Problematic Use of the Mobile Phone: A Literature Review and a Pathways Model

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Abstract: Despite its unambiguous advantages, cellular phone use has been associated with harmful or potentially disturbing behaviors. Problematic use of the mobile phone is considered as an inability to regulate one's use of the mobile phone, which eventually involves negative consequences in daily life (e.g., financial problems). The current article describes what can be considered dysfunctional use of the mobile phone and emphasizes its multifactorial nature. Validated assessment instruments to measure problematic use of the mobile phone are described. The available literature on risk factors for dysfunctional mobile phone use is then reviewed, and a pathways model that integrates the existing literature is proposed. Finally, the assumption is made that dysfunctional use of the mobile phone is part of a spectrum of cyber addictions that encompasses a variety of dysfunctional behaviors and implies involvement in specific online activities (e.g., video games, gambling, social networks, sex-related websites).

Keywords: Addiction, assessment, cellular phone, cyber addiction, mobile phone, pathways model, risk factors.

PROBLEMATIC USE OF THE MOBILE PHONE: A GROWING CONCERN

Mobile phone use has dramatically increased in industrialized countries during the last decade. Early research conducted on mobile phone use has emphasized its positive outcomes. In particular, it has often been argued that cellular phones allow people to enter into communication without being constrained by physical proximity or spatial immobility [1]. A growing number of studies also highlighted the efficacy of cellular phones for delivering change interventions in health behavior *via* text messages (e.g., diabetes self-management, smoking cessation) [2].

Despite its unambiguous advantages, the use of cellular phones has been extensively associated with harmful or potentially disturbing behaviors. The first studies that focused on problematic mobile phone use aimed at determining its impact upon driving abilities. On the whole, these studies emphasized that using a cellular phone while driving reduces attentional capacities, even in the case of hands-free devices [3]. Moreover, although phoning while driving is usually not perceived as dangerous behavior [4], studies in which retrospective analyses of accident characteristics were conducted have shown that mobile phone owners are more often involved in fatal accidents compared with persons who do not own a mobile phone [5]. Nowadays, a growing number of countries have banned mobile phone use while driving, although this does not hinder numerous people from continuing to use their mobile phone when they drive [6]. Ironically, cellular phones can also change from the status of an instrument that supports social exchanges to an object than indubitably interferes with them. Most individuals have indeed found themselves in situations where the use of a cellular phone disturbed their social exchange. As a consequence, and similar to smoking, mobile phones tend to be banned in a growing number of public places (e.g., library, public transit) [7].

Nevertheless, one of the most important concerns associated with mobile phone use is that it may become uncontrolled or excessive, which has an impact upon daily living. Among the most common negative outcomes resulting from overuse of the mobile phone, one could cite financial problems [6,8] or sleep disturbance [9]. Nowadays, excessive use of the mobile phone is often considered a behavioral addiction, along with other nonchemical addictions such as pathological gambling, compulsive shopping or video-game addictions [10]. This mainly results from pioneer studies (mostly conducted in Asia and Australia) that identified symptoms of addiction to the mobile phone in young adults and adolescents (e.g., cravings, mood regulation expectancies, lack of control) [11,12]. More recently, surveys conducted in Switzerland revealed that a significant proportion (about 30%) of the participants overtly perceived themselves as "addicted to the mobile phone" [6,13].

On the whole, mobile phone use has been associated with dangerous or "antisocial" behaviors, as well as with uncontrolled use and dependence symptoms. For these reasons, clinicians and researchers should be aware of the instruments currently available to measure problematic use of the mobile phone, as well as the socio-demographic and psychological factors that have been demonstrated to play a role in its development and maintenance.

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ASSESSMENT OF PROBLEMATIC USE OF THE MOBILE PHONE

The assessment of an individual's mobile phone use should take into account three distinct aspects: (1) the user's profile, (2) actual use and (3) problematic use. This assessment should be realized by combining semi-structured interviews and validated questionnaires.

Mobile phones are no longer instruments that are solely devoted to communication between two individuals. Indeed, the latest generation of mobile phones (smartphones) allows people to engage in a wide range of online activities—such as Internet surfing, managing email, playing video games, gambling or involvement in social networks (e.g., Facebook, Twitter)—without being constrained to their home or office. These kinds of online activities differ in important ways from traditional mobile phone communication, which was restricted to calls and written messages (Short Message Service; SMS). The possibilities offered by these new hybrid mobile phones imply that prior to the assessment of an individual's potential problematic use, one should be aware of the various types of activities being practiced with the cellular phone. If someone mainly overuses the mobile phone for playing online video games (rather than keeping in constant touch with relatives), potential overuse could be only the tip of the iceberg, and the dysfunctional behavior to target may be an online video game addiction rather than a mobile phone addiction. If this is the case, the cellular phone is solely a device used to satisfy the desire or need to play online games. Consequently, disentangling a person's mobile phone user profile is a preliminary step necessary to avoid regrouping dissimilar behaviors into a deceptive label of "mobile phone addiction."

After having determined the user's profile, assessment should focus on the actual use made of the mobile phone. On the basis of published studies, daily assessment of actual use seems to be more suitable than weekly or monthly assessment [6,14]. Actual mobile phone use assessment comprises an evaluation of the number of calls emitted daily and their duration, as well as an estimation of the number of text messages (SMSs) sent daily. Actual use can be more

