The Role of Impulsivity in Actual and Problematic Use of the Mobile Phone

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SUMMARY

Several authors have investigated the risks arising from the growth in mobile phone use (e.g. debts incurred by young people). The aims of the present study are (1) to validate a new questionnaire assessing problematic mobile phone use: the Problematic Mobile Phone Use Questionnaire (PMPUQ), and (2) to investigate the relationships between the PMPUQ and the multi-faceted construct of impulsivity. With these aims, 339 subjects were screened using the PMPUQ and the UPPS Impulsive Behaviour Scale (UPPS) which assesses four distinct components associated with impulsive behaviours (urgency, lack of premeditation, lack of perseverance and sensation seeking). The results showed that the PMPUQ has an acceptable fit and assesses four different dimensions of problematic mobile phone use (prohibited use, dangerous use, dependence, financial problems). While each facet of impulsivity played a specific role in mobile phones use, urgency appeared to be the strongest predictor of problematic use. Copyright © 2008 John Wiley & Sons, Ltd.

Cellular phone use has greatly increased in Europe in recent years. According to the Swiss Federal Statistics Office (2006), in 2004, approximately 90% of the inhabitants of most European countries owned a mobile phone. Cellular phone use has frequently been associated with positive outcomes. For example, Geser (2004) argued that cellular phones allow people to engage communication without being constrained by physical proximity or spatial immobility. However, the use of cellular phones has been increasingly associated with harmful or disturbing behaviours. In this regard, several studies have focused on the negative impact of mobile phone use on driving abilities. Thus, it has been emphasized that using a mobile phone while driving reduces attentional capacities, even in the case of hands-free device use (e.g. Barkana, Zadok, Morad, & Avni, 2004). Another growing concern is the fact that intensive use of the mobile phone may promote financial problems, especially for young people. Indeed, several studies (e.g. Funston & MacNeill, 2004) emphasized that uncontrolled mobile phone use could be a factor leading young people into debt. Furthermore, it is also interesting to note that the status of the mobile phone may change from an instrument that supports social exchanges to an object that clearly

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interferes with them. Indeed, most individuals have found themselves at least once in a situation where a mobile phone disturbed their social activities. As a consequence, the use of cellular phones is prohibited in a growing number of public places (e.g. public transit, restaurants). Finally, recent studies (e.g. Billieux, Van der Linden, d'Acremont, Ceschi, & Zermatten, 2007b; Toda, Monden, Kubo, & Morimoto, 2004) using self-report question-naires have shown that mobile phone use may become addictive. Thus, mobile phone dependence could be integrated into the spectrum of technological addictions, such as Internet addiction (e.g. Beard & Wolf, 2001).

Despite its personal and social importance, the psychological factors involved in problematic use of the mobile phone have received little attention. Nevertheless, Bianchi and Phillips (2005) recently tried to determine the psychological predictors of illegal or dangerous use of the mobile phone. This research revealed that problematic use of the mobile phone is predicted by low self-esteem and high extraversion. The authors hypothesized on one hand that individuals with negative self-views have greater tendencies to seek reassurance and thus are more likely to use their mobile phone inappropriately, and on the other hand that extraverts, who are fundamentally social in nature, are more likely to overuse the mobile phone. The results also showed that young people are more likely to use the mobile phone in an exaggerated manner. Interestingly, this research emphasized that self-reported problematic use of the mobile phone was related to both actual use (i.e. self-reported time spent using the mobile phone each week) and an established measure of addiction, the MMPI-2 Addiction Potential Scale (MMPI-2, Weed, Butcher, McKenna, & Ben Porath, 1992). Taken together, results of this study support the view that the spectrum of addictions offers an appropriate starting point for the consideration of problematic mobile phone use.

