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Online game addiction among adolescents: motivation and prevention factors

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Abstract

Online game addiction has become a common phenomenon that affects many individuals and societies. In this study we rely on the functionalist perspective of human behavior and propose and test a balanced model of the antecedents of online game addiction among adolescents, which simultaneously focuses on motivating, and prevention and harm reduction forces. First, a sample of 163 adolescents was used for validating and refining a survey instrument. Second, survey data collected from 623 adolescents were analyzed with Partial Least Squares techniques. The findings point to several functional needs (e.g., need for relationship and need for escapism) that drive online game playing and addiction, as well as to several prevention and harm reduction factors (e.g., education, attention switching activities) that reduce game playing time and alleviate online game addiction. The effects of motivation and prevention factors on online game addiction are often partially mediated by online game playing. Implications for research and practice are discussed.
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Introduction

The driving forces behind individuals' informed decisions to keep on using information technologies (IT) have been widely studied in the MIS literature (Bhattacherjee *et al*, 2008; Kim, 2009). The basic assumptions of such studies were that information systems are beneficial in terms of hedonic or utilitarian gains, and that people are mostly rational decision makers. However, information systems are not always beneficial, and users may develop distorted rationales (Turel *et al*, 2011b). When being used improperly IT may also have negative impact on individuals as well as on the society (Block, 2008). One such potential negative outcome is technology addiction.

Building on the definition of drug addiction (Robinson & Berridge, 2003), technology addiction is defined as a user's psychological state of maladaptive dependency on IT use that is manifested through the obsessive-compulsive pattern of IT-seeking and IT-use behaviors that take place at the expense of other important activities. This phenomenon has been observed in numerous IT contexts, including, for example, online video games (Charlton & Danforth, 2007), mobile email (Turel & Serenko, 2010; Turel *et al*, 2011a), and online gambling (McBride & Derevensky, 2009). It is imperative to study these addictions because they can negatively influence many facets of life, including personal, school, social, financial, and family relationship aspects (Caplan, 2002; Billieux *et al*, 2008; Turel & Serenko, 2010; Turel *et al*, 2011a).

One of the prominent and worrisome technology-related addictions is online game addiction (Huh & Bowman, 2008; Charlton & Danforth, 2010). Building on our definition of general technology addictions, online game addiction is defined as a state of maladaptive psychological dependently 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. Online video games have become a popular form of electronic entertainment, especially among children and adolescents (Griffiths *et al*, 2003, 2004; Choi & Kim, 2004). Although not all online games are addictive or harmful, some games, including many massively multiplayer online games can be addiction-prone owing to their interactive and collaborative/competitive nature (Liu & Peng, 2009; Barnett & Coulson, 2010). These features give such games a social aspect which may be missing from offline activities, and make it difficult to stop playing (Young, 2010b). As such, excessive use of online video games and addiction to them have become common, and may result in many negative psychological and physical damages, including social isolation, suicide, lack of sleep, hypertension, and death (Bruner & Bruner, 2006). These phenomena may be more prevalent among adolescents; a group which tends to engage in more risk behaviors than adults (Quadrel *et al*, 1993; Nelson *et al*, 1997), including in the context of video games (Anderson *et al*, 2004).

In this study we therefore focus on online game addiction, and try to explain its formation among adolescents. By understanding the antecedents of this psychological state, better prevention, screening, and intervention techniques can be developed. This also represents a gap in the literature that we intend to fill. Specifically, much research so far has been devoted to the drivers of online game playing (Choi & Kim, 2004; Yee, 2006), but these antecedents may have different roles in forming addictions. Other studies dealt with the definition and measurement of online game addiction (e.g., Charlton & Danforth, 2007; Byun *et al*, 2009), but only a limited set of potential correlates with online game addiction have been identified (e.g., Huh & Bowman, 2008; Charlton & Danforth, 2010).

To advance our understanding of the formation of online game addiction among adolescents, a model explicating the links between two families of predictors and this phenomenon is proposed. We take the functionalist approach (Smith *et al*, 1956; Katz, 1960), and build on research on game playing motivations (Yee, 2006), in chorus with research on problematic behavior prevention (Dickson *et al*, 2002; van Hamel *et al*, 2007). The joint focus on motivating and preventing factors is advantageous as it provides a more holistic view of the phenomenon we study. After all, game players are often exposed simultaneously to both types of factors (e.g., a social need that drives them to play combined with parental monitoring that inhibits playing).

Specifically, in line with functionalist approach of motivation we argue that online gamers follow a program of behavior to serve their functional motives. Their key functional motives may include the need for advancement, need to master the mechanics of games, need for relationship, and need for escapism (Yee, 2006). Although these are internally formulated motivations, the prevention factors among adolescents are often external to the person and fall into one's environment. These can include parental monitoring, education regarding the potential harms of the excessive activity, the cost of conducting the activity (playing online games), resources shortage, and alternative, attention switching activities (Dickson *et al*, 2002).

To test our model, two surveys were conducted. First, data from a sample of 163 Chinese adolescents were utilized for developing the measurement scales that were not found in the literature. Second, using these scales, data from a sample of 623 Chinese adolescents were collected and subjected to Partial Least Squares (PLS) analysis. The results point to several motivation and prevention factors that explain variation in game playing and addiction, and also show that some prevention factors may not have merit.

The remainder of this paper is organized as follows. The Theoretical Background section reviews the literature on online game addiction, some of its antecedents, and the functionalist approach. The Hypotheses section presents the development of our research model. The Methods section describes the approaches taken for survey operationalization and data collection. The Analysis and Results section provides information on, and the results of the analyses performed. In the Discussion section we summarize the results, outline implications for research and practice, and acknowledge limitations that point to future research directions. Concluding remarks are provided in the Conclusion section.

Theoretical background

Online game addiction

Game addiction is one type of Internet addiction that encapsulates the maladaptive psychological dependency on a specific family of IT artifacts – online games. To capture it, many researchers have adopted the criteria of Internet addiction (Young, 1998b, 2010a) or a broader set for diagnosing problematic non-substance-related compulsions, that is, behavioral addictions (Brown, 1997). These works largely build on a closely related disorder – problem pathological gambling, which is described in DSM-IV (Diagnostic and Statistics Manual of Mental Disorders – Fourth Edition; American Psychiatric Association, 1994). Because no official cutoff points to classify a person as addicted exist (Block, 2008), much of the research on this topic so far has treated online game and other technology addictions as continuous concepts – ranging from low to high levels of addiction (Hur, 2006; Ferraro *et al*, 2007; Byun *et al*, 2009), and hence assumed that all users may have a certain level

of addiction, though low for most users (Turel *et al*, 2011b). We adopt this perspective in this study.

Like other behavioral addictions, online game addiction can be manifested through six core symptoms described by Brown (1997). These include conflict (e.g., playing online games meaningfully conflicts with other important tasks), withdrawal (i.e., negative emotions arise if one cannot play online games), relapse and reinstatement (i.e., inability to voluntarily reduce the time spent on online games), and behavioral salience (i.e., playing online games dominates one's life and takes over other tasks). Other less severe symptoms are indicative of high engagement and serve as a precondition for the more severe addiction symptoms (Charlton & Danforth, 2007, 2010) including tolerance (need to increase the time spent on online games), euphoria (a buzz of excitement from playing online games), and cognitive salience (frequently thinking about online games).

How is online game addiction formed? While not all reasons are clear, evidence so far suggests that it has to do with at least two families of factors: internal psychological and socio-environmental (Shi, 2008), as well as potentially with neurobehavioral deficiencies (Ko *et al*, 2009a). For example, socio-behaviorally inactive personality traits, such as shyness, dependence, depression, aggression, low self-esteem, low self-control, and narcissism, may predispose some individuals to play excessively and possibly develop higher levels of online game addiction (Dominick, 1984; Ho & Lee, 2001; Yang & Tung, 2007; Kim *et al*, 2008). Socio-environmental factors can include one's working routine (e.g., working night shifts), socio-economic status (Hur, 2006), and demographics (e.g., age and gender) (Ko *et al*, 2005). Game design is another external factor that can influence online game addiction. Role playing games, action games, adventure games, strategy games, and fighting games are more addictive than others (Shi, 2008), plausibly due to their interactive, collaborative, and competitive nature (Liu & Peng, 2009; Barnett & Coulson, 2010) which serves social needs of individuals that are missing in their real lives (Young, 2010b)

Although focusing on such variables is important and fruitful, the functionalist perspective which we take in this study suggests that these factors inform a set of functional motives, which in turn, influence behavioral outcomes (Clary *et al*, 1998; Mowen, 2000; Mowen *et al*, 2007). Thus, one's functional motives are different from traits, and are more proximal determinants of his or her program of behavior (Mowen & Sujan, 2005). Accordingly, in this study we focus on functional motives and inhibitors.