Table 1. Existing Measures of Problematic Mobile Phone Use

Measure	Authors	Basis	Subjects	Items	Factor(s)	Validation Technique
Mobile Phone Problem Use Scale (MPPUS)	Bianchi and Phillips (2005) [12]	Substance abuse literature	University students and community participants	28-item Likert (10 points)	Unique factor of problem use[†]	Index of reliability, external and internal validity. Factorial structure not reported
Problematic Mobile Phone Use Questionnaire (PMPUQ)	Billieux *et al.* (2008) [6]	Existing studies on problem mobile phone use	Community participants	30-item Likert (4 points)	Prohibited use dangerous use; dependence; financial problems	Index of reliability, external and internal validity. Exploratory and confirmatory factor analyses
Text-Message Dependency Scale (TMDS)	Igarashi *et al.* (2008) [22]	Existing studies on text-message use/Young's criteria for Internet addiction	College students (15-18 years old)	15-item Likert (5 points)	Emotional reaction; excessive use; relationship maintenance	Index of reliability, external and internal validity. Exploratory and confirmatory factor analyses
Mobile Phone Dependence Questionnaire (MPDQ)	Toda *et al.* (2004) [11]	Evidence of excessive and prohibited use in students	Female university students	20-item Likert (4 points)	Unique factor of problem use	Index of reliability, external and internal validity. Exploratory factor analysis
SMS Problem Use Diagnostic Questionnaire (SMS-PUDQ)	Rutland *et al.* (2007) [23]	Young's criteria for Internet addiction	University students	8-item dichotomous	Pathological use; excessive use	Index of reliability, external and internal validity. Exploratory factor analysis
Mobile Phone Involvement Questionnaire	Walsh *et al.* (2010) [18]	Substance abuse literature	Community participants	8-item Likert (7 points)	Unique factor of problem use	Index of reliability, external and internal validity. Principal component analysis
Problem Cellular Phone Use Questionnaire (PCPU-Q)	Yen *et al.* (2009) [19]	Substance abuse literature	Adolescents	12-item dichotomous	Symptoms of problematic use[‡]; functional impairment	Index of external and internal validity, cut-off analysis

[†]Although the validation article of the MPDQ (published in Japanese) proposed a six-factor solution of the scale, subsequent studies by the same authors considered either a one-factor solution or dissimilar multifactorial factorial structures. Accordingly, this scale is here mentioned as a one-factor scale.
[‡]A cut-off of at least four of the seven symptoms composing the scale is proposed to define pathological mobile phone use.

deeply explored by, for example, determining the percentage of usage related to social versus professional purposes. Eventually, if a person uses the mobile phone for other types of online activities, the daily time spent on these activities should be noted. It is then important to distinguish between heavy and problematic use of the mobile phone. Indeed, although elevated actual use of the mobile phone is often a correlate of problematic use [6], certain individuals may be heavy users of the mobile phone without being involved in any kind of problematic use. A similar distinction between heavy use and overuse has, for example, been proposed in the framework of online video game involvement [15]. Thus, specific assessment of problematic use is required.

Only a few validated scales are currently available for researchers and clinicians (see Table **1**). As a consequence, many published studies have investigated problematic use of the mobile phone by using their own pooled items [e.g., 13,16,17], which, among other issues, raises problems in replicating results. There is thus a real need to translate and diffuse the available validated instruments. One of the most used among them is Bianchi and Phillips' Mobile Phone Problem Use Scale (MPPUS) [12]. The MPPUS is an unifactorial 27-item questionnaire inspired by the addiction literature, which covers issues such as tolerance, withdrawals, escape from other problems, craving and negative consequences upon daily life (at social, familial, professional and financial levels). The items are scored with a 10-point Likert scale, allowing dimensional rather than categorical (i.e., "yes" or "no") responses. The MPPUS was administered in several studies and can be considered a useful tool to assess a global score of mobile phone addiction. Other comparable unidimensional tools have been developed [11,18,19], including scales based on diagnostic criteria (inspired by the substance abuse nosography) and developed to determine a tentative cut-off for "pathological mobile phone use" [19]. Mobile phone use was nevertheless shown to imply various types of dysfunctional behaviors and adverse consequences, raising the need to develop multidimensional measures. Currently, the only validated multidimensional scale is the Problematic Mobile Phone Use Questionnaire (PMPUQ)[1] [6,20]. The PMPUQ is a 30-item questionnaire that measures four distinct facets of problematic mobile phone use. Each item is assessed on a 4-point Likert scale, allowing dimensional answers. The constructs measured by the PMPUQ are the following: (1) dangerous use, defined as the tendency to use the mobile phone while driving; (2) prohibited use, defined as the tendency to use the mobile phone in banned places; (3) dependence symptoms, based on features of addictive behaviors (e.g., loss of control, occurrence of negative affect in situations or contexts in which the use of the mobile phone is not possible or allowed); and (4) financial problems, which reflect the extent to which mobile phone use resulted in tangible financial problems (this latter subscale can be considered a measure of negative outcome in daily life). Interestingly, a significant correlation was found between the PMPUQ and a scale assessing compulsive buying [21], which supports the view that both problematic mobile phone

use and compulsive buying are behavioral addictions sharing some common etiological factors. Finally, attempts have been made to develop scales that specifically focus on the assessment of problematic use of SMS [22,23].

On the whole, it appears that psychometrically sound questionnaires have been developed to measure a global score of mobile phone addiction, as well as the different facets of problematic use. However, these instruments have been developed recently and further studies are required to confirm their validity.

PREDICTORS OF PROBLEMATIC USE OF THE MOBILE PHONE

During the last decade, several studies have tried to delimit risk factors associated with problematic mobile phone use. The existing literature emphasizes that demographics and psychological factors are involved. In the next sections, these studies are reviewed. Although the number of studies conducted is currently limited, research on this topic can surely be expected to flourish in the next few years.

Socio-demographic Factors

Some studies highlighted gender differences regarding problematic use of the mobile phone. Most found that women have more intensive actual use of the mobile than men do, with the most pronounced difference occurring for text message use [6,16,24]. Other studies emphasized that females are more prone to experience dependence on the mobile phone [6,24,25]. Nevertheless, males were shown to have a greater tendency to use the mobile phone while driving [6]. Young age was also shown to predict more elevated actual use and symptoms of dependence on the mobile phone [6,25].

