

Understanding and Predicting Compulsive Smartphone Use: An Extension of Reinforcement Sensitivity Approach

Research-in-Progress

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Abstract

Compulsive smartphone use has received increasing attention due to its ubiquitous and disturbing outcomes. However, integrative research that investigates the process and possible antecedents of compulsive behavior in the use of smartphones remains limited. Based on an extensive review of literature on compulsive behavior, we define compulsive smartphone use in general and explain its specific differences from other compulsive behaviors. We propose a research model that uses the reinforcement sensitivity approach to provide a better understanding and explanation for compulsive smartphone use. Both craving and compensation lenses are systematically integrated into this theoretical foundation to identify the underlying mechanism of compulsive smartphone use. We further identify possible situational factors that influence reinforcement sensitivity from social, experiential, and technological perspectives. We believe such an integration of both craving and compensation mechanisms is of crucial importance for scientific and practical research.

Keywords: Compulsive behavior, reinforcement sensitivity, negative social influence, perceived risk, feedback mechanism, smartphone, problematic IT use

Introduction

With the advanced and integrated features of smartphones for communication, computing, and mobility (Sarwar and Soomro 2013), preventing individuals from excessive and even compulsive use of smartphones has become difficult. Anecdotal evidence on instances of compulsive behaviors in the use of smartphones include checking habits (Oulasvirta et al. 2012), phantom vibrations (Evans 2012), cycle of responsiveness (Perlow 2012), and smartphone addiction (McCafferty 2011). More seriously, a study has found that 29% of Gen Y check their smartphones so constantly that they lose count (Sidhaarthaa 2012). Moreover, 88% of professionals feel either disoriented, distraught, lonely, or physically ill when they do not use their smartphones (McCafferty 2011).

Despite the increasing negative impact of compulsive smartphone use, it has drawn little attention in IS research. The few existing studies have limited their focus on specific categories and general measurement of compulsive smartphone use from either a conceptualization approach (Billieux 2012; Kwon et al. 2013) or a statistical perspective (Casey 2012; Hato 2013). To date, few studies have considered the underlying mechanisms and enacting variables that promote and reinforce compulsive behavior in the use of smartphones, and scientific understanding of this issue is still evolving. The majority of extant literature on smartphone use problematic, addictive, and compulsive behaviors interchangeably, while ignoring the substantially distinct characteristics of compulsive smartphone use (e.g., a joint function of craving and compensation mechanism). Hence, further systematic investigations on the process and possible antecedents of compulsive behavior occurring in smartphone use are necessary to gain insights and provide support for more effective management for both users and clinicians.

This study aims to shed light on the theoretical process of compulsive smartphone use. We first define compulsive behavior in the smartphone context by reviewing previous literature on compulsive behavior, and then adapt and extend the reinforcement sensitivity theory to comprehend the theoretical mechanism. We further identify the possible antecedents with social, experiential, and technological factors that might have an influence on users' reinforcement sensitivity. We believe that the expected contributions should pave the way for future empirical research to explain, validate, and test compulsive smartphone use.

Theoretical Background

Compulsive Behavior

The concept of compulsive smartphone use is relatively new in literature and thus, we initiate our discussion by situating it in previous compulsive behavior research. In this study, we primarily conduct a keyword search with the use of keywords, such as “compulsive behavior”, “compulsive technology use”, and “problematic smartphone use” (including addictive and compulsive behavior) from the database of Google Scholar. Given the space limitations, we only list literature that explains compulsive technology use and problematic smartphone use in the current study (summarized in the Appendix). Our literature review shows that scholars have attempted to understand compulsive behavior from different perspectives, and no consensus on its exact definition has been reached. We outline two contrasting views of compulsive behavior following the literature review: compensation and craving-based advocates.

In the view of compensation-based advocates, compulsive behavior refers to the performance of repetitive behavior with the goal of alleviating tension, anxiety, or discomfort aroused by an obtrusive thought or obsession (American Psychiatric Association 2000). Consistent with this definition, we should underline that compulsion typically occurs with a compensatory component that reflects “a chronic, repetitive, and excessive behavioral response to inner deficiencies, negative feelings, and events” (Neuner et al. 2005, p. 510). Such tendency to compensate is acted upon due to distorted autonomy and low self-esteem to relieve stress, disappointment, and structural deficit (Scherhorn 1990). Following this line of reasoning, an automaticity-based theoretical foundation is used to describe compulsive behavior as a behavioral pattern that is stereotyped, effortless, stimulus-orientation, and uncontrolled (Tiffany and Carter 1998).