The functional approach for online game playing

Most if not all activities humans perform are driven by purposeful striving toward social and personal goals (Snyder, 1993) such as to increase one's social status, gain wealth, or become healthy. People's actions hence cater to various functional needs (Clary *et al*, 1998). These needs often evolve around key themes, such as serving knowledge seeking (better understanding a concept or object), value expressive function (need to express one's values), ego-defense needs (need to protect a person from threatening truths about oneself), and utilitarian functions (need for obtaining rewards and avoiding punishment) (Katz, 1960). This perspective has been utilized and validated in numerous studies (Cooper *et al*, 1998; Rioux & Penner, 2001; De Cremer & Tyler, 2005).

Given the broad range of needs that this perspective covers in the abovementioned themes, it is fair to ask what the more specific needs human behaviors serve are. There are many elemental needs that are being served by human behaviors (food, sleep, etc.) and other sometimes less prominent psychological and physiological needs (Dietch, 1978; Watson, 1996; Brugha, 1998) that mostly fall into Maslow's hierarchy of needs (Maslow, 1943). But, each behavior serves different needs (Clary *et al*, 1998; Mowen, 2000; Mowen & Sujan, 2005). For example, we may conduct research to gain various benefits (e.g., merit-based salary increase, to increase knowledge, and to express beliefs on a topic). Other activities, such as writing software code, may be motivated by other needs, say only utilitarian needs. Thus, it is imperative to focus on the specific functions served by online game playing, which is the phenomenon of interest in this study, to understand people's decision to play online games.

Several studies have addressed this issue. It has been suggested that the motivation to play online games stems from three types of needs: sense of achievement, social visibility, and feeling of immersion (Wan & Chiou, 2006). Other studies further decompose these needs. The sense of achievement includes the need to advance in games, need to master the mechanics of a game (to be an expert), and need to challenge others (Yee, 2006). All these factors relate to a broader need for sense of control that drives people to play online games (Chou & Tsai, 2007). The social visibility need includes both social and emotional needs, and the need to develop one's social skills; and the immersion motivation encapsulates a desire to become virtually a part of the experience itself in the game (Yee, 2006), that is, to experience the fascination of a temporary escape into another world (De Castell & Jenson, 2007).

Note that the functionalist perspective assumes calculated decision making. It is reasonable to expect game players in general to apply rational decision-making processes. Rational humans want to maximize their subjective utility, and game players are not different. Even in cases of high addiction, where strong psychological dependency develops, game players can follow the distorted-rationality processes described by Turel *et al* (2011b). It means that addicted individuals will still follow a program of behavior that in their mind, best serves their functional and emotional needs. Their belief system may be distorted, but they will employ calculated considerations to make informed decisions regarding online game playing.

Online game addiction prevention and harm reduction

Motivating game playing through the functional needs lens is one side of the coin. The other side in many

problematic programs of behavior (e.g., smoking), is a set of external inhibitors that operate to prevent and later reduce the harm of one's program of behavior (Marlatt, 1996; Hatsukami *et al*, 2004; Benowitz, 2008). We include these elements in our model as well. Note that the term prevention refers to *a priori* acts (i.e., before a person engages in a harmful pattern of behavior and develops addiction), whereas harm reduction refers to acts that take place throughout, and potentially after, the execution of the potentially problematic program of behavior. Because there are no accepted medical or academic criteria for determining when the problematic program of behavior begins and when addiction develops (Block, 2008; Turel & Serenko, 2010), we do not distinguish between prevention and harm reduction strategies, and treat them interchangeably. For example, efforts to teach adolescents about the risks of online game playing can take place before someone starts playing games, throughout the development of a game playing pattern, and after a person has presented strong addiction symptoms.

Although little research has been conducted on Internet addiction and specifically online game addiction prevention, there has been substantial research on the prevention of substance abuse and problematic pathological behaviors, such as gambling (Stockwell *et al*, 1996; Dickson *et al*, 2002). We argue that it is reasonable to draw on these lines of work because there are many similarities between technology addictions and alcohol or gambling addictions (Young, 1998b). In fact, they even share similar neurobehavioral pathways (Ko *et al*, 2009a) and symptoms (Charlton & Danforth, 2007). Building on typical gambling prevention and harm-reduction tactics, we argue that four key strategies may be relevant in the context of online game playing. These include education to mold and/or correct one's belief system (e.g., talking with a child regarding the risks of excessive online game playing), behavioral interventions (e.g., keeping a person busy with other activities such as sports), resource restrictions (e.g., limiting one's pocket money), and social environment improvement (e.g., providing parental support) (Flay & Petraitis, 1991; Hwang *et al*, 2004; Wiehe *et al*, 2005; Stice *et al*, 2006). We discuss these in detail in the hypotheses section.

Hypotheses

The influences of motivating factors on online game addiction

Taking the functionalist perspective and focusing on the needs that a program of behavior of online game playing fulfils, we argue that the stronger these needs, the higher one's game playing time will be. The needs represent a gap between one's current ego, physical and psychological well-being and social status, to his or her desired state. A calculated program of behavior is presumed to be able to help a person reach these objectives and bridge the gaps (Clary *et al*, 1998).

Yee (2006) suggested the Player Motivation Factors Model, which describes three groups of game-playing functional needs (i.e., motivating factors) similar to the sense of achievement, social visibility, and immersion motivation described by Wan & Chiou (2006): need for achievement, need for socialization, and need for immersion. Each of these needs includes several sub-dimensions, or more specific needs. For example, the need for achievement can be expressed through a need to advance in a game. On the basis of past research (Yee, 2006; Seay & Kraut, 2007; Lu & Wang, 2008) we propose that the needs for advancement and mastering the mechanics (sub-dimensions of a broader need for achievement), need for relationship (a sub-dimension of a broader need for social visibility), and need for escapism (a sub-dimension of immersion motivation) are important motivation factors that may have positive effects not only on game playing, but also on the formation of higher levels of technology addiction. These factors represent all the facets described by Yee (2006) and by Wan & Chiou (2006). Their definitions are listed in Table 1.

People with strong needs for advancement and for mastering the mechanics of a game are likely to spend more time playing online games. The same goes for those with strong needs for forming relationships and escaping reality through online games. These functional objectives are often unattainable without practice, repeated attempts, and perseverance; and hence are expected to be positively related to game playing. Anecdotal evidence suggests that these needs are associated with continued game playing (Joe & Chiu, 2009; Golub, 2010; Lin, 2010), and that many online game players engage in this activity to escape reality (Hussain & Griffiths, 2009), socialize (Blais *et al*, 2008), to serve a need to excel, at least in the virtual world, as a potential alternative to deficiencies in some aspects of the real world (Yee, 2006; Young, 2010a, b). Hence:

H1a: *Need for advancement increases the extent of online game playing.*

Table 1 Key functional needs

Construct: Need for …	*Definition*
Advancement	The desire to gain power, progress rapidly, and accumulate in-game symbols of wealth or status
Mechanics	Having an interest in analyzing the underlying rules and system in order to optimize character performance
Relationship	The need to form long-term relationships with others
Escapism	Need to avoid thinking about real life problems through immersion in the game

H1b: *Need for mastering a game's mechanics increases the extent of online game playing.*

H1c: *Need for relationship increases the extent of online game playing.*

H1d: *Need for escapism increases the extent of online game playing.*

We argue that the functional needs that motivate game playing can also cater to the formation of high levels of online game addiction. When one's abovementioned needs become constant, frequent, strong, and automatic, he or she can develop a compulsive pattern of game-seeking and use behaviors which is a manifestation of addiction (Robinson & Berridge, 2003). The competitive aspects of games cater to ones needs for achievement and mastering the game mechanics, which in turn, help the formation of higher levels of addiction (Hsu *et al*, 2009). The social and interactive aspect of games caters to the social and escapism needs of game players, and can also inform the formation of higher levels of online game addiction (Klimmt *et al*, 2009).