Although the relationships described here may be of interest in targeting prevention policies, they are probably mediated by other psychological variables that vary across gender (e.g., personality traits) and age (e.g., self-control abilities). Further studies are thus required to address these questions. Finally, no clear relationship was established for educational level or socio-economic status, but researchers conducting studies on actual and excessive mobile phone use may be interested in controlling for these variables (especially if mobile phone expenditures are taken into account).

Personality Traits and Related Psychological Mechanisms

Most of the investigations conducted on the psychological variables that lead to problematic mobile phone use have focused on individual differences in certain personality traits. In particular, problematic use of the mobile phone has been related to high neuroticism (i.e., the tendency to be emotionally unstable) and extraversion (i.e., the tendency to be sociable), whereas relationships with other personality traits (e.g., agreeableness, consciousness) were less consistent across studies [12,14,22,26]. Extraversion and neuroticism might in fact sustain two distinct pathways leading to dysfunctional mobile phone use, as well illustrated in a recent innovative Japanese study by Igarashi and

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[1]The original French PMPUQ and its English translation can be requested from the author.

colleagues [22]. These authors, who were interested in dysfunctional use of text messages (e.g., using text messages while having a face-to-face interaction with another person), conducted a study in order to determine how self-perception of text-message dependency is influenced as a function of extraversion and neuroticism. By using structural equation modeling techniques, they emphasized two different paths leading to text-message dependency and excessive use: (1) an extraversion pathway through which dependency results from the strong desire to communicate with peers or to establish new potential relationships and (2) a neurotic pathway through which dependency is explained by a constant need to seek reassurance promoted by the fear of being rejected and by anxiety about relationship maintenance.

Another psychological construct that has been related to problematic mobile phone use is impulsivity [6,13,21]. Such research has in particular been motivated by accumulating evidence suggesting that diminished impulse control is a hallmark of addictive behaviors [27–29]. Studies that explored the links between impulsivity and problematic mobile phone use were based on the theoretical framework provided by Whiteside and Lynam's UPPS model [30], which clarified the multidimensionality of impulsivity by subdividing it into four dimensions. These four dimensions are defined as follows: urgency, the tendency to act rashly when experiencing intense emotions (positive and/or negative emotions); premeditation, the tendency to take into account the consequences of an act before engaging in that act; perseverance, the capacity to remain focused on a boring and/or difficult task; and sensation seeking, the tendency to enjoy and pursue new and exciting activities. Recent evidence suggested that the various facets of impulsivity are related to specific psychological mechanisms. More precisely, these studies emphasized that three of the dimensions of impulsivity (urgency, lack of premeditation, lack of perseverance) are related to executive mechanisms underlying self-control abilities (e.g., inhibitory control), whereas the last dimension (sensation seeking) depends on motivational mechanisms related to reward sensitivity and approach tendencies [21,31,32].

The impulsivity facet of urgency strongly predicts problematic mobile phone use. High urgency is indeed associated with all aspects of everyday use of the mobile phone (number of calls, duration of calls, number of SMSs sent), as well as with several dimensions of problematic mobile phone use measured with the PMPUQ (dependence symptoms, financial problems, phoning while driving) [6]. It thus seems that the pronounced difficulties of high urgency people in exerting self-control in intense emotional contexts puts them more at risk for developing problematic use of the mobile phone. Examples might include someone who calls many friends in response to an event that triggers euphoria or joy, or a person who cannot delay using the phone in the heat of the moment when experiencing intense anger. Urgency has also been related to greater use of maladaptive emotion regulation strategies, such as ruminative thinking, which may promote and maintain negative affect states [33]. Dysfunctional use of the mobile phone can therefore result both from an intense emotional context, implying loss of

self-control, and from the desire to communicate with someone to cope with a negative affect state (e.g., making calls or SMSs when feeling distressed or anxious). This latter point is sustained by the growing number of studies emphasizing that depressive symptoms frequently co-occur with dysfunctional or excessive use of the mobile phone [6,9,16,17,19] and by the fact that a wide range of problematic and addictive behaviors serves as a short-term strategy to deal with unpleasant emotions or moods [34,35].

Other impulsivity facets have also been differentially linked to problematic use of the mobile phone. The lack of perseverance mainly predicts actual use of the mobile phone (number and duration of calls) and financial problems [6,13]. This facet of impulsivity is at least partly underlain by a proneness to unwanted thoughts and mind-wandering [32,36], suggesting that phoning helps certain individuals who lack perseverance rid themselves of irrelevant thoughts (e.g., thoughts related to a recent quarrel or to an upcoming event). Lack of premeditation was specifically related to prohibited use of the mobile phone [6]. Low premeditators thus seem to use their mobile phone even in situations in which the adverse consequences of prohibited use are easily conceivable (e.g., social disapproval, fines, banishment from a public place). This type of problematic mobile phone use resembles certain behaviors observed in persons displaying antisocial personality traits, which is in line with studies having shown that low premeditators are prone to antisocial behaviors [37]. Finally, high levels of sensation seeking result in more frequent mobile phone use while driving [30]. This suggests that, for individuals with elevated sensation seeking, phoning while driving may promote exciting hedonic stimulation (e.g., in demanding situations in which the driver needs to concentrate).

