general addiction types (Baciewicz, 1993; Baler & Volkow, 2006; Grover et al., 2011; Koob & Le Moal, 2008) and assumed different stages leading to substance abuse. For instance, Marlatt et al (1988) discussed the common stages of addiction, including the experimentation and acquisition stage, the transition and maintenance of the addictive behavior

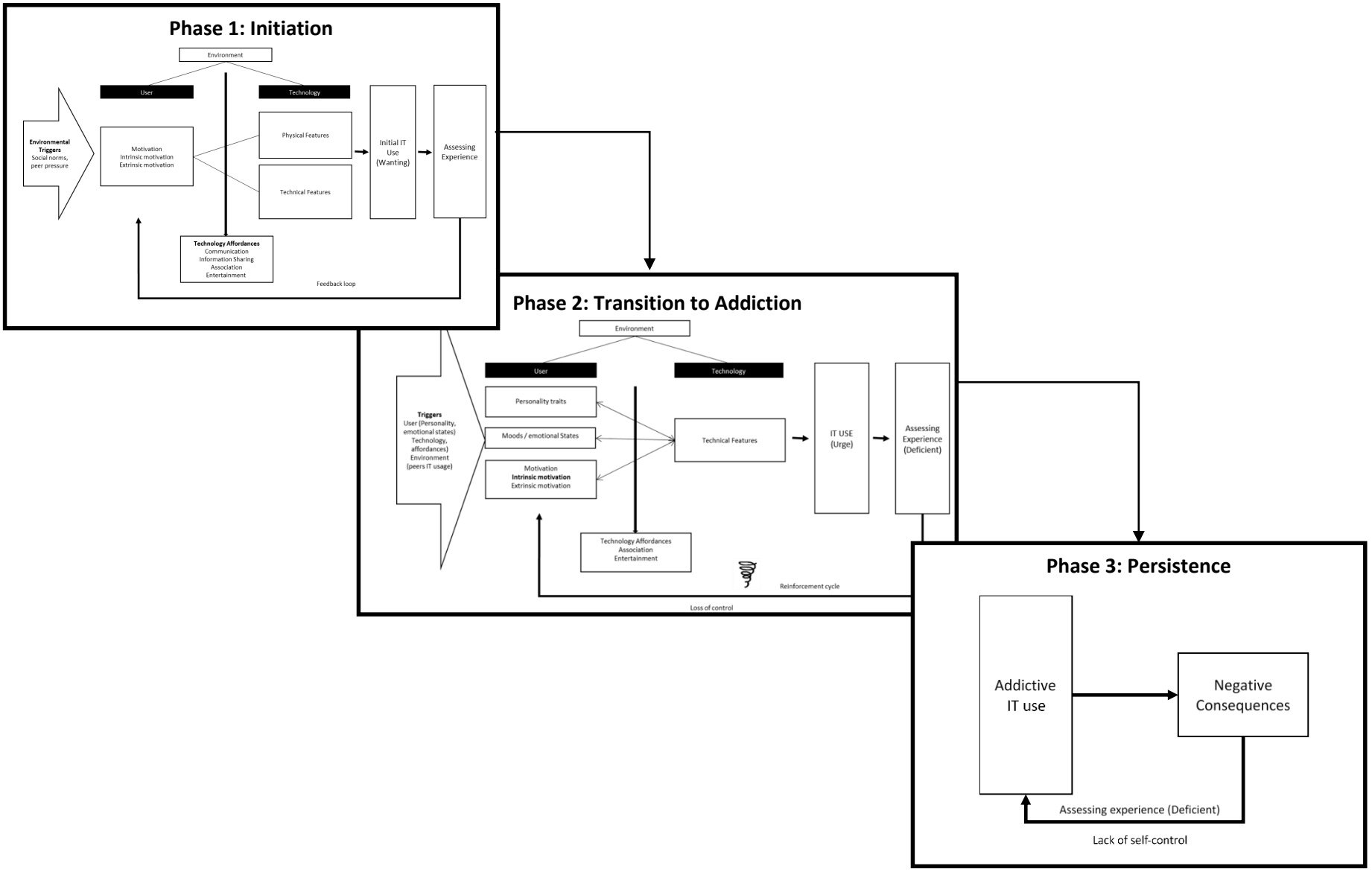

Figure 11: The process model of IT addiction development

stage and the active change stage.[2] Our findings are also consistent with Grover et al.'s (2011) and Martin et al.'s (2013) models that depict various stages of consumption addiction from non-use to addiction.

The results show that three main elements interplay during the development of IT addiction: the user, the technology and the environment. First, we found that individuals are indeed important in studying IT addiction. Our study contributes to our knowledge about the role of users in the development of IT addiction by highlighting the role of users' motivations and showing how they shape usage behaviors by defining affordances that users may enact. Both intrinsic and extrinsic motivations were found to be critical in this process, and they particularly help to understand which affordances of the technology will be perceived and enacted by the user across phases. These findings echo previous research that looked the role of extrinsic (usefulness) and intrinsic (enjoyment) motivation on IT use (Davis et al., 1992) in different contexts, such as microcomputers, the internet and social networks (Igbaria 1996; Teo et al., 1999; Ross et al., 2009; van der Heijden 2004, Soliman et al., 2015). Considering motivation along with users' personality traits and emotions was critical and enriched our insights about the development of excessive and compulsive IT use. Indeed, our results showed that although the extrinsic motivations (e.g. information and productivity) are critical during the earlier stages of addiction development, intrinsic motivations (enjoyment, staying in touch etc.) become more salient at the advanced stages of use (i.e. phase 2), which is consistent with recent findings on the changing nature of users' motivations over a period of usage (Soliman et al., 2015).

Our investigation of IT addiction adds to the extant knowledge, as it focuses on technology and its role during the development of IT addiction. The extant literature (especially in the health and psychology literature) generally treats technology addiction as equal to other types of addiction and thus overlooks the role of technology's characteristics in the development of addiction. Only recently have some studies hinted at the fact that technology can be important in the emergence of IT addiction. For instance, Turel and Serenko (2010) argued that the ubiquitous nature of mobile email technologies may instigate excessive dependency and preoccupation with them. Our study specifically highlights the characteristics that are related to technology's physical attributes and technical aspects. The study also enhances our

[2] Our model does not focus on behavior change and recovery after the persistence phase.

understanding of the role of technology in the IT addiction process by using technology affordance to study the specific opportunities provided to users (for communication, entertainment, association, and information sharing) that may lead to IT addiction. Although focusing on the affordances of technology in studying the outcomes of IT use has recently received attention (Treem & Leonardi 2013; Strong & Volkoff, 2013), our study looks at affordances in a novel context, which casts light on the specific interactions and dynamics involved during the development of IT addiction.

Moreover, our findings reveal the instrumental role of the environment surrounding users in triggering different phases of IT addiction. Although the intricate interactions between user and technology appear to be key in determining IT addiction, it is important to take into account these interactions in relation to the contexts in which they occur. Our analysis showed that the behaviors of peers and social norms could directly influence users' behaviors and, thus, should be taken into account in studying addiction. Despite the importance of context, with the exception of Turel and Serenko (2012), the usage context is not well recognized in the IT addiction literature. Yet in the general addiction literature, the roles of social environment and culture have been mentioned as both enablers and inhibitors of addiction to various substances (Marlatt et al., 1988; Caprioli et al., 2007; Martin, 2013). Our model adds to knowledge by providing insights into the role of context during the initiation and transition phases of the IT addiction process.

Several mechanisms were found to work with each other during the process of IT addiction. First, the reinforcement cycle, in which a subject is being stimulated to continue a behavior or a substance usage as long as the rewards persist, has been addressed in previous studies of technology addiction (Armstrong et al., 2000; LaRose et al., 2003). Some researchers, for instance, framed addiction as a brain reward produced every time usage occurs (Baciewicz, 1993). In such cases, addiction has been considered a physiological process that produces "the inherently pleasurable" reward for individuals. In order to reinforce the same pleasant feeling, individuals may increase self-administration of the substance to the point of losing control over their behavior (Armstrong et al., 2000; Baciewicz, 1993). In our study, we found that as the cycle continues and usage increases, users fail to control their usage and exert low or minimum regulation to stop the cycle. The reward deficiency theory can also be useful in explaining the

dynamics of the reinforcement cycle. According to this theory (Murali & George, 2007; Porter & Kakabadse, 2006), certain individuals tend to consume substances excessively to enhance stimulation of rewards. In our study, we found that IT users who have certain personality traits, emotional states, and motivations increase their engagement with technology above the regular levels of use. It appears that technology provides a quick and immediate reward, such as entertainment or a pleasant feeling that is comparable to the effects reported in other studies of addiction.

Furthermore, our model shows that IT usage goes through significant transformations throughout the course of addiction development. The intensity of use will increase over time, first when all users gain experience with technology, and then when some of them go through the transition phase of IT addiction. Previous research indeed has shown that habits can grow to be problematic (Ouellette & Wood, 2005; Turel, 2014). As users experience the thrill from a rewarding behavior, they tend to develop a constant desire to repeat the same behavior in order to receive that reward, while underestimating the cost of repeating that action (Turel & Serenko, 2012). Second, the nature of usage behaviors can change over time from a non-problematic "wanting" to use IT to a problematic "urge" to do it. Similar findings were reported in other addiction-related contexts (West, 2005; Goodman, 2007; Turel et al., 2011). As users repeat a specific action, "the brain can become more sensitive to use cues and overemphasize the salience of the thrill generated by the behavior" (Turel, 2014, p. 6) until it forms a pathological urge and reaches a state of compulsion to use again (West, 2005).

Overall, our study shows that IT addiction is a complex process that is affected by several elements and interdependencies between the user, the technology and the environment. Addictive behaviors can develop gradually, depending on the nature of interactions among these elements. While most users who develop an addiction appear to go through a similar process and show pathological usage behaviors over time, they progress through these phases at different speeds. In relation to previous research, our results suggest that some supporting conditions (e.g. those related to the user, technology and environment) may facilitate speeding up or slowing down this process. Yet once developed, addictive behaviors will be followed by negative consequences, at which point users may experience social, psychological and occupational problems. While we know that only a small proportion of IT users display extreme

levels of IT use and addiction (Turel & Serenko, 2010; Chou & Ting, 2003; Widyanto & Griffiths, 2006; Porter & Kakabadse, 2005), a substantial percentage of users may exhibit mild degrees of IT addiction (Vaghefi & Lapointe, Paper1); many users are even unaware of their dependency and deny having problems as a consequence of their IT use behaviors (Vaghefi & Lapointe, Paper1).

Some limitations have to be acknowledged and considered in interpreting our results. First, our data was collected at one point in time. In line with our research design, our interviewees had to recall and articulate the progress of their IT usage behaviors retrospectively. Hence, there is a risk of biased or incomplete recollection of the events. In this regard, a longitudinal data collection or observations would have been more effective in lowering such risks and complementing our database. For instance, conducting interviews at different points in time (e.g. during phases 1, 2 and 3) could have shed more light on other mechanisms (if any) and shown better how they evolve through time. Even though our respondents displayed confidence in their responses to our questions, conducting interviews in a longitudinal manner might have helped identify other interactions that users might overlook when they become addicted to technology. Second, our data was collected from young individuals, which could affect the generalizability of our findings. Third, our investigation focused on two technologies (smartphones and social networks), which both have a social and entertainment nature by design. This limitation offers an avenue for future research, as examining a broader range of systems and technologies could help refine our insights and further push the generalizability of the findings.

Despite its limitations, our study makes novel contributions to theory and practice. First, this paper clearly identifies the phases and the mechanisms that underlie the development of IT addiction. In this regard, it adds to the existing knowledge that mainly provides a static view of IT addiction. Rather than only discussing each component involved in this process in isolation, our study provided a process-based overview of interdependencies and entanglements between the user, technology and the environment and showed how IT addiction emerged from these dynamic interactions over time. Second, our findings contribute to further theorization of the IT addiction phenomenon by specifically focusing on the technology and showing the elements and mechanisms that come into play through interaction with the user (i.e. unique technology

affordances). Despite the depth and breadth of research on IT addiction, existing models have generally adopted existing frameworks from the substance addiction literature (Armstrong et al., 2000; Murali & George, 2007; Byun et al., 2009), and most have not focused on the unique nature of excessive and compulsive IT use. This study contributes to the extant knowledge by showing interactions that are exclusive to the IT use context. By focusing on technology features and affordances, we provide valuable insights into specific user-technology interdependencies associated with the development of IT addiction. Finally, our study adds to the technology affordance perspective by empirically examining the main affordances associated with IT addiction and how they evolve over time. Looking at the temporal trends between phases showed that while all affordances were influential during the initiation phase, the entertainment and communication affordances became more important during the transition phase of IT addiction. The results of this study call for further research on the changing and evolving nature of factors and mechanism underlying IT-related phenomena (such as IT habits) and an examination of their importance over time.

In terms of practical implications, our findings are helpful in providing a more comprehensive understanding of excessive IT usage and addiction. By understanding the process of IT addiction development, managers and employees can get detailed insights about when and how normal IT usage might turn into an addiction. The results suggest that some users (depending on their personality, moods and motivation) have a greater tendency to develop IT addiction, especially when they use a technology that at one and the same time enables them to fulfill their specific needs and provides a positive and thrilling experience. The results can be used in order to design preventive and intervening mechanisms to make sure that technology users do not develop excessive dependency and addiction to IT. This can ensure that users and organizations will not suffer from the negative consequences of IT addiction. Depending on the evolution of their problematic behaviors through different phases, differentiated actions can be taken, such as prevention (if users are in phase 2) or intervention and treatment (if they are in phase 3). The findings also emphasize that it is important to take into account the negative aspects of IT when making decisions about adopting new technology innovations and promoting existing technologies. Examples of technologies that can have such double-edged effects are organizational social networks or smartphones given to employees. As we mentioned in the

introduction, while there are indeed benefits associated with the use of these technologies, the negative consequences should be taken into account by managers and employees.

On the whole, the literature on IT addiction is new and developing in the IS/IT discipline (Turel et al., 2011). Given the novelty of the topic, this paper yields important contributions to the theorization of the phenomenon. We hope that our study will stimulate future research on IT addiction and other similar phenomena when technology usage is found to be undesirable. As technology continues to advance and intermingle with our daily lives, it is important to be aware of the process of addiction-driven technology use and the unexpected outcomes that may follow from such behaviors. We hope that other studies will further examine the key building blocks (user, technology, and environment.) as well as the micro dynamics involved in the addiction development process in order to push further our understanding of such irregular and sophisticated types of IT use.

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Appendix I: Smartphone Addiction Interview Guide

8- Introduction:

Thank you for meeting me. The purpose of this interview is to gather information for research on smartphone use.
I will start with general questions about the subject and then discuss impacts of smartphone use. I will continue with questions about the long-term usage of these tools, the reasons for that and the potential consequences. In the end, I will ask you to fill out a very, very short questionnaire (about 2 minutes). The conversation will be recorded to ensure the accuracy of data collection. Be assured that all information collected will be confidential.
[Consent form]

9- General Question

To begin with, I want to become familiar with your general smartphone use. If I follow you through a typical day, what would I see you doing on your smartphone?

- For what purposes you currently use your smartphone?
    - Professional? Personal? Social?
    - What applications (e.g. e-mail, texts, social networks, games, internet surfing,)

How much time, on average, do you spend using your smartphone every day?
Estimate of what proportion of that time is devoted to a) e mail b) texts c) social networks; d) games; and e) internet surfing?

- What time of the day do you use your smartphone? (Mostly morning, afternoon, evening, night?, any free time)
- How would you compare your use of other types of technology (laptop, tablets, TV) with your use of your smartphone (in terms of overall amount of time and time of day)?

How do you feel about your level or amount of time of smartphone usage?

10- The Process

You've told me about…… Now, I'd like to ask you about your experience over time with your smartphone. Let's go back to when you first bought your smartphone and go through your experience up to present.

So, How did you come to buy a smartphone? What were the main reasons you decided to do it?