Online game playing can become a substitute for real-life social interaction (Hussain & Griffiths, 2009). When one's needs for virtual social interactions and escaping real-life interactions are high, he or she can also engage in excessive game playing which predicts addiction (Lo *et al*, 2005). Indeed, it has been shown that at least the need for escapism, and need for advancement predict online game addiction (Yee, 2006). Possibly, fulfilling these needs is rewarding, and the gap between the functional needs and the actual rewards grows over time due to neural sensitization, which can lead to constant state of 'wanting'. Therefore:

H2a: *Need for advancement increases the level of online game addiction.*

H2b: *Need for mastering a game's mechanics increases the level of online game addiction.*

H2c: *Need for relationship increases the level of online game addiction.*

H2d: *Need for escapism increases the level of online game addiction.*

Addiction often develops through excessive and repetitive use, which re-wires people's brains and makes them develop a somewhat unrealistic set of positive expectations from the IT artifact (Turel *et al*, 2011b). In substance abuse settings, people's brains become hypersensitive to cues from the addictive substance and overemphasize the salience of the thrill, until it forms a pathological state of 'wanting' (Robinson & Berridge, 1993; Robinson & Berridge, 2001). Given the neurobehavioral similarities between substance addictions and online game addiction (Ko *et al*, 2009a), it is reasonable to expect that the same holds in the context of online games. Taken together, we expect that the more a user plays online games, the stronger the psychological dependency he or she develops, and the stronger his or her addiction symptoms (e.g., conflict with other activities) will be. Hence:

H3: *The extent of online game playing increases the level of online game addiction.*

The influences of prevention and harm reduction factors on online game addiction

On the basis of a review of the addiction prevention and harm reduction literature (Flay & Petraitis, 1991; Marlatt, 1996; Dickson *et al*, 2002; Eissenberg, 2004; Hatsukami *et al*, 2004; Hwang *et al*, 2004; Wiehe *et al*, 2005; Stice *et al*, 2006; van Hamel *et al*, 2007; Echeburua & de Corral, 2010), we identified six prevention and harm reduction factors that can reduce online game playing, ease some of the symptoms of online game addiction (e.g., conflict with other activities), and ultimately alleviate one's level of addiction. These factors and their definitions are listed in Table 2.

We believe that general extracurricular activities (e.g., sports) may make adolescents focus less on game playing and thus reduce the extent of game playing and ultimately one's level of online game addiction. Even though motivating factors such as a strong need for advancement may push individuals toward excessive use and potentially addiction, the constant occupation with other activities will plausibly reduce one's online game playing time, shift his or her attention away from online games, and ultimately alleviate his or her addiction levels. Indeed, it has been reported that attention switching can stop or reduce participation in online games, which is an attitude-discrepant behavior for addicts and excessive users (Wan & Chiou, 2006). Hence:

H4a: *Attention switching reduces online game playing.*

H4b: *Attention switching reduces the level of addiction to online games.*

To dissuade means to advise against something by means of exhortation or argument. The term implies coaxing rather than browbeating, using reason instead of coercion. It is a common practice exercised by external forces (regulators, parents, teachers, and friends) for the prevention of undesirable behaviors such as smoking, alcohol abuse, and unsafe sex (e.g., Eiser & Vanderpligt, 1986; De Brouwere *et al*, 1998). Studies have demonstrated that dissuasion can make a difference, at least in the case of alcohol abuse (Babor, 1994). In the same vein, we believe that dissuasion is a common tactic employed by parents and social circles, which may be effective in reducing

Table 2 Prevention and harm reduction factors

Construct	*Definition*
Attention switching	The extent to which other meaningful activities are offered to distract an addict's attention from engaging in the problematic behavior
Dissuasion	The extent to which an individual perceives others' efforts to prevent playing online game by means of exhortation, argument, coaxing, browbeating, or coercion
Rationalization/education	The degree to which an individual is trained to understand the issues associated with a problematic program of behavior
Parental monitoring	The extent to which an individual perceives his or her parents or guardians to pay attention to and track his or her whereabouts, activities, and outcomes
Resource restriction	The degree to which a player perceives that he or she is being restricted by the constraining of game playing resources such as money, equipment, regulation, and guidance
Perceived cost	The extent to which a player perceives the financial cost of playing online games to be high

online game use and ultimately addiction. Turel *et al* (2011b) has shown that technology addicts have a distorted rationality, and dissuasion is one potential means for shaping and fixing one's belief system. Therefore:

H5a: *Dissuasion reduces online game playing.*

H2b: *Dissuasion reduces the level of addiction to online games.*

Rationalization/education refers to knowledge-focused or educational efforts aimed at one's cognitions. As opposed to dissuasion, which is an active effort against existing cognitions, rationalization is aimed mostly at building good cognitive foundations, and can be self-managed. That is, it does not have to come from an external source such as parents and teachers. Rather, a person can educate herself regarding the risks of a certain program of behavior (e.g., by reading newspaper articles or watching TV news about the topic).

Some online game players may not naturally realize the potential negative consequences of online game-playing, and may have distorted beliefs and attitudes toward online games (Yang & Tung, 2007). Exposure to appropriate education and guidance may encourage rational thinking so as to reduce the chance of excessive use, which may ultimately prevent high levels of addiction (Faggiano *et al*, 2008). This mechanism operates, like dissuasion, against the potential distorted rationality of online game players and addicts (Turel *et al*, 2011b). Thus:

H6a: *Rationalization/education reduces online game playing.*

H6b: *Rationalization/education reduces the level of addiction to online games.*

Parental influence is an important risk factor or protective factor of youth problem behaviors (Chen *et al*, 2008), and especially addictions (Mogro-Wilson, 2008; Loke & Wong, 2010). Lack of parental monitoring is correlated with risky behavior of young children, leading to accidental injury, antisocial and delinquent behaviors, and substance use in adolescence (Dishion *et al*, 2003; Kiesner *et al*, 2009). Greater parental monitoring or parents' knowledge of their children's daily activities and whereabouts is associated with less deviant behavior, risky behavior, and substance abuse among adolescents (Chuang *et al*, 2005).

Monitoring in the case of online games is an effective strategy preventing users from engaging in seemingly unsupervised acts of excessive or inappropriate use (Young, 1998a, 2010b; Bruner & Bruner, 2006). Even the location of one's computer (how observable it is in one's house) can affect online game playing and addiction (Park *et al*, 2007). It is therefore reasonable to expect that stronger parental monitoring (through asking probing questions, placing the computer in an observable spot, tracking a child's whereabouts, showing interest in school performance, etc.) will reduce one's playing time, and prevent higher levels of online gaming addiction. Hence:

H7a: *Parental monitoring reduces online game playing.*

H7b: *Parental monitoring reduces the level of addiction to online games.*

Individual's perceptions regarding the availability of resources (e.g., technical support) influence their usage of information systems (Taylor & Todd, 1995). The same applies to online games (Blakely *et al*, 2010). In this context tangible resources, such as funding, and equipment, can be constrained by parents/guardians and teachers in the case of adolescents, or by employers, life circumstances, and family members in the case of more mature individuals. Such constraints can reduce one's access to online games. Many resources are needed for game playing (e.g., money, network access, and fast computers) (Jeong & Kim, 2007); and if these are

constrained, one's play time and level of addiction should be diminished. Hence:

H8a: *Resource restriction reduces online game playing.*

H8b: *Resource restriction reduces the level of addiction to online games.*

Prevention and harm reduction strategies focusing on increasing substance prices can diminish substance problems (Mosher, 1999; Ponicki *et al*, 2007). The same logic should apply to potentially problematic use of information systems, and specifically online games. The perceived cost of using an IT artifact or service is an important determinant of IS use because it influences its perceived value (Turel *et al*, 2007). If this cost is increased, the perceived benefits seem lower compared with the costs, and subsequently use is reduced (Turel *et al*, 2010). Thus, we expect that the perceived cost of online games will reduce one's willingness to play games, and his or her addiction levels.

Note that in the Chinese online gaming market, gamers can incur any combination of four types of costs. One type of games is free of charge at lower levels, but as gamers advance in the game they need point-cards, which they can buy at stores. Another family of games is also free of charge, but gamers may need to purchase virtual property online to do better in these games. Regardless, a third type of cost is very common among adolescents in China. Many of them do not have computers at home, and even if they do, they may want to socialize and/or avoid parental monitoring. Thus, the use of Internet cafes for gaming purposes is very popular. The fees for Internet cafes are therefore another cost they may face. Lastly, even if a person has a computer, he or she may need to purchase special gamming gear and pay for high speed Internet connection. Thus, in the majority of cases there is some cost involved in online gaming, which is the basis for perceived cost assessments.

H9a: *Perceived cost reduces online game playing.*

H9b: *Perceived cost reduces the level of addiction to online games.*

The hypotheses translate into the nomological network presented in Figure 1.

