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A Grounded Theory Model of Mobile Technology Addiction

ABSTRACT

Individuals are increasingly hyperconnected to their computing devices, particularly mobile phones. Most of the research that explores individuals' dependency on technologies has focused on online gaming and Internet addictions. In this research, a grounded theory approach is used to explore the factors that make individuals vulnerable to mobile technology addiction and the implications of such addiction. Subjects were first asked to not use mobile technologies for a predetermined period and then to describe their experience. Data was collected from 289 individuals of varied ages. Based on a qualitative analysis, a model of mobile technology addiction is developed.

KEYWORDS: Mobile technology addiction, end-user computing, grounded theory

INTRODUCTION

Nomophobia: "stress caused by having no access to or being unable to use one's mobile phone" (http://www.collinsdictionary.com/dictionary/english/nomophobia)

Research suggests young people are addicted to their technology (e.g., Bright et al. 2015). However, there is limited research on addiction to technology in general, with the exception of Internet and online gaming addictions. Since the mid-2000s, a number of studies have examined how individuals are increasingly spending "too much" time on the Internet and often described such individuals as being addicted to various Internet services, such as online gaming (e.g., Hsi-Peng and Wang 2008; Jiang 2014; Xu et al. 2012; Young 2004), online auctions (e.g., Turel et al. 2011b; Young 2004), and chat services (e.g., Atchley and Warden 2012; Thomas 2011; Young 2004).

One definition of Internet addiction is "compulsive activity involving excessive use, withdrawal, and negative repercussions" resulting from Internet use (Kapahi et al. 2013, p. 72). Interestingly, Internet addiction seems to be a particularly acute problem in Asia with several centers and clinics established to help individuals with their addiction (Jiang 2014; Kapahi et al. 2013). More recently, studies have started to examine addiction to social networking sites (Bright et al. 2015; Kang et al. 2013; Turel 2015; Turel et al. 2014). Another area of research is Internet abuse in the workplace (e.g., Beard 2002; Griffiths 2010), which can lead to increased cybercrimes (Porter and Kakabadse 2006). Yet, most of the literature is focused on young people and the Internet (e.g., Aslanbay et al. 2009; Jiang 2014; Kapahi et al. 2013; Soule et al. 2003; Xu et al. 2012). However, we argue that young people are not the only demographic at risk of developing addictions to technology, and thus seek to study a more diverse sample of individuals with respect to age. In addition, rather than collecting survey data, we use a grounded theory approach to examine qualitative data in order to understand individuals' reactions to being deprived from their technologies.

Mobile technologies are one of the more recent technological innovations that have dramatically changed the way individuals interact and communicate with others. Mobile phones serve as our phones, watches, browsers, entertainment, links to social networks, and much more. As a result, individuals are self-describing themselves as "hooked" to their phones (e.g., Ahmed et al. 2011; Khang et al. 2012). What is unclear, however, is what the long-term implications of this dependence are. Is addiction to mobile technologies really a problem? What

are the consequences for the self and others if one never disconnects? How does this potential addiction influence the use of other technologies? What are the positive and negative implications of mobile technology addiction for working adults?

In summary, the limited research that exists on technology addiction has mostly focused on Internet addiction and younger individuals. Furthermore, the research typically takes a cross-sectional approach and, with a few exceptions (Khang et al. 2012; Turel and Serenko 2010), does not consider addiction to mobile technologies specifically. Therefore, this research attempts to fill this gap by using a qualitative grounded theory approach (Eisenhardt 1989; Orlikowski and Baroudi 1991; Strauss and Corbin 1990; Yin 1994) to explore the following questions:

- What factors affect possible addiction to mobile technologies across age groups?
- What are the positive and negative consequences of such addiction?