- What kind of phone you had before? How did you feel about the previous phone?
- Were there any hesitations about buying a smartphone?

- Was there any pressure from the environment or friends?
- What did you expect from a smartphone?
- In the beginning what were the things you especially liked-if anything-about smartphones?
- What did you dislike?
- What applications (games, email, social media, internet browsing) did you use more at the beginning?
- Tell me how you used the smartphone in the beginning? How often, what times of day, for how long?
- What did you think of your experience at the beginning?
- As you became more experienced, how did your smartphone use change, if at all?
- Overall, how did your experience with the smartphone match your expectations at the beginning?
    - Did you feel satisfied or dissatisfied?

Okay, now I'd like to ask some questions about your smartphone use experience now versus your experience at the beginning

- How do you feel about your smartphone usage if you compare it to the time when you began usage?
    - Do you notice any change in your behaviors overtime? (in term of amount of use, frequency of use , etc)
    - How do you think it happened?
- In case there is a change, what do you think could be the reasons for change in your usage?
    - Did you learn about new functions, features, applications, etc
    - What applications do you use now compared to the beginning? Please elaborate for what reasons you use them.
- What would people around you (like your friends and family) say about your smartphone use? About how much you used it before and now? How do they feel about it?

If you have some friends and you feel that they use their smartphone excessively, how would you describe their behaviors? Please give me some examples.

What about yourself? Do you think at times you might engage in excessive use? Tell me about those times.

From your point of view, what's the difference between excessive use and addiction or dependency? Can you describe someone's behavior who you think is addicted, or at least borderline? Please provide some examples or tell a few stories about people you've observed.

Please tell me about any concerns you've had that you could become addicted? What do you think it would look like in your case? How would excessive use possibly become addiction?

What do you think might make some people more inclined than others to excessive use or addiction?

Causes and triggers

1. Have you ever wondered why some people might be more interested in new technologies or smartphones?
    - What would be different in them?
    - How would you describe their personality?
    - How do you think they are different form you?

2. What should you see in a new technology to be interested in using it? How about smartphones? Think about a friend or family who uses smartphone excessively, what would be important for them?

Impact

How would you describe the impact of smartphone use on your life? At work? At home? Other?

- How does it influence, if at all, your work/study performance? (Positive and negative)
  - Overload
  - Procrastination
  - Productivity
  - Performance
  - Satisfaction
  - Stress
  - Spillover
- How does it influence, if at all, your well-being? (Positive and negative)
  - Tired
  - Headache
  - Hearing problems
- How does it influence you, if at all, financially? (Positive and negative)
  - Over budget?
- How does it influence, if at all, your social life? (Positive and negative)
  - Relationship with Family
  - Relationship with Friends

Have you ever got in to trouble cause of your smartphone usage?

If you think of someone around you with smartphone dependency, how do you think it impacts their life? (Negative)

11- Conclusion:

Thank you for your participation. The time you have spent with us is greatly appreciated and your comments are very important for the success of our study.

- Is there anything else about smartphone use you want to add that you think is important to understand the use of smartphones?

For questions 1-8, please circle the appropriate answer.

1. Do you feel preoccupied with your smartphone (think about previous smartphone use or anticipate next smartphone use)? YES NO

2. Do you feel the need to use your smartphone over increasing periods of time to achieve satisfaction? YES NO

3. Have you repeatedly made unsuccessful efforts to control, cut back, or stop your smartphone use? YES NO

4. Do you feel restless, moody, depressed, or irritable when attempting to cut down or stop your smartphone use? YES NO

5. Do you use your smartphone longer than originally intended? YES NO

6. Have you jeopardized or risked the loss of a significant relationship, job, educational or career opportunity

because of your smartphone use? YES NO
7. Have you lied to family members, therapists, or others to conceal the extent of involvement with your smartphone? YES NO
8. Do you use your smartphone as a way of escaping from problems or feelings of helplessness, guilt, anxiety, and depression, etc.? YES NO

Socio demographic questions:
Email address? Age? Student: Level? Program? Where? Worker: Profession? Where? For how long have you had a smartphone? How much time, on average, do you spend using your smartphone every day? How much is your smartphone plan value? Approximately how much are your monthly cell phone bills?

Appendix II: Social Media Addiction Interview Guide

1- Introduction:

Thank you for meeting me. The purpose of this interview is to gather information for research on the use of social networks.

I will start with general questions about the subject and then discuss the impacts of social network use on your life. I will continue with questions about the long-term usage of these tools, the reasons for that and the potential consequences. In the end, I will ask you to fill out a very, very short questionnaire (about 2 minutes). The conversation will be recorded to ensure the accuracy of data collection. Be assured that all information collected will be confidential.

[Consent form]

2- General Question

To begin with, I want to become familiar with your general Facebook use. If I follow you through a typical day, what would I see you doing on it?

- What type of activities on Facebook?
    - Surfing, commenting, chatting, leaving messages, likes, play games/apps
- How much time, on average, do you spend using Facebook every day?
    - What time of the day do you use Facebook? First thing in the morning? Afternoon? At night?
    - What device you use Facebook? Laptop, tablet, smartphone

How would you compare and contrast using Facebook with other technology use during the day? such as gadgets, games, internet

- Amount of time
- Time of day

How do you feel about your level of use and amount of time spent on Facebook?

- Has anyone ever commented on that?

3- The Process

You've told me about your everyday behavior. Now, I'd like to ask you about your experience over time with Facebook. Let's go back to when you joined Facebook for the first time and go through your experience up to present.

So, How did you come to join a Facebook? What were the main reasons you decided to sign up?

3. Did you join in any other network before Facebook? If any, how did you feel about your experience with that?
4. Were there any hesitations about joining Facebook?
5. What were the motivations?
6. What did you expect to gain from Facebook?

How would you describe your Facebook use early on (when you began usage)?

a. What were the things you liked-if anything-about Facebook at the beginning?
b. What did you dislike?
c. What activities did you do more at the beginning? Why so?
d. Tell me how much you used to use Facebook at the beginning?

7. What did you think of your experience at the beginning?

a. How was your first Facebook experience with regards to your expectations at the beginning?
b. Were you satisfied/ dissatisfied? Tell me why you think so?
c. What were the advantages of Facebook use for you? What were the drawbacks if any?

Okay, now I'd like to ask some questions about your Facebook experience now versus your experience at the beginning

8. How did your behaviors of Facebook use evolve?
    a. Do you notice any change overtime?
    b. How do you think the change happened?
    c. Please explain to me how you learned about new functions?
9. How do you **describe** your current Facebook usage if you compare it to the time when you just began using it?
    a. How would you see the difference? (e.g. intensity, frequency of use , etc)
    b. What do you think could be the reasons for change in your usage?
10. How do you feel about your current Facebook usage, if you compare it to the time when you just began using it?
    a. What are the advantages of Facebook for you? What are the drawbacks if any?
11. What would people around you (like your friends and family) say about your Facebook use? How do they feel about it?

Excessive use/addiction

12. If you have some friends and you feel that they use Facebook excessively, how would you describe their behaviors? Please give me some examples.
13. What about yourself? Do you think at times you might use Facebook excessively? Tell me about those times.
14. From your point of view, what's the difference between normal use and excessive use?
15. Do you see any difference between excessive use and addiction? What would it be?
16. Can you describe someone's behavior who you think is addicted, or at least borderline? Please provide some examples or tell a few stories about people you've observed.
17. Have you ever had any concerns that you might become addicted? What do you think it would look like in your case? How would use or excessive use possibly become addiction?

4- Causes and triggers of Facebook use

- What was the reason for joining a social network like Facebook?
- What does prompt you to use Facebook more?

1. Have you ever wondered why some people to be more inclined to excessive use of social networks (or any other technological innovation) or addiction compared to others?
    a. What would be different in these individuals regarding their personality or specific traits they have? What kind of individuals would use Facebook more?
2. What should you see in a new technology to be interested in using it? How about Facebook?
    a. Technical Features (Social, Control, Presentation, Rewards and punishment Features)
    b. What technology features allow you to do? Affordances
3. Think about someone from your friends or family, who'd use social network a lot; what features of technology would make them use it a lot?

5- Impact of Facebook use

What has been the impact of Facebook throughout your period usage? initial impact

How would you describe the impact of Facebook use on your life?

4. How does it influence, if at all, your work/study performance?
    a. Positive /e.g. communication, connectivity, productivity, collaboration
    b. Negative/ e.g. Overload, Procrastination, Productivity, Performance, Satisfaction, Stress, Spillover
5. How does it influence, if at all, your well-being?
    a. Positive and negative
        i. Tired
        ii. Headache
        iii. Hearing problems
6. How does it influence you, if at all, financially? (Positive and negative)
    a. Ever went over budget?
7. How does it influence, if at all, your social life? (**Positive** and negative)
    a. Relationship with Family
    b. Relationship with Friends
    c. Connectivity to others

Have you ever got in to trouble cause of your Facebook usage? examples
Please describe occasions, if any, that you or your friends have caused any harm due to Facebook usage?

If you think of someone around you with Facebook addiction, how do you think it impacts their life?

6- Conclusion:

Thank you for your participation. The time you have spent with us is greatly appreciated and your comments are very important for the success of our study.

- Is there any story or anecdote about Facebook use you want to add that you think is important to understand?
- Is there anything you want to add?

Thanks for your time

For questions 1-8, please circle the appropriate answer.

1. Do you feel preoccupied with Facebook use (think about previous time you used Facebook/comments or anticipate next Facebook use)? YES NO

2. Do you feel the need to go on Facebook over increasing periods of time to achieve satisfaction? YES NO

3. Have you repeatedly made unsuccessful efforts to control, cut back, or stop your Facebook use? YES NO

4. Do you feel restless, moody, depressed, or irritable when attempting to cut down or stop your Facebook use?

YES NO
5. Do you use your Facebook longer than originally intended? YES NO
6. Have you jeopardized or risked the loss of a significant relationship/friendship, academic performance, or career opportunity because of your Facebook use? YES NO
7. Have you lied to family members, therapists, or others to conceal the extent of involvement with Facebook? YES NO
8. Do you use your Facebook as a way of escaping from problems or feelings of helplessness, guilt, anxiety, and depression, etc.? YES NO

Socio demographic questions:
Age? Student: Level? Program? Where? Worker: Profession? Where? For how long have you used Facebook? How much time, on average, do you spend using Facebook every day? Approximately how much are your monthly cell phone/internet bills?

Appendix III: The building blocks of addiction development process

Building Block 1: The User

The results of our analysis generally confirmed that the user agent plays a significant role during the process of IT addiction development. We found that although the overall usage of technology in respondents could be high, some similarities and common patterns exist among users who tend to use IT excessively and compulsively. We discuss these patterns below. Although we do not argue that these are the only circumstances related to the user in regard to IT addiction, we found that they are helpful in understanding the role of the user, an understanding which we believe is required when one studies the process of IT addiction.

Personality: First, we found that some personality traits are associated with the development of IT addiction. The results show that those who have a very quiet social life (i.e. introverts) and less engagement in real-life interactions with others (e.g. friends, classmates etc.) tend to become deeply involved in technology and IT mediated communication and tools. The extended interaction with IT supplements the lack of interpersonal relationships these individuals may experience in their real life. Such behaviors were also noticed by their peers, since many interviewees mentioned the behaviors of their introvert friends.

> *"For example, I can say some of my non-social friends would be addicts. I mean it's pretty obvious.… I don't know why they won't hang out with many people. But I see them on my Facebook all the time posting things, sending messages. Though they don't really go out that much, it looks like they do so much, if you look at their page." (15)*

> *"It also depends I think on how outgoing you are as a person. Although I do use Facebook to talk to people and to tell people how I'm feeling and what I'm doing, I can also go and do that myself. I'm pretty outgoing I don't care about that I'm not a shy person so that doesn't really affect me but people that rely on Facebook to do that they can't, well not that they can't, but prefer not to go and talk to people in person. I think they would find it harder." (38)*

Similar to this, we found that the users who may perceive themselves as shy, and those who have difficulty when communicating with others, tend to spend too much time with smartphones or on Facebook and engage heavily in virtual discussions. For such users, IT

appears to provide a medium that facilitates communications and helps users express themselves.

> *"Like people I knew that were super shy and never said anything; on Facebook they would just make all these posts and talk about everything which to me is crazy because you're like yeah, yeah. I know that like my boss used the example of a girl in high school, this girl was really quiet never said anything, never had any friends blah, blah, blah and I have her on Facebook now and like she just she posts every second of the day; I think because you don't have to say it. So, I find that really interesting as well." (18)*

Contrary to our expectation, we also found that some users who may have a very active social life (i.e. extrovert) could also use technology excessively to maintain their real-life relationships with friends and peers, and to keep themselves updated on current events. However, such patterns of usage come at a cost of losing time on other productive tasks.

> *"I see that some of my friends are more into it [Facebook], because they are more social and they enjoy interacting with people a lot more…. They have a lot of things to say. There are some people that are just consistently very social like social activists who will just bombard if exciting things are happening in their life." (24)*

The results also showed that users with a *self-centered personality* type tended to use communicative technologies more than others. Such individuals use these tools in order to gain visibility within their network of friends and peers and receive admiration from them.

> *"I notice there's some snobby people with they tend to use Facebook more and just like post every picture they have and there's like a million different selfies of* themselves and then put all of them and say 'Oh I look so ugly' and then you know *people comment 'Oh no you're not ugly' and it's just like hit the like. That's people who would put everything on Facebook and just like they…" (34)*

Emotions: In addition to the traits that were related to the social life of users, another issue that could drive problematic technology usage was found to be related to *users' emotions* and their mental state while engaging with a technology. First, our results show that inner insecurities and doubts about self may be associated with higher levels of technology use. Although our respondents did not directly address their own insecurity, many emphasized that insecurity of friends in their network could explain why these users constantly engage in social networks (post images, leave comments) and maintain a high level of interaction with their online friends.

Through interactions a user may seek attention of others or hope to gain validation from peers. The following quote addressees this issue:

> *"I think sometimes it [addiction] comes with insecurities in a way like I think that someone who feels less secure about themselves might use Facebook a lot more often.… I think there are other people who are kind of pretentious and think highly of themselves or people who think really negatively of themselves but want people to think that they think positively about themselves." (25)*

> *"Let's say we just got back from spring break and I think I had a good spring break but I need to go look at everyone else's profile to just look at their photos to see if it looks they had more fun than me. And then if I've looked at them a possible good outcome would be, oh well from my pictures it looks like I had much more fun than all these other people so I'm cooler and more popular." (27)*

Our analysis also showed that most users will increase their usage when they feel bored. As mentioned by the interviewees, they tend to pull out their smartphone, play games, check different applications, or go on Facebook and surf other users' profiles, pictures and other updates. Such behaviors will occur on any occasion when users feel disinterested, such as during classes, during meetings, and other generally inappropriate social occasions (e.g. out with friends, dinner with family etc.). Using technology provides a tool to escape from such situations. Although boredom could be a temporary emotional state, constant interaction with technology to get over boredom can become problematic for some users and appears to be associated with some negative outcomes.

> *"I think it's the same reason, but I think those reasons are maybe more heightened for them. I just use it because I'm bored. Others may do it too because I see some of them use it in class…. Yeah and I think it's also just boredom that you're subconsciously doing it for no reason and that's what especially if you're doing it in class when there's teaching going on. If you're doing it during then there's absolutely no reason for you unless something really important is happening but it usually isn't." (13)*

> *"I definitely use Facebook a lot more because I'll choose to if I'm bored. I'll choose to take Facebook because it's easy to put away too. I'd definitely choose Facebook over my phone games but it's like if I'm bored of Facebook and I've already been on I'll usually just leave it." (29)*

> *"I use it a lot when I'm bored; maybe I'm trying to pass time that's probably, yeah probably procrastinating, yep that's probably a big one." (7)*

> *"I notice the more bored I get or the more free time I have the more I check Facebook to look for sorts of distraction. In the summer if I'm not doing much and just at home I'll just check it more often." (35)*

The extent of getting bored may be different for users, depending on how quickly they get bored with the situation, i.e. their degree of *boredom proneness*. While some users mentioned that their attention span has become shorter through the years and they feel the urge to check their devices very frequently, others did not report such a strong tendency for constant usage. The continuous interaction with smartphones or social networks to get over boredom may develop uncontrolled IT usage habits and addiction over time.