Methods

A paper-based survey was used for data collection. The survey (see Appendix A)[1] was developed through a simplified process of survey translation and adaptation (Geisinger, 1994; Beaton *et al*, 2000), which involved item generation, synthesis, forward and backward translation, and review. Whenever possible, valid existing scales were used, after adjusting them to the context of online game playing, and some scales were developed based on concepts described in the literature. Content validity was established through literature review, interviews, and panel discussions (described below). Published papers on game addiction, and intervention and prevention of various addictions were employed to prepare a broad understanding of the concepts, and a list of candidate items for new scales.

Several steps were then taken in order to make the survey suitable to adolescent game players. First, a semi-structured open-ended face-to-face interview was conducted. One author and a research assistant interviewed a convenience sample of three university students and two high school students who were highly engaged in online game playing. Each interview lasted about 30 min. The interviews elicited gamers' game playing history, patterns, motivations, and inhibitors, and opinions on, and suggestions regarding our measures. Second, the same team interviewed in a similar process a convenience sample of two high-school teachers and two parents, to better understand the prevention and harm reduction tactics they have employed. Toward this end, two authors also performed a semi-structured interview with a government officer responsible for adolescence development affairs. This helped refining the list and measures of prevention and harm reduction factors. Third, a focus group of six students (three university students and three high school students) was formed to validate the insights gathered in the previous steps and the measures that were formulated in this process. This discussion was moderated by one of the authors and lasted about an hour. Lastly, three professors who are familiar with this line of research were invited to evaluate the resultant questionnaire. Minor modifications were applied based on their feedback.

The instrument based on all of these inputs was first drafted in English, and then translated into Chinese independently, and cross checked by two of the authors who are proficient in both languages. The Chinese version was then presented to several game players to get further feedback, and translated back into English by these two authors to check for inaccuracies. Several adjustments were applied to the original version until the authors all agreed that the items accurately reflect the intention of the measurement. All of the motivation constructs as well as Rationalization/Education, Dissuasion and Cost prevention were operationalized as reflective latent variables. The Attention Switching, Parental Monitoring, and Resource Restriction constructs were operationalized as formative composite variables. The questionnaire also captured respondents' gender and grade. Below we provide details on the different measurement scales.

Online game addiction: We follow Charlton and Danforth (2007)'s scale, according to which technology

[1]The Chinese version of the survey is available upon request by contacting the first author.

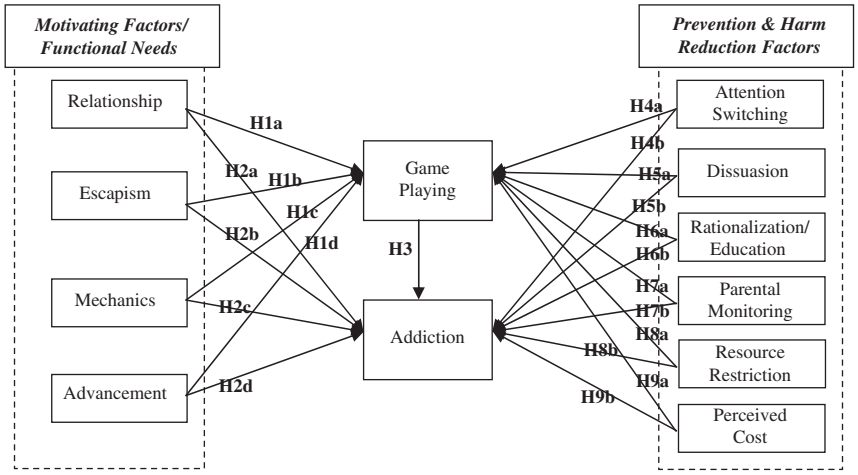

Figure 1 Research model.

addiction is captured by the magnitude of key symptoms: behavioral salience, conflict, withdrawal, and relapse/ reinstatement. The measure has been reliable (Charlton, 2002; Charlton & Danforth, 2007, 2010) and hence we use it.

Four motivation factors based on the functional needs online game playing addresses were measured by a total 17 items with reference to prior research. These factors are Need for – Advancement, Mechanics, Relationship, and Escapism. Reflective scales that capture these concepts were adapted from Yee (2006).

There were no well-established measures for some of the prevention and harm reduction factors. We hence developed these scales utilizing extant frameworks for scale development (Sweeney & Soutar, 2001) as described above. Synthesizing inputs from academics, university and high school students with insight from the literature, the following measurement instruments were developed. All used a 7-point Likert-type scale ranging from 'completely disagree' to 'completely agree'.

Dissuasion: It was conceptualized as a reflective scale and measured with 4 items from Babor (1994), as reinforced by expert-matter interviewees and focus groups.

Rationalization/education: We developed a 4-item reflective scale based on the definition from Eisen *et al* (2002; Eisen *et al*, 2003), which were then adjusted using feedback from the expert-matter interviewees and focus groups.

Perceived cost: We adopt the 5-item scale from Wu & Wang (2005).

Attention switching: This construct was conceptualized as a second-order factor consisting of two first-order constructs: Inner attention switching and External attention switching; each component factor is important, but not individually sufficient, for reflecting the latent construct. If addicted players participate in meaningful activities with higher priority over game-playing, their addiction-driven behavior will be restrained (Wan & Chiou, 2006). These activities can come from internal sources (e.g., interest in other hobbies) or external forces (e.g., attending family events). Thus, the attention is shifted away from the addiction-driven behavior using two mechanisms: internal and external. Expert-matter interviewees and focus groups assisted in adjusting this concept and items.

Parental monitoring: On the basis of the definition and our interviews with expert online gamers, parental monitoring can be active or passive. Passive monitoring involves getting some information, but not necessarily 'spying' on one's children. In contrast, active monitoring includes more hands-on approaches to monitoring and ensuring that the boundaries set-up are not infringed. Following this conceptualization we operationalized parental monitoring as a second-order composite, which includes two first-order constructs, PM_Passive and PM_Active. We adopt 6-scale items from Dishion & McMahon (1998) as modified based on comments from our expert game players.

Resource restriction: We developed 4 items that captured the restrictions users observe, based on key resource concerns discussed in the literature: guidance, money, equipment, and network connection availability (e.g., Jeong & Kim, 2007; Wan & Chiou, 2006). The items were refined using inputs from the panels of experts. These items focused on tangible resources, and not on time resources because it was assumed that time constraints are captured by internal and external attention switching activities which consume users' time.

Game playing: We focused on relevant aspects of this behavior, including the longest online playing time and

the percentage online game playing occupies one's free time. On the basis of inputs from the panel these items best reflect the extent to which they are engaged in online game playing.

Pilot test

A pilot test was conducted to assess the scales. A total of 163 records were collected from adolescent online game players. They were recruited from a middle school[2] in a large city in China. Their ages ranged from 13 to 15. The data were used to run an array of reliability and factor analysis tests. A number of modifications were made to the instrument based on feedback from respondents and reliability tests. The four subcomponents of motivation factors, advancement, mechanics, relationship, and escapism, obtained Cronbach's αs of 0.95, 0.71, 0.87, and 0.70, respectively. The addiction factor yielded a Cronbach's α of 0.83.

Factor analysis of the data partially supported the previous findings regarding the distinct motivations for playing online games. Although some factors were not completely distinct within one construct (with somewhat high cross-loadings), we decided to refine and retain them. The logic was that first, our pilot test sample was somewhat small. And, second, our scales were translated to Chinese and hence items may have slightly shifted from their original meaning, even though a back-and-forth translation procedure was employed. As a result, the items adopted were preserved and the translation was rechecked. We modified some ambiguous expressions. The final English version of the survey can be found in Appendix A.

Data collection

Participants were selected from middle schools in a big city in China. This was done for two reasons. First, from a convenience and practical stand point – the city was big enough to encompass many online game players; who were potentially reachable by one of the researchers. Second, the penetration of Internet in this city is the second highest in China (CNNIC, 2007), and presumably, adolescents in this city are more likely to be susceptible and exposed to online games.

Two data collection approaches were taken: in school and on the street surveys. First, 600 copies of paper-based questionnaires were randomly distributed to several middle schools in this city over a period of 2 months. The surveys were administrated by a research assistant with the supervision and help of the teachers of the relevant classes. Survey completion was voluntary, and was encouraged with small monetary incentives ($<$\$1). In addition, 200 copies of the survey were handed out on specific locations on the streets. Potential adolescents were approached in person at locations such as McDonalds and Internet Cafes. Potential participants were asked if they have played online games before given a copy of the survey. In total, 800 surveys were distributed and 682 (85%) were returned, out of which 623 (78%) were valid. A Multivariate Analysis of Variance procedure applied to the data showed that the source of data (school *vs* street) had no significant omnibus effect (Pillai's Trace $= 0.16$, $P < 0.13$), implying that there were no significant differences between the datasets. Thus, subsequent analyses were performed on the whole dataset. Participants' ages ranged from 12 to 18 with an average age of about 15 years. The modal age was 14 with 36% of our sample representing this age group. The sample was slightly male dominant (56%).