Grounded theory methods allow researchers to explore problems that need a deeper understanding of the phenomenon of interest (Weber 2003). This approach requires proper definitions of the problem and an in-depth data collection, which are followed by theoretical formulation (Urquhart and Fernandez 2013). Figure 1 summarizes this approach.
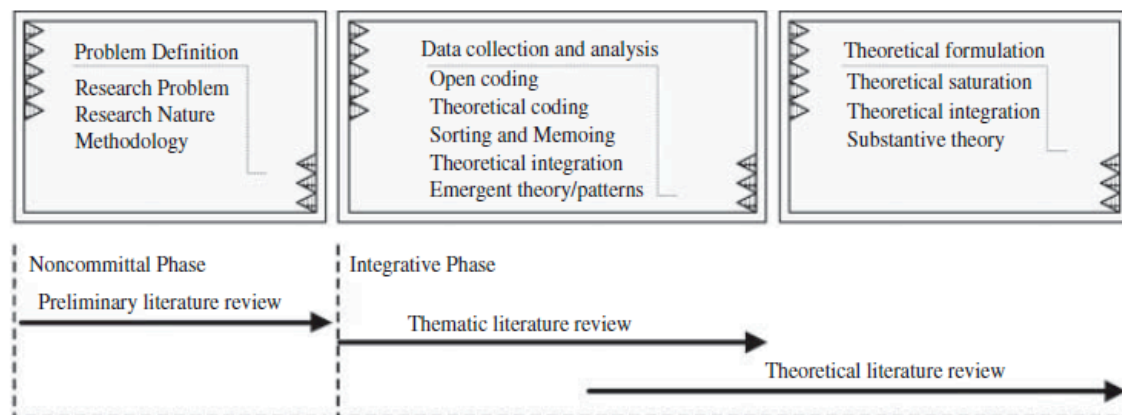

Figure 1. Grounded Theory Methodology (Urquhart and Fernandez 2013)

METHODOLOGY

This research develops an emergent model of mobile technology addiction by following the grounded theory approach and the steps proposed by Eisenhardt (1989). The activities required to conduct this research are summarized in Table 1. Qualitative approaches are particularly useful for theory building because they are designed to focus on understanding and describing a phenomenon (Eisenhardt and Graebner 2007; Yin 2010).

Table 1. Grounded Theory Activities (Adapted from Eisenhardt (1989), p. 533))	
Activity	Description
Definition of research questions	Presented above
Possible a priori constructs	Addiction, positive outcomes, negative outcomes, demographics

Specified population	Individuals with mobile phones
Multiple data collection methods	Written blogs and live discussions
Qualitative and quantitative data combined	Qualitative analysis of written blogs; Quantitative analysis of emergent themes
Multiple investigators	One researcher; one assistant
Overlapping data collection and analysis; field notes	Iterative process conducted over four years
Flexible and opportunistic data collection	Blog instructions vague and non-leading; open discussions; flexible coding templates
Within-case analysis	Themes compared across gender and age groups
Cross-case pattern search using divergent techniques	Themes analyzed for cross theme correlations and differences
Iterative tabulation of evidence	Presented later in this section
Replication, not sampling, logic across case	Similarities across demographic groups are analyzed
Search evidence for why behind relationships	Theories that may explain reactions are discuss in next section
Comparison with conflicting literature	Compared with Self-Control theory
Comparison with similar literature	Compared with Habit Theory
Theoretical saturation	Proposed Model of Mobile Technology Addiction

Data Collection and Sample

Over a four-year period, individuals registered for a variety of Masters and Executive classes were asked to participate in a real-life experiment. The experiment asked them to spend one half day (four to five hours with sleeping hours not allowed to be counted) without using information technology (IT), including their mobile phones and devices. Instructions were not specifically targeted at mobile phones, but the findings reported in this research are focusing on this particular technology. Participants were then asked to blog about their experience. The use of Executive and Masters students was necessary so that there would be enough similarities for comparable properties to exist (Miles and Huberman 1994; Yin 1994), and yet offer differences in terms of individual characteristics (working professional vs. student; age).

The blogs served as the primary means of documenting the experiences of participants (Myers 1997). Blogs offer a more informal discussion than a submitted text file or document, and blogs do not require individuals to write using proper grammar. This was appropriate for our study because the interest was in getting their genuine reactions to the experience. The instructions and questions posed for the blogs were carefully phrased not to lead the subjects. Therefore, the words "hooked", "addiction" or similar words were avoided. The instruction for the blogs read as follows: "So, how well did you do? Could you spend four or five hours without any information technology?" After the experiment, discussions were held with each group of participants to further review their experience. These discussions led to the initial coding template that is described in the next sub-section.