Self-esteem and Related Psychological Mechanisms

Some studies explored the links between mobile phone use and self-esteem, that is, the extent to which individuals view themselves as likeable and worthy [38]. Two different types of evidence motivated these studies. First, persons with low self-esteem seem to favor indirect communication (e.g., email, SMSs), compared with individuals with high self-esteem who generally preferred face-to-face communication [39]. Second, several studies found low self-esteem as a predictor for addictive behaviors [40,41], although this link was not consistently demonstrated [42]. In the framework of mobile phone research, low self-esteem was demonstrated as a strong predictor of dysfunctional use [12,14,17,25,26]. These results were generally interpreted in the sense that individuals with low self-esteem often experience the need to seek reassurance by contacting other people (e.g., friends or partners), which makes them susceptible to excessive use and dependence on the mobile phone. Despite having established a clear relationship between problematic mobile phone use and low self-esteem levels, these studies bring about limited comprehension of the psychological mechanisms involved. Indeed, as emphasized by Heatherton and Polivy [38], self-esteem may differ within specific domains (e.g., social, appearance or professional self-esteem) and across time (e.g., trait vs. state self-esteem). For example, excessive use of the mobile phone could be

specifically related to fluctuations in social self-esteem. If this assumption is true, an individual whose social self-esteem fluctuates and is context dependent would need to seek reassurance through mobile phone use following a negative appraisal of a social interaction. Accordingly, both disentangling the construct of self-esteem and taking into account its dynamic nature seem to be required to better understand the role of low self-esteem in dysfunctional mobile phone use. Of importance, some psychological factors underlying individual differences in self-esteem should be taken into account when considering the accumulating evidence linking low self-esteem and dysfunctional mobile phone use. First, low self-esteem has been related to negative core beliefs about the self that take the form of maladaptive cognitions (e.g., a depressive cognitive style involving erroneous cognitions about the self or others) [43]. For example, someone whose low self-esteem is underlain by negative core beliefs about the self (e.g., "I am a boring and unlovable person") would seek frequent reassurance from his or her partner and is susceptible to excessive mobile phone use. Another relevant self-esteem-related factor for understanding problematic mobile phone use lies in attachment styles, which have been conceptualized as mental working models that play a crucial role in affective relationships [44]. According to Bowlby's theory, attachment styles organize cognition, affect and behavior in close relationships, and they shape self-image. Three attachment categories are often considered: the *secure* style is sustained by confidence in the availability of attachment figures in times of need and by comfort with closeness and independence; the *avoidant* style is characterized by insecurity concerning other's intentions and by a preference for emotional distance; and the *anxious-ambivalent* style is defined by insecurity concerning other's responses, as well as with a strong desire for intimacy and a high fear of rejection [45]. Several developmental and cross-sectional studies emphasized that insecure attachment styles (avoidant and anxious-ambivalent) are associated with low levels of self-esteem [46,47]. In fact, people with an insecure attachment have been found to have a positive mental model of others and a negative mental model of themselves, which makes them highly dependent on the approval of others and in need of constant reassurance from their partners [48]. Anxious-ambivalent individuals, who are characterized by both a need for intimacy and a fear of rejection, are probably more at risk for developing a dysfunctional use of the mobile phone. Indeed, for them, phoning could serve as a means of obtaining constant reassurance from their partners. The existing literature nevertheless only indirectly supports these assumptions. For example, recent research highlighted that excessive text-message dependency is related to concerns about relationship maintenance [49]. Further studies are therefore required to directly investigate the role of the psychological mechanisms underlying low self-esteem in dysfunctional mobile phone use.

Limitations of Existing Studies on Problematic Mobile Phone Use

Some limitations of the studies reviewed here warrant further discussion. First, most of the research conducted on the problematic use of the mobile phone was realized in the absence of a theoretical rationale, which has, among other concerns, resulted in the validation of scales developed from an atheoretical perspective (e.g., *Diagnostic and Statistical Manual of Mental Disorders* criteria for substance abuse). Second, the great majority of studies on excessive use of the mobile phone are cross-sectional, but more longitudinal studies are required. For example, an alternative explanation to the established link between self-esteem and dysfunctional mobile phone use could be that negative outcomes resulting from exaggerated use of the mobile phone (e.g., financial problems) have a negative impact on self-esteem. Third, although excessive mobile phone use is generally considered to lie within the addictive behaviors spectrum, studies are still needed to explore the similarities and differences between "mobile phone addiction" and other behavioral addictions. In accordance with these limitations, further studies and theoretical advances are required to direct both prevention policies (mobile phones are often the first vector of debt for children and young adults) and potential psychological interventions in problematic use. The next section of this article is devoted to the presentation of a pathways model that integrates the available literature on problematic mobile phone use. The proposition is also made that "mobile phone addictions" should be incorporated within a broader spectrum of cyber addictions.

A PATHWAYS MODEL OF PROBLEMATIC MOBILE PHONE USE

Research on problematic mobile phone use is limited by the lack of a theoretical framework that allows understanding of its etiology and maintenance. In fact, the majority of the studies conducted considered problematic mobile phone use as an addictive disorder, without taking into account its different manifestations, as well as the various psychological factors involved. On the basis of these empirical concerns, I have synthesized the findings of the studies described earlier into an integrative model that aims to provide a theoretical framework for further studies. This model, illustrated in Fig. (**1**), describes the various pathways leading to dysfunctional mobile phone use. The model allows consideration of both the heterogeneity of dysfunctional mobile use and the specificity of the factors involved. It also proposes that the adverse consequences resulting from the excessive or uncontrolled use of the mobile phone generates a vicious circle through the perpetuation of negative affect. It is noteworthy that, although distinct pathways are proposed here to account for dysfunctional mobile phone use, they should not be considered as mutually exclusive. Indeed, it is obvious that the mechanisms involved in the various pathways proposed can co-exist (e.g., someone characterized by both high impulsivity and low self-esteem), implying that the same individual can display more than one proposed pathway to problematic mobile phone use.