[2]In China, middle school is 6 years long, from ages 12 to 18. The middle school is also divided into 3-year junior level and 3-year senior level.

Analysis and results

Since our research model contains both reflective and formative components, PLS was chosen for data analysis. PLS can easily support such models with no identification issues, as demonstrated in past MIS research (Chin & Gopal, 1995; Turel *et al*, 2007). The hypothesis testing was conducted using SmartPLS version 2.0 (Ringle *et al*, 2005) following the two-step approach for model estimation (Anderson & Gerbing, 1988).

The measurement model

We first examined factor loadings. Almost all were above 0.7, but the loading of Addiction item 1 was 0.52. In addition, the average variance extracted (AVE) of Addiction with all items was 0.49 which is slightly below the recommended threshold of 0.5. Hence, we deleted the problematic item. As a result, the AVE of Addiction with 6 items (A2-7) was acceptable (0.59). The same procedure was applied to the perceived cost construct. The loading of COST5 was low (0.31), and the AVE was acceptable (0.57). Nevertheless, we deleted the item. As a result, all loadings were over 0.7, and the AVE was 0.72. Consequently, reliability coefficients were above 0.70 and all AVE scores were over 0.50 (see Appendix B). This indicated that the measurement scales were reliable and that the latent variables account for more than 50% of the variance in the items. As shown in Appendix B, the loadings are in an acceptable range and the *t*-values indicate that they are significant at least at the 0.01 level. The results in Appendix B further suggest sufficient discriminant validity, because the square root of the AVE is greater than all of the related inter-construct correlations (Chin, 1998). In order to further assess validity, a cross-loadings table (Appendix C) was constructed. It can be seen that each item loading is much higher on its assigned construct than on the other constructs, supporting adequate convergent and discriminant validity.

To further evaluate the formative composites (Attention Switching, Parental Monitoring, and Resource Restrictions), we followed the guidelines provided by Cenfetelli & Bassellier (2009). First, we checked multicolinearity

Table 3 VIF, factor weights, *P*-value, and factor loadings for the formative measurement

	VIF	*Factor weights*	*P-value*
Attention switching			
InnerAS	1.333	0.651	<0.001
ExternalAS	1.333	0.500	<0.001
Parental monitoring			
PM_Passive	1.246	0.604	<0.001
PM_Active	1.246	0.573	<0.001
Resource restrictions			
RES1	1.253	0.043	<0.5
RES2	1.461	0.104	<0.05
RES3	1.343	0.131	<0.01
RES4	1.085	0.153	<0.001

among the indicators with Variance Inflation Factor (VIF) scores. The highest VIF calculated was 1.461 (Table 3) and was thus below the recommended upper border (Diamantopoulos & Siguaw, 2006).

The second guideline assumes that a large number of indicators will yield many non-significant weights. Owing to the fact that our measurement model consists of only four formative indicators, this test may be irrelevant. Guideline three assumes the co-occurrence of negative and positive indicator weights, which could lead to a misinterpretation of the results. In our case, only positive weights were observed (Table 3), and the suppressor effect was thus not tested.

The fourth guideline discusses absolute *vs* relative indicator contribution. Indicators with a non-significant or low weight can still have an important absolute contribution. All related indicators must be independently assessed from other indicators to prevent misinterpretation of formative indicator results. As Table 3 shows, only the factor weight of RES1 is not significant. Other formative construct indicators are significant at the 0.01 level. It suggests that they contribute significantly to the formation of Attention Switching and Parental Monitoring composites.

Overall while the statistical evidence regarding the validity of the formative conceptualization is not always conclusive, when synthesized with the theoretical background and opinions of subject-matter experts, it points to potential plausibility. We hence proceed with treating these concepts as formative composites.

Common method bias

As with all self-reported data, there is a potential for common method biases (Podsakoff *et al*, 2003). We performed statistical analyses to assess the potential severity of this problem in our data. First, Harman's one-factor test was performed. In a Principal Component Analysis with no rotation 12 components emerged; and the first component explained only 10.5% of the variance. Second, following Podsakoff *et al* (2003), we included in the PLS model a latent common method factor whose indicators included all items. We then calculated the variance explained in our endogenous construct, online game addiction, with- and without- the latent common methods variance factor in the model. The first was 0.418, and the second was 0.408. The difference is very small. Both tests point to the conclusion that the method is unlikely to be a major source of variation.

Hypothesis testing

Table 4 presents the estimates obtained from PLS analysis (Bootsrapping with 200 re-samples).[3] An R^2 value of 0.408 indicates that the model explains a substantial amount of variance in addiction. The results provide some support for the hypothesized partial-mediation role of game playing and the direct effects of functional needs motivating factors, and prevention and harm reduction factors on the formation of online game addiction. Among the motivation factors, need to master the mechanics of games was positively associated with game playing but not with game addiction. As expected, needs for relationship and escapism were positively associated with game playing and addiction. Need for advancement had no significant influence on addiction.

The data suggest that attention switching has a significant negative impact on game playing and addiction. It implies that alternative activities could distract adolescents' attention from online games and thus reduce their risk of high levels of addiction. Furthermore, rationalization/education and cost had significant influences on game playing, but no direct effect on online game addiction. Thus, they can alleviate the level of addiction through the reduction of one's online play time.

Dissuasion was expected to reduce game playing and addiction. Nevertheless, contrary to the expectation, it was positively associated with game playing and online game addiction. It seems that dissuasion does not serve as a prevention factor but turns out to be more of a remedy, which is plausibly exercised only after high levels of game playing and online game addiction are observed. We also found that Resource Restrictions were positively associated with addiction and had no significant impact on game playing. We expected that when fewer resources are available, people will be less likely to play online games and develop online game addiction. But as the data demonstrate, an alternative explanation is in order. It is possible that if a person has high levels of online game addiction, he or she may need more resources and may thus feel stronger resource restrictions. This proposition should be tested in future research.

The data also demonstrate that parental monitoring has no significant effect on game playing while it does

[3]We first included gender and grade as control variables in our model. The results show that they have no significant impact on the endogenous constructs.

Table 4 Test of hypotheses

Order number	*Hypothesis*	*Path coefficients*	*t-value*
H1a	Need for Relationship → Game Playing	0.11	2.76**
H1b	Need for Escapism → Game Playing	0.09	2.03*
H1c	Need for Mastering the Mechanics → Game Playing	0.21	3.53***
H1d	Need for Advancement → Game Playing	0.01	0.25
H2a	Need for Relationship → Addiction	0.09	2.28**
H2b	Need for Escapism → Addiction	0.14	3.55***
H2c	Need for Mastering the Mechanics → Addiction	0.06	0.94
H2d	Need for Advancement → Addiction	0.07	1.10
H3	GamePlaying → Addiction	0.24	6.13***
H4a	Attention Switching → Game Playing	−0.11	2.41**
H4b	Attention Switching → Addiction	−0.19	4.80***
H5a	DissuasionGame Playing	0.08	2.31*
H5b	Dissuasion → Addiction	0.22	6.34***
H6a	Rationalization/ Education → Game Playing	−0.17	4.34***
H6b	Rationalization/Education → Addiction	−0.02	0.50
H7a	Parental Monitoring → Game Playing	−0.02	0.67
H7b	Parental Monitoring → Addiction	−0.10	2.66**
H8a	Resource Restriction → Game Playing	0.05	0.80
H8b	Resource Restriction → Addiction	0.13	3.11**
H9a	Perceived Cost → Game Playing	−0.13	3.53***
H9b	Perceived Cost → Addiction	−0.02	0.24

***$P<0.001$; **$P<0.01$; *$P<0.05$.

have a negative influence on online game addiction. It seems that parental monitoring is an effective prevention method. Finally, excessive game playing helped in the formation of high levels of game addiction.

Discussion

This paper bridges a gap in the technology addiction literature by examining how motivating factors and prevention/harm reduction factors shape adolescents' game playing behaviors and levels of online gaming addiction. Although the majority of studies on game playing and addiction examined mostly the functional needs, and other drivers, such as demographics and personality (e.g., Hur, 2006; Yee, 2006; Charlton & Danforth, 2010), we included prevention and harm reduction factors to present a more complete picture. As a result, we managed to explain over 40% of the variation in online game addiction.