In total, 289 valid data points were collected over four years, with a wide range of age groups (students below the age of 18 were not allowed to participate due to institutional review board (IRB) requirements). The age range was 20 to 64 years old. Table 2 summarizes the classification of the participants. Blog entries varied in length from a paragraph of three to five sentences to several paragraphs that would cover approximately one to two pages if converted to a word processing document. All blog entries were imported into an Excel spreadsheet, stripped of personal data, and then imported into the nVivo software for analysis, which involved three stages of coding and interpretive analysis (Bazeley and Jackson 2013).

Table 2. Classification of Study Participants*			
	Executives (professionals)	Masters (Students)	Total (n = 289)
Males	46	118	164
Females	23	102	125

* Due to IRB requirements, age, group membership, and other personally identifiable data cannot be reported.

Coding

Both open and axial coding were used in the data analysis. During open coding, transcripts were analyzed line-by-line using an initial coding template (Strauss and Corbin 1990). Once this was completed, axial coding was used to identify possible relationships between and within categories (Strauss and Corbin 1990). To do so, codes were grouped into sub-categories where appropriate.

Based on prior literature and information gathered during the post-experience discussions, an initial list of coding categories was developed. The list was refined as more blog entries were coded in an iterative process, and as more blogs were collected over time (Miles and Huberman 1994). Table 3 shows a summary version of the coding categories that emerged from this process.

The unit of analysis in this research is the individuals' blog entries. Based on the initial coding template, the researcher and an assistant both coded three blog entries independently (Miles and Huberman 1994). We then compared results and discussed differences until agreement was reached on the categories, definitions, and future coding procedures. We then each coded three additional blog entries using the revised coding template. An inter-rater reliability was computed with Cohen's Kappa (Reynolds 1977), which measures agreement above and beyond that which would happen by chance. The inter-rater reliability was 0.93. Since Landis and Koch (1977) suggest that values above 0.80 represent almost perfect agreement, one member of the team then coded the remaining blog entries. Categories that were common across multiple blogs were added to the coding template and all blog entries were reviewed to include the added concepts. Saturation was reached early in the process – i.e., no new concepts were identified during analysis of the later blogs. However, all blog entries were coded, in particular to identify any changes over the four years of the study. Once the data were coded, a thematic analysis was performed, and is discussed in the next section.

Table 3. Coding Categories	
Positive Outcomes	Spent more time with people (friends/family); increased productivity, increased amount of exercise, spent more time outdoors, more chores accomplished
Negative Outcomes	Stressed about school/work, missed communication from friends, missed communication from work, didn't abstain because accidentally used IT, didn't abstain from IT use because didn't want to
Positive Emotions	Felt refreshed, felt accomplished
Negative Emotions	Feelings of withdrawal, lack of concentration, felt disconnected from the world, felt lost (didn't know what to do with themselves), frustrated, compulsive feeling to use phone/check time on phone
Timing of Experiment	Sunday, Saturday, Weekday – day, Weekday – night
Reasons for Timing	Planned outdoor activity, no work, no pressure, other
Experience with Abstaining from IT	Very easy, somewhat easy, somewhat difficult, very difficult, not completed/failed
Explanations for Outcome	Culture/society, part of daily life, wired to do it

ANALYSES AND RESULTS

The purpose of this research is to understand the antecedents and consequences of mobile technology addiction through the development of an emergent model. The data collected over four years reveal that there were no major differences between blogs written in the first year and blogs written in the last year. Analysis of the data between regular Masters students (typically between the ages of 20 and 28) and Executives (typically between the ages of 35 and 64) revealed very similar experiences with both positive and negative outcomes and emotions (discussed below) from the experience of abstaining from IT for half of a day. The main difference between the two groups was the type of activities performed while not using mobile technologies. Executives spent the "time off from their IT" with their spouses and children, while Masters students performed more activities and time spent with friends (or studying). The main themes identified in the analysis of the coded data are presented below.