On the contrary, a craving-based view (i.e., characterized as an inability to resist the impulse to continue the behavior) is embraced by several scholars to investigate the mechanism of compulsive behavior. Advocates of such view claim that craving, impulsivity, and rewarding experience serve as key

determinants in the spur of compulsive technology use, such that sex and pornography cravings have important effects on motivating compulsive Internet use (Wood 2007), and rash spontaneous impulsivity acts as the strongest predictor of compulsive Internet use (Meerkerk 2007). Correspondingly, social cognitive theory and cognitive-behavioral approach are broadly applied to investigate the underlying network of compulsive behavior (Rachman 2002). For instance, the cognitive-affective structure (i.e., cognitive appraisal-emotional reaction-behavioral response) is highlighted as an important determinant of compulsive behavior (Doron and Kyrios 2005; McFall and Wollersheim 1979).

In line with previous studies, the limited extant literature that explain compulsive smartphone use focused their attention on either the compensation mechanism such as the feeling of missing out (Hato 2013), or the craving mechanism such as impulsivity, urgency, sensation seeking, and lack of premeditation (Billieux 2012; Roberts and Pirog 2013; Wu et al. 2013).

In summary, the assumption of compulsive behavior is a dichotomy of craving and compensation base; however, despite their considerable merits, we argue that both craving and compensation mechanisms exert a joint effect on subsequent behavior modification (i.e., compulsive smartphone use). To explain this rationale, it should be noted that compulsive smartphone use differs from previous compulsive behavior for the following reasons. First, compulsive smartphone use is conducted as a personal reinforcement process to maximize the perceived utility (e.g., information, connection, and entertainment) in usage behavior, instead of a completely irrational behavior (e.g., compulsive gambling and buying) with several psychological problems. In the presence of high mobility and localization, multimedia capture and distribution, instant connection, and ubiquitous access, smartphones provide an effective and efficient method for instant connection and information obtainment (Pitt et al. 2011). Regular use of smartphones to pursue and maximize its utility gradually transforms into uncontrolled behavior modification. Second, compulsive smartphone use is performed not only to pursue the craving and rewarding experience, but also to avoid the “punishment” experience of non-use behavior. People have to approach the use of smartphones defensively to overcome potential conflicts from occurring when they are not allowed to use their smartphones, such as the strong fear of missing out on information, phone calls, and social connections (Hato 2013), as well as anxiety and withdrawal symptoms (Sidhaarthaa 2012). Therefore, in essence, we can assume that compulsive smartphone use is a joint function of both a rewarding and punishment experience. According to this theoretical foundation, we define compulsive smartphone use as individuals’ performance of repetitive and persistent checking of their smartphones with the goal of alleviating tension, anxiety, discomfort, or obtaining potential reward and pleasure.

A Reinforcement Sensitivity Approach in Understanding Compulsive Behavior

The reinforcement sensitivity theory was originally proposed by Gray (1970) to illuminate the dissociation among neurophysiological, neurochemical, and behavioral levels (McNaughton and Corr 2004). This theory predicts that the sensitivities of neurological systems, which include behavior activation system (BAS), behavior inhibition system (BIS), and fight/flight system, represent individuals’ responses to external environmental cues (Carver and White 1994). More importantly, BAS is proposed to reflect reward sensitivity; whereas both BIS and FFS reflect a common dimension of punishment sensitivity (Corr 2004). In the current study, we focus mainly on BAS and BIS for the present exposition.

Reinforcement sensitivity theory assumes that the reactivity to reward and punishment generated from reinforcing stimuli leads to a change in motivation, affect, and even behavior (Pickering and Gray 2001). In broad terms, the reactivity of BAS, summarized to the measure of impulsivity, conforms to an individual’s behavioral response to reward; whereas the reactivity of BIS, manifested by the measure of anxiety, corresponds to an individual’s behavioral response to punishment (Smillie et al. 2006). More specifically, BAS mediates the effect of response to both unconditioned and conditioned appetitive stimuli, thereby resulting in an approach behavior (Gray and McNaughton 2000). In contrast, BIS mediates the response to all sources of conflict including the conditioned and unconditioned aversive stimuli, thereby leading to the arousal and defense against these conflicting stimuli (Jackson 2009). Therefore, reinforcement sensitivity theory is also identified as a theory of impulsivity and anxiety with focus on the neuropsychology of motivation, emotion, and learning (Smillie et al. 2006). Table 1 provides a summary of the reinforcement sensitivity theory.