In terms of motivating factors, the findings suggest that (1) needs for mastering game mechanics, relationship and escapism increase online game playing, (2) needs for relationship and escapism increase online game addiction. In terms of prevention and harm reduction factors, the findings suggest that (1) attention switching, perceived cost, and education/rationalization reduce game playing, and (2) attention switching and parental monitoring can reduce online game addiction. In contrast to our expectations, dissuasion and recourse restrictions were positively associated with online game playing and addiction. It is therefore possible that such prevention/harm reduction strategies are often employed only after high levels of game playing and addiction are observed. Finally, the findings suggest that online game playing partially mediates the effects of prevention/harm reduction and functional needs/motivation factors on the formation of online game addiction. Based on these findings, we discuss below several important insights and directions for future research.

Theoretical contributions

This study proposed a somewhat holistic game addiction model to explore the impact of motivation/functional needs and prevention/harm reduction factors on adolescent online game addiction. This broad perspective is a key contribution because it can potentially explain more variance in the phenomenon of interest, compared with studies that focus only on one set of predictors (motivating or preventing). For example, focusing only on personality traits, 20% of the variation in addiction was captured (Charlton & Danforth, 2010), and focusing on a broad range of motivating functional need factors, as well as on demographics, a model explained 34% of the variation in online game addiction (Yee, 2006). We managed to explain over 40% of the variation in this concept, presumably because a broader set of predictors was taken into account, which portrays a more balanced view of the forces that operate on an individual and determine in part whether he or she develops high levels of online game addiction.

Given the added value of amalgamating prevention and harm reduction factors with the conventional view regarding motivating factors, our second contribution is in identifying, conceptualizing, and measuring several important prevention and harm reduction factors.

These, and additional harm reduction and environmental factors, can be used in future research on technology addiction, to increase the contextual richness and explanatory power. It further shows that there is merit to borrowing concepts from the vast literatures on addiction, substance abuse, and problematic behaviors, which have advanced and evolved over decades, to the study of technology-related addictions. It hence adds to previous research that points to similarities between substance and technology addictions (Ko *et al*, 2009b) and substance and behavioral addictions (Helmuth, 2001).

This study also contributes to research by supporting and supplementing previous findings. First, the motivation side of the results generally agrees with Yee's (2006) study, but with some small differences. Both studies support the notion that motivating factors stemming from functional needs push people to play online games, and potentially develop high levels of online game addiction. Second, this study also support past research that links technology addiction to loneliness, mood disorders or social deficiencies (LaRose *et al*, 2003; Hur, 2006; Ferraro *et al*, 2007; Block, 2008; Turel & Serenko, 2010); in our study one's need for relationship and escapism were strong and significant predictors of game playing and addiction, and these are plausibly associated with some forms of social deficiency. Third, this study shows that at least some of the addiction prevention and harm reduction strategies that are common in other contexts such as problem drinking, gambling, smoking, and drug use may be also relevant in the context of technology addictions (Flay & Petraitis, 1991; Dishion & McMahon, 1998; Dickson *et al*, 2002; Hwang *et al*, 2004; Kiesner *et al*, 2009). Fourth, our study supplements the body of research on the antecedents of technology addiction by focusing on proximal predictors. It goes beyond simplistic views that emphasize personality antecedents (Shi, 2008) and looks at more proximal motivators and inhibitors, as well as behaviors (game playing).

Although the observed significant relationships are important, so are the observed non-significant effects. Thus, another contribution of our study is in pointing to potential propositions that should be studied in future research. The positive associations between addiction and two prevention factors: dissuasion and resource restriction, point to the possibility that these measures are taken by parents only after high levels of problematic online game playing and addiction are observed, that is, as remedies or interventions, and not as prevention factors. According to this view, the higher a child's online game playing time and level of addiction, the stronger the dissuasion and restrictions he or she will face. Future research should test this proposition by plausibly using designs that distinguish between prevention and intervention factors. Another possible explanation is that psychological reactance may affect the effectiveness of dissuasion. Psychological reactance is a motivational force aroused to restore the loss of, or the threatened loss of perceived behavioral freedoms, and ostensibly results in compensatory or corrective behaviors known as reactance effects (Johnson & Buboltz, 2000; Woller *et al*, 2007). If parents exercise too much dissuasion and resource restrictions on adolescent game players, psychological reactance will be evoked and online game players may perceive manipulative intent. In such cases they may ignore persuasive attempts and experience instead a boomerang effect, where they do the opposite of the intended behavior advocated by the persuasive messages or acts (Reinhart *et al*, 2007). Again, future research should examine this possible explanation.

Finally, our findings add to the mounting evidence regarding the potential existence of online game addiction (Chou & Ting, 2003; Bruner & Bruner, 2006; Park *et al*, 2007; Kim *et al*, 2008; Qian *et al*, 2008; Wolfling *et al*, 2008; Klimmt *et al*, 2009). The average level of addiction in our study was 2.68. It indicates that most of the sample (and plausibly the adolescent population) had no problematic levels of this state, but some did (e.g., individuals with average scores of over 6 out of 7). While we cannot classify individuals as addicted or not due to lack of acceptable criteria (Block, 2008), we do see quite a few records with high scores on the addiction scale. This therefore calls for further research on this phenomenon, its antecedents, and consequences.

Practical implications

Our findings can provide guidelines for society to develop more effective ways to reduce the levels of addiction to some applications among adolescents. First, because social deficiencies expressed as need for relationship and escapism are important drivers of excessive online game playing and addiction, from a society's perspective, methods for reducing these needs should be devised. For example, cities can invest in offline opportunities for adolescents to interact face-to-face and escape reality (e.g., more parks, sports clubs, and community centers).

Focusing on prevention and harm reduction factors, our study indicates that attention switching, rationalization/education, costs, and parental monitoring can alleviate one's level of addiction (directly, or indirectly through game playing). Thus, parents and teachers (and possibly employers in the case of adults) should (1) encourage and support alternative activities (e.g., sports), (2) educate people about the potential problems of excessive online game playing (e.g., by having classes on the topic), (3) increase the perceived cost of playing online games, by, for example, controlling and monitoring one's allowance, or from a government perspective, taxing these games (Ponicki *et al*, 2007), and (4) actively and passively monitor online gamer activities (e.g., by checking game logs).

Online service providers and system developers may have a different perspective that could also be informed by our findings. They may be interested in increasing users' play time, because their revenues are often associated with user activity. However, as our findings show, playtime is instrumental to the formation of high levels of addiction, which can lead to liability issues (Turel & Serenko, 2010). Thus, such service providers and developers need to strike a balance: promote playing, but avoid yielding high addiction levels. Our model suggests that focusing on parental monitoring can help in this regard. This is the only prevention factor that reduces addiction, without significantly reducing one's play time. Companies can help parents monitor the game playing activities of their kids by implementing features that allow online tracking. For example, Leapfrog allows parents to follow their kids' activities and record their progress in different games, via their website. In addition, companies may develop and provide parents with parental monitoring guidelines and best practices when they purchase or subscribe to a game. This strategy may have limited success, though, because parents may not always be involved in game purchasing/subscription decisions of adolescents.

Although three functional needs were identified as the basis for game playing and ultimately for the formation of high levels of addiction, only need for mechanics seems to increase play time, but not addiction. Thus, online game developers may focus on this need, and help users create and optimize their characters in online games, and track their performance. For example, they can make it easier to create and update one's character from any device, improve the ease of use of the interface, and provide text message alerts regarding the performance and relative standing of characters. Game developers may also cater to other user needs, for example, by promoting interactive features between online gamers, because these can address the need for relationship and possibly escapism. Nevertheless, as our study shows, they should be aware because these may come at the cost of leading to addiction, for which they may be held liable.

Limitations and future research

Several limitations should be acknowledged, together with the research directions they point to. First, we considered only a limited set of functional needs and prevention/harm reduction factors in this study. Additional motivating factors can be included such that more variation in addiction is explained; for example, personality (Charlton & Danforth, 2010), individual differences (Kim *et al*, 2008), demographic and socio-economic factors (Hur, 2006) and elements in one's environment (e.g., family or school relationships) (Tyas & Pederson, 1998). Similarly, additional prevention and harm reduction factors should be considered. These may include government policies, industry self-regulation, and parent–child relationship management (Marlatt, 1996; Weeks *et al*, 1998; Hatsukami *et al*, 2004; Benowitz, 2008).

Second, based on our findings dissuasion and resource restriction are not good strategies for addiction reduction among adolescents. But, caution should be exercised here. As mentioned in the theoretical implications section, our design fails to distinguish between pre-addiction prevention and potential harm reduction factors, and post-addiction interventions. Different research designs that focus on this distinction can be employed to better understand the efficacy of the abovementioned techniques.