Personal and Task Characteristics

Most participants could be placed in two major categories: those for whom it was extremely difficult not to use their mobile phones (many would even say: "why even try?") and those who found it relatively easy and cherished the time they regained from not using their phones. These quotes exemplify these extremes:

- *"you know what? I … failed. … When I want to go to the tennis court to play tennis with some of my friends, I had to connect with them by iPhone; I was also glad to spend the whole morning … cooking, but I must get some cooking [recipe] online…. I definitely*

surrendered. I am gonna die if no Information Systems [are available to] me." – Female,
Masters

- *"While this experiment was challenging in many ways even though I attempted it on a Saturday, it became obvious that by eliminating technology for a limited period of time, the time I spent with my family and friends was quality time. I was not checking email, using various apps, texting etc. In fact, … [we will implement] our own version of this experiment regularly and try to put our phones/computers down for one hour in the evening in an attempt to have an uninterrupted conversation as a family."* – Female, Executive

- *"Everyone always talks about "real-time information" and being two steps ahead of other people. This technology developed for a reason and out of need. I definitely feel as though people have become too reliant…"*– Female, Masters

Clearly, different individuals make different decisions about how to use their mobile devices. For some, use is impulsive while for others use involves more self-control. The following quotes illustrate these ideas.

- *"I do believe, to a certain extent, that I am hooked on technology. When I am bored or 'ed out, it is very easy for me to just pick up my phone and search the web."* – Female, Masters

- *"So although I was able to get away from information technology … it appears that it has become an integral, unconscious aspect of our lives."* - Female, Masters

These quotes suggest that addiction can occur when individuals have more impulsive use than executive (self-controlled) use. In the health addiction literature (tobacco, drugs, etc.), researchers refer to decisions regarding such behaviors as either impulsive or executive. Temporal discounting theory suggests that in a strategic decision process, a delayed outcome (the future) may be discounted by some individuals, in which case the impulsive decision areas of the brain take over and the individuals perform an immediate action (Bickel et al. 2014; Bickel et al. 2007). The executive decision section of the brain regulates social competence, whereas the impulsive decision is brief and intense. For example, in a study of texting addiction, Atchley and Warden (2012) found that individuals who believe information will lose value over time cannot help themselves and must respond to texts immediately.

When impulsive decision making is stronger than executive decision making, addiction occurs. For example, Turel et al. (2014) find that addictions to technology offer similar neural reactions to substance and gambling addictions. The executive decision making portion of the brain is considered to be fully developed for most individuals in their mid-20s (Lebel and Beaulieu 2011), usually around the age of 28. This suggests that younger people may be more susceptible to addiction than mature individuals. Therefore, age, gender, and other personal characteristics might influence who is more at risk of developing addiction to mobile technologies. In one of the few studies on mobile phone addiction, Khang et al. (2012) find that the "self" is an antecedent to such addiction. Another study identifies the need for personal connections to be related to social media addiction (Bright et al. 2015). Building on the theories and literature mentioned above, we suggest that certain personal and task characteristics affect the type of use.

Proposition 1: Individuals' personal characteristics (age, gender, need for connectedness, extroversion, work ethic) influence whether they will have a rational (executive) or addicted (impulsive) use of mobile technologies.

Proposition 2: Perceived task characteristics (time sensitivity) influence whether individuals will have a rational (executive) or addicted (impulsive) use of mobile technologies.

Outcomes

Individuals who found it extremely difficult when asked not to use their mobile phones for four hours described many negative effects from abstaining from their mobile phones. After grouping emergent themes, the most frequently mentioned negative outcomes and emotions were lack of concentration/focus (27), lack of communication (18), stress (6), feelings of withdrawal (5), and frustration (5).   Positive outcomes and emotions centered on social connection (83), healthier activities (being outdoors, exercise, etc.) (51), increased productivity (21), and self-esteem (6). Examples of quotes that address outcomes include:

- *"I couldn't imagine living without my smart phone for a long period of time. I would feel very disconnected from my friends and family."* – Male, Masters

- *"Overall …[it] was not bad at all, it was actually kind of relieving. Although I did want to see the news headlines and check my phone, not connecting to the world was calming. I enjoyed not seeing the light blink on my phone."* – Male, Masters

- *"it provided me time to catch up with my brothers, relive history, and just have a good time… I'd now argue the best way to relax and catch up with people is out in the woods, across a fire, with no pressures or cares in the world. This is something technology will never be able to simulate."* – Male, Executive