Table 1. Summary of BAS and BIS (Smillie et al. 2006)

	Stimulus input	Trait manifestation	Emotion reactivity	Behavioral output
BAS	Conditioned and unconditioned reward	Impulsivity	Positive affect	Approach
BIS	All sources of conflict including the conditioned and unconditioned aversive stimuli	Anxiety	Negative affect	Defensive approach

To further illustrate the relationship between BAS and BIS, the reinforcement sensitivity theory hypothesizes that the underlying biological processes of sensitivity to reward and punishment jointly induce the surface expression of impulsivity and anxiety, which in turn have an integrated effect on the level of behavior response. Acting as competitors for control over the behavior, BAS and BIS separately exert an influence on both reward and punishment-mediated behavioral responses (Smillie et al. 2006). The output of the decision making process is thus the calculus of inputs from the two systems, and their respective influences depend on external factors (Corr 2002). From this perspective, we can conclude that the effect of situational factors on behavior response depends not only on the strength of the stimuli and activated system reactivity, but also on the mutual inhibition of the two systems.

Compared with other theories (e.g., social cognitive theory (Caplan 2005; Wu et al. 2013)), the reinforcement sensitivity theory can be generalized more effectively to understand compulsive behavior and is particularly illuminating in the context of smartphone use for two reasons. First, the reinforcement sensitivity theory integrates the process of compulsive behavior from both a craving and a compensation perspective. The theory investigates the effect of impulsivity (i.e., behavioral approach to rewarding experience), as well as the effect of anxiety (i.e., defensive approach to punishment experience), and thus represents a more comprehensive tool for explaining compulsive smartphone use. Second, the reinforcement sensitivity theory focuses on the reinforcement effect of situational factors on behavioral response (Smillie et al. 2006). In other words, people's sensitivity to reward and conflict is contingent on the situational factor, rather than acting as a constant characteristic. Consistent with this theoretical assumption, it has been highlighted that situational factor exerts a more crucial effect on behavior resistance and enactment, although an individual's personality has an effect on the primary formalization of desire strength (Hofmann et al. 2012). Therefore, in the current study, we argue that situational factors play a relatively more important role in the development of compulsive smartphone use than the intrinsic psychological variables. This lens also provides the reason why a great number of regular users (or without psychological problems) transit their rational behavior into compulsive smartphone use. In summary, we believe that the reinforcement sensitivity theory is a more appropriate tool for understanding the development of compulsive smartphone use.

Situational Factors that Influence the Reinforcement Sensitivity

Despite the dichotomy in understanding the underlying mechanism of compulsive behavior, numerous studies have reached a consensus on addressing the possible factors that activate compulsive behavior. The three main considerations come from social, experiential, and personal motivations (Carman 1979). However, in the context of smartphone use, we believe that situational factors including social, experiential, and technological factors, rather than personal characteristics, exert a more important effect on compulsive smartphone use.

First, social environments and conditions (e.g. social roles, social influence, and opportunities) play a crucial role in influencing the degree of users' behavior. Evidence of this relationship can be found in previous literature. For example, Ball-Rokeach and DeFleur (1976) claimed that a relatively high degree of change and conflict in a society will increase mass communication dependency to "achieve a broad range of cognitive, affective, and behavioral effects" (p. 7). Similarly, scholars have found that social influence and public self-consciousness are strongly associated with individuals' compulsive behavior (d'Astous