The model depicted in Fig. (**1**) permits identification of at least four pathways leading to dysfunctional mobile phone use. The first pathway, called the *impulsive pathway*, describes individuals whose mobile phone use is mainly driven by poor self-control and/or maladaptive emotion regulation. This pathway regroups persons who can be
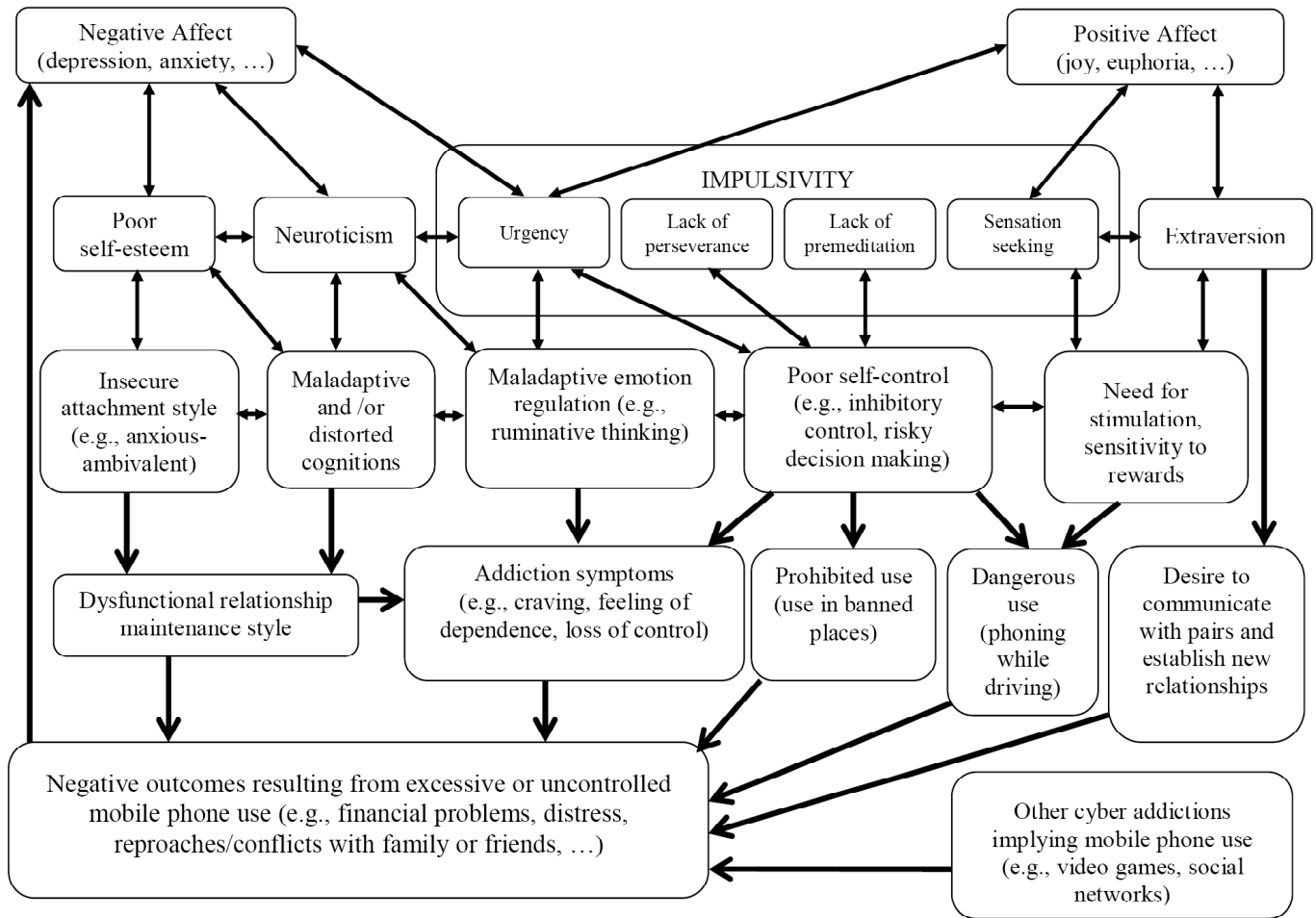
Fig. (1). Integrative model depicting four pathways to problematic mobile phone use: (1) the impulsive pathway; (2) the relationship maintenance pathway, (3) the extraversion pathway, and (4) the cyber addiction pathway.

characterized by heterogeneous impulsivity profiles, as previously explained. For example, some of these people cannot delay using the phone when experiencing intense emotions because they lack self-control in such contexts (people with high urgency), whereas others excessively use their mobile phone because they do not take into account the potential future consequences (people with low premeditation). This pathway also emphasizes how apparently similar dysfunctional use can be allotted to heterogeneous mechanisms. Some individuals thus phone when they drive because they like to take risks or seek stimulation (people with high sensation seeking), whereas others use the phone while driving because they cannot inhibit phoning for another reason (e.g., they experience an intrusive thought that generates an occasion to use the mobile phone). The second pathway, called the *relationship maintenance pathway*, describes individuals who use the mobile phone excessively to obtain reassurance in affective relationships (partner, family, friends). These individuals are generally characterized by a low level of self-esteem and a high level of neuroticism. For them, dysfunctional use of the mobile phone is postulated to arise from a constant need for reassurance promoted by maladaptive cognitions and/or insecure attachment. The third pathway, named the *extraversion pathway*, describes individuals who are

susceptible to excessive use of their mobile phone because they are sociable and outgoing and hold an elevated desire to communicate with peers and to establish new potential relationships. This pathway probably leads to less problematic outcomes, which mostly take the form elevated expenses resulting from excessive use. Finally, the fourth pathway, which was not directly inspired from studies on dysfunctional mobile phone use, is called the *cyber addiction* pathway. Indeed, as described earlier, smartphones allow people to engage in a wide range of online activities, such as video games or social networks. For example, recent generations of smartphones enable engagement in massively multiplayer online role-playing games (MMORPGs), which are a type of video game that allow a large number of players to interact in permanent virtual worlds. As a consequence, some people who are addicted to MMORPGs are susceptible to exaggerated mobile phone use despite not being addicted to mobile communication *per se*. Although not depicted in Fig. (**1**) for reasons of clarity, behaviors related to this fourth pathway are also underlain by some of the psychological mechanisms underlying problematic mobile phone use. A growing number of studies have indeed found Internet-related disorders to be predicted by factors such as impulsivity facets [50], maladaptive cognitions [51], or low levels of self-esteem [52].