- *"IT WAS GREAT! … I found that I was able to focus more on living my ACTUAL life versus my VIRTUAL life. I might be one of the only people who celebrates being device free, but I think that others around me, to include my extended family that I usually see during the weekends, still need to be reading/working/playing with some sort of device even when we are having family time. After explaining my [experiment], their initial thoughts were that it was odd. How/why would anyone do that?"* – Male, Executive

It is evident from the various blog entries that some participants experienced great benefits from disconnecting from their mobile phones while others were negatively affected. Prior research has identified some of these outcomes related to social media addiction, such as changes in productivity (Bright et al. 2015). One recent study suggests stress at work leads to risks of Internet addiction (Chen et al. 2014). This is interesting since the authors suggest stress leads to addiction, whereas our study finds that addiction leads to stress. Clearly, this highlights the need to study the recursive relationship between these two constructs. Our data suggest that individuals who planned how they would spend the time they abstained from IT, and focused on either time with friends and family or outdoor and/or physical activities to pass the time, were more positive about the outcomes and more likely to succeed in disconnecting for the required amount of time. In another study of addiction focusing on massively multiplayer online games (MMOG), loss of control and withdrawal were identified as two of seven dimensions of MMOG addiction (Lee et al. 2015). Finally, one study found that overuse

(addiction) to mobile phones for work can lead to information overload and work-family conflict (Turel et al. 2011a). Based on the analysis of the data and the discussion above, the following proposition is put forth:

Proposition 3: The type of use (impulsive/executive) influences the type of outcomes individuals perceive they get from such use.

Habit and Culture

In explaining how they succeeded or not in abstaining from their mobile devices, many individuals indicated that they were "wired" to use their cell phones, even mentioning that mobile phone use is a cultural aspect of their lives.

- *"This … activity was much harder to complete than I anticipated. I figured if I removed myself from information technology I could avoid it. … I use it on a day-to-day basis in things I don't even know or realize I'm using it… information technology … defines us."* – Male, Masters

- *"I can conclude that it is nearly impossible for our culture to spend even a short amount of time in the absence of technology. It is embedded in our brains and daily activities whether we realize it or not."* – Female, Masters

This finding is interesting since habit has been an increasingly studied construct in recent years. For example, habit was added to the Information Systems (IS) Continuance Model as a moderator between usage intentions and actual usage behavior (Bhattacherjee and Lin 2015; Limayem and Cheung 2008; Limayem et al. 2007). Discussing past research on IS continued usage, Ortiz de Guinea and Markus (2009) suggest that research has been neglecting the roles of emotions and habits. Research has shown that as individuals develop strong automatic cues over time, certain behaviors become associated with rewards, and habits can become addictions (Robinson and Berridge 2001). Examples of such addictions can be found in the use of social networks where individuals feel they cannot control their urge to use the systems, and having strong temptations can become addictions (Turel and Serenko 2012). Similarly, Bright et al. (2015) discuss how habitual usage is involved in the development of social media addiction. Culture has also been found to influence addiction to the Internet (Chen and Nath 2016). Building on these ideas, this research proposes that habit and culture affect the type of use (impulsive or executive) of mobile phones.

Proposition 4: Habit influences whether individuals will have a rational (executive) or addicted (impulsive) use of mobile technologies.

Proposition 5: Culture influences whether individuals will have a rational (executive) or addicted (impulsive) use of mobile technologies.