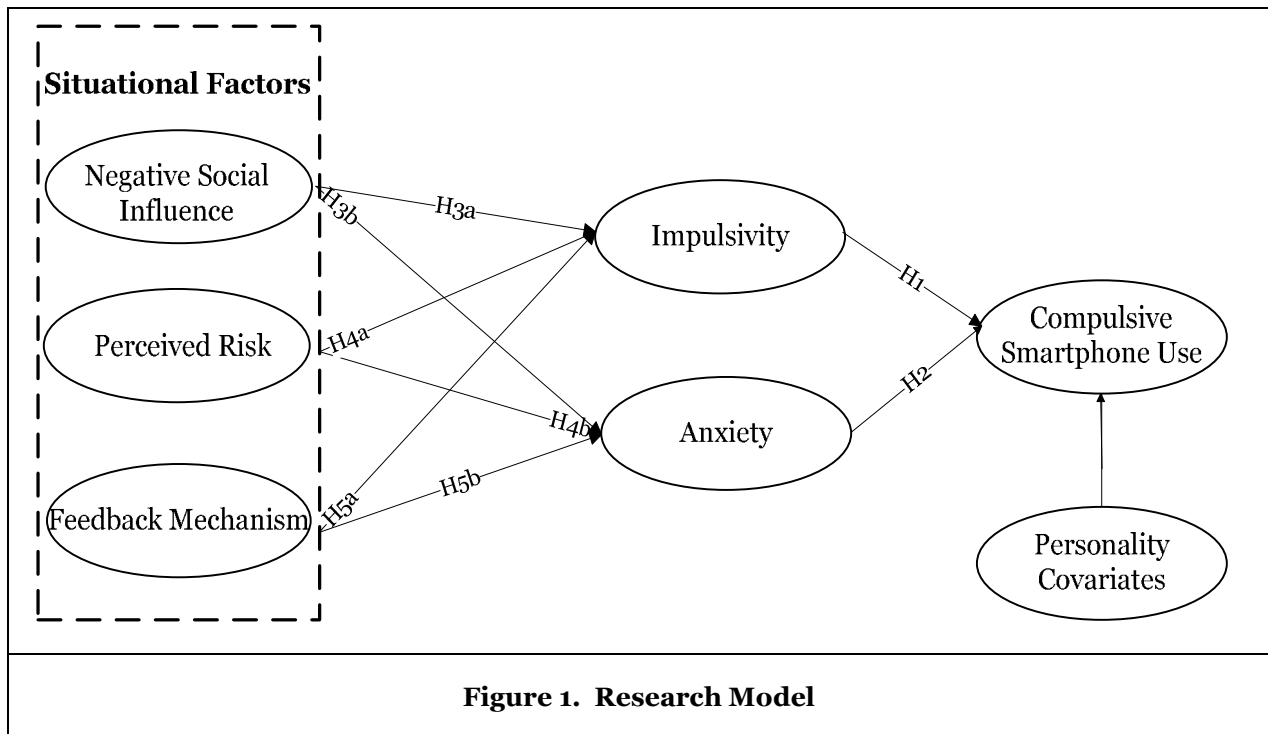
1990). Extending this point to the use of smartphones, in the presence of negative social influence from family, friends, and social models, the fact that a large proportion of rational individuals eventually become compulsive disorders to keep score, maximize human interaction, and seek constant companionship on smartphones is not surprising (McCafferty 2011).

Second, particular experiential stimuli might become a key determinant in the development of compulsive behavior. Positive and negative reinforcing properties, such as experiences of pleasure, relief, and enjoyment, change people’s cognitive and affective perceptions following the enhanced or relied upon effects (Chou et al. 2005). This claim is supported by studies that show that perceived enjoyment (Park and Lee 2011) and missing out experiences (Hato 2013) are positively correlated with individuals’ compulsive usage of the smartphone.

Third, the technological factor of smartphones has been determined to facilitate and reinforce the development of problematic smartphone use. For instance, many people use their smartphones all the time to pursue valued functions, such as managing social networking sites, listening to music, watching movies, and checking the latest information and emails that increase the level of compulsive usage behavior (Park and Lee 2011). Hence, we attempt to understand the mechanism of compulsive smartphone use and investigate controllable situations (i.e., social, experiential, and technological factors) that could be managed to prevent individuals from compulsively using their smartphones.

Proposing a Theoretical Model of Compulsive Smartphone Use

Consistent with previous studies, we attempt to integrate craving with compensation lenses systematically to investigate the effect of situational factors (i.e., social, experiential, and technological factors) on compulsive smartphone use. We also control the personality covariates that might have an influence on the compulsive behavior. The research model is shown in Figure 1.