> *"Definitely the current mode of always being updated I'm perhaps a bit impatient or have shorter attention span. Yeah like it's not enough that it significantly gets in the way of my you know I can still pay attention in lectures but when someone is speaking slowly I find myself you know twiddling my fingers and wanting them—because you know when you're reading on Facebook you can just read for the important parts whereas when someone is talking they take some time." (27)*

> *"Occasionally I will do it too, which is kind of bad and I really, really try to stop myself from that because I'd be a hypocrite otherwise. And yeah I think that really for me establishes who excessively uses when you can't take an hour for group work and really concentrate and focus on the work. I definitely think social media as well as smartphones have really affected the attention span of students, which is sad in a sense…. I keep seeing it more and more because people just can't go 10 minutes without doing something else or concentrating on one thing." (33)*

Motivations: Beside the role of traits and emotions, we found that *users' motivations* are another key issue that should be taken into account in studying IT use and addiction. As we discussed, motivation can be extrinsic or intrinsic. Our analysis showed that both intrinsic and extrinsic reasons motivate users to adopt and increase their usage of technology.

Looking at the extrinsic motivations, many users mentioned that they bought a smartphone and joined social networks because of the several benefits that these technologies provide for users. For instance, they addressed the utilitarian aspect of technology that is instrumental in doing several *productive tasks*. For instance, in regard to the smartphone, users mentioned that they tend to use it because it allows them to do several useful tasks using one device, such as checking emails, making calls, playing games, checking news, scheduling their calendar etc.

> *"What you would do without it – it would be different, it would be like multiple devices, like last year I would have my agenda in my bag, my iPod in one pocket, I'd have my telephone in the other – so now with the iPhone everything is in one device." (18)*

Also, users were found to be motivated to use technology in order to satisfy their *information seeking* needs. Both smartphones and social networks were found to be used because of their capacity to provide information for users. In order to get more information accessible through smartphone applications (e.g. internet browser, news agency applications) and social networks (e.g. through news feed).

> *"I guess they're always just trying to get information out of you like whenever you click and ask it's like they ask for information and I just want it to be informed yeah." (29)*

> *"There I think the most important reason that people are willing to use it [social network] because they can get more information. Many famous people and even the government even like the PlayStation will have their official accounts." (12)*

> *"To get access to that information more quickly, I would say. And it's also like a trend these days – like you see a thing and you want it to be shared, you just take out your phone; information coming from you gets on the web faster." (14)*

The third extrinsic motivation for using technology was found to be related to the need for *communication* with others. Many users stated that they started to use technology in order to connect to and stay in touch with people around them. Driven by these motivations, some users reported having a high level of online communication and/or maintaining extensive virtual interactions (through text messages, voice and video calls, Facebook comments, posts and chats) with people in their network or in the contact list.

> *"I just do it [checking Facebook] on my phone … to stay in the loop and to feel like they're not missing out, yeah." (22)*

> *"I'm messaging back and forth between friends over a long period of time I just like to see if they've replied. I'm in like a group from our res, so I like to see if anyone's posted on that, just like a little distraction I guess." (23)*

> *"Basically to communicate with your friends through this website [Facebook] and it's really easy … and slowly MSN started to get outdated and we started talking more on Facebook." (13)*

Finally, many interviewees mentioned the role of intrinsic motivation and stated that they tend to use a technology because they enjoy using it and like to spend their time with it. As we discussed above, using technology for such purposes forms the basis of intrinsic motivation. While any user may adopt these technologies for entertainment to some extent, some users stated that they tend to excessively use various smartphone applications (particularly mobile games), or they spend a significant amount of time per day surfing social network pages for fun. The feeling of pleasure or excitement produced by hedonic IT use makes users repeat the similar action over and over to experience the same pleasant feeling.

> *"Sometimes, I am like the people who are playing games or are spending hours just scrolling through news feed just scrolling through pages … those who are probably like obsessed with Facebook I guess in the same way." (25)*

> *"Well it was just a pastime. It was just I would spend time playing games and there was 1-2 websites that I knew at least that had many games and I didn't have to download something, it was all on my Facebook." (30)*

Building Block 2: The Technology

Besides the user-related factors, some technology features were found to be important in understanding the development of IT addiction. These characteristics were related either to the *physical* attributes of the technology that could facilitate accessibility and extended interactions with it or to the *technical* characteristics (features) of the technology that were serving various purposes.

Regarding the physical attributes of technology (which mainly was the case with smartphones), we found that the constant improvement of hardware technology and shrinkage in size and weight of smartphones have enabled the tool's portability and increased its accessibility. Respondents mentioned that the pocket-sized device can be easily carried anywhere and used at any time and place. The portability of smartphones enhances users' opportunity to extend their interactions with the tool as well as the embedded applications, including social networks and games. Accordingly, many respondents mentioned that their usage of technology has increased because now they are able to carry their small device around and have instant access to its embedded applications. Although the physical characteristics are not directly related to the use

of a software application, such as social media networks, the portability of smartphones collectively increases the usage of (all) applications and features available on them.

> *"It comes in handy and it goes in the pocket and in terms of the weight and design it's awesome." (3)*

> *"I never had an Android phone before, so it [Facebook use] was much less. But since I've been here it's because it's so readily available, it's because of that I use it a lot.… Yeah because I have my phone everywhere and as soon as I get a Wi-Fi connection Facebook is on. Or even I have data so if I'm really bored or have nothing to do I can switch to it." (14)*

> *"The accessibility is a huge aspect. Like I said, half the reason I didn't use Facebook as excessively as I do now when I was younger is because I didn't have a smartphone.… I mean people had laptops, but like the ability to check things wasn't there." (18)*

> *"… now we can have Facebook very easily on our phone because of an app and before access wasn't on mobile was not so easy. So I think this also changes because now we can have Facebook whenever we want." (19)*

From a technical features perspective, our analysis showed that the *telecommunication features* of both smartphones and social networks are associated with excessive and compulsive IT usage behaviors. Many users started and later continued to use smartphones because of the multiple communication channels embedded in them, such as text messaging service, email applications, and voice/video call services. Similarly, social media networks tend to be frequently used as a result of their wide range of communication features, e.g. messages, wall posts chat service etc. A portable smartphone with access to a broadband or wireless network and the internet facilitates immediate access to the aforementioned tools and in this way provides a context for excessive usage habits to develop. The following quotes shed light on the importance of communication features for IT addiction:

> *"Communication aspect! It's how I like stay in contact not I say 'in contact' but know what my friends from high school are doing through Facebook. Whereas if there was no Facebook I would have to text message and talk to them but I don't have to because I know what they're doing." (18)*

> *"I think so keeping in touch with people. Using it to get news and watch cool videos and read cool articles that people post and the private messaging is good for certain people who I just happen to like mostly communicate with on Facebook and I'd say events like be invited to events." (21)*

> *"I think that's an effective way to reach out to people so whether that be keeping in touch with friends or like maintaining friendships." (22)*

> *"I guess it's more interactive. You can track the people easier than I guess texting is easy too, but you can maybe contact a lot of people at one time.... You can spend a long time on it while if you're texting you just text and it's done. Well if you're on it, you can be on it for a long time; it keeps you busy." (33)*

Both smartphone and social network technologies appear to encourage users to broaden their IT interactions and demand immediate and real-time usage through a *notification service* composed of sounds, lights and vibrations. For instance, now it is possible to be notified about emails and Facebook messages the moment you receive them (e.g. a message will pop up on your phone). As mentioned by some interviewees, the notifications received for any update or change in their social network increased the urgent need to check the tool as soon as a message was received. As one interviewee explained:

> *"I check Facebook and because I receive the notifications on my cell phone and it's like near me then I hear the notification again I maximize my Facebook and see…. I receive notifications by my phone. I also go to the computer, to check other stuff." (14)*

Finally, technologies that integrate and bring together a wide array of *services and applications* were found to receive more attention from users. As we discussed above, smartphones provide several benefits for individuals that draw them to use the device more and more. For instance, our interviewees mentioned that smartphones are valuable because of their high functionality, which allows the users to make calls, send text messages, exchange emails, play games, schedule daily activities, check the weather and listen to music. The high functionality of smartphones (compared to other technologies that have a single functionality, such as music players) increases the frequency and the amount of time spent on IT usage. Similar usage patterns were reported by Facebook users. Our respondents explained that Facebook provides different services that are helpful for personal or group chatting, participating in groups of interest, managing group work, sharing information, posting photos/videos and playing games. As one user indicated, "*Facebook always comes first I would say. I think the things that it allows you to do is so much greater so I would use that way more."* However, her usage of other technologies was limited and at a low level, and she stated *"Twitter! It's just a status and Instagram seems to be just photos."* The capacity of technology to integrate and bundle

different services and applications was found to be an important aspect of technology in forming the behaviors of users, which may encourage extended interaction and the development of excessive IT usage.

> *"I think just being compact and having everything I why I'm on it always, having your friends you can have offline message, you can chat with them you can play with them you can see their photos etc. It makes me want to use it. You can you know read some political news or health news, jokes, watch videos, listen to music, it has everything that you need to do." (14)*

> *"I think because Facebook has a large variety like I said games, you have apps you can download or you can join groups, messages, privacy that's a really big thing, like you have your own profile which can entail everything from pictures, groups, your friends or your about section. It shows everything, where you're checking in like Facebook provides everything like…. I guess because they've covered everything. Everything is just like in one place so you don't need to go in different places to use it." (15)*

> *"I think it's because it [Facebook] has so many features and like it does it all. You can post photos, you can post events, you can have like a chat feature; you can have like an email kind of thing for private messaging. So it just kind of like comprises a bunch of different things, which is why I am using it always." (22)*

> *"You can also, have all the music and everything so it's [smartphone] really one gadget which has almost everything that you need for entertainment – and almost everything is entertainment. If you can look at music – if you look at, you know, the games, puzzles or whatever it is – look at social media. Most of it is kind of entertainment – there might be some part of it which is kind of maybe you are sharing information or doing other things … at least for me, that is why I'd use it much." (1)*

Technology Affordances: Although any technology may have several features and characteristics equally available to all users that may influence users' behaviors, such effects exist only when users perceive the features and utilize them in line with their goals and motivations (Volkoff & Strong, 2013). As we discussed above, the concept of technology affordance is useful for studying these relationships between users and technology and can help us understand "the particular ways in which an actor perceives materiality" (Leonardi, 2011, p. 153). Looking at the affordances is also helpful in getting a nuanced understanding of when, why, and how interactions between users and technology result in obsessive and compulsive usage of technology.

The analysis of the interviews with smartphone and social network users shed light on four technology affordances that could be associated with IT addiction (see Table 1). We found that even though users' behaviors vary and may follow different patterns, there are specific and repeatedly mentioned affordances that appear to be the driving force behind excessive and compulsive use of technology. We should mention that our goal was to find the affordances that play a role in the development of addiction rather than to look at general affordances of the studied technologies. Here, we discuss each of these unique affordances that were shared between smartphones and social networks in detail.

Communication affordance: First, our results suggest that some people use IT excessively in order to maintain a steady level of *connection with their surrounding environment*. As we discussed above, the telecommunication features of smartphones and social networks (e.g. call, text, and internet) allow users to have constant access to their peers and be able to receive necessary (or even unnecessary) information at any moment and to get immediate updates about current events and happenings. Both smartphones and social networks provide quick and easy access to a nearly infinite amount of information. Accordingly, many interviewees described the urge to check their smartphone or Facebook page in order to stay in touch with the latest updates in their social world. The persistent need for getting updates and IT's ability to provide access to information were found to be a suitable environment for development of excessive IT usage habits. The following quotes specifically address this interaction between user and technology:

> *"Well I don't really need to do it [check Facebook], but I kind of want to do it especially talking to friends, like keeping in touch that's important to me. The whole thing is looking at their pictures and their lives…. My close friends I like to see what they're doing, but people that I don't really know it's a little unnecessary." (13)*

> *"So if I don't go to Facebook for two days, I have well lots of new posts. So, I have to scroll down for hours to check them, but if you go several times/day you know you go and say okay there's ten new posts. You check them for half an hour, then again in 1 hour you go there are just 20 more. So you know you don't make anything. I know it's not something important but the way you get the news is to check everything." (14)*

> *"I think feeling connected to people is why I am super active on it. Because if you're active on Facebook, then you are just connected with your friends and people you*

know in another way. And if you're absent from that, it's almost you're missing out on interaction." (35)

Although many technologies provide access to information, immediate accessibility to various communication channels and the internet is a critical element that shapes excessive usage behaviors. The minimum effort required to initiate communication and maintain connections appears to be followed by higher user-technology interaction. Therefore, the availability of information enabled by the portability of smartphones (or social network apps) can be followed by an increase in the usage of technology for users because of the enhanced connectivity afforded for users. Some interviewees clearly addressed this issue.

"… now we can have Facebook very easily on our phone because of an app and before access wasn't on mobile was not so easy. So I think this also changes [our behaviors] because now we can have Facebook whenever we want." (19)

"Yeah so, okay so technology, more people have it available to them so they started using it, and when more people use it more often I am also going to use it more often, because [there is]more information, more people online to talk to and yeah it's like the connections are up." (13)

"Yeah because like my 2 best friends are all in different places this year but we also have like a group chat on Facebook where we'll just chat and talk about things so that's really useful because texting you can only text one person at a time. That's something that BBM tries to get around but not everybody is on BBM, but everybody's on Facebook." (24)

"Well I don't really need to do it but I kind of want to do it especially talking to them, like keeping in touch that's important to me. The whole thing is like looking at their pictures and their lives. My close friends yeah I like to see what they're doing but people that I don't really know it's a little unnecessary." (29)

Having constant connection provides more opportunities for users to interact with technology. The extended time and opportunities to use (now portable) technologies could change usage patterns over a long period of time and make them develop into obsessive patterns of usage.

"The accessibility is a huge aspect, like I said half the reason I didn't use Facebook as excessively as I do now when I was younger is because I didn't have a smartphone that constantly told me what was going on or did I have I mean people had laptops but like the ability also especially like I have a Mac so I can have my paper open right here and yet I can also see what's going on Facebook at the exact same time." (18)

> *"I just have 6-7 hours which doesn't seem very normal to me. I think that the more availability you have the more time you're going to spend on it and that leads to excessive use." (24)*

Entertainment affordance: In addition to the connectivity, we also found that interviewees excessively use smartphones and social networks because these technology afford a great deal of entertainment, leading to continued enjoyment. Many interviewees indicated that they used technology frequently, because they found the various mobile applications and features of social networks enjoyable and amusing. As they mentioned, the abundance of tools and applications enabled them to spend a great deal of time using technology just for fun. Examples were listening to music, watching videos, checking emails, playing individual or multi-player games, tracking fitness progress, sending and receiving messages, reading online content, following other people's pages and checking photos. Using technology for fun helps users pass their time.

> *"What do I get out of it [my smartphone usage]? Well, I am checking it often mostly because when I'm bored I have to look through it and it passes time. So I guess that's fun for me." (13)*

> *"Seeing what's going on in people's lives, contact with people is fun. I follow 'spotted at university' Facebook page and it's funny to read the stuff and it's nice like seeing pictures of my friends and stuff." (23)*

> *"Most of them are, you know, entertainment – games and other puzzles and those things, but apart from that there's a – that's the only thing you can count on. You can also, have all the music and everything so it's really one gadget which has almost everything that you need for entertainment – and almost everything is entertainment. If you can look at music – if you look at, you know, the games, puzzles or whatever it is – look at social media – that's also entertainment, right – it does not do anything but entertainment." (5)*

The interviewees also indicated that they interacted with technology in order to overcome boredom on many different occasions. Examples were the use of smartphone in social meetings and when commuting or surfing Facebook pages when they feel that class is uninteresting, especially for individuals with high levels of boredom proneness. Furthermore, some users mentioned that, although technology helps them get over their boredom, overall they have developed a shorter attention span and tend to get bored more frequently. A couple of instances from the interviews clearly address this issue.