Considering that exaggerated mobile phone use could be viewed as a 'behavioural addiction', we conducted an initial study (Billieux et al., 2007b) in order to investigate the relationships between mobile phone use and impulsivity, which plays a pervasive role in dependence-related disorders (see for example Moeller, Barratt, Dougherty, Schmitz, & Swann, 2001, for a review). According to the view that impulsivity must be considered as a multi-faceted construct (e.g. Evenden, 1999), the study was based on Whiteside and Lynam's (2001) work, which clarified the construct of impulsivity by identifying four separate components associated with impulsive behaviours. These four facets of impul-sivity, which are the bases for the creation of a scale called the UPPS Impulsive Behaviour Scale (UPPS, Whiteside & Lynam, 2001), are as follows: (1) Urgency, defined as 'the tendency to experience strong impulses, frequently under conditions of negative affect'; (2) Premeditation, defined as 'the tendency to think and reflect on the consequences of an act before engaging in the act'; (3) Perseverance, defined as 'the ability to remain focused on a task that may be boring or difficult'; (4) Sensation Seeking, defined as 'a tendency to enjoy and pursue activities that are exciting, and openness for new experiences'. Using a sample of female undergraduate psychology students, this research showed a relationship between actual cellular phone use (e.g. number and duration of the calls made in 1 day) and perceived dependence on the cellular phone (measured on a Likert scale ranging from 1 to 10) with two facets of impulsivity: urgency and lack of perseverance. In addition, depression and anxiety were not found to be predictors of actual mobile phone use or perceived dependence. More specifically, it was postulated on one hand that urgency may increase perceived dependence because mobile phone use could be a way of satisfying certain strong impulses with the aim of relieving negative affect in the short term, and on the other hand that low perseverance and the related attentional difficulties may promote

the occurrence of irrelevant thoughts and memories, which could increase the number of potential occasions to use the mobile phone.

However, the main limitation on the two studies that have been presented (Bianchi & Phillips, 2005; Billieux et al., 2007b) is the fact that the questionnaires used did not assess all the various types of problematic use of the mobile phone (e.g. prohibited or dangerous use). Consequently, the first goal of the present study was to develop and validate a new multi- dimensional questionnaire assessing problematic mobile phone use: the Problematic Mobile Phone Use Questionnaire (PMPUQ). In this regard, the PMPUQ was constructed to target the various types of problematic use of mobile phones highlighted in the literature, namely (1) dangerous/prohibited use, (2) financial problems and (3) dependence-related symptoms.

The second goal of this study was to investigate in detail the relationships between actual and potentially problematic use of the mobile phone with regard to the various components of the UPPS impulsivity model (Whiteside & Lynam, 2001). Several *a priori* predictions could be formulated concerning the relationships between mobile phone actual and potential problematic use and the different dimensions of impulsivity. Firstly, based on previous results (Billieux et al., 2007b), it was postulated that actual use of the mobile phone (number and duration of the calls made in 1 day, number of short message system (SMSs) sent daily) may be related to high urgency and low perseverance. Furthermore, assumptions were also made about problematic mobile phone use. First of all, it could be supposed that sensation seeking may be related to both dangerous and prohibited use. Indeed, these two types of problematic use of the mobile phone have been shown to be related to extraversion (Bianchi & Phillips, 2005), which has frequently been associated with sensation seeking (Aluja, García, & García, 2003). Then, taking into account the fact that low premeditation is defined as a tendency not to consider potential negative consequences of an action (Whiteside & Lynam, 2001), it could be assumed that this component of impulsivity may predict dangerous and prohibited use of the mobile phone, as well as the occurrence of financial problems due to mobile phone use. Next, it may be hypothesized that high urgency and low perseverance, which have been both related to the increased actual use and perceived dependence on the mobile phone (Billieux et al., 2007b), are related to four different types of problematic mobile phone use (dangerous use, prohibited use, dependence, financial problems).

Finally, while considering exaggerated mobile phone use in the spectrum of behavioural addictions, it may be postulated that actual and potentially problematic mobile phone use may increase over time as a result of a habituation phenomenon (comparable to the classic tolerance symptoms of chemical addictions). In other words, it could be supposed that having a mobile phone for a longer time may be a predictor of greater actual use of the phone.

METHOD

Participants and procedure

A total of 430 volunteer participants from the community (216 females and 214 males) took part in the study. We chose to limit the age range of the sample to 20–35 years old because (1) young people have more problems with the mobile phone use (Bianchi & Phillips, 2005) and because (2) it has been highlighted that older people are less likely than younger people to

embrace new technology (Brickfield, 1984). All participants were screened using the French version of the UPPS (Van der Linden et al., 2006), and the PMPUQ. The Beck Depression Inventory (BDI-2, Beck, Steer, & Brown, 1998) and the Trait Anxiety Inventory (STAI-T, Spielberger, Gorsuch, Lushene, Vagg, & Jacob, 1993) were also included in order to investigate the relationships between impulsivity and problematic mobile phone use while controlling for depressive and/or anxious symptoms.