Compulsive Smartphone Use

Impulsivity, dysfunctional impulsivity in particular, refers to “the tendency with rash actions, irresponsibility, and a failure to consider consequences of behavior” (Smillie and Jackson 2006, p. 2). According to the reinforcement sensitivity theory, individuals with a higher level of impulsivity are more sensitive to signals of reward, thereby leading to appetitive motivation and evoking positive affect (Corr 2004). Following this line of reasoning, people high in impulsivity are more likely to display compulsive behavior for reward seeking, and their ability to control the compulsion is relatively low (Meerkerk 2007). In the context of smartphone use, the impulsivity for instant connection and information obtainment has been acknowledged to be a key determinant that promotes users’ compulsive checking behavior (Roberts and Pirog 2013; Wu et al. 2013). Therefore, we postulate that a high level of impulsivity is positively associated with compulsive smartphone use.

H1: A high level of impulsivity increases individuals’ compulsive smartphone use.

Anxiety is defined as “an emotional system that is sensitive to uncertainty and social evaluative stimuli” (White and Depue 1999, p.866). Based on the reinforcement sensitivity theory, individuals with a higher level of anxiety are more sensitive to signals of punishment, thereby leading to a bias of conflict (Corr 2004). The detection and resolution of such conflict, in turn, evoke the feeling of negative affect and spur individuals to engage in defensive approach (e.g., compulsive behavior) (Smillie et al. 2006). Corresponding to this theoretical assumption, it has been highlighted that people engage in compulsive behavior to avoid the negative affect and to escape the deficit experience (Neuner et al. 2005). For instance, compulsive smartphone use has been found to be practiced due to a strong need to prevent the “punishment” experience of non-use, such as anxiety and withdrawal (Sidhaartha 2012). Hence, we hypothesize that a high level of anxiety will promote individuals to engage in more compulsive behavior in the use of their smartphones.

H2: A high level of anxiety increases individuals’ compulsive smartphone use.

Social Factor: Negative Social Influence

Negative social influence is defined as the tendency to rely on others’ action to perform inappropriate behavior (Cialdini 1993). Deviance literature shows that negative social influence can shape and adapt value, as well as readily and rapidly reinforce propensities in peers’ attitudes (Kahan 1997). If individuals belong to a group that promotes the deviant behavior, they are more likely to assimilate the norms and engage in similar behavior (Bocij and McFarlane 2003). Consistent with this claim, Hofmann, et al. (2012) proposed that the presence of others and enactment models would reinforce impulsivity of self action.

Compulsive behavior primarily serves as a social adjustive function (d’Astous 1990). Acting as a kind of situational factor, individuals’ beliefs on others’ behavior in a specific situation has been found to exert a relatively stronger effect on decision making to deviant behavior (Kahan 1997). Extending this point to the current context, in the presence of other users’ excessive usage behavior, individuals are more likely to experience a high level of impulsivity, and use their smartphones compulsively. Hence, negative social influence could act as a key determinant of situational factor that positively influences the level of impulsivity to use ones’ smartphones.

H3a: Negative social influence increases the level of individuals’ impulsivity to use smartphones.

On the other hand, negative social influence exerts social pressure on individuals, causing them to perform a specific behavior constantly (Lee et al. 2011). For example, some people may feel that they are perceived by others as “old fashioned” because they do not use their smartphones frequently. Hence, to avoid the pressure and associated anxiety, individuals would adopt and even compulsively use their smartphones to keep score and maximize human interaction (McCafferty 2011), regardless their positive or negative attitude toward smartphones. From this perspective, we postulate that negative social influence positively influences users’ anxiety to use their smartphones.

H3b: Negative social influence increases the level of individuals’ anxiety to use smartphones.

Experiential Factor: Perceived Risk

The role of anticipated probability and seriousness of risk has been recognized in the formalization of compulsive behavior (Rachman 2002). In the use of smartphone, compulsive users would deem that they “could not receive important news and information” (Koo 2009), “become preoccupied with the thought of missing a call” (Casey 2012), and “feel disconnected” (Salehan and Negahban 2013) in specific situations (e.g., when they are forced not to use their smartphones). Intolerance of such uncertainty leads to an implicit bias, such as the experience of risk (Sookman and Pinard 2002), which is triggered by the cognitive process with the appraisal of threat relative to one’s coping capacity (McFall and Wollersheim 1979). Hence, the use of smartphone for compulsive individuals becomes mandatory (Park and Lee 2011), and the risk in the cognitive assessment increases the impulsivity to engage in compulsive smartphone use.