"It is hard to stop yourself, you know, going on Facebook … but the one thing that really bothers me is people that actually go on Facebook while you're doing group work.… Because you can't take that hour and not go on Facebook and wait until after. Most people occasionally check it. I will do it too, and I really, really try to stop myself from that because I think that really for me establishes like who excessively uses, when you can't take an hour for group work and really concentrate and focus on the work. And I definitely think social media as well as smartphones and things have really affected the attention span of students, which is sad in a sense. And I keep seeing it more and more, people just can't go 10 minutes without doing something else or concentrating on one thing, right. So I think websites such as Facebook have really taught us and almost shaped us to be constantly checking and always be checking on this website to make sure nothing's happening there." (26)

"People who spend a lot of time on it do it just because you know they're bored or whatever, they're just wasting time but if you took that away they'd probably just turn to something else like Tumblr or something and just scroll through that." (23)

Association affordance: Several respondents also said that they tend to have prolonged interactions with smartphone and social network technologies (and through them with their network of friends), since they provide a sense of belonging for the user. In order to keep these valuable social relationships active, individuals have to maintain their high IT usage behaviors. As an example, one interviewee (30) referred to this as "feeling connected to this community" or "being a part of something", which required steady interaction with members of different groups. Both smartphones and social networks provide an environment to connect people and facilitate communication between them. Some examples mentioned were sending messages/posts to a friends' group on Facebook and posting rating/reading others' rating for a restaurant on Foursquare[3] smartphone app. Also, the quotes from interviews address this affordance of technology.

"Well I liked that it was like the community of my friends but online so we could all sit in the privacy of our homes. I mean I already had that with AIM and MySpace so Facebook was a combination of this that we could all have Internet identities and interact with each other. And you could do that on AIM but AIM was very much a very much a one-to-one interaction whereas Facebook with the new speed multiple people would comment and you could have a community engagement." (22)

"I think that Facebook's massive popularity is because of the fact that it kind of it enhances in theory your external communities by creating a forum that you can bring those offline communities online and then you know eventually I guess, I don't know,

[3] A search and discovery service mobile app available at foursquare.com

> *it's like in blogging, we always talk about bringing your online communities offline. And like once you have these connections bringing it offline and doing community engagement. And I think Facebook it does that as well, but, I don't know you, can 'like' a page and become involved with a cause and then make real world differences through it." (27)*
>
> *"[I use it a lot] because I think it facilitates actually my social life because it's how I communicate with my friends to meet them somewhere and also to maintain a relationship with a friend like even after a few months or a year have gone by and then we can meet up again. But without Facebook I don't think it would be possible to stay connected." (31)*

Although some respondents admitted that their behavior was excessive and (sometimes) out-of-control, they believed that it was necessary and that it could bring many benefits for them, such as validation, feeling of self-worth, satisfaction and being part of a community. As two respondents mentioned:

> *"There's some sort of belonging associated with this [constant Facebook use]. There's definitely a personal satisfaction that when you see your profile and timeline that you say and yeah like you can overall get some sense of pride after it." (28)*
>
> *"You know I am obsessed with it, particularly after I moved abroad, because all my friends are far from me and my family. Every day, I just open my Facebook and see that they are okay and happy, like my sister has passed her exam. Getting all the news about them you know I feel kind of peaceful…. You know because it's not possible to call everyone every day and but you have it's like a compact thing that you have everyone in there so that's why I'm enjoying it a lot and using it all the time." (14)*

Information sharing affordance: Another affordance of technology that was identified in the analysis is the ability to share information with others. Many interviewees emphasized that they tend to engage with their smartphone and social networks in order to share their opinions, emotions, feelings or important information with their virtual network and circle of online/offline friends. Sharing information is a common affordance that is provided by all forms of social networks (and smartphones allow instant access to such applications) with a minimum of effort.

At the same time, individuals would like to regularly seek out such information shared and posted on social networks by other people. The telecommunication features of technology and internet access allow users to send individual or group text messages, post status updates, share

photos, videos and interests and inform others about their key life events (e.g. relationships, graduation, parties, trips etc.). This is a unique affordance of technology that gives a powerful sharing ability to every individual who owns and uses a smartphone or participates in a social network. As one interviewee explains:

> *"I now use it as a more informative source rather than just hanging out with friends. Facebook contributes to one factor towards connecting with old friends but it's more informative in daily use. I mean people share articles, people share daily updates. If I'm living in the ghetto and somebody pulls something there okay they're offering free pizza here so I'm getting live updates. It's like 'RSVP' on your phone. So there are multiple groups on Facebook which you can join based on your interests… [for example] the Fieldhouse page where they tell you when there are drop-in hours and you can just always go there…. And other than that there's groups which is really coming into power since everybody is on Facebook and everybody has it on their phone you can just connect to groups immediately." (15)*

Similar to the previous affordance discussed (i.e. association), information sharing and receiving feedback through likes or comments could also create social support and/or sense of self-worth and bring validation for users, which motivates them to use technology even more than before.

> *"I think the ability to like share what you're doing … I think before when I used to text people and ask them what they were doing you wouldn't constantly give people updates of what you're doing because that's weird to do over text and people don't really do that now unless you're kind of prompted apart from on Facebook it will also prompt you to tell and then. And you can comment and you can see what everyone else is doing and especially the fact that like people you're not so close friends with that you really just wouldn't text, you know what they're doing like you can see like their pictures, like events they've been at so things like that." (18)*

> *"Also people post so many things on Facebook out of anger and whatever and going through high school obviously someone breaks up with you, you type away blah, blah, blah and some people 'like' it. I mean that's another thing." (23)*

> *"Yeah especially if maybe you think in a way and people don't agree with you in person then you write it and then you get all these 'likes' and you're like oh well I'm right then. It's kind of for support. You could do it through email I guess but like it still wouldn't really happen but if you take a picture and you post it and say oh this is our new house in Canada then people can 'like' it and they can, so like it also enables her to be able to communicate in that way with her friends." (15)*

Building Block 3: The Environment

As we expected from our literature review, user- and technology-related factors are the main concepts in the context of IT addiction development. While these two set of factors are key in developing addiction, additional analysis of the interviews showed that studying the context in which usage occurs is necessary to understanding the process. We found that, at any point of time, the behaviors of IT users is under the influence of their peers and surrounding environment. Many interviewees mentioned the importance of their peers and their IT usage behaviors on their own actions. These influences become important at the beginning of usage, since people tend adopt a technology if many people around them (including friends, family, colleagues, classmates etc.) are using it. The importance of the surrounding environment was also deemed to be a driving force of usage through the influence of social norms on technology users. We found that the popularity and extensive adoption of a technology by people can push late or non-adopters to adopt and start using a technology, as evidenced by the following quotes.

> *"When it first started there was something called Netbook that all my friends joined that first. Then someone said Facebook, and so I had to Google it and see like oh it's the new rage, everyone had Facebook accounts. I don't think I used it for a couple of months because I didn't really understand what it was and so people were saying that oh I took pictures of an event. I said oh can I have them? And they'd say like oh no it's on Facebook so this is how it just started to get more and more and I figured out how to use the different apps whatsoever." (36)*

> *"If I post to a friend's page I would expect a reply within the next 30 minutes. Like that depends on the person I'm actually tagging. There are some friends who are like on the marketing group I tag them and I know they're not going to reply for a day or two but there are some friends who I know they are very like you know tech savvy. Yeah it's rude like if it's a general question and they don't reply that's rude." (15)*

> *"It's definitely a norm…. There are some people that don't have Facebook in fact because they don't want to I guess really accept, like not accept the norm, but I personally had to participate in the norm and really need to check the Facebook regularly." (33)*

In addition to the initial stages of use, we found that users increase their technology usage gradually in order to keep up with their peers and society's trends. For example, if a user is among a group of people who use technology all the time (e.g. when hanging out, during a party or when going out), then that person will more likely develop similar usage patterns. Thus, not

only the environment (e.g. peer pressure, social norms etc.) may influence usage behaviors when users adopt a technology, but it can play a role at advanced stages of use when they have gained experience and begun to increase their usage, which could progress into problematic levels.

> *"I don't mind that I use it too much because the others use it obviously as much as I do … but I think I'm addicted to Facebook. I think a lot of us are, I think most teenagers are addicted to Facebook." (13)*

> *"I think that within friends it's almost been socially accepted the amount of time that I and other people use Facebook, and definitely I think I use it less than people with smartphones just because I have that time where I don't have my laptop and then I'm socially disconnected. But now everyone is on it like all the time." (27)*

> *"A lot of people of my age, use Facebook. And since I began to have Facebook when I was 12-13, so we always go there. So, I might be addicted to it a little bit, but I think like everybody is like that." (22)*

Chapter IV (Essay #3): An Examination of Technology Craving for Social Networks

Abstract

This paper focuses on technology craving in the context of social network use. Defined as a psychological attachment to a substance/non-substance, craving has been cited as an important concept in the emergence of addiction, especially after a period of abstinence. Yet there is no study in the IS discipline that integrates craving with the IT addiction literature. On the basis of the extant literature (in IS and other fields), a motivational model of social network craving is proposed. The model sheds light on the key users' needs that lead to craving and the structural features of technology that moderate the effect of those needs on social network craving. The paper ends with a discussion of the contributions and implications for researchers and practitioners.

Introduction

Technology, in its various forms, has penetrated most aspects of our lives, and its usage is still on the rise. IT tools provide capabilities for people to obtain information, communicate inexpensively, entertain themselves, join networks, and share their thoughts and ideas. As a result, there has been a dramatic increase in individuals' use of IT during the last decades. For instance, the population of internet users has grown more than five times since 2000, now accounting for almost one third of the world's population (Alexander, 2011). More than 45% of US mobile users now have smartphones (Nielsen Report, 2012). Another popular technology, social networking websites, have also become so predominant that more than 70% of North Americans are now using Facebook, and nearly 165 million of them are active users on a daily basis (Facebook Newsroom, 2015). The soaring use of technology has recently raised much public concern over excessive and unregulated IT behaviors (Turel, Serenko, & Bontis, 2011), and it warrants specific scholarly and managerial attention.

In fact, there is evidence in recent research that reveals that excessive and compulsive IT usage can become unpredictable and out-of-control and may lead to some undesired outcomes (Turel et al., 2011; Yellowlees & Marks 2007; Vaghefi & Lapointe, Paper 1), which conflicts with the conventional view regarding technology use (as a positive and desired behavior). Hence, not surprisingly, there have been increasing efforts to understand technology addiction. Specifically in the psychology and health disciplines, existing theories and models focused mainly on the users and their characteristics, such as personality, genetic factors, and demographics, as antecedents of technology addiction (Byun et al., 2009; Murali & George 2005; see Armstrong et al., 2000 for a review) or discussed the negative consequences of IT addiction (such as isolation, depression, decreased performance, etc.) (Caplan et al., 2002; Caplan, 2006, Young, 1996, Yellowlees & Marks, 2007). In a recent effort to introduce IT addiction to IS and streamline it with IT use research, Turel et al. (2011) showed that addiction can influence basic beliefs and perceptions about system use such as usefulness, ease of use, and enjoyment. Other studies showed how good IT habits may turn into problematic behaviors, psychological dependency, and addiction (Turel, 2014; Soror et al., 2015).

In spite of this growing interest in the IS discipline, there have been several calls for more theorizing of the IT addiction phenomenon, (Turel et al., 2011; Tarafdar et al., 2015), especially in regard to the antecedents of addiction beyond users' personality and psychological health.

One of the constructs that has been shown to play an important role in understanding general types of addictions (e.g. to drugs, alcohol, or gambling) is *craving* (Marlatt et al., 1988; Tiffany 1999; Verheul et al., 1999; Skinner & Aubin, 2010). Craving has been defined as strong memories linked to the pleasant effect of addictive substances. Hence, craving is considered a key concept in understanding addiction and an important factor in designing successful controlling mechanisms (Jaffe, 2010). In classic research on addiction, it is widely believed that craving plays a significant role in the transition between controlled use and addiction (Robinson & Berridge, 1993) and in treatment of addictive behaviors (Drummond et al., 1995; Verheul et al., 1999). For example, the concept of craving helped researchers find out why substance abuse might be reinstated long after the discontinuance of usage (Addolorato et al., 2005). Despite its critical role before and after the development of addiction (Robinson & Berridge, 1993; Gendall et al., 1997) and the extensive attention to craving in substance use research (see Skinner &

Aubin, 2010 for a review), there is no study that takes into account craving within the technology use domain or examines its role when theorizing about excessive and compulsive use of technology. This is an interesting and relevant issue to IT use and addiction, especially as both craving and IT use have been linked to various needs of individuals (such as the needs for reward or enjoyment) (Verheul et al., 1999; Davis et al., 1992; Venkatesh, 1999; Xu et al., 2012).

Furthermore, there is a need in IS research to look in more detail at the IT artifact itself in studying addiction. Indeed, prior research on IT addiction generally viewed IT as a black box that is used equally and similarly by all users. As mentioned above, previous studies typically focused on the user component of addiction (personality, genetics, moods, etc.) and mostly left the technology component—and its properties—unexplored. However, recent research evidence suggests that technology's characteristics, features, and specifications play a role in the formation of addictions (Greenfield, 1999; Joinson, 2008; Turel & Serenko, 2010). For instance, Turel and Serenko (2010) mention that the ubiquity of email and convenience of mobile phones are among the reasons why BlackBerry email is overused. In another study, Greenfield (1999) mentioned the nature of internet technology (speed, accessibility, and intensity of information) among reasons why users develop pathological usage behaviors. Despite this evidence, the role of IT as a predictor of addiction has not been systematically studied, and there is not much information about the potential role of technology features on technology craving and addiction. One main reason for this probably relates to the challenges that exist in studying the design of IT artifacts (Markus & Silver, 2008; Benbasat & Zmud, 2003). First, it is difficult to come up with a list that parsimoniously addresses all the features and sub-features embedded in a technology (DeSanctis & Poole, 1994). Also, different technologies "vary so much in the presentation of their features that information based on features alone makes it virtually impossible to compare systems" (DeSanctis & Poole, 1994, p. 333). Despite the challenges that exist in studying technology, more effort is warranted to understand the role of technology as a driver of excessive and compulsive technology use.

Therefore, in this paper, we aim to study an instance of technology craving (specifically social network craving) and identify its key antecedents by looking specifically at the features of technology and their effect on users' motivations and needs that are being fulfilled by social

networks use. Drawing on models of substance and non-substance addiction (Blaszczynski & Nowar, 2002; Verheul et al., 1999; Turner et al., 2008), motivation theory, and structural features of technology (Wood et al., 2004; King et al., 2010), we propose a model of social network craving that shows how the interactions between technology's features and user's needs can predict craving and addiction.

We expect to make several contributions to theory and practice. First, we introduce the concept of technology craving to the IT addiction literature, for it can help improve our understanding of technology addiction and relapse. While there has been increasing attention to addiction in the IS literature, to our knowledge, there is no study that looks at craving in IS research. Second, our study contributes to theories of IT addiction by proposing a model of social network craving and explains the interactions between user's motivations and technology's features that may cause craving and addiction. Third, we examine in detail the role of technology's features in IT addiction. Despite extensive research on the role of users and related factors as drivers of addiction (Armstrong et al., 2000; Widyanto & Griffiths, 2006; Byun et al., 2009), the role of technology in IT addiction has not been systematically studied.

In terms of practical implications, our study will show the importance of craving as a key determinant of addiction. This is important for managers, since craving—if not managed and controlled—has been shown to be associated with various negative experiences and outcomes for users. In addition, the model can be used to develop guidelines showing how craving (and ultimately addiction) can be prevented or curbed by manipulating users' needs or altering certain features of technology so that they could mitigate craving.