The PMPUQ was developed to assess both actual use and potential problematic use of the mobile phone. The questionnaire includes six general questions: (1) a question concerning whether or not the participant owned a mobile phone; (2) a question asking the participant how long he or she had owned a mobile phone (participants have three possible responses, namely 'less than 1 year', 'between 1 and 5 years' or 'more than 5 years');[1] (3) a question concerning the number of calls made in 1 day (participants have three possible responses, namely 'between zero and two call(s)', 'between three and five calls' or 'more than five calls');[1] (4) a question concerning the duration of the calls made in 1 day (participants have three possible responses, namely 'from 0 to 10 minutes', 'between 10 and 30 minutes' or 'more than 30 minutes');[1] (5) a question concerning the number of SMSs sent per day (participants have three possible responses, namely 'from 0 to 3 SMS(s)', 'between 4 and 10 SMSs' or 'more than 10 SMSs')[1]; (6) a question concerning whether or not the participant owned a driving licence. The assessment of problematic mobile phone use comprises 30 items developed to target (1) prohibited/dangerous use of the mobile phone (10 items; example: 'I avoid using my mobile phone when driving on the highway'), (2) financial problems due to mobile phone use (10 items; example: 'I have difficulties paying my mobile phone bills'), and (3) dependence on the mobile phone (10 items; example: 'I feel lost when I do not have my mobile phone'). The 30 items of the scale are scored from $1 =$ 'I strongly agree' to $4 =$ 'I strongly disagree'. The questionnaire also includes an item asking the participant to answer 'yes' or 'no' to the question: 'Do you feel dependent on your mobile phone?' which was included as a measure of self-perceived dependence.

Only participants who own a cellular phone and a driving licence were retained in the study because several items of the PMPUQ concern driving practices. Thus, our final sample was composed of 339 participants (169 females and 170 males). The mean age of the sample was 25.80 (SD $= 3.99$) and the mean years of schooling was 14.91 (SD $= 2.26$).

RESULTS

The Results section is subdivided into three parts. Firstly, the psychometric properties of the PMPUQ will be analysed. The second part will concern the relationships between actual mobile phone use and the various components of impulsivity. The influences of gender differences and time since acquisition of the mobile phone on use of the phone will also be analysed. Finally, problematic mobile phone use, as assessed by the PMPUQ, will be considered. This last section will comprise the modelling of problematic mobile phone use, a comparison of problematic mobile phone use by males and females, and the consideration of the predictors leading to a feeling of dependence on the mobile phone.

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[1]We selected these three response choices by analysing previous results asking the same question overtly (Billieux et al., 2007b).

Validation of the problematic mobile phone use questionnaire (PMPUQ)

An exploratory factor analysis (using Promax rotation to allow correlations among factors) was performed to see whether the maximum loading of each item was found on the predicted factor. Then, a confirmatory factor analysis was computed in order to validate the psychometric properties of the PMPUQ. All confirmatory factorial analyses were done with LISREL 8.72 (Jöreskog & Sörbom, 1996). From this perspective, three different models were calculated: (1) an expected model with three latent factors (prohibited/dangerous use; financial problems; dependence); (2) a second model in which problematic use is seen as a single general latent factor; (3) a third model considering prohibited and dangerous use as separate dimensions and comprising four latent factors (prohibited use, dangerous use, financial problems, dependence).