Third, our findings are based on a sample of adolescents collected in one country. To increase the generalizability of the findings, future research should replicate and adjust the model with different samples – varying by at least age and geography. Also, our sample had access to a limited and varying set of online games. It may be desirable to see how our model is attuned when focusing on different types of games (e.g., violent *vs* non-violent games).

Finally, our findings provide imperfect support for the proposed causality, and limited explanation for the observed phenomena. For example, game playing could be both an antecedent and a consequence (symptom) of online game addiction. Future research should employ other designs (longitudinal, qualitative, etc.) to provide evidence in support of the directed causality we propose, and better unearth the rationales of online game players.

Conclusion

This study proposed, tested and validated a model that focuses on key factors that motivate and key factors that inhibit online game playing and addiction among adolescents. The findings point to key motivating functional needs, and suggest that various prevention/harm reduction strategies may counterbalance these motivations, and be efficacious in reducing online game playing and addiction. It hence implies that families, teachers, governments and regulators may help preventing and reducing the harm of game addiction through for example, education, cost increases, and providing access to alternative activities. Given the tremendous growth of this industry and the potential dire consequences of online game addiction, more research on this topic is warranted.

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Appendix A

Table A1 Measurement instrument

Game Playing	
Longest playing time	☐ <5 h, ☐ 5–10 h, ☐ 10–20 h, ☐ 20–30 h, ☐ >30 h
Playtime per week	Game playing occupies ___ % of my free time
Addiction (*1 = strongly disagree; 7 = strongly agree*)	
A1[a]	My social life has sometimes suffered because of my online game playing
A2	Playing online games has sometimes interfered with my work or study
A3	When I am not playing online games I often feel restless
A4	I have made unsuccessful attempts to reduce the time I spend playing online games
A5	Arguments have sometimes arisen at home because of the time I spend on online games
A6	I often fail to get enough sleep because of playing online games
A7	I often miss meals because of playing online games
Need for Advancement (*1 = strongly disagree; 7 = strongly agree*)	
ADV1	It is important for me to level up my game character as fast as possible
ADV2	It is important for me to acquire rare items that most players will never have
ADV3	It is important for me to become powerful in the game
ADV4	It is important for me to accumulate resources, items, or money in the game
ADV5	It is important for me to be well-known in the game
ADV6	It is important for me to be part of a serious, raid/loot-oriented guild
Need for mastering the Mechanics (*1 = strongly disagree; 7 = strongly agree*)	
MEC1	I am interested in the performance measures of my game character
MEC2	It is important for me to optimize the roles played by my game character
MEC3	I usually use a character builder or a template to plan my character's advancement at an early stage
MEC4	I like to know as much as possible about the game playing rules and winning strategies
Need for Relationship (*1 = strongly disagree; 7 = strongly agree*)	
REL1	I often have interesting conversations with other online players
REL2	I usually talk to my online friends about my personal issues
REL3	My online friends usually offer me support when I have a real life problem
REL4	I enjoy having some cyber romantic relationship with other players
REL5	I hope to join a social network through online game playing
Need for Escapism (*1 = strongly disagree; 7 = strongly agree*)	
ESC1	I usually play games so I can avoid thinking about some of real-life problems or worries
ESC2	I usually play games in order to relax from the day's work or study stress
ESC3	I often use game playing to escape from real world problems
ESC4	I often use game playing to alleviate my depression
Attention switching (Formative) (*1 = strongly disagree; 7 = strongly agree*)	
InnerAS	
AS1	Besides playing online games, I have other hobbies
AS2	There are activities more appealing than online games

Table A1 Continued

Game Playing	
ExternalAS	
AS3	I often take part in extracurricular activities
AS4	I often attend family gatherings
AS5	I often attend parties hosted by my friends
Parental Monitoring (Formative) (*1 = strongly disagree; 7 = strongly agree*)	
PM_Passive	
PM1	My parents know where I am after school
PM2	My parents know whom I am with after school
PM5	My parents exchange information with other parents about their children
PM_Active	
PM3	My parents check whether I am playing online games when they are out
PM6	My parents control my game playing time
PM7	My parents set a time for me to back home
Resource Restrictions (Formative) (*1 = strongly disagree; 7 = strongly agree*)	
7-item Likert scale (strongly disagree/strongly agree)	
RS1	I don't have enough pocket money to play online games
RS3	It is difficult for me to find a computer to play online games
RS4	Low network speed annoys me when playing online games
RS5	Parental guidance is available to me in the game selection (reversed)
Dissuasion (Reflective) (*1 = strongly disagree; 7 = strongly agree*)	
DISS1	My teachers/parents intervened my game playing at an early stage
DISS2	My teachers/parents constantly remind me not to play online games
DISS3	My teachers/parents dissuade me from playing online games
DISS4	My teachers/parents warn me not to keep playing online games
Rationalization/Education/(Reflective) (*1 = strongly disagree; 7 = strongly agree*)	
RAT1	Education by teachers and parents helped me realize the consequence of excessively playing online games
RAT2	Educational movies and videos helped me realize the consequence of excessively playing online games
RAT3	Media and news reports on online game addiction helped me realize the consequence of excessively playing online games
RAT4	The symptoms that my friends suffered from excessive online game playing helped me realize the consequence of it
Perceived cost (reflective) (*1 = strongly disagree; 7 = strongly agree*)	
COST1	Equipment costs of playing online games are high
COST2	Per hour playing cost is high
COST3	Internet access fee is high
COST4	The associated costs, such as drinks and snacks, are high
COST5[a]	Fees for playing online games are reasonable (reversed)

[a]Item deleted due to low loading.

Appendix B

Table B1 Descriptive statistics, construct reliabilities, AVE, and correlations

Construct (N = 623)	*Mean*	*SD*	*α/AVE*	ρ_c	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*	*(11)*	*(12)*	*(13)*	*(14)*	*(15)*	*(16)*
ADV	3.92	1.90	0.94/0.77	0.95	0.88															
AS	5.31	1.32	−/−	—	−0.19	—														
COST	4.68	1.76	0.87/0.72	0.91	0.04	0.18	0.85													
DISS	3.67	1.92	0.91/0.79	0.94	0.03	0.02	0.01	0.89												
ESC	3.17	1.71	0.86/0.71	0.91	0.34	−0.23	0.00	0.11	0.84											
ExternalAS	4.92	1.54	0.79/0.71	0.88	−0.19	0.90	0.15	0.09	−0.20	0.84										
Game playing	10.76	10.75	0.71/0.78	0.87	0.28	−0.26	−0.16	0.08	0.27	−0.20	0.88									
InnerAS	5.9	1.48	0.78/0.82	0.90	−0.13	0.83	0.18	−0.07	−0.21	0.50	−0.27	0.90								
MEC	3.84	1.79	0.89/0.74	0.92	0.75	−0.16	0.01	0.05	0.38	−0.15	0.33	−0.12	0.86							
PM	4.35	1.40	−/−	—	−0.04	0.23	0.10	0.19	−0.03	0.26	−0.09	0.13	0.04	—						
PM-active	4.76	1.58	0.63/0.58	0.80	−0.02	0.13	0.02	0.25	0.05	0.20	−0.03	0.01	0.06	0.84	0.76					
PM-passive	3.93	1.71	0.65/0.60	0.82	−0.05	0.26	0.16	0.07	−0.10	0.25	−0.12	0.20	0.00	0.86	0.44	0.78				
RAT	4.74	1.76	0.92/0.81	0.94	−0.16	0.34	0.24	0.12	−0.16	0.34	−0.29	0.25	−0.13	0.32	0.25	0.30	0.90			
REL	3.14	1.66	0.84/0.61	0.89	0.24	−0.10	0.11	0.10	0.34	−0.05	0.20	−0.14	0.22	0.04	0.10	−0.03	−0.06	0.78		
RES	3.68	1.46	−/−	—	0.30	−0.09	0.19	0.14	0.28	−0.06	0.13	−0.11	0.30	0.10	0.14	0.02	0.02	0.23	—	
Addiction	2.68	1.37	0.82/0.53	0.87	0.34	−0.36	−0.07	0.25	0.39	−0.26	0.44	−0.37	0.34	−0.12	0.01	−0.21	−0.21	0.28	0.29	0.73

Note 1: $N = 623$, ρ_c = composite reliability, ADV = need for advancement, AS = attention switching, COST = perceived cost, DISS = dissuasion, ESC = need for escapism, ExternalAS = external attention switching, InnerAS = inner attention switching, game playing = action to play game, MEC = need to master game mechanics, PM = parental monitoring, PM-active = active parental monitoring, PM-passive = passive parental monitoring, RAT = rational/education, REL = need for relationship, RES = resource restriction.
Note 2 : Diagonal elements are the square roots of average variance extracted by variables from their indicators.
Note 3: attention switching, parental monitoring and resource restriction are modeled using formative indicators, thus ρ_c and average variance extracted do not apply.