Conceptual Background

In this section, we provide an overview of the theoretical concepts and key theories that pave the way to our theoretical model.

IT addiction

In the psychology literature, addiction has been defined as "a repetitive habit pattern that increases the risk of disease and/or is associated with personal and social problems … [and it is]

often experienced subjectively as the loss of control [that] continues despite volitional attempts to abstain or moderate use" (Marlatt, et al., 1988, p. 224). Although gambling addiction is the only pathologically compulsive behavior that has been formally recognized in the *DMS-V*, technology addiction types, such as game addiction, smartphone addiction, and online auctioning disorder, are increasingly receiving scholarly attention (Widyanto & Griffiths, 2006; Turel, 2014; Vaghefi & Lapointe, Paper1; Chóliz, 2010). In these studies, researchers examined any psychological dependency on and excessive use of technology when users felt compelled to continue usage despite negative consequences that appeared to be irrational (Griffiths et al., 1999; LaRose et al., 2003; Turel et al., 2011). This scholarly trend could be partly related to the recent statistics that confirm high technology usage by both youth and adults (Pempek et al., 2009; Thompson, 2011; Scott, 2012). For example, only in the US, more than 11 hours per month are spent on social networking websites (Kagan, 2011). The popularity and mass appeal of technology can become a cause for concern for both researchers and practitioners (Kuss et al., 2012). In fact, IT addiction research has shown that there can be negative consequences associated with IT addiction that may affect both individuals and organizations (Thadani & Cheung, 2012; Turel et al., 2011). From a review of the literature (see Paper1), IT addiction can be defined as *a psychological dependency on IT that involves excessive and compulsive use despite significant negative consequences.*

Craving

The concept of craving has been known in the addiction literature for decades (Skinner & Aubin, 2010). Since the 1954 World Health Organization (WHO) meeting, craving has been recognized as an important concept in substance use/abuse (Sayette et al., 2000). Previous research shows that people experience craving in many different substance use contexts, such as drinking, food, and tobacco, as well as non-substance use contexts, such as the internet (e.g., Castellani & Rugle, 1995; Field et al., 2008; Moreno et al., 2009; Spada et al., 2014). In spite of the long history of research on craving, the conceptualization of craving and its semantics have been inconsistent (Kozlowski & Wilkinson, 1987; Pickens & Johanson, 1992; Skinner & Aubin, 2010.). Because of the confusion between the general and everyday connotation of craving as a desire for a something (Gendall et al., 1997) and craving as a technical term, several divergent definitions have been proposed (Skinner & Aubin, 2010); hence, there has been some difficulty

in contrasting research findings and accumulating knowledge in this area (Tiffany, 1999; Potgieter et al., 1999)

Despite these challenges, attempts have been made to provide a conceptualization of craving as a broad cognitive-emotional construct (Young, 2013). In an early effort, Marlatt (1987) argued that craving is a strong appetitive quality of an individual and should be defined as a type of psychological attachment to a substance. Furthermore, he noted that "Craving is the 'grasping' quality of the mind as it attempts to pursue its attachments" (p. 43). According to this definition, craving is a form of motivational state that is usually tied to the positive outcomes expected from a behavior (Marlatt & Gordon, 1985; Marlatt, 1987). Other scholars focused on the subjective component of craving and emphasized the fact that, instead of being an objective desire, craving is a subjective desire for the positive effects of a substance use (Gendall et al., 1997; Volkow et al., 2006; Young, 2013). As an example, Kozlowski and Wilkinson (1987) defined craving as a strong desire that surpasses the "subjective threshold of intensity". In this way, the definition of craving has been associated with the out-of-control level of use that addicts usually experience (Bruehl et al., 2006). Borrowing from the definition of substance craving (Marlatt, 1987; 1985; Skinner & Aubin, 2010; Tiffany, 1999; Addolorato et al., 2005; Potgieter et al., 1999), we define technology craving in this study as *a psychological attachment to technology and an urge to pursue technology use*.

From this definition, it becomes evident that although craving and addiction are conceptually related, there are meaningful differences between them. While craving is viewed as an *urge* to pursue usage, addiction refers to the *obsessive and compulsive usage* that is associated with some negative outcomes. Therefore, craving can be seen at the heart of addiction development and a key to understanding the process whereby an ordinary behavior turns into a problematic one (Anton & Drobes, 1998; Tiffany & Conklin, 2000). As Robinson and Berridge (1993) state, the transformation of a regular behavior into an addiction occurs when a user develops an obsessive and powerful craving for something that is irresistible and thus quickly moves on to an emerging dependency. In addition, craving has been found to be play a critical role in compulsive behaviors, addiction, and dependence by predicting a relapse, especially after abstinence (Childress et al., 1999). For example, a person who recently stopped taking alcohol might be stimulated by seeing a bar sign or an empty beer bottle. It is possible that this person

could resist these stimulating cues for some time; but if they occur often, he might be overwhelmed by craving and start using alcohol again (Anton & Drobes, 1998). The positive correlation between craving and relapse has been established by different studies on substance and no-substance addiction (Paille et al., 1995; Potgieter et al., 1999). Several mechanisms have also been found to contribute to this relationship, such as loss of control (Anton et al., 1995), intrapersonal temptation (Marlatt, 1978), and response to cue exposure (Littleton, 1995; Potgieter et al., 1999). Figure 1 illustrates how craving plays a role in the process of addiction and shows the focus of our study, which is on craving (and its antecedents) and addiction.

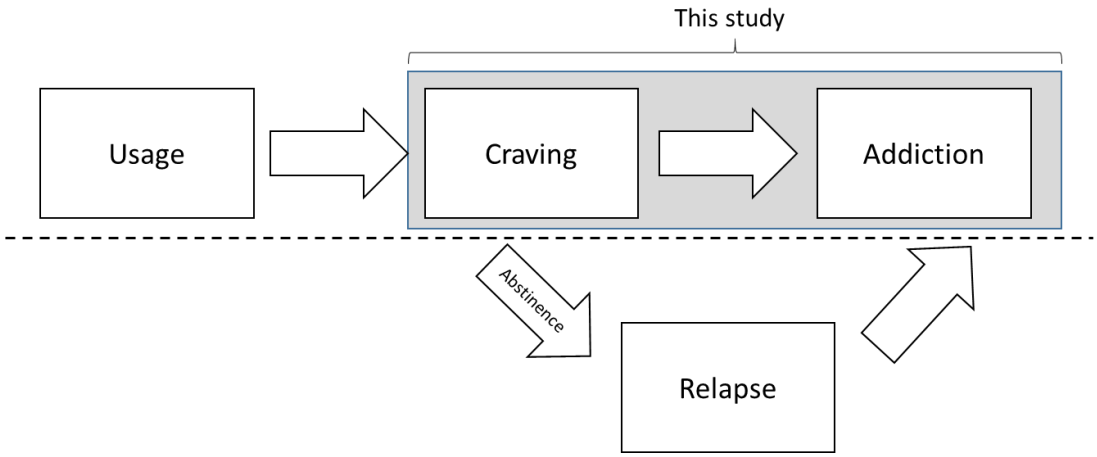

Figure 12: Potential effects of craving on addiction

Even though craving has long been studied in the general addiction literature, IS research has yet to pay special attention to the concept of craving. While some antecedents of technology addiction, such as habits (Turel & Serenko, 2012; Turel, 2014), self-regulation (Soror et al., 2015), and personality factors (Vaghefi & Lapointe, Papers 1 & 2), have been recognized, the role of craving as a concept that represents "the operation of non-automatic processes" has still to be explored. Thus, it is important to improve theories of addiction by understanding how technology craving is situated within this growing body of literature, especially as a non-automatic process (for instance, in contrast to habits, which are automatic processes). Also, understanding craving is important for theories of IT addiction because of its role in relapses since it can reverse an already-controlled problematic behavior back to addiction (Robinson & Berridge, 1993; Verheul et al., 1999). Studying craving will also suggest important practical implications. While responding to craving could provide pleasant experiences for individuals (such as experiencing pleasure or relief from discomfort) (Anton & Drobes, 1998; Skinner &

Aubin, 2010), the inability to manage craving has been found to be associated with some negative experiences, such as incessant cigarette use (Killen & Fortmann, 1997), binge eating (Fischer et al., 2004), or pathological gambling (Smith et al., 2007). Therefore, in order to avoid the negative consequences of craving (e.g. pathological use, addiction, relapse, etc.), it is critical to know how cravings are developed in the context of technology use.

The antecedents of craving

During the last few decades, a variety of models have been advanced by applying research lenses to depict the development of craving in individuals. As an example, a social learning model of craving was proposed by Marlatt (1985), who explains that the craving to perform a behavior (e.g. substance use) is rooted in two reasons: anticipation of euphoria or relief from withdrawal symptoms. A review of these models has shown that according to their research approach, there are overall four types of craving models (Skinner & Aubin, 2010; Addolorato et al. 2005): 1) conditioning-based models, 2) cognitive models, 3) psychobiological models, and 4) motivational models.

The first type, conditioning-based models, are generally established on the classical conditioning theory and learning processes formulated by Pavlov (1936). The underlying assumption of these models is that craving is developed either by withdrawal-based processes or the expectation of rewards (Skinner & Aubin, 2010). In these models, craving is considered "an epiphenomenon of addictive conditioning processes" (Spada et al., 2014, p. 475). For example, a withdrawal model of craving argues that addicts pursue substance use usually to escape for the negative states associated with non-usage (Wikler, 1948). The conditioning process underlying the development of craving works in order to avoid aversive states. As Baker et al. (1985) explained initially the lack of drugs (an unconditioned stimulus) provokes a withdrawal syndrome (an unconditioned response). Associated with the lack of substance are perhaps cues such as drug paraphernalia and negative affect that then become conditioned stimuli to the withdrawal discomforts. Prior to substance use or during a period of abstinence, these cues may provoke a withdrawal response (a conditioned response) that is thought to create a desire to use the substance in question (cited in Skinner & Aubin, 2010, p. 608). Other models proposed with the basic premise of classical conditioning are compensatory response model (Solomon & Corbit, 1974), opponent-process model, and incentive model. (Stewart et al., 1984)

The second type of models purports that craving is generally a higher order cognitive construct that emerges as a function of information processing (Tiffany, 1999); thus, cognition plays a crucial part in the formation of craving. Cognitive models of craving generally include concepts such as expectancy, self-efficacy, attribution, and decision making (Tiffany, 1999). For instance, an outcome expectancy model posits that external cues in an environment can provoke expectancies about the positive effect of a certain behavior (Marlatt, 1985). These models also emphasize the motivation construct that is related to the intention to use (labeled "urge"), meaning that it is possible that an individual is tempted to use but does not have an intention to use the substance (Skinner & Aubin, 2010). Also, self-efficacy (Bandura, 1977) has been found to have a reverse effect on the relationship between craving and urge (Witkiewitz & Marlatt, 2004). Another cognitive model (dual-affect) hypothesizes that there are two networks of positive and negative emotions that interplay with craving. The positive affect network is composed of information that contributes to the appetitive potencies of use (e.g. relaxation), while the negative affect network will activate craving on the basis of the negative potencies (e.g. depression). Baker et al. (1986) argued that since the functional properties of the brain do not allow individuals to process both networks of information simultaneously, a degree of coherence between the two is required for craving to appear.

The third type, psychobiological models, suggests that craving is caused mainly by biological neural systems. In these models, scholars emphasize user motivation and individual differences (Skinner & Aubin, 2010). For instance, in the incentive sensitization model, craving has been associated with the brain's neural systems, especially the reward system (Robinson & Berridge, 1993). Here, craving is developed through "hypersensitization of the dopamine neural transmitter system" that enhances the saliency of a specific substance, which makes it more attractive and wanted. The increase in salience turns regular wanting into excessive craving for a substance. Other researchers have developed more neurological models of craving, such as the neural opponent motivation framework (Koob & Le Moal, 2008) and the neuroanatomical model (Anton & Drobes, 1998).

Finally, the fourth type considers *motivation* as the main driver of craving. Scholars who pursue this path argue that the final common pathway to substance craving is through studying individual motivation, which is linked to the emotional state a person desires to reach (Cox &

Klinger, 1988). The motivational model argues that in any situation in which a person decides, the decision is based on the degree of incentive motivation, which refers to the person's commitment to the pursuit of this goal or other related goals (Skinner & Aubin, 2010). For instance, as is the case with the conditioning models, Cox and Klinger (1988) view substance usage as a choice based on people's motivation to receive positive effects associated with usage. Another framework, called the multidimensional ambivalence model, looks at two competing pathways—approach and avoidance—that work in parallel and discusses the "evaluative space" where these two motivations meet (Breiner et al., 1999). According to the model, one pathway encourages craving and is favorable to use, whereas the other path is sensitive to threats from substance use and thus inhibits craving. When an individual is provided with an opportunity for use, s/he picks a choice in the so-called evaluative space (Skinner & Aubin, 2010). When approach and avoidance are being assessed in this evaluative space, four behaviors might be opted for: approach (high approach, low avoidance), avoidance (low, high), indifference (low, low), and ambivalence (high, high).

While all these types of models have merit and provide different insights into the multidimensional mechanisms and factors underlying craving, the *motivational models* are especially relevant to studies of IT use and addiction and can provide a unique contribution to the understanding of technology craving. This is due to the significant evidence in IS research that links user's motivations and needs with IT usage behavior (Davis et al., 1992; Venkatesh, 2000; Igbaria et al., 1995; van der Heijden, 2004) and IT addiction (Xu et al., 2012). Similarly, the motivational models of craving generally assume that individuals' needs are what drives craving and excessive usage behaviors (Verheul et al., 1999; Skinner & Aubin, 2010).

Hence, in this study, we adopt a motivational model of craving in the context of social media use in order to understand users' craving for these systems. By introducing the concept of craving to the IS literature and integrating it with our knowledge of IT addiction, we hope to add to the growing body of literature on IT addiction, further advance our knowledge of excessive and compulsive technology use, and help managers and policy makers find precise methods to prevent, control, and manage the situations in which technology usage can become problematic.

Motivation and User Behaviors

In IS research, user motivation and its role in driving technology use have long been recognized (Venkatesh, 1999; Venkatesh et al., 2003). Davis et al (1992) specifically formulated a motivational model of IT use to understand technology adoption and use and developed the Technology Acceptance Model (TAM). According to them, users' intrinsic and extrinsic motivations are key drivers of intention to use IT. The extrinsic motivation refers to the perception that users will perform an activity in order to achieve a specific goal, while the intrinsic motivation refers to the inherent pleasure and expected satisfaction as a result of an activity (Deci & Ryan 1987; Davis et al., 1992; Venkatesh et al., 2003). Motivation of users has also been found to be correlated with actual usage (measured in terms of the amount of daily usage and number of interaction times) (Ross et al., 2009).

In recent years, user motivations that are related to a specific context or technology have also received attention (van der Heijden, 2004, Hwang, 2005). For example, van der Heijden (2004) showed that in the context of hedonic information systems, perceived enjoyment (associated with the user's intrinsic motivation) plays a bigger role in user acceptance of technology than the usefulness of the system (associated with the user's extrinsic motivation). Research on social media has shown as well that the need to belong to a particular community as well as the desire for recognition will determine the intention to use and contribute to blogs and wikis (Hsu and Lin, 2008; Okoli and Oh, 2007).

In another study, in the context of social networking sites, Nadkarni and Hofmann (2012) posit that the usage of social networks is primarily motivated by two sets of needs. The first is the need to belong, which refers to the intrinsic motivation to be accepted and affiliated with others. Previous research has shown that most people are generally in need of social support (Baumeister & Leary, 1995), and social isolation or lack of association with social groups can have negative effects on aspects of psychological well-being such as self-efficacy, self-worth, and emotional stability (Leary, 2007). The second source of motivation comes from the need for self-presentation, which refers to the process of managing the image and impression of the self (Back et al., 2010). This also has been referred as the need to present an idealized version of the self to others in a network (Gosling et al., 2007). Although identifying these needs was well-

grounded in theoretical accounts and supported by previous research, the validity of the constructs was not tested empirically by Nadkarni and Hofmann (2012).