Thus, mobile phone addiction should be conceptualized within a broader spectrum of "cyber addictions" that covers a wide range of behaviors relying on online activities and/or activities involving communication among individuals through technological devices. Besides cellular phone addictions, the most frequent cyber addictions are online video-game addictions [50], online gambling addictions [53], online sex addictions [54] and social network addictions [55]. These examples are not exclusive, and other activities, although less represented, can be envisaged (e.g., compulsive information seeking or "surfing"). Considering these various behaviors under the label (and ultimately the diagnosis) of "Internet addiction" is a counterproductive shortcut. Indeed, individuals are not addicted to the Internet, but rather to one or several specific online activities.

A prerequisite to the grouping of technological addictions into a spectrum of related disorders is the existence of common or shared risk factors. This review highlighted that specific psychological factors (e.g., personality traits, impulsivity facets, self-esteem) are associated with problematic mobile phone use. Actually, these psychological factors can be viewed as shared risk factors, as they have consistently been related to the various behaviors composing the spectrum of cyber addictions [50,56,57] and more largely to other behavioral or substance addictions [27,58,59]. As a consequence, several other factors that have been related to the etiology of addictive behaviors should be considered in relation to the development and maintenance of cyber addiction-related behaviors. We can cite, among others, psychological factors (e.g., cognitive impairments, attentional bias), biological factors (e.g., gene polymorphisms), social factors (e.g., peer influence) and contextual factors (e.g., negative life event/trauma). Studies are thus required to elucidate the multiple risk factors (and their interactions) that lead to cyber addictions.

Of importance, cyber addictions also appear to be related to specific risk factors, that is, risk factors that are not necessarily shared across the various types of cyber addictions. For example, research on gambling pointed out that cognitive distortions are highly prevalent in problem gamblers [60] and influence gambling behaviors (e.g., persistence in playing despite losses) [61]. These distortions include mistaken beliefs about skill involvement in chance situations (the "illusion of control") [62], as well as failures to appreciate the statistical independence of turns (the "gambler's fallacy") [63]. Such cognitive distortions are thus specific to gambling addictions, whether gambling behaviors take place "in real life" (e.g., in casinos or bars) or on the Internet. Accordingly, it is better for online gambling addiction to be integrated in a spectrum of related but distinct disorders (the cyber addiction spectrum), rather than in an artificial construct of Internet addiction. From the cyber addiction studies, several other specific risk factors can be identified, including motives behind the online behavior (e.g., social networks and mobile phone overuse are often linked to interpersonal motives, whereas online game overuse is often linked to achievement, immersion and escapism motives) [50,55,64]; degree of social competence or anxiety (e.g., some socially anxious persons prefer to meet people through specific online activities such as video online games or social networks) [56,65]; and gender (e.g., females are more frequently mobile phone addicts, whereas males are more prone to online gambling and video-game addictions) [6,56,66]. These examples are not exhaustive and other specific factors (e.g., psychological, social, contextual) should be considered and addressed in further studies on cyber addictions. Fig. (**2**) depicts how certain risk factors are shared across cyber addictions (and more largely addictive behaviors), whereas these disorders are also related to specific risk factors (i.e., not shared by all cyber addictions).
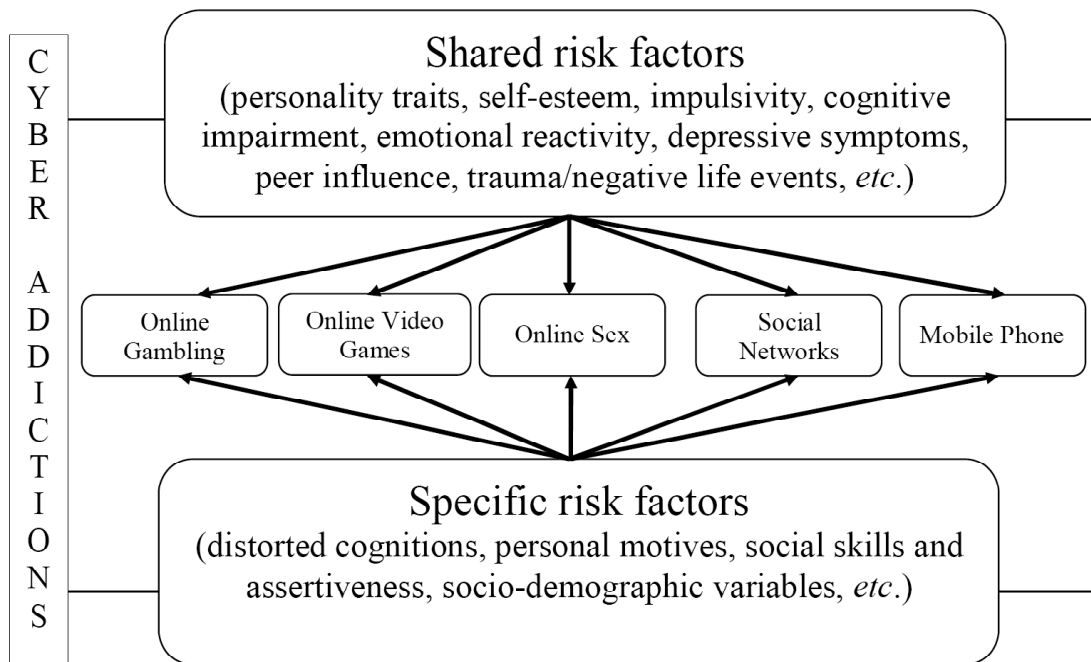

Fig. (2). The spectrum of cyber addictions.

To conclude, and on the basis of the evidence presented in this article, I submit that it would be better for investigators to further elucidate the various factors and pathways leading to a problematic engagement in one (or more) online activity than to struggle with the need to establish a valid diagnosis of "Internet addiction."

CONFLICT OF INTEREST

The author(s) confirm that this article content has no conflicts of interest.