H4a: Perceived risk increases the level of individuals’ impulsivity to use smartphones.

According to cognitive science research, the underlying vulnerability of compulsive behavior is identified as being two-fold, that of the failure of sensitive self-consciousness and cognitions jeopardizing of self-worth sense, both of which engender extreme anxiety (Doron and Kyrios 2005). In other words, overestimation of risks (i.e., the likelihood and severity of vulnerability) in a specific situation causes excessive behavior and irrational fear and anxiety (Olatunji et al. 2009). Therefore, perceived risk is positively related to the level of anxiety to use smartphones.

H4b: Perceived risk increases the level of individuals’ anxiety to use smartphones.

Technological Factor: Feedback Mechanism

Individuals are stimulated to participate in smartphone use through attention seeking and relationship building. In this process, the role of feedback is particularly highlighted given that the delivery and valence of feedback provide a noteworthy venue in the communication channel (Davis 2001). Immediate feedback enables users to capture the latest information and participate in interactive communication. In this way, the high responsiveness of smartphones (e.g., the real-time note system) reinforces the interactivity of user-to-smartphone and user-to-user (Zhao and Lu 2012), and induces the impulsivity for instant participation. Additionally, the mobility and pervasive access of smartphones facilitate the delivery of feedback, which in turn promote users’ compulsive use of smartphone at all times (Park and Lee 2011).

The valence of feedback is reflected by interpersonal relationships development and reputation obtainment through consecutive participation (Katz et al., 1973). Consistent with this claim, the positive effect of feedback on pathological technology use has been identified in previous studies – if an individual receives positive response through the online activity, the reinforcement will drive him or her to excessive use of the technology in order to receive the desired response (Davis 2001). From this perspective, interpersonal valence plays a key role in the added “buzz” mood of smartphone users and sparks impulsivity to engage in compulsive smartphone use. Hence, feedback mechanism positively influences the level of impulsivity to use smartphones.

H5a: Feedback mechanism increases the level of individuals’ impulsivity to use smartphones.

In contrast, given the expectation of feedback from smartphones, individuals’ anxiety will be aroused if they cannot obtain the desired feedback from smartphones. In line with the reinforcement sensitivity theory, we assume that feedback mechanism positively influences the level of anxiety.

H5b: Feedback mechanism increases the level of individuals’ anxiety to use smartphones.

Controlled Variables: Personality Covariates

Scholars probe into individuals’ personalities from the perspective of biochemical and psychological characteristics, and even genetics to explain possible variables that affect compulsive behavior (Chou et al. 2005). For example, low self-esteem weakens social ties and adds to the possibility of compulsive behavior (Hirschi 1969). Self-esteem is thus highlighted as an important characteristic that leads to individuals’ compulsive behavior (d’Astous 1990; Hofmann et al. 2012). Similarly, as an important individual attribute in various compulsive behaviors, the low level of self-control has been found to serve

as a psychological mechanism that may influence individuals' compulsive behavior (Casey 2012; Rose 2007). Individuals with psychological variables such as loneliness and shyness also have a tendency to engage in compulsive smartphone use (Casey 2012; Park and Lee 2011). Therefore, we controlled these personality covariates for their potential effects on the users' level of compulsive smartphone use.

Research Methodology

The aim of this research is to develop a theoretical model to investigate the development of compulsive smartphone use and to capture its possible antecedents. An online survey of smartphone users will be conducted to address the proposed research model empirically. The measurement is adapted from previous studies into the context of smartphone use. Specifically, we use the scales informed by Meerkerk (2007) to measure compulsive smartphone use, impulsivity, and anxiety; the scales adapted from Victorir et al. (2007) to measure negative social influence; the scales adapted from Caplan (2002) to measure perceived risk; and the scales adapted from Liu (2003) to measure feedback mechanism. All constructs use seven-point Likert scales ranging from "strongly disagree" to "strongly agree." The measurement model and theoretical model will be tested using a structural equation modeling approach with PLS or LISREL, depending on the quantity and statistical distribution of data collected.