On the 339 participants, 9 had 1 item with a missing value and 2 had 4 items with missing values. Thus, the exploratory factor analysis was carried out on 328 participants. The sums of the squared loadings were 7.45, 2.04 and 1.72 for factors 1, 2 and 3, respectively. A 3-factor solution explained 37.35% of the variance (the three factors explained 24.83, 6.81 and 5.72% of the total variance, respectively). Financial problems items loaded more on factor 1, dependence items more on factor 2 and prohibited/dangerous use items more on factor 3. However, the exploratory factor analysis revealed that six items may be problematic with the 3-factor solution. Firstly, items 15 ('I would like to spend less time using my mobile phone'), 20 ('I spend too much time using my mobile phone') and 30 ('My mobile phone conversations last longer than I would like') load on factor 1 (financial problems) rather than on factor 2 (dependence). Nevertheless, considering that these three items all concern the duration of calls (which affects their cost), it is not surprising that their maximum loadings were found on the financial problems factor. Second, item 7 ('I don't use my mobile phone in a library') loads on factor 2 (dependence) rather than on factor 3 (prohibited/dangerous use), implying that this item may be problematic. Third, items 22 ('I am concerned when I consider the importance that I attach to my mobile phone') and 25 ('I avoid using my mobile phone in places where it is necessary to be quiet') load similarly on two factors, implying that they may not be very discriminant. Consequently, this first analysis showed that several items of the questionnaire may be problematic, which will be important to take into account in subsequent analyses.

The 30 items of the PMPUQ then underwent a confirmatory factor analysis with Full Information Maximum Likelihood method (FIML), which neither replaces incomplete data nor eliminates participants with incomplete data. The χ^2 statistic was significant for the three models (see Table 1): Model 1 (3 latent factors), $\chi^2 (402) = 1487.79$, $p < .001$; Model 2 (1 latent factor), $\chi^2 (405) = 2062.53$, $p < .001$; Model 3a (4 latent factors), $\chi^2 (399) = 1323.03$, $p < .001$. Although a non-significant χ^2 corresponds to an acceptable fit, the χ^2 is known to increase with sample size, and it has been shown that it is unusual to

Table 1. Comparison of the confirmatory factor analyses for the three models

Model	χ^2	df	RMSEA
Model 1 (3 factors)	1487.79[*]	402	0.089
Model 2 (1 factor)	2062.53[*]	405	0.110
Model 3a (4 factors)	1323.03[*]	399	0.083

Note: RMSEA, Root Mean Square Error of Approximation.
[*]$p < .001$.

Table 2. Comparison of the alternative model and the modified alternative model

Model	χ^2	df	RMSEA	AIC	BIC
Model 3a	1323.03[*]	399	0.083	1455.03	2092.06
Model 3b	1093.78[*]	399	0.072	1225.78	1862.81

Notes: RMSEA, Root Mean Square Error of Approximation; AIC, Akaike's Information Criterion; BIC, Bayesian Information Criterion.
[*]$p < .001$.

obtain a non-significant χ^2 when performing confirmatory factor analyses on self-report questionnaires (Byrne, 1994). We therefore complemented the χ^2 by examining another goodness of fit index; the Root Mean Square Error of Approximation (RMSEA) (see Table 2). Based on the published guidelines, RMSEA values of less than 0.08 indicate reasonable fit (Byrne, 2001). Comparisons between the RMSEAs of the three different nested models were calculated using FITMOD (Browne, 1992), a software that provides point and interval estimates for RMSEA differences. Those comparisons indicated that Model 1 (3 latent factors) is better than Model 2 (1 latent factor), but that Model 3 (4 latent factors) is the best of the three models (see Table 1 for goodness of fit indices). Consequently, it appears that prohibited and dangerous use of the mobile phone should be considered as separable latent factors.

The modification indices proposed by LISREL indicated that three items (15, 20, 30) should be allotted to the factor concerning financial problems rather than to the factor concerning dependence, which supports the results of the exploratory factor analysis. The χ^2 statistic of the modified model (see Model 3b, Table 3) was significant, χ^2 $(399) = 1093.78$, $p < .001$. To be able to compare Models 3a (initial 4-factor model) and 3b (modified 4-factor model), we computed Akaike's Information Criterion (AIC) and the Bayesian Information Criterion (BIC) (see Table 2), which are goodness of fit indices suitable for non-nested models. Lower values for AIC and BIC indicate a better fit, although there is no absolute cut-off for a good fit. Thus, these two indices supported the determination that the modified 4-factor model (Model 3b) is better than the initial 4-factor model (Model 3a). Following these modifications, the final model has an RMSEA of 0.072, which corresponds to a reasonable fit (Byrne, 2001).