Similar to the research on IT-related behaviors, in general behavioral research adopting a motivation-based model in order to understand a behavioral phenomenon is common; many scholars have used such theories to study people's behaviors in different contexts (Alderfer, 1972; see Vallerand, 1997 for a review). For example, in his pioneering work, Maslow (1954) presented a hierarchy of needs and argued that human behavior is activated to respond to a set of needs ranging from physiological (e.g. food, sleep) to self-actualization (e.g. self-fulfillment and reaching one's own potential). In a follow-up work, Alderfer (1972) classified Maslow's needs into three main categories related to existence needs (including basic safety and food needs), relatedness needs (such as social and relationship needs), and growth needs (such as satisfaction from self). Rather than seeing these needs as a hierarchy, Alderfer argued that the needs could be different depending on the individual and the context in which the individual lives. Similar works by other researchers have expanded these frameworks and provided additional insights into the nature of needs that motivate human behavior. For example, Ryan and Deci (2000) developed the self-determination theory of motivation and acknowledged three basic psychological needs of the human being: 1) the need to feel autonomous, independent, and self-expressive), 2) the need to be competent and masterful, and 3) the need to be close and connected to others (Ryan & Deci, 2000, 2008; Sheldon & Gunz, 2009).

In line with these theories, motivational models of craving also assume that the craving for usage develops because of the desire to fulfill and satisfy users' needs. Earlier research and models on craving focused generally on one set of needs that might lead to craving (e.g. providing relief or escape from problems) (e.g. Drummond et al., 1990). However, other scholars maintained that focusing on one aspect of a behavior or one specific need that applies equally to everyone is "a misguided venture" because of the heterogeneity in individuals' behavior (Blaszczynski & Nowar, 2002). An alternative, more informative approach is to acknowledge the existence of various subtypes of needs, each of which is influenced by different factors, but they all exhibit a similar phenomenon (e.g. craving, addiction symptoms, etc.). For instance, reviewing the existing literature on substance craving, Verheul et al. (1999) posit that there are three basic needs underlying individuals' craving to use a substance: *need*

for reward, need for relief, and *obsessive and compulsive need*. Accordingly, individuals may experience three different types of craving (relief craving, reward craving, and obsessive craving). Furthermore, the authors explain the personality types, sensitivity to substance effect, and neurotransmitter system underlying each type of craving.

More specifically, the need for reward addresses individuals who develop craving and addiction because of their strong desire for the positive outcomes of substance usage. Verheul et al. (1999) showed that this generally includes people who have high impulsivity or sensitivity to positive rewards, and who therefore continuously seek rewards that can balance their low cortical arousal. The stimulating and enhancing effects of substance use (also referred as positive reinforcement) result in the formation of an intensified desire for usage in certain individuals (reward craving). The second type, need for relief, involves those people who use a substance as a means of seeking relief from tension, which leads to relief craving. This usually occurs for users who are anxious and sensitive to "external stressful events, and internal physiological arousal" (Verheul et al., 1999, p. 212). The behavior of these users has also been associated with the aversive motivational system or the behavioral inhibition system, which inhibit a motivated behavior by highlighting the negative consequences that might follow a specific behavior (Gray, 1987; Skinner & Aubin, 2010). To avoid the negative feeling or moods associated with conditioned withdrawal (also referred as negative reinforcement), some users may develop a craving for a specific substance (Cooney et al., 1997).

The third type of craving describes the obsessive and compulsive characteristics of the needs of people who are unable to control their thoughts about substance use. It is associated with impaired functioning (e.g. excessive amounts of time spent on substance use thoughts, resistance thoughts to restrain substance-related thoughts) (Modell et al. 1992). It corresponds to a type of compulsive craving that develops through time, as users pursue different needs via substance use while enforcing low control and inhibition on their behaviors (Verheul et al., 1999). Although Verheul et al. (1999) consider the obsessive characteristics as a separate category of cravings, obsessive characteristics can be associated to any other type of need that drives craving. For instance, any specific need (e.g. gaining reward or relief) ranging from low to high can be considered obsessive once it falls into the high and excessive range.

In this paper, we draw on the extant literature on motivation and behaviors in order to formulate a motivational model of technology craving in the context of social network use. In line with the research in psychology and IS, we focus on the specific user's needs that can lead to the development of craving. To be more specific, we use Verheul et al.'s (1999) set of needs to argue that some specific needs generally instigate technology craving. We also add two extra types of needs in order to consider the specific needs of users in the context of the study (social networks); they are the need to belong and the need for self-representation (Nadkarni & Hofmann, 2012; Back et al., 2010).

Technology Factors

In order to pursue our second research aim, which is to open the IT black box, we will look at the role of technology and how it can influence technology craving and addiction. Compared to the numerous studies explaining the role of personality types as drivers of addiction (Armstrong et al., 2000; Widyanto & Griffiths, 2006), the role of technology (as the object of addiction) has been relatively understudied. Nevertheless, it can be expected that the IT artifact characteristics will influence technology craving or cause excessive and compulsive usage behaviors. For instance, consider the case of two smartphone manufacturers, BlackBerry and Apple. While both produce smartphones, the patterns of usage and market share of their products are substantially different (50% for iPhone vs 0.4% for BlackBerry in the first quarter of 2015) (Gartner Report, 2015). Although we can assume that some psychosocial or ecological factors influence the usage of these technologies, the significant difference between smartphones' adoption and use may be partly due to the variations in design and functionalities of these phones. Similarly, excessive and compulsive usage behaviors can be expected to be driven by technology features, to some extent. In fact, recent research findings hint that technologies can be addictive because of their features and the (usage) opportunities they provide for individuals (Salehan & Negahban, 2013; Ng & Wiemer-Hastings, 2005; Lee et al., 2007; Chee & Smith, 2005).

Some studies have tangentially looked at the role of technology as a cause of addiction-driven usage by comparing the nature of game addiction with other known types of addiction (such as substance abuse or gambling). In an early study, Fisher and Griffiths (1995) compared the structure of videogames with slot machines and argued that the common features between the

two (such as rapid span of play, color combinations, etc.) can help us understand why some games are more addictive. Other researchers focused on the unique features of the technology itself and tried to understand what is different about a specific technology that can cause addiction. For example, in a study of internet addiction, Griffiths et al. (1999) found that some characteristics of the internet, such as accessibility, mobility, and communicative features, may speed up the formation of pathological internet use. In another study, Ng and Wiemer-Hastings (2005) discussed how advances in 3D graphics and virtual representation accelerated the interaction of players with online games and increased dependency on usage. Further research on videogames also revealed that, depending on the games' special features and their interactive and competitive environment, some genres (e.g. adventure, action, and strategy) can be more addictive than others (Barnett & Coulson, 2010; Liu & Peng, 2009). In a recent study in the context of mobile phones, Salehan and Negahban (2013) found that the use of social networking applications can contribute to the development of mobile addiction. Table 1 provides an overview of the studies that have directly or indirectly focused on technological factors.

Factor	**Studied Phenomenon**	**Supporting literature**
Mobile features and characteristics	Excessive use of cellular phones	Chóliz, 2010
Challenge, fantasy, curiosity, control, reward, cooperation, competition, recognition, belonging, obligation, and role-playing	Massively Multiplayer Online Role Playing Games (MMORPGs Addiction	Hsu et al., 2009
Social connection, shared identities, content, social investigation, social network surfing, and status updating	Facebook use	Joinson, 2008
Object of addiction (e.g. the medium of communication), aspects of its specific style (e.g. no face-to-face etc.), the information that can be obtained (e.g. pornography), the playing of (role) games, gambling, and/or chatting with others	Internet addiction	Griffiths et al., 1999
The process of typing, the role of the internet as a medium for communication, the information gained, particular applications (e.g. email, gambling, video games, pornography, and multiuser domains/dungeons – MUDs), and the anonymity afforded by the internet	Internet addiction	Griffiths, 1998; Caplan, 2002
Immersion	Addiction to videogames	Seah & Cairns, 2008
Nature of the internet (speed, accessibility, intensity of information accessed online, and the potency (stimulation)	Internet addiction	Greenfield, 1999
Interactivity (human–computer and interpersonal), ease of use, availability, and breadth of information accessed online	Internet addiction	Chou, 2001
Structural characteristics (e.g. interactivity and anonymity)	Pathological use	Griffiths, 1997, 1998
Message characteristics (richness, synchronicity)	SNS addiction	Xu & Tan, 2013
Convenient, fun and efficient, design, speed, access to internet and social networks	Smartphone addiction	Lapointe et al., 2013

Factor	Studied Phenomenon	Supporting literature
Structural characteristics: (a) social features, (b) manipulation and control features, (c) narrative and identity features, (d) reward and punishment features, and (e) presentation features	Excessive video-game playing	King et al., 2010
Sound, graphics, background and setting, duration of game, rate of play, advancement rate, use of humor, control options, game dynamics, winning and losing feature, character development, brand assurance, multiplayer features	Addictive behaviors	Wood et al., 2004
Social interaction	Online gaming problem	Griffiths et al., 2004
Using social network apps, network size, social networking intensity	Mobile Addiction	Salehan & Negahban, 2012
Game genres	Game addiction	Lee et al. 2007
Calls, SMS, email, social networks, videogames/gambling	Problematic Mobile Phone Use	Billieux et al., 2015

Table1: Technology-related factors and problematic technology use

While most studies provided a limited view of technology factors and focused mostly on one aspect of addictive technology, Wood et al. (2004) put together a theoretical model to explain a wide range of *structural features* of videogames, those that may trigger game usage at the beginning and later contribute to problematic usage of games. They also discussed how these factors may influence behaviors irrespective of other factors related to the person (such as psychological or socio-economic status) (Wood et al., 2004). To be specific, in their study they tested the effect of twelve factors: the sound and graphics, background and setting, duration of game, rate of play, advancement rate, use of humor, control options, game dynamics, winning and losing features, character development, brand assurance, and multi-player features. Their results highlight the key role of some factors, such as realism in the game (created by sound and graphics capabilities), character advancement, and multiplayer capabilities. In a follow-up study, King et al. (2010) validated and refined Wood et al.'s framework through interviews with excessive game players. They posit that there are generally five key feature categories that contribute to the development of addictive gaming behaviors. First, *social features* address the socializing use of games and communicative features in videogames. For instance, in-game voice and chat features, online support forums, and leader boards are among the examples of social features associated with a specific game. Second, *manipulation and control features* refer to the impact and degree of control of users' input over the properties of the game. These features refer to the user-input features, game-saving capabilities, player management features and general settings. The third set of features comprises the ability to form a new identity as

well as interactive storytelling in the game (*narrative and identity features*), which could be referred to avatar creation, game genres, scripted events in the game, etc. Fourth, *reward and punishment features* address the ways a skillful play is rewarded, such as achievement points or punishment features. Finally, the *presentation features* are about the aesthetics of the game as experienced by users and include graphics and sound features, explicit content, and in-game advertisements. As King et al. (2010) argue, these features together provide an environment that could lead to excessive and compulsive game-playing habits.

Despite the potential role of technology in craving and addiction, there has been no study to our knowledge in the IS discipline that provides an overview of such factors, and no unifying theory exists that could explain why a technology (such as a social network) would drive users' craving. To examine the relationship between technology, craving, and addiction, we borrow from the gaming and gambling literature to study the structural characteristics of social networks. We argue that extending this framework to the social network context can be deemed appropriate, since these contexts share common characteristics. Like games, social networks are supported by software capabilities and are generally equipped with sound and graphics features that make them appealing to users. Furthermore, both games (especially multiplayer games) and social networks provide various communicative tools and a virtual environment that can establish communities and reinforce social ties. As a result of the commonalities that exist between these contexts, we would expect that the structural features of technology could predict technology craving as well as addiction.

Theoretical Development: A Model of Technology Craving

Context of the Study

Given the wide range of technologies available, it would be virtually impossible to study general technology craving in a single study. In addiction research, prior studies usually focused on a single instance of technology (Turel et al., 2011). One of the technologies that has experienced exponential growth is social networks. A social network refers to any social site that allows interaction between users on the basis of their association and interests (Kuss & Griffiths, 2011). In other words, it is a web-based virtual community that "allows users to (1) construct a public or semi-public profile within a bounded system, (2) articulate a list of other

users with whom they share a connection, and (3) view and surf their list of connections and those made by others within the system" (boyd & Ellison 2007, p. 211). Along with the fast-paced growth of social networks, these technologies serve as an essential media channel for over a quarter of the world's population (socialmediatoday.com, 2014; Aboujaoude, 2010).

Social network users are generally active and spend a significant amount of time each day surfing these websites. For instance, it has been found that a third of Facebook users check the website at least once a day (Correa et al., 2010) and, on average, spend 20 minutes on it during each visit (Infodocket.com, 2013). Although the use of such networks provides many benefits for the users, the increasing trend of joining and actively using such networks for long hours has been a warning sign of users' dependence. In fact, recent research has shown that social networks can be potentially addictive (Turel & Serenko, 2012; LaRose et al., 2010; Turel, 2015). Hofmann (2012) showed that, as in the case of email addiction, social networks can be addictive, and that their effect is comparable to that of alcohol and drugs, meaning that users feel withdrawal when not engaged with them. The results of a recent study also show that some users feel an incessant desire to check their social networks throughout the day and at night (Chan et al., 2014). In this paper, we focus on social network craving, its key antecedents, and its effect on obsessive and compulsive use and addiction.

Hypotheses

As mentioned above, researchers have looked at craving from different angles and have developed various models that provide conditioning-based, cognitive, psychobiological, and motivational perspectives of craving and its underlying factors and mechanisms (Tiffany, 1999; Skinner & Aubin, 2010; Addolorato et al., 2005). Furthermore, our review showed that motivational models of craving are the most relevant to studies of the technology craving type, since the role of users' motivation in the IS discipline has been recognized and validated in prior research of IT use and addiction (Venkatesh, 1999; Xu et al., 2012). Accordingly, in this paper, we take a motivational approach in order to understand and predict technology craving. Our model shows the role of needs as antecedents of social network craving and illustrates how the structural features of technology interact with users' needs (see Figure 2).