Discussion and Conclusion

With our proposed research model, this study attempts to contribute to extant compulsive behavior research and respond to the calls for studies on the problematic use of smartphones. First, we contribute to research on compulsive behavior by forwarding the theoretical argument that compulsive behavior is developed by both craving and compensation-oriented motivation. Such an integration of the reward and punishment experience is a more effective and efficient tool for shedding light on the underlying mechanism of compulsive behavior from a scientific standpoint.

Second, we contribute to the field of study on problematic mobile usage behavior. Although compulsive behavior has been widely studied in the psychological context, few comprehensive and theoretical studies explain and predict compulsive mobile use in the IS context. In this study, we primarily propose a common definition for compulsive smartphone use in general and explain its specific differences from other compulsive behaviors. Although compulsive behavior is commonly regarded as a deviant behavior that could inflict harm on individuals and the society, we argue that the motivation for compulsive smartphone use is not always irrational. Under this assumption, the motivations that lead to compulsive smartphone use (e.g., situational factors) differ from traditional factors that lead to compulsive behavior in individuals (e.g., psychological problems). With our proposed model, it is expected that situational factors (i.e., technological, social, and experiential factors) play a key role in influencing the development of compulsive smartphone use.

Our study also provides practical implications for clinicians and individuals themselves to manage smartphone use. The expected results show that individuals with a compulsion to use smartphones should prevent themselves from being exposed to "reinforcing" situations such as social communities with unregulated use of smartphones and note systems with immediate feedback from smartphones. A high level of self-control and self-esteem will also help individuals use their smartphones in a healthier and more sustainable manner.

Appendix

Literature Review on Compulsive Behavior			
Resources	Research Object	Theoretical Background	Findings
(Caplan 2005)	Problematic Internet use	Cognitive-behavior model	A preference for online social interaction fosters compulsive Internet use.
(Meerkerk 2007)	Compulsive Internet use	General measurement	Loss of control, preoccupation, conflict, withdrawal symptoms, and coping

	(CIU)		
(Kim et al. 2009)	Problematic Internet use	Psychosocial problems	Lonely individuals develop strong CIU behaviors.
(Koo 2009)	Cell phone addiction	Impulsivity	Cell phone addiction is significantly correlated with self-control, impulsiveness, and cell phone use.
(Meerkerk et al. 2010)	Compulsive Internet use	Punishment experience	A positive relationship between sensitivity to punishment and CIU exists, whereas the effect of the sensitivity to reward on CIU is not significant.
(Van Rooij et al. 2010)	Compulsive Internet use	Rewarding experience	Downloading, social networking, MSN use, Haboo Hotel, chatting, blogging, online games, and casual games are correlated with CIU, but online gaming has the strongest effect on CIU.
(DeLonga et al. 2011)	Compulsive Internet use	Loneliness and sexual risk model	CIU is positively correlated with both loneliness and internalized homophobia.
(Park and Lee 2011)	Compulsive usage of smartphone	User's characteristics and experiential factors	Perceived enjoyment, satisfaction, and personal innovativeness have a positive impact on compulsive smartphone use, whereas loneliness does not have any effect.
(Billieux 2012)	Problematic use of mobile phone	Impulsivity	Impulsivity, relationship maintenance, extraversion, and cyber addiction are the four pathways to problematic mobile phone use.
(Casey 2012)	Smartphone addiction	Psychological variables	Loneliness, shyness, and present absence positively influence addiction, whereas face-to-face communication negatively relates to smart phone addiction.
(Hato 2013)	Compulsive mobile phone checking behavior	Punishment experience	A fear of missing out is positively correlated to smartphone engagement and checking frequency of mobile phones.
(Kwon et al. 2013)	Smartphone addiction	General measurement	Daily-life disturbance, positive anticipation, withdrawal, cyberspace-oriented relationship, overuse, and tolerance
(Salehan and Negahban 2013)	Mobile phone addiction	Technology addiction	The use of SNS mobile applications is a significant predictor of mobile addiction.
(Wu et al. 2013)	Addiction to social networking sites on smartphones	Social cognitive theory	Addictive tendencies are positively correlated with both outcome expectancies and impulsivity, but negatively associated with Internet self-efficacy.

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