The reliability of each latent factor was calculated on Model 3b with the formula reported by Raines-Eudy (2000). Reliability was equal to .67 for prohibited use, .74 for dangerous use, .85 for dependence and .89 for financial problems (see diagonal of Table 3). These values are comparable to Cronbach's α and indicated that two latent factors of Model 3b have excellent internal reliability (dependence and financial problems) and the other two have acceptable internal reliability (prohibited and dangerous use). In addition, it appears that each variable is correlated with one another (see Table 3).

Table 3. Correlations (reliabilities) between latent variables of the PMPUQ

Latent variables	1	2	3	4
1. PMPUQ—prohibited use	(.67)			
2. PMPUQ—dangerous use	.28[**]	(.74)		
3. PMPUQ—dependence	.36[**]	.26[**]	(.85)	
4. PMPUQ—financial problems	.26[**]	.31[**]	.48[**]	(.89)

[**]$p < .01$.

Table 4. Mean, standard deviation and Cronbach's α of the questionnaires

Scale	α	M	SD
BDI-2	.90	8.63	7.7
STAI-T	.92	40.27	9.72
UPPS—urgency	.86	28.35	6.08
UPPS—lack of premeditation	.86	22.97	4.76
UPPS—lack of perseverance	.82	19.81	4.51
UPPS—sensation seeking	.86	31.98	7.36
PMPUQ—prohibited use	.65	7.68	2.56
PMPUQ—dangerous use	.73	8.52	3.19
PMPUQ—dependence	.84	12.75	4.53
PMPUQ—financial problems	.85	21.92	6.93

To sum up, confirmatory factor analysis allows to validate the PMPUQ as a questionnaire measuring four different facets associated with problematic mobile phone use. This questionnaire, which has reasonable psychometric properties, assesses: (1) dangerous use of the mobile phone (5 items); (2) prohibited use of the mobile phone (5 items); (3) dependence on the mobile phone (7 items); (4) financial problems related to mobile phone use (13 items).

Psychological and demographic factors related to actual mobile phone use

Means, standard deviations and Cronbach's α for the PMPUQ, the UPPS, the BDI-2 and the STAI-T are presented in Table 4.

The reliability coefficients (Cronbach's α) were excellent for the impulsivity scale (UPPS—urgency: 0.86, UPPS—lack of premeditation: 0.86, UPPS—lack of perseverance: 0.82, UPPS—sensation seeking: 0.86), the depression scale (BDI-2: 0.90) and the anxiety scale (STAI-T: 0.92). Concerning the PMPUQ, reliability coefficients are excellent for two subscales (PMPUQ—dependence: 0.84, PMPUQ—financial problems: 0.85) and acceptable for the remaining two subscales (PMPUQ—prohibited use: 0.65, PMPUQ—dangerous use: 0.73). Thus, the good internal validity of the questionnaires used is confirmed.

Spearman correlations[2] were then computed between the three variables related to the actual use of the mobile phone (number and duration of calls made in 1 day, number of SMSs sent daily), the four components of impulsivity, depression, anxiety, age and the number of years the participant has owned a mobile phone. Correlation analyses revealed that actual use of the mobile phone was related to impulsivity. More specifically, the number of calls made in 1 day significantly correlates with the urgency ($r = .16, p < .01$) and lack of perseverance ($r = .11, p < .05$) components of the UPPS. Concerning the daily duration of the calls, positive significant correlations appeared with three facets of the UPPS: urgency ($r = .19, p < .01$), lack of premeditation ($r = .11, p < .05$) and lack of perseverance ($r = .17, p < .01$). The number of SMSs sent is significantly correlated with the urgency component of the UPPS ($r = .13, p < .05$). It also appears that the number of years since the acquisition of the mobile phone is related to all aspects of actual mobile phone use. Indeed, significant positive correlations exist between this measure and the

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[2]We computed Spearman correlations because the variables relating to the actual use of the mobile phone are ordinal.