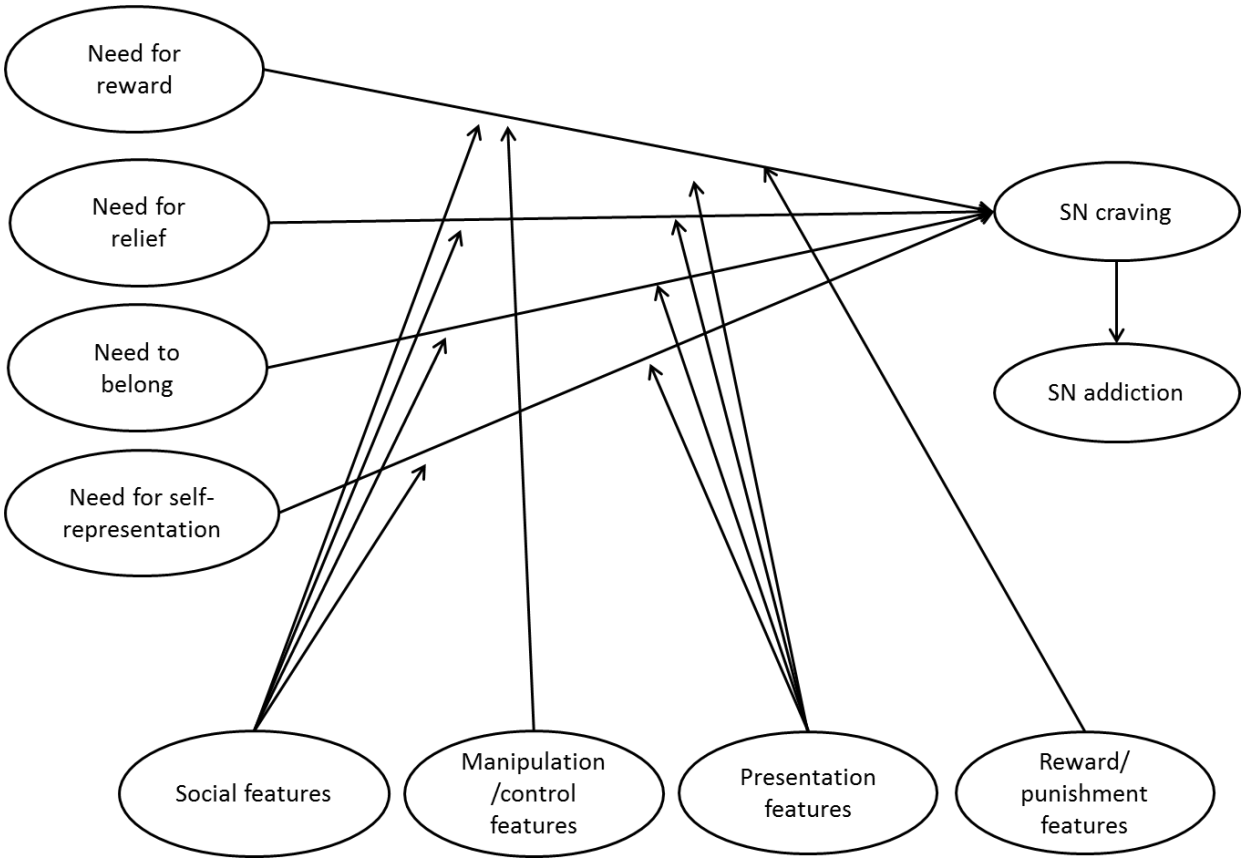

Figure 13: The proposed model of social network craving

Addiction and Craving

For decades, addiction researchers have recognized craving as the underlying basis of excessive substance intake (Kozlowski and Wilkinson, 1987; Skinner & Aubin, 2010). As Tiffany and Carter (1998) argued, it is widely accepted that pathological substance use represents the existence of a pathological desire for the substance. Other researchers discussed this relationship more directly and argued that craving is the main cause for addiction to substances (Tiffany, 1999; Drummond, 2001). Craving has also been shown as the necessary condition for the transition from non-pathological to pathological behaviors. For instance, Robinson and Berridge (1993) asserted that

> To understand addiction, therefore, we need to understand the process by which drug-taking behavior evolves into compulsive drug-taking behavior. Presumably, this transformation in behavior occurs because addicts develop an obsessive craving for drugs, a craving that is so irresistible that it almost inevitably leads to drug seeking and drug taking. (p. 247)

The effect of craving on addiction can be summarized in the following way: first, the existence of a stimulus (e.g. internal or external cues) activates a state of intense desire for substance/nonsubstance use (i.e. craving). The internal pressure and tension experienced as a result of this desire (and a lack of control and disinhibition) ignites an incessant increase in behaviors that generate excessive and compulsive patterns of addiction. Over time, such addictive use leads to significant negative consequences for the individual (Tiffany & Carter, 1998). Previous research also showed that craving is what causes the conditioned pairing of usage and the positive effects of the substance, which triggers compulsive substance administration (Stewart et al., 1984; Robinson & Berridge, 1993; Tiffany & Carter, 1998).

Consequently, in the context of social network use, one can expect that the craving to use a technology will work as an internal tension that requires users to increase their usage of social networks. The craving can, in this way, lead to excessive and compulsive use and drive social network addiction. Thus we, propose that:

H1: Social network craving has a direct positive effect on social network addiction.

Users' Needs and Craving

As Snyder (1993) stated, almost all human activities are being purposefully performed to pursue a personal or social goal such as to increase social status or improve personal health, and people act in order to serve different needs (Clary et al., 1998). Accordingly, technology use is commonly referred to as a goal-directed and purposeful behavior (Limayem 2007), and users' motivation has been commonly referred to as a key factor in driving IT use (Davis et al., 1992; Taylor & Todd, 1995; Teo et al., 1999; Venkatesh, 2000; Venkatesh et al., 2003; van der Heijden, 2004). Also, the importance of both extrinsic motivations (e.g. usefulness of the system) and intrinsic motivations (e.g. enjoyment) has been pinpointed in the IS discipline (Igbaria et al., 1995; Hwang 2005).

In a similar way, in the context of excessive and problematic technology use, the role of motivational factors has been addressed (Young, 2004; Goodman, 2007; Volkow & Li, 2005; Vaghefi & Lapointe, Paper 2). For example, in a study on 623 online game users, Xu et al. (2012) used classical decision making and a functional approach to study IT use and addiction and argued that users generally play games for three key reasons: sense of advancement, social

visibility, and feeling of immersion; the stronger the users' needs, the more time they spend playing online games (Wan & Chiou, 2006).

With respect to craving, Verheul et al. (1999) suggest that craving develops as people use a substance in order to cater to three specific needs. First, they use it in order to receive and enhance its positive effects (need for reward) or to avoid its negative effects (need for relief) when not using it. Satisfying these needs could be cued by internal or external stimuli. For instance, substance/non-substance consumption could be a response to the need for stimulation of internal moods or acceptance and approval by a group of friends (Cox and Klinger, 1988). The development of craving by pursuing the need for reward or relief has also been addressed by other scholars (e.g. Marlatt & Gordon, 1985; Marlatt, 1987). In addition, research shows that the effect of these needs on craving will be higher, when the needs have obsessive and excessive characteristics. That is, in situations in which there is a lack of control, individuals feel an increasing internal pressure to increase their usage in order to satisfy an existing need (such as a need for relief or reward). The higher the needs and the more excessive they become, the higher the associated craving will be (Verheul et al., 1999).

Drawing on the extant body of research (Verheul et al., 1999; Cox and Klinger, 1988), we propose that the need for reward (i.e. positive effects) and the need for relief (i.e. breaks from negative moods, feelings, etc.) are critical factors that have a positive direct effect on social network craving. People with stronger needs for positive rewards or relief tend to spend more time using social networks, usually to enhance their gains from the system (e.g. receive information about others and events) or to find relief from an unceasing situation and to escape from reality. Over time, the persistence of these needs and the ability of social networks to satisfy them will lead to users' craving.

As we discussed above, the obsessive and compulsive characteristics of these needs encourage higher levels of social network use (such as constant connection with Facebook) and thus are associated with higher levels of user craving.

H2a: The more the need for reward, the higher the social network craving.

H2b: The more the need for relief, the higher the social network craving.

We also argue that two additional social needs can predict social network craving, namely need to belong, and need for self-representation. Previous research has shown that individuals have tendency to use communicative technologies in order to take advantage of internet and communicative technologies for social purposes (Liu & Kuo 2007). Similarly, in the context of social networks, social needs were found as a driver of technologies usage for different user segments (Nadkarni & Hofmann, 2012; Pelling & White 2009).

Also, social needs were found to predict problematic technology use. For instance, people with higher social needs were found to be particularly at high risk for developing addictive social network use (La Barbera et al., 2009). In order maintain their ties to a community or a group, and broadcast and keep a positive image about themselves with other users in the network, social networks users tend to increase their use of technology (to a level that is parallel or higher than other members in their network). Over time, the strong needs tied with the regular high level of usage will create an urge to use social networks. Hence:

H2c: The more the need to belong, the higher the social network craving.

H2d: The more the need for self-representation, the higher the social network craving.

Technology and Users' Needs

On the basis of our review of technology the addiction literature in the IS (Turel & Serenko, 2010; Salehan & Negahban, 2013) and non-IS disciplines (Wood et al., 2004; King et al., 2010; Ng & Wiemer-Hastings, 2005; Griffiths et al., 1999; Billieux, 2008; Firmin et al., 2012; Chóliz, 2010), we argue that technology-related factors influence craving through interaction with various user needs. We borrow from the psychology and game addiction literature to examine the role of four structural features of technology (Wood et al., 2004; King et al., 2010) in the context of social network use, namely, *social features, manipulation and control features, reward and punishment features, presentation features*. We omit narrative and identity features from this study, as they are relevant only to the storytelling features of games and the identity formation of game players.

First, social features refers to the features that enable the social aspects of a technology that allow users to connect and communicate with others in their network (King et al., 2010). Computer mediated communicative features embedded in social networks, such as chat

services, direct wall posting, tagging, voice call, and video call features, enable users to establish connections with new people or maintain existing social relationships and to engage in social interactions with a network of friends at any point of time without the need to be online or present (King et al., 2010). The interactions with others may trigger different emotions, such as excitement, encouragement, frustration, or disappointment, all of which have been shown to reinforce that behavior (King et al., 2010). In some way, the positive emotions and social interactions enabled by social features are highly rewarding and contribute to the link between the need for reward and craving. For instance, making new friends or receiving interesting articles in the newsfeed gives a positive feeling to the user and allows for the gratification that in turn drives craving. At the same time, social technologies help provide an escape from existing pressures and problems or work as a temporary relief from negative emotions (Caplan, 2002; Billieux, 2008; Liu and Kuo, 2007; Sheldon, 2008) and facilitate the development of craving. As an example, social features (such as chat services) used by college students provide a distraction from schoolwork and an escape from reality when the students are pressured by assignment deadlines or exams and can lead to further craving. Therefore, we argue that:

H3a: The use of social features positively moderates the influence of need for reward on social network craving.

That is, the need for reward will have a greater, positive effect on social network craving when the use of social features is higher as compared to when the use of social features is lower.

H3b: The use of social features positively moderates the influence of need for relief on social network craving.

That is, the need for relief will have a greater, positive effect on social network craving when the use of social features is higher as compared to when the use of social features is lower.

Almost all people have a fundamental need for belonging to a community or social group (Baumeister & Leary, 1995). Several social features help satisfy such needs of users. Private or public groups (in terms of friendship, school, work, specific activity, etc.) available through social networks are primarily used in order to increase information sharing and cooperation among users within a group. Although it is not always formally specified, the users usually face an obligation to contribute to the goals of the community. The person who does not play his/her part in an electronic community may be penalized by losing others' trust or respect, or even asked to leave the group (King et al., 2010). Indeed, the research evidence shows that the social

relationships in the online world can be as important and "powerful" as real-life interactions (Williams, 2006).

In addition, social networks allow for a digital profile, which is a unique identifier of an individual "that is constructed by the user, by members of their network, and by the platform" (Kane et al., 2014, p. 279), or basically a platform to "type oneself into being" (Ellison & boyd, 2013). Social networks provide an opportunity for an individual to create self-identity, which may sometimes represent a preferred and rather ideal version of the self (Beck et al., 2010). Previous research has shown that in some cases observers of a profile can even accurately predict the personality of the user without having an in-depth acquaintance with that person. For instance, Gosling et al. (2007), in their study of undergraduate students, found that research assistants were able to determine accurately the personality of users from impressions gained solely from the targets' Facebook profiles. Furthermore, creating and maintaining a certain image is among the main reasons for both IT use and IT addiction (Firmin et al., 2012). For instance, the results of a study on college students' Facebook use showed Facebook allows users to broadcast a self-image through certain social interactions. As an example, people who posted inappropriate messages or posts were found to have intentions to show themselves as wild and sexually appealing persons. On the other hand, people may avoid exchanging information or sharing posts in order to portray the image of a hard-working individual (Peluchette & Karl, 2010). Altogether, this evidence shows that social features have a tremendous capability to foster self-representation goals that lead to higher levels of craving. Thus, we argue that using the embedded social features of social networks moderates the associations between both the need to belong/the need for self-representation and the social network craving.

H3c: The use of social features positively moderates the influence of need to belong on social network craving.

That is, the need to belong will have a greater, positive effect on social network craving when the use of social features is higher as compared to when the use of social features is lower.

H3d: The use of social features positively moderates the influence of need for self-representation on social network craving.

That is, the need for self-representation will have a greater, positive effect on social network craving when the use of social features is higher as compared to when the use of social features is lower.

Manipulation and control features refer to the ways that users can manage the properties and settings of a system. In other words, this category includes all the functions that provide a way for users to take control the properties of a system and create a feeling of mastery over it (e.g. general system settings or privacy settings, etc.). For example, privacy control has been found to be a significant issue in using social networks (McCreary, 2008).

Research in cognitive psychology shows that users of a technology rapidly develop a mental scheme that helps them understand how a system works (Graham, 2006). A system that give users the ability to control the properties of a system and customize it to their needs usually appears more interesting to them (Van Deventer & White, 2002; Chappell et al., 2006). Control features allow users to modify system properties as they learn the system and to be able to maximize the rewards they receive from it, whether internal or external (Wood et al., 2004; King et al., 2010). Therefore, these features can moderate the influence of users' need for reward and craving.

In addition, some features are beyond the control of the users, either by design or technical necessity (King et al., 2010). For instance, Facebook newsfeed is designed intentionally to be infinite, which gives users an opportunity to scroll down to older information without being interrupted. Also, users are not provided with an option to control the length of the newsfeed or limit the amount to information being provided to a user. Lack of access to such features encourages extended interactions with social networks (Wood et al., 2004), which paves the way to satisfy the need for reward even further, leading to greater craving. Therefore:

H4: The use of manipulation and control features positively moderates the influence of need for reward on social network craving.

That is, the need for reward will have a greater, positive effect on social network craving when the use of manipulation and control features is higher as compared to when the use of manipulation and control features is lower.

Reward and punishment features refer to the general ways that mastery and frequent use of a system is reinforced for users through gains or losses. For example, in the context of online games, this category could include the flexible or fixed rewards that users can accumulate when they can play fast and skillfully (King et al., 2010). At the same time, designers generally embed some punishment features in the system that negatively reinforce low usage behaviors or system abandonment. Common punishment features would be loss of resources (e.g. losing life

in a game, limited access to certain information) or failure scenarios in video games (Kent, 2001). Examples in the context of social networks are losing time-sensitive information, missing out on events because of low engagement with the user's network, or inability to receive notifications and emails from a social network once an account has been deactivated.

First, we expect that these features will have a direct influence on the relationship between the need for reward and craving. As explained, the reward and punishment features are generally designed to reinforce extended interaction of users with a system (Wood et al., 2004) and to discourage withdrawing from or abandoning its use. The reward and punishment features enforce extended interaction with a technology, as they encourage individuals to use the system to get more benefits and achieve mastery over all parts and applications offered to the user. Pursuing use of a technology in order to take advantage of all these benefits will strengthen the perception of the rewards resulting from use of the system above and beyond what is usually perceived by less committed, causal users of the technology. Over time, the link between the need to achieve the highest possible reward from a system and craving will be stronger as individuals use the existing reward and punishment features. Hence,

H5: The use of reward and punishment features positively moderates the influence of need for reward on social network craving.

That is, the need for reward will have a greater, positive effect on social network craving when the use of reward and punishment features is higher as compared to when the use of reward and punishment features is lower.

Finally, presentation features refer to the aesthetic qualities related to the external look of technology and any features that would influence its presentation (King et al., 2010). This can be referred to the quality of system interface, themes, backgrounds, and visual and sound features. The role of aesthetics on technology usability and users' experience has been previously established (Tractinsky et al., 2000).

We argue that the presentation features of technology moderate the effect of all user needs on craving. It is been found that the visual and auditory features of technology can generally contribute to the excitement of the users, and enhancing the quality of these features can make a system increasingly appealing to users (Salen & Zimmerman, 2004). As a result, users will tend to have a higher tendency to use a system with higher aesthetic qualities in order to take advantage of the benefits and satisfy their own specific needs.

This moderating effect of presentation features can also be explained through classical conditioning theory (Tiffany, 1999). In line with this theory, users associate various experienced emotions, feelings, and stimulations with the corresponding technology (and its features) over time. For example, the combination of multiple colors in a game becomes associated with a pleasant feeling (i.e. a type of reward) in users' minds. When not controlled, the association between these feelings and the technology will be positively reinforced. In the case of games, this translates into the association between the colors in the game and the pleasant feeling so that the user will become excited and stimulated the moment s/he see those colors. The excitement and arousal caused by the presentation features contribute to the effect of users' needs (of any type) and eventually lead to more craving. Therefore, we propose that the higher quality of these features will moderate positively the relationship between needs and craving.