RESEARCH MODEL

Based on the analyses of the data, the proposed model of Mobile Technology Addiction is presented in Figure 2. This emergent model helps identify some of the processes and antecedents to mobile technology addiction, including personal and task characteristics, culture, and habit. Whether an individual is addicted to mobile technology is partly dependent on whether their use is directed from their executive or impulsive decision making systems.
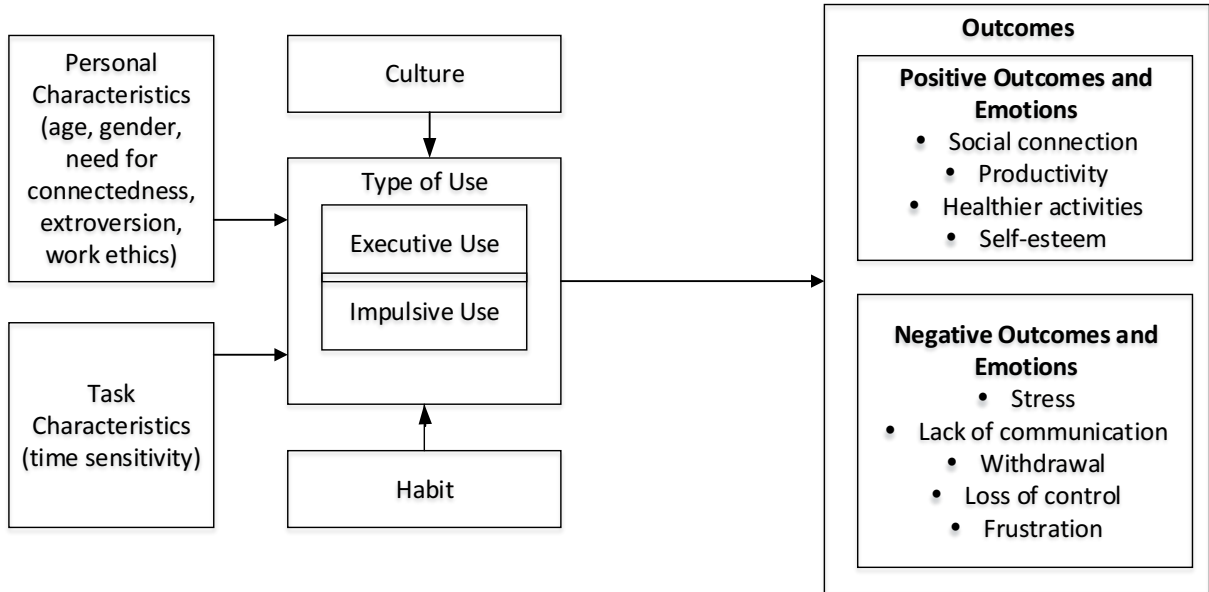
Personal Characteristics (age, gender, need for connectedness, extroversion, work ethics)	Culture		Outcomes

Figure 2. Model of Mobile Technology Addiction

Antecedents to Mobile Technology Addiction

The proposed model of mobile technology addiction starts to unearth some of the key characteristics of individuals and tasks that seem to influence whether individuals will make impulsive or executive use of their mobile technologies. These characteristics need to be further explored in both qualitative and quantitative research. Longitudinal studies are needed to explore how habit can be an enabler or an inhibitor of mobile technology addiction. Similarly, the role of culture needs to be further studied. While the model of mobile technology addiction depicts culture as a direct antecedent to the type of use (executive vs. impulsive) based on limited prior studies, it is possible that culture moderates the link from type of use to outcomes. It is also possible that habit is a moderator of the same relationship. All of these possibilities need to be explored in future research. Finally, cross-sectional studies are needed to validate the effects of the factors presented in the model in Figure 2, but also to identify additional factors that may lead to executive versus impulsive use of mobile technologies.

Consequences of Mobile Technology Addiction

The mobile technology addiction model highlights both positive and negative outcomes of mobile technology use. This is because the model includes both impulsive and executive use of

mobile technologies. Research is needed, however, to clearly delineate whether impulsive use always leads to negative outcomes or whether at times even executive use leads to some of those same outcomes. Studies are also needed to identify additional outcomes, both negative and positive, that result from excessive use of mobile technologies. Furthermore, a true longitudinal study is needed to explore the effects over time, and particularly to explore the seemingly recursive relationship between stress and addiction.

CONCLUSION

This research offers an initial examination of mobile technology addiction and its consequences. Using a grounded theory approach allowed emergent constructs and relationships to be identified. While the findings were consistent with some of the prior literature on Internet or online gaming addictions, additional concepts such as need for connectedness, lack of communication, social connection and healthier activities are uniquely derived from the context of this study. Given the increasing dependence of individuals on their mobile devices, researchers need to further explore the consequences of impulsive use. This research offers a building block upon which future research can further explore mobile technology addiction.

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