three variables related to actual use of the mobile phone, namely the number ($r = .30$, $p < .01$) and duration ($r = .22$, $p < .01$) of the calls made in 1 day and with the number of SMSs sent daily ($r = .16$, $p < .05$). Although a significant negative correlation took place between the age of the participants and the number of SMSs sent daily ($r = -.14$, $p < .01$), age neither correlates with other aspects of actual use, nor with the time since the mobile phone was acquired. A positive significant relation was found between both depression ($r = .16$, $p < .01$) and anxiety ($r = .15$, $p < .01$) and the number of SMSs sent each day. Correlation analyses also showed that actual use of the mobile phone was strongly related to the problematic use of the mobile phone. More specifically, the number of calls made in 1 day significantly correlates with prohibited ($r = .13$, $p < .05$) and dangerous ($r = .31$, $p < .01$) use of the mobile phone, dependence on the mobile phone ($r = .40$, $p < .01$) and financial problems due to mobile phone use ($r = .47$, $p < .01$). The duration of the calls significantly correlates with the dangerous use of the mobile phone ($r = .19$, $p < .01$), dependence on the mobile phone ($r = .38$, $p < .01$) and financial problems due to mobile phone use ($r = .40$, $p < .01$). Finally, the number of SMSs made in 1 day is significantly related to prohibited ($r = .12$, $p < .05$) and dangerous ($r = .15$, $p < .01$) use of the mobile phone, dependence on the mobile phone ($r = .39$, $p < .01$) and financial problems due to mobile phone use ($r = .31$, $p < .01$).

Gender influence on actual mobile phone use was also considered. Mann–Whitney tests were used to compare independent samples when the normality of the data is not assumed. Thus, it appeared that there is no difference between females and males concerning the number (Mann–Whitney $U = 13\,758$, $p = .44$) and duration (Mann–Whitney $U = 13\,625$, $p = .34$) of calls made in 1 day, but that females sent more SMSs in 1 day than males (Mann–Whitney $U = 11\,867.5$, $p < .01$).

Psychological and demographical predictors of problematic mobile phone use

Relationships between problematic mobile phone use and impulsivity were analysed with structural equation modelling computed with LISREL 8.72 (Jöreskog & Sörbom, 1996) and the FIML method. Two models were thus computed. The first model (Model A) tests all the relationships between the four facets of the UPPS (for the confirmatory factor analysis of the UPPS, see Van der Linden et al., 2006) and the four types of problematic mobile phone use assessed by the PMPUQ. To define a model with four related dimensions of impulsivity, the four latent variables were allowed to correlate. The number of years since acquisition of the mobile phone was also entered as a manifest variable according to its importance with regard to the actual use of the mobile phone. Depressive and anxious symptoms were not entered in the model. Indeed, four regression analyses carried out on the different facets of the PMPUQ highlighted the fact that the depression and anxiety scales cannot be considered as significant predictors of problematic mobile phone use.[3] However, a second model depending specifically on our *a priori* hypotheses (Model B) was also computed. In this second model, specific links between the components of impulsivity and the various problematic uses of the mobile phone were tested. More specifically, according to our previous assumptions, this second model tests the relationships between (1) the urgency component of impulsivity and the four types of problematic mobile phone use (dangerous use, prohibited use, dependence and financial problems); (2) the premeditation component of impulsivity and both prohibited

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[3]Regression analyses were not reported here. Structural equation modelling is more suitable than regression analysis when simultaneously testing the relations between different variables while controlling for the effects of other variables included in the model and adjusting for measurement errors.

Table 5. Fit indices of Models A and B

Model	χ^2	df	RMSEA
Model A	4850.69[*]	2747	0.048
Model B	4828.97[*]	2751	0.047

Note: RMSEA, root mean square error of approximation.
[*]$p < .001$.

and dangerous use of the mobile phone, as well as the occurrence of financial problems resulting from mobile phone use; (3) the perseverance component of impulsivity and the four types of problematic mobile phone use (dangerous use, prohibited use, dependence and financial problems); (4) the sensation seeking component of impulsivity and both prohibited and dangerous use of the mobile phone. Except for the relations between impulsivity and problematic use of the mobile phone, this second model is exactly equivalent to the first model. The χ^2 statistic was significant for both models (see Table 5): Model A, χ^2 (2747) = 4850.69, $p < .001$; Model B, χ^2 (2751) = 4828.97, $p < .001$. However, as with the confirmatory analysis done on the PMPUQ, it is important to keep in mind that it is unusual for a non-significant χ^2 to be obtained when performing confirmatory factor analyses with self-report questionnaires (Byrne, 1994). The RMSEAs of both models (Model A and Model B) are lower than 0.05 (see Table 5), which indicates a close fit to the data (Byrne, 2001). The RMSEA indices of Model A and Model B were then compared using the FITMOD software (Browne, 1992), which emphasized that the model based on our *a priori* hypothesis (Model B) is better than the model testing all the relationships between the components of impulsivity and the type of problematic mobile phone use. The model retained (Model B) is illustrated in Figure 1.