Appendix C

Table C1 Item loadings and cross-loadings

	ADV	*COST*	*DISS*	*ESC*	*ExternalAS*	*InnerAS*	*MEC*	*PM-active*	*PM-passive*	*RAT*	*REL*	*Game playing*	*Addiction*
ADV1	**0.866**	0.036	0.019	0.234	−0.147	−0.041	0.680	−0.018	−0.008	−0.068	0.152	0.250	0.266
ADV2	**0.892**	0.016	0.046	0.268	−0.129	−0.110	0.662	−0.004	−0.045	−0.118	0.211	0.263	0.319
ADV3	**0.919**	0.036	−0.007	0.324	−0.208	−0.144	0.668	−0.022	−0.061	−0.166	0.194	0.236	0.312
ADV4	**0.901**	0.058	0.040	0.312	−0.178	−0.100	0.686	−0.019	−0.027	−0.133	0.225	0.204	0.297
ADV5	**0.871**	0.029	0.047	0.328	−0.177	−0.171	0.615	0.003	−0.052	−0.150	0.275	0.254	0.315
ADV6	**0.814**	0.067	0.015	0.314	−0.181	−0.116	0.622	−0.047	−0.033	−0.195	0.191	0.269	0.277
COST1	0.065	**0.937**	−0.026	−0.030	0.133	0.222	0.018	−0.019	0.134	0.188	0.068	−0.143	−0.086
COST2	0.052	**0.907**	0.019	0.011	0.085	0.142	0.025	0.004	0.136	0.221	0.110	−0.159	−0.032
COST3	−0.012	**0.804**	0.053	0.036	0.145	0.075	−0.020	0.083	0.145	0.240	0.132	−0.140	−0.043
COST4	0.019	**0.668**	0.039	0.062	0.138	0.092	−0.011	0.021	0.106	0.209	0.148	−0.103	−0.020
DISS1	0.015	0.025	**0.864**	0.069	0.097	−0.037	0.049	0.214	0.050	0.097	0.061	0.062	0.214
DISS2	0.043	0.043	**0.882**	0.078	0.099	0.006	0.076	0.196	0.097	0.133	0.082	0.050	0.188
DISS3	0.018	−0.029	**0.913**	0.123	0.095	−0.086	0.028	0.259	0.067	0.093	0.098	0.113	0.257
DISS4	0.037	0.004	**0.892**	0.127	0.027	−0.103	0.046	0.220	0.067	0.107	0.110	0.061	0.224
ESC1	0.258	0.019	0.119	**0.878**	−0.190	−0.198	0.300	0.046	−0.072	−0.115	0.309	0.221	0.352
ESC2	0.314	0.007	0.089	**0.813**	−0.078	−0.134	0.354	0.055	−0.068	−0.095	0.280	0.220	0.306
ESC3	0.343	−0.020	0.098	**0.839**	−0.179	−0.171	0.370	0.017	−0.061	−0.145	0.290	0.268	0.313
ESC4	0.230	0.006	0.078	**0.840**	−0.216	−0.191	0.258	0.070	−0.111	−0.169	0.277	0.214	0.356
AS3	−0.144	0.113	0.092	−0.130	**0.859**	0.440	−0.117	0.133	0.174	0.272	−0.037	−0.201	−0.212
AS4	−0.216	0.120	0.085	−0.236	**0.865**	0.422	−0.175	0.205	0.260	0.340	−0.064	−0.211	−0.272
AS5	−0.127	0.139	0.046	−0.134	**0.801**	0.401	−0.077	0.150	0.199	0.231	−0.013	−0.084	−0.176
AS1	−0.097	0.152	−0.026	−0.168	0.445	**0.903**	−0.084	0.028	0.201	0.198	−0.127	−0.217	−0.320
AS2	−0.140	0.177	−0.093	−0.205	0.459	**0.906**	−0.133	−0.013	0.146	0.251	−0.124	−0.264	−0.349
MEC1	0.674	0.058	0.062	0.309	−0.117	−0.085	**0.881**	0.035	0.013	−0.075	0.205	0.263	0.304
MEC2	0.674	0.015	0.003	0.301	−0.133	−0.074	**0.875**	−0.005	−0.002	−0.118	0.135	0.280	0.305
MEC3	0.569	−0.043	0.111	0.340	−0.117	−0.129	**0.828**	0.131	−0.015	−0.089	0.227	0.227	0.297
MEC4	0.651	−0.005	0.019	0.356	−0.139	−0.128	**0.865**	0.064	0.015	−0.150	0.188	0.343	0.286
PM4	0.007	−0.017	0.234	0.081	0.110	−0.022	0.068	**0.790**	0.370	0.179	0.078	0.006	0.025
PM5	−0.036	0.043	0.193	0.003	0.169	0.030	0.015	**0.799**	0.371	0.218	0.077	−0.075	−0.006
PM6	−0.019	0.012	0.139	0.039	0.169	0.015	0.063	**0.681**	0.299	0.161	0.067	0.008	−0.001
PM1	−0.088	0.156	0.001	−0.154	0.202	0.243	−0.058	0.208	**0.805**	0.249	−0.166	−0.143	−0.293
PM2	−0.058	0.126	0.025	−0.140	0.172	0.189	0.003	0.274	**0.830**	0.249	−0.097	−0.127	−0.224
PM3	0.032	0.079	0.136	0.057	0.198	0.031	0.052	0.530	**0.667**	0.189	0.177	−0.019	0.024
RAT1	−0.149	0.228	0.165	−0.134	0.323	0.247	−0.115	0.245	0.320	**0.911**	−0.061	−0.279	−0.211
RAT2	−0.181	0.206	0.102	−0.163	0.292	0.208	−0.155	0.213	0.259	**0.938**	−0.061	−0.255	−0.201
RAT3	−0.139	0.235	0.055	−0.176	0.309	0.243	−0.133	0.211	0.249	**0.934**	−0.062	−0.286	−0.209
RAT4	−0.077	0.184	0.112	−0.055	0.282	0.184	−0.011	0.223	0.237	**0.799**	−0.005	−0.196	−0.113
REL1	0.183	0.122	0.095	0.199	0.015	−0.073	0.154	0.071	0.068	−0.005	**0.781**	0.154	0.201
REL2	0.088	0.048	0.074	0.247	0.002	−0.083	0.096	0.132	−0.034	−0.042	**0.794**	0.116	0.220
REL3	0.128	0.068	0.138	0.219	0.014	−0.115	0.118	0.113	0.029	0.012	**0.781**	0.123	0.157
REL4	0.244	0.076	0.063	0.336	−0.095	−0.114	0.234	0.094	−0.055	−0.087	**0.783**	0.198	0.259
REL5	0.245	0.123	0.042	0.301	−0.079	−0.149	0.207	−0.011	−0.058	−0.076	**0.768**	0.183	0.234
Time per week	0.252	−0.160	0.064	0.240	−0.200	−0.256	0.294	−0.041	−0.097	−0.271	0.159	**0.874**	0.401
Longest time	0.244	−0.127	0.082	0.242	−0.152	−0.215	0.281	−0.009	−0.113	−0.239	0.200	**0.889**	0.375
Addic2	0.185	0.050	0.184	0.224	−0.104	−0.165	0.160	0.051	−0.054	−0.037	0.111	0.177	**0.553**
Addic3	0.290	−0.060	0.177	0.318	−0.222	−0.331	0.303	0.056	−0.116	−0.137	0.257	0.329	**0.777**
Addic4	0.253	−0.011	0.237	0.303	−0.194	−0.306	0.250	−0.021	−0.195	−0.170	0.236	0.378	**0.782**
Addic5	0.255	−0.067	0.235	0.325	−0.191	−0.240	0.273	0.054	−0.083	−0.128	0.243	0.335	**0.760**
Addic6	0.204	−0.106	0.165	0.254	−0.169	−0.289	0.226	−0.042	−0.219	−0.170	0.191	0.357	**0.735**
Addic7	0.287	−0.074	0.111	0.288	−0.242	−0.262	0.273	−0.048	−0.188	−0.253	0.163	0.314	**0.742**

Note: Bold values are significant at $p < 0.001$.