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REFERENCES

[1]   Geser H. Toward a sociological theory of the mobile phone. Zürich: Soziologisches Institut der Univ. Zürich: Online Publications 2004 [cited 2011 Sept 26]. Available from: http://socio.ch/mobile/t_geser1.htm

[2]   Fjeldsoe BS, Marshall AL, Miller YD. Behavior change interventions delivered by mobile telephone short-message service. Am J Prev Med 2009; 36(2): 165-73.

[3]   Barkana Y, Zadok D, Morad Y, Avni I. Visual field attention is reduced by concomitant hands-free conversation on a cellular telephone. Am J Ophthalmol 2004; 138(3): 347-53.

[4]   White MP, Eiser JR, Harris PR. Risk perceptions of mobile phone use while driving. Risk Anal 2004; 24(2): 323-34.

[5]   Violanti JM. Cellular phones and fatal traffic collisions. Accid Anal Prev 1998; 30(4): 519-24.

[6]   Billieux J, Van der Linden M, Rochat L. The role of impulsivity in actual and problematic use of the mobile phone. Appl Cognit Psychol 2008; 22(9): 1195-210.

[7]   Nickerson RC, Isaac H, Mak B. A multi-national study of attitudes about mobile phone use in social settings. Inter J Mobile Communications 2008; 6(5): 541-63.

[8]   Funston A, MacNeill K. Mobile matters: young people and mobile phone. Sydney: Communication Law Center 1999.

[9]   Thomée S, Harenstam A, Hagberg M. Mobile phone use and stress, sleep disturbances, and symptoms of depression among young adults: a prospective cohort study. BMC Public Health 2011; 11(1): 66.

[10] Chóliz M. Mobile phone addiction: a point of issue. Addiction 2010; 105(2): 373-4.

[11] Toda M, Monden K, Kubo K, Morimoto K. Cellular phone dependence tendency of female university students. Jpn J Hyg 2004; 59(4): 383-6.

[12] Bianchi A, Phillips JG. Psychological predictors of problem mobile phone use. Cyberpsychol Behav 2005; 8(1): 39-51.

[13] Billieux J, Van der Linden M, d' Acremont M, et al. Does impulsivity relate to perceived dependence and actual use of the mobile phone? Appl Cognit Psychol 2007; 21(4): 527-37.

[14] Ehrenberg A, Juckes S, White KM, Walsh SP. Personality and self-esteem as predictors of young people's technology use. Cyberpsychol Behav 2008; 11(6): 739-41.

[15] Charlton JP, Danforth IDW. Distinguishing addiction and high engagement in the context of online game playing. Comput Hum Behav 2007; 23(3): 1531-48.

[16] Sánchez-Martínez M, Otero A. Factors associated with cell phone use in adolescents in the community of Madrid (Spain). Cyberpsychol Behav 2009; 12(2): 131-7.

[17] Ha JH, Chin B, Park DH, et al. Characteristics of excessive cellular phone use in Korean adolescents. Cyberpsychol Behav 2008; 11(6): 783-4.

[18] Walsh SP, White KM, Young RMD. Needing to connect: the effect of self and others on young people's involvement with their mobile phones. Aust J Psychol 2010; 62(4):194-203.

[19] Yen CF, Tang TC, Yen JY, et al. Symptoms of problematic cellular phone use, functional impairment and its association with depression among adolescents in Southern Taiwan. J Adolesc 2009; 32(4): 863-73.

[20] James D, Billieux J. [homepage on the Internet]. English version of the Problematic Mobile Phone Use Questionnaire (PMPUQ). [cited 2012 Feb 6]. Available from: http:// http://sites.google.com/site/joelbillieux/questionnaires

[21] Billieux J, Gay P, Rochat L, Van der Linden M. The role of urgency and its underlying psychological mechanisms in problematic behaviours. Behav Res Ther 2010; 48(11): 1085-96.

[22] Igarashi T, Motoyoshi T, Takai J, Yoshida T. No mobile, no life: self-perception and text-message dependency among Japanese high school students. Comput Hum Behav 2008; 24(5): 2311-24.

[23] Rutland JB, Sheets T, Young T. Development of a scale to measure problem use of short message service: the SMS problem use diagnostic questionnaire. Cyberpsychol Behav 2007; 10(6): 841-4.

[24] Geser H. Are girls (even) more addicted? Some gender patterns of cell phone usage. Zürich: Soziologisches Institut der Univ. Zürich: Online Publications 2006 [cited 2011 Sept 26]. Available from: http://socio.ch/mobile/t_geser3.htm

[25] Leung L. Linking psychological attributes to addiction and improper use of the mobile phone among adolescents in Hong Kong. J Child Media 2008; 2(2): 93-113.

[26] Butt S, Phillips JG. Personality and self-reported mobile phone use. Comput Hum Behav 2008; 24(2): 346-60.

[27] Dawe S, Loxton NJ. The role of impulsivity in the development of substance use and eating disorders. Neurosci Biobehav Rev 2004; 28(3): 343-51.

[28] Billieux J, Gay P, Rochat L, et al. Lack of inhibitory control predicts cigarette smoking dependence: evidence from a non-deprived sample of light to moderate smokers. Drug Alcohol Dep 2010; 112(1-2): 164-7.

[29] Goudriaan AE, Oosterlaan J, de Beurs E, van den Brink W. Neurocognitive functions in pathological gambling: a comparison with alcohol dependence, Tourette syndrome and normal controls. Addiction 2006; 101(4): 534-47.

[30] Whiteside SP, Lynam DR. The five factor model and impulsivity: using a structural model of personality to understand impulsivity. Pers Indiv Diff 2001; 30(4): 669-89.

[31] Bechara A, Van der Linden M. Decision-making and impulse control after frontal lobe injuries. Curr Opin Neurol 2005; 18(6): 734-9.

[32] Gay P, Rochat L, Billieux J, et al. Heterogeneous inhibition processes involved in different facets of self-reported impulsivity: evidence from a community sample. Acta Psychol 2008; 129(3): 332-9.