The final model shows that our *a priori* predictions were partially confirmed. Firstly, dangerous use of the mobile phone was reported by individuals who have high urgency and sensation seeking scores, but not low perseverance. Second, prohibited use is only related to low premeditation. Thus, contrary to our predictions, other components of impulsivity did not predict a tendency to use mobile phones in areas where they are prohibited. Third, dependence-related symptoms are associated with high urgency but not with low perseverance. Finally, financial problems due to mobile phone use are predicted by high urgency and low perseverance, but not by low premeditation. In addition, the model confirmed that the number of years since acquisition of the mobile phone plays a prominent role in all facets of problematic mobile phone use.

It was not possible to analyse gender differences in problematic mobile phone use by developing separate structural equation models because the number of parameters in the model is higher than the number of participants of each gender. Thus, gender differences in both impulsivity and problematic mobile phone use were compared by using Student *t*-tests. Concerning problematic use of the mobile phone, we found that men use their mobile phones more frequently in dangerous situations ($t = 2.28$, $p < .05$) and that women are more dependent on their mobile phones ($t = -2.64$, $p < .01$). For impulsivity, the results show that men have significantly higher levels of sensation seeking ($t = 6.34$, $p < .001$) and lower levels of perseverance ($t = 2.64$, $p < .01$) and that women have significantly higher levels of urgency ($t = -3.15$, $p < .01$). No other gender differences were found.

At the end of the PMPUQ, participants were asked whether or not they considered themselves to be dependent on the mobile phone (participants have to answer either 'yes' or 'no' to this question). This last item was introduced with the aim of analysing perceived
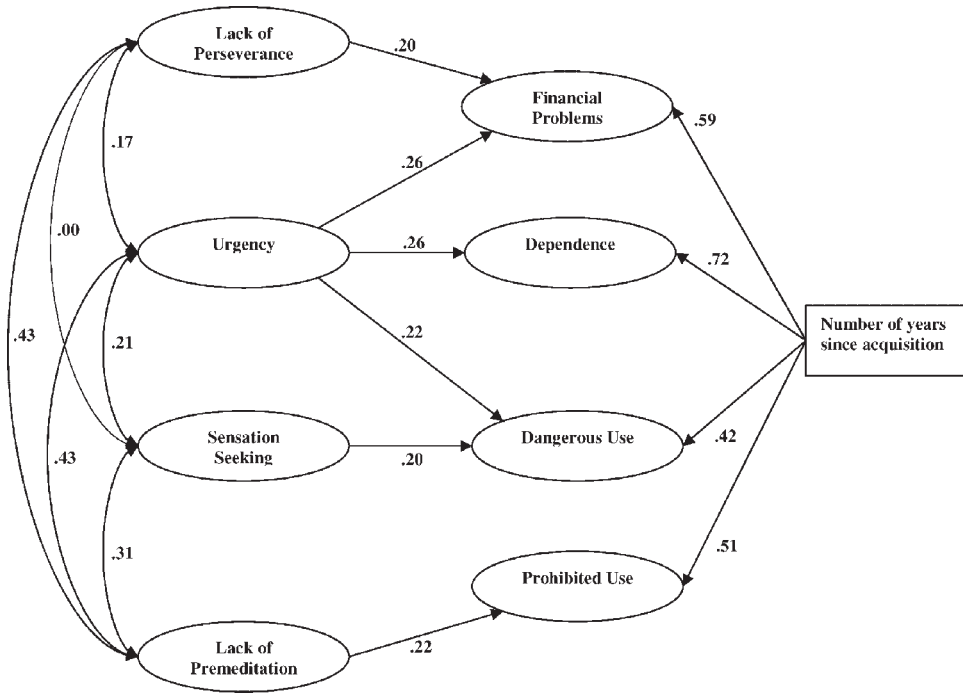
Figure 1. The structural equation model of the relationships between problematic mobile phone use and the various components of impulsivity. Values of the single-headed arrows reflect significant (at the .05 level) standardized regression weights. Values of the double-headed arrows at left are correlations

dependence on the mobile phone. A multivariate logistic regression model was tested to determine which factors could predict a feeling of dependence on the mobile phone. In the model, the dependent group was coded 1 and the non-dependent group was coded 0. Five predictors were entered into the logistic regression using the direct method: the four dimensions of the UPPS Impulsive Behaviour Scale and the number of years since the mobile phone was acquired. Depressive and anxious symptoms were not entered in the regression because they did not predict problematic mobile phone use. A test of the full