H6a: The quality of presentation features positively moderates the influence of need for reward on social network craving.

That is, the need for reward will have a greater, positive effect on social network craving when the quality of presentation features is higher as compared to when the quality of presentation features is lower.

H6b: The quality of presentation features positively moderates the influence of need for relief on social network craving.

That is, the need for relief will have a greater, positive effect on social network craving when the quality of presentation features is higher as compared to when the quality of presentation features is lower.

H6c: The quality of presentation features positively moderates the influence of need to belong on social network craving.

That is, the need to belong will have a greater, positive effect on social network craving when the quality of presentation features is higher as compared to when the quality of presentation features is lower.

H6d: The quality of presentation features positively moderates the influence of need for self-representation on social network craving.

That is, need for self-representation will have a greater, positive effect on social network craving when the quality of presentation features is higher as compared to when the quality of presentation features is lower.

Discussion & Conclusion

The main objectives of this paper are twofold: first, to introduce *craving* to the existing literature on technology addiction and examine its antecedents on the basis of key user needs;

second, to study the specific role of *technology* in craving and addiction. From a review of the literature in psychology, neurology, and the IS disciplines, we first provided a conceptualization of craving as a psychological attachment to use technology and highlighted the role of motivations and needs as predictors of craving. Regarding the role of technology, we drew upon the literature on gaming addiction (Wood et al., 2004; King et al., 2010) to examine the structural characteristics of technology, user needs, technology craving, and technology addiction. Building on the existing research on these elements, we propose a theoretical model of craving in the context of social networks which shows that the structural features of technology (social, manipulation/control, reward/punishment, presentation) have an indirect effect on user craving and addiction through satisfying the key user needs (need for reward, need for relief, need to belong, and need for self-representation).

Future Research and Limitations

Future empirical testing of the model is warranted to verify the relationships proposed in the model and to draw more salient conclusions. In order to collect data on the model, robust measures of user needs, technology features, and craving will have to be developed or adapted from existing reliable measures. For example, to develop measures for technology-related factors, we can follow guidelines by Wood et al. (2004). To be more specific, we will first pick a specific social network (e.g. Facebook) and compare it to other relevant types of technologies that have been linked with craving (games, shopping) in order to identify the key features of the social network that are important in extending technology use. Additional items will be added. To do so, we will form a panel composed of heavy Facebook users and ask panel members to identify new items and then categorize the pool of items into specific clusters (corresponding to the structural features). Finally, we will confirm the categories and factors using a panel of experts and the Delphi method. Feedback from scholars and practitioners as well as a round of pilot testing will also be useful to verify and refine the final pool of items.

One limitation of our model is that it is based on a motivational view of craving. As we explained in the literature review, several other types of models have been proposed, such as conditioning-based models, psychobiological models, and neurological models of craving (see Skinner & Aubin, 2010), which can provide additional insights into how technology craving is being created for users. It would be interesting for future research to have a closer look at the

role of personality types, brain mechanisms, and the ecological factors that are conducive to extended usage behaviors and the sense of craving.

Another limitation of our model is that it is developed in the context of social network use. While we believe that the broad interpretation of the findings in terms of the impact of technology features on users' needs and craving retains its value in a broad technology use context, additional research is required to test and validate the model in other contexts of technology use that include a risk of craving and addiction, such as online games, online shopping, and media use. Such studies will help advance our knowledge of the mechanisms and interactions between humans and technology as well as the factors that predict craving.

Theoretical and Practical Contributions

Despite its limitations and the need for empirical validation, this paper makes several contributions to theory and practice. First, we introduce craving to the IT addiction context as an important concept that can drive or exacerbate addiction or cause relapses. Existing research has addressed the key role of several factors in IT addiction, such as IT habits, personality types, demographics, and social/ecological factors (Armstrong et al., 2000; Widyanto & Griffiths, 2006; Byun et al., 2009; Turel, 2014). Nevertheless, there is no study that exclusively examines "technology craving". By integrating craving into the IT addiction stream of research, we contribute to further theorizing the IT addiction phenomenon (Turel et al., 2011). In addition, we borrowed from existing models of craving in reference disciplines (e.g. psychology) to investigate the underlying motivations and corresponding needs that may instigate the formation of craving. Although user motivations have been linked to IT use and addiction in some studies (Venkatesh et al., 2003; Xu et al., 2012), we showed that the impacts of such needs on usage behaviors can be understood on the basis of how they influence users' craving. We also theorized the effect of four unique needs that drive craving in the context of social networks. Therefore, we believe our study provides a new lens through which excessive and compulsive behaviors of IT use can be viewed and understood.

This study contributes to the IS literature by investigating the IT artifact and its effect on user behaviors. Throughout decades of research on IT use (and within the growing body of research on IT addiction), the IT artifact has generally been treated as a "black box" (Orlikowski &

Iacono, 2001; Benbasat & Zmud, 2003), i.e. a generic entity that has a similar impact no matter what its components are. Especially in IT addiction research, the role of technology has been addressed only in passing (e.g. see Turel & Serenko, 2010; Salehan & Negahban, 2013). In this paper, we put significant emphasis on technology components by discussing the role of the structural features of technology vis-à-vis user needs and motivations and explain how different aspects of technology may address different users' needs and how they can lead to craving. Our model (and future empirical testing) will contribute to our understanding of the IT artifact within the behavioral IS research field.

For practitioners, our study will help in understanding the importance of user craving as an important determinant of addiction and how it may emerge, depending on different needs of individuals. Because of the potential role of craving in relapse after cessation of excessive and compulsive behaviors, understanding craving and managing it are important in overcoming problematic IT use behaviors and alleviating the significant negative consequences they might impose on users' lives (see Paper 2). For example, managers, clinicians, or policy makers are encouraged to find ways that can alleviate the excessive need for reward or relief by reinforcing other productive IT use habits (e.g. incentivizing e-book reading instead of online chatting in free time) or promoting real-life interactions instead of virtual relationships to satisfy users' need for belonging, which could instigate technology craving and addiction.

Another important practical implication of our study is understanding the unique role of technology in driving craving and addiction. As can be deduced from our model, technology features play a part in users' craving and addiction, which may raise some issues with the legal liability of systems developers and companies that aim to design and promote such highly engaging technologies. Indeed, there is evidence that shows that lawsuits may be filed against IT companies by addicted users (Kakabadse et al., 2007; Turel et al., 2011). The model can also be useful in developing guidelines on how to control craving and minimize the potential harms caused by addictive technologies through understanding the relationships among technology features, user needs, and craving. For instance, managers might need to control or limited access to software technologies that have high social features to make sure that these features will not be used for excessive and unproductive socializing habits that could eventually affect the productivity and performance of users.

Conclusion

IT addiction is a new and growing field in IS research. To better understand what drives IT addiction, the notion of craving needs to be extended to the IT use context. This paper provides the first necessary step to integrate this concept within the IT addiction literature. It theorizes the relationships among technology craving, users' motivations and needs, and technology features in the context of social network sites. We hope that the model will be validated, refined, and extended in future studies and will eventually act as a catalyst for further research on technology craving and addiction.

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Chapter V: Conclusion

There have been several calls in IS research for further research and theory building about the IT addiction phenomenon (Turel et al., 2011; Tarafdar et al., 2015). Putting forward these separate essays to investigate various IT addiction-related issues, this dissertation provides a step forward in order to answer these calls and enhance the current understanding of IT addiction. Specifically, three essays were presented that focus on the liability of users to IT addiction (essay #1), the process of IT addiction development (essay #2), and the role of craving on IT addiction (essay #3). To reiterate the contribution of this work, in summary form, the essays showed the following:

Essay #1 introduced *liability to IT addiction* and, on the basis of both qualitative and quantitative data analysis techniques, provided a typology of five types of users that shows variations among users in regard to their liability to IT addiction. While ADDICTs (associated with the very high liability level) usually receive attention from managers or clinicians, FANATIC and HIGHLY-ENGAGED types of users also have a significant propensity (High and Medium) for developing severe problematic behaviors. In contrast to these high liability types, the results showed that a group of users have minimal IT usage, which inhibits them from taking advantage of the potential benefits associated with technology usage. Finally, the paper provided detailed insights on the nature of the profile and identified the individual differences, the technology features, and the users' behaviors, as well as the negative consequences associated with each liability type. Propositions were put forth for further testing as well as a research agenda for future research in this area.

Essay #2 proceeded to enhance existing knowledge of IT addiction development. Rather than taking the widely used variance-based approach to study addiction (e.g. Turel et al., 2011; Soror et al., 2015), the essay used a process-based approach to examine the mechanisms underlying the development of IT addiction over time. Building on a pool of interviews collected from users of smartphone and social network technologies, three building blocks were identified: *the user*, *the technology*, and *the environment*. Additional mechanisms were found to contribute to the development of IT addiction, including change in usage intensity, lack of control, and the reinforcement cycle. The analysis suggested that IT addiction develops from the interactions

among users and technology within a specific environment, and that the transformation of regular IT use into problematic uses occurs in three phases: *initiation, transition to addiction,* and *persistence*. The model suggests that a temporal understanding of IT addiction is critical in designing effective strategies that can control IT addiction at different stages of its development.

Finally, essay #3 integrated the notion of craving with mainstream IT addiction research. In this essay, we studied technology craving as one of the key antecedents of addiction when it forms initially or after a period of abstinence. The paper further theorized the specific role of technology characteristics through an extension of prior models that have focused mainly on users and individual differences. Building on the motivation theories of craving, the proposed model shows how users' specific needs can predict craving in the context of social networks. The essay also hypothesized that interactions between various needs and the different structural features of technology that lead to craving and addiction.

In addition to these theoretical contributions, the findings have considerable practical implications for managers and decision makers. Essay #1 shows the importance of understanding liability to addiction instead of assessing IT addiction on the basis of a threshold (i.e. addiction vs non-addiction). While a group of addicts may be identified when using diagnostic criteria, there is a risk that other users who have a higher risk of developing problematic behaviors may be disregarded; thus, having a holistic understanding of all users' behaviors and their liability to addiction is important. The findings from essays #2 and #3 can also be used in order to design guidelines on how to prevent and control problematic behaviors in order to avoid the negative consequences of IT addiction. They encourage managers to be mindful when making decisions about implementing a potentially addictive technologies, such as social networks, in their organization.

Future Research

The avenues for future research related to each essay were stated in each. Although essay #1 is currently under review at an IS journal, future research is needed to develop an instrument to directly measure liability to addiction and validate it in the context of smartphone use or other addiction-related contexts (e.g. online shopping, online games, electronic gambling, etc.). Furthermore, the typology of IT liability types and the suggested propositions developed in this

essay should go through additional testing and validation by using large surveys and quantitative techniques. To prepare essay #2 for publication, building on the three-phase model proposed, subsequent efforts are required to establish precisely the sequence of events and interactions between the building blocks and to explain how an IT use changes as the user goes through the phases. In the same way, a deeper analysis of the difference between smartphone use and social network use will be helpful to better clarify the role of technology features and affordances in the model and identify additional affordances (if any) that could enable the development of addictive behaviors. For essay #3, the subsequent steps before publication are to develop and test a measurement instrument for technology craving and to identify specific measures for users' needs and the structural features of technology. Once the instrument and operationalization of the constructs have been developed and the items are validated through card sorting and a pilot study, it will be appropriate to run a large survey and collect data from the user population of a major social network (e.g. Facebook) and to test the hypotheses proposed in the essay.

Aside from the future research works directly related to the dissertation, there are two other streams of research that are particularly interesting and will be pursued following the completion of the doctoral dissertation. The first stream relates to *big data analytics* (more specifically behavioral analytics) in order to study IT addictive behaviors. Behavioral analytics are the collection of techniques that provide a humanistic view of data by focusing on how and why users behave in a certain way in online and electronic platforms (such as online shopping, gambling, and game sites). In order to analyze users' behaviors, these tools take advantage of the user data that is collected when users actually interact with a platform (e.g. navigation paths or clickstream in a website). Given the volume, velocity, and variety of data more and more available to scholars, it is becoming increasingly important to use this massive amount of data to identify and predict usage patterns that may become problematic over time. For instance, by using transactional data available from online shopping or auctioning sites, one would be able to investigate the algorithms that help identify addictions or determine users' propensity for online shopping/auctioning disorders. In this way, behavioral analytics will bring a unique perspective to studies of addiction by using seemingly unrelated data points in order to predict future usage trends and depict how users may behave in their future interactions with a technology. Furthermore, comparing self-reported usage data with actual usage data can provide interesting

insights on how to interpret the results of data analysis of data collected through perceptive measures of a behavior, which will have important implications for both IS and behavioral research.

In addition, given the recent developments in the field of Neuro IS (Dimoka et al., 2011; Lian & vom Brock, 2014), another promising avenue for future research is to apply cognitive neuroscience theories and methods to understand the brain mechanisms and neural systems subserving the excessive and compulsive use of technology; this has been referred to as "opening the brain's black box" (Dimoka et al., 2011). An in-depth understanding of the brain mechanisms underlying IT addiction can help improve IS theories and enhance our knowledge of how interactions between human and technology and subsequent decision making truly occur. For instance, one interesting research aim would be to understand the brain mechanisms of users who develop technology addiction and to compare and contrast them with other general types of behavioral disorders, such as alcohol or drug addiction. As an example, a recent study by Turel and his colleagues (2014) looks at two critical brain regions that have been shown to be linked to substance addiction, namely, the impulsive, amygdala-striatal system and the reflective-inhibitory prefrontal brain system, and examines them in users who have high exposure to Facebook. Identifying the similarities and differences between the substance and technology-related types of addictions can help improve the validity of the technology addiction concept and its acceptance and inclusion in future revisions of the *Diagnostic and Statistical Manual* of mental disorders.

Concluding Remarks

All in all, this dissertation has been an exceptional opportunity to push forward existing theories of addiction in the IS discipline and to study a number of important concepts that can improve our general understanding of problematic technology use. In doing so, a number of original findings were made that are unique to this dissertation.

We showed that there are significant variations among users' behaviors and these differences can be captured by focusing on the liability of users to addiction (and its dimensions, namely, propensity and severity). Compared to a notion of addiction that can be applied only to a sub-sample of users, liability was shown to be an inclusive concept that can be extended to the entire

user population. Propensity can be defined in relation to dependency and self-awareness, and severity can be determined according to the intensity of use and negative consequences associated with technology use. The differences among liability types can be better understood by considering them as a profile that includes individual differences, technology features, usage behavior patterns, and types of negative consequences. By analyzing data collected from smartphone and social network users, we showed that the development of IT addiction is a complex process that arises from interactions among users, technology, and the environment. Taking into account different mechanisms, such as loss of control and increase in usage intensity, the results indicate that IT addiction develops when regular behaviors go through different phases of change that transform these ordinary behaviors into problematic ones. Once developed, the problematic behavior and the negative reinforcement cycle (in phase 3) will persist unless there are changes in the conditions of the user, the technology, or the environment. The interaction between user and technology is also found to be important in explaining craving for technology, which is a key driver of addiction. The dissertation shows that users' needs are the main drivers of craving and addiction, especially when these needs are being satisfied with a technology that has certain social, control, reward/punishment, and presentation features.

This dissertation is an effort to increase IS scholars' awareness and knowledge of the dark side of IT use and IT addiction. While the author's intention is to pursue the avenues of research discussed above in the near future, his sincere hope is that this work will prove to be generative of IS theories regarding the unconventional and *negative* forms of IT use, which have been relatively less studied in the IS discipline (Tarafdar et al., 2015). Given the contributions of this work in terms of clarifying the conceptualization of several key addiction-related concepts (e.g. IT addiction, liability, and craving) and providing key models and a framework to understand how IT addiction works (e.g. a typology of liability types, a process model of IT addiction development, and a motivational model of technology craving), the hope is that the dissertation will sustain its theoretical value in the IS community, and that the findings will be shown to be practically helpful for managers and decision makers in better understanding problematic behaviors and effectively handling them in work-related contexts.

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