[33] D' Acremont M, Van der Linden M. How is impulsivity related to depression in adolescence? Evidence from a French validation of the cognitive emotion regulation questionnaire. J Adolesc 2007; 30(2): 271-82.

[34] Brandon TH. Negative affect as motivation to smoke. Curr Dir Psychol Sci 1994; 3(2): 33-7.

[35] Jacobs DF. A general theory of addictions: a new theoretical model. J Gambl Behav 1986; 2(1): 15-31.

[36] Gay P, Courvoisier DS, Billieux J, et al. Can the distinction between intentional and unintentional interference control help differentiate varieties of impulsivity? J Res Pers 2010; 44(1): 46-52.

[37] Jones S, Lynam DR. In the eye of the impulsive beholder: the interaction between impulsivity and perceived informal social control on offending. Crim Justice Behav 2009; 36(3): 307-21.

[38] Heatherton TF, Polivy J. Development and validation of a scale for measuring state self-esteem. J Pers Soc Psychol 1991; 60(6): 895-910.

[39] Joinson AN. Self-esteem, interpersonal risk, and preference for e-mail to face-to-face communication. Cyberpsychol Behav 2004; 7(4): 472-8.

[40] Richter SS, Brown SA, Mott MA. The impact of social support and self-esteem on adolescent substance abuse treatment outcome. J Subst Abuse 1991; 3(4): 371-85.

[41] Conrad KM, Flay BR, Hill D. Why children start smoking cigarettes: predictors of onset. Brit J Addiction 1992; 87(12): 1711-24.

[42] Luhtanen RK, Crocker J. Alcohol use in college students: effects of level of self-esteem, narcissism, and contingencies of self-worth. Psychol Addict Behav 2005; 19(1): 99-103.

[43] Fennell MJV. Cognitive therapy in the treatment of low self-esteem. Adv Psychiatr Treat 1998;4(5): 296-304.

[44] Bowlby J. A secure base: clinical applications of attachment theory. London: Routledge 1988.

[45] Hazan C, Shaver P. Romantic love conceptualized as an attachment process. J Pers Soc Psychol 1987;52(3): 511-24.

[46] Collins NL, Read SJ. Adult attachment, working models, and relationship quality in dating couples. J Pers Soc Psychol 1990;58(4): 644-63.

[47] Allen JP, Hauser ST, Bell KL, O'Connor TG. Longitudinal Assessment of Autonomy and Relatedness in Adolescent-Family Interactions as Predictors of Adolescent Ego Development and Self-Esteem. Child Dev 1994;65(1): 179-94.

[48] Bartholomew K. Avoidance of intimacy: An attachment perspective. J Soc Pers Relat 1990;7(2): 147-78.

[49] Lu X, Watanabe J, Liu Q, *et al*. Internet and mobile phone text-messaging dependency: Factor structure and correlation with dysphoric mood among Japanese adults. Comp Hum Behav 2011; 27(5): 1702-9.

[50] Billieux J, Chanal J, Khazaal Y, *et al*. Psychological predictors of problematic involvement in Massively Multiplayer Online Role Playing Games (MMORPG): illustration in a sample of male cybercafés players. Psychopathology 2011; 44(3): 165-71.

[51] Davis RA. A cognitive-behavioral model of pathological Internet use. Comp Hum Behav 2001;17(2): 187-95.

[52] Armstrong L, Phillips JG, Saling LL. Potential determinants of heavier Internet usage. Int J Hum Comp Stud 2000;53(4):537-50.

[53] Griffiths M. Internet gambling: Issues, concerns, and recommendations. Cyberpsychol Behav 2003;6(6): 557-68.

[54] Meerkerk G-J, Van den Eijnden RJJM, Garretsen HFL. Predicting compulsive Internet use: it's all about sex. Cyberpsychol Behav 2006; 9(1): 95-103.

[55] Wilson K, Fornasier S, White KM. Psychological predictors of young adults' use of social networking sites. Cyberpsychol Behav Soc Netw 2010; 13(2): 173-7.

[56] Lemmens JS, Valkenburg PM, Peter J. Psychosocial causes and consequences of pathological gaming. Comput Hum Behav 2011; 27(1): 144-152.

[57] Peters CS, Malesky LA. Problematic usage among highly-engaged players of massively multiplayer online role playing games. Cyberpsychol Behav 2008; 11(4): 481-4.

[58] Marlatt GA, Baer JS, Donovan DM, Kivlahan DR. Addictive behaviors: etiology and treatment. Annu Rev Psychol 1988; 39(1): 223-52.

[59] Fischer LA, Elias, JW, Ritz K. Predicting relapse to substance abuse as a function of personality dimensions. Alcohol Clin Exp Res 1998; 22(5): 1041-7.

[60] Michalczuk R, Bowden-Jones H, Verdejo-Garcia A, Clark L. Impulsivity and cognitive distortions in pathological gamblers attending the UK National Problem Gambling Clinic: a preliminary report. Psychol Med 2011; 41(12): 2625-35.

[61] Billieux, J., Van der Linden, M., Khazaal, Y, *et al*. Trait gambling cognitions predict near-miss experiences and persistence in laboratory slot machine gambling. Brit J Psychol 2012; 103(3): 412-27.

[62] Langer EJ. The illusion of control. J Pers Soc Psychol 1975; 32(2): 311-28.

[63] Oskarsson AT, Van Boven L, McClelland GH, Hastie, R. What's next? Judging sequences of binary events. Psychol Bull 2009; 135(2): 262-85.

[64] Yee N. Motivations for play in online games. Cyberpsychol Behav 2006; 9(6): 772-5.

[65] Lo SK, Wang CC, Fang W. Physical interpersonal relationships and social anxiety among online game players. Cyberpsychol Behav 2005; 8(1): 15-20.

[66] Griffiths M, Barnes A. Internet gambling: an online empirical study among student gamblers. Int J Ment Health Addict 2008; 6(2): 194-204.