Table 6. Logistic regression on perceived dependence on the mobile phone ($N = 339$)

Predictors	B	SE	Wald statistic	p-values	OR	95% CI Lower	Upper
UPPS—urgency	.05	.02	4.2	.04[*]	1.05	1.00	1.09
UPPS—lack of premeditation	−.02	.03	.29	.59	.98	.93	1.05
UPPS—lack of perseverance	.07	.03	4.33	.04[*]	1.07	1.00	1.13
UPPS—sensation seeking	.02	.02	1.05	.31	1.02	.98	1.06
PMPUQ—acquisition	.66	.24	7.87	.005[**]	1.94	1.22	3.09
Constant	−5.25	1.12	21.83	.000[***]			

Note: Model 1 full model with all predictors (five-factor model): −2 log likelihood = 370.9; $\chi^2 = 21.2, p < .001$.
[*]$p < .05$; [**]$p < .01$; [***]$p < .001$.

model against a constant-only model was statistically significant ($\chi^2 = 21.2$, $p < .001$), implying that our five predictor variables distinguished participants who considered themselves as being dependent on the mobile phone from those who considered themselves not to be dependent on the mobile phone. The classification rate for the model was 68.6%. Table 6 presents the regression coefficients, SE, Wald statistics, odds ratios (ORs) and 95% confidence intervals for each predictor variable.

The OR revealed that participants with high urgency and low perseverance and who had possessed a mobile for a longer time were significantly more likely to consider themselves dependent on the mobile phone. In addition, Wald statistics indicated that the predictor that best distinguished between participants who considered themselves dependent and those who did not was the number of years since the acquisition of the mobile phone.

DISCUSSION

The main goals of this study were (1) to develop and to validate a questionnaire to assess actual and problematic use of mobile phones, and (2) to identify which facets of impulsivity are associated with such use. The first point to be mentioned is that confirmatory factor analyses emphasized that the PMPUQ has an acceptable fit and measures four separate facets of problematic mobile phone use (prohibited use, dangerous use, dependence, financial problems). Second, this research confirmed and extended previous results obtained regarding the relationship between impulsivity and mobile phone use (Billieux et al., 2007b). Indeed, our results not only confirmed that elevated actual use of the mobile phone is related to specific components of impulsivity (mainly urgency and lack of perseverance) but also revealed that high urgency and low perseverance are significant predictors of a feeling of dependence on the mobile phone. However, the study goes further and allows us to focus on several interesting new perspectives that will contribute to a better understanding of the determinants of exaggerated and/or problematic mobile phone use. More specifically, structural equation modelling showed that: (1) dangerous use of the mobile phone is predicted by high urgency and high sensation seeking; (2) prohibited use of the mobile phone is predicted by low premeditation; (3) dependence on the mobile phone is predicted by high urgency; (4) financial problems due to mobile phone use are predicted by high urgency and low perseverance; (5) all facets of problematic mobile phone use were predicted by the number of years since the mobile phone was acquired. Moreover, gender differences also appeared in problematic mobile phone use, namely the fact that males tend to use their mobile phones more often in dangerous situations, while females are more likely to develop dependence-related symptoms with regard to mobile phones.

Urgency is the component of impulsivity that is most strongly related to the various aspects of actual and problematic mobile phone use. More specifically, this facet of impulsivity is associated with all aspects of 'everyday' use of the mobile phone (number of calls made in 1 day, duration of the calls made in 1 day, number of SMSs sent in 1 day), as well as with several dimensions of problematic mobile phone use (dangerous use, depen- dence, financial problems). It may be postulated that, in substance-dependent persons, craving states are related to increased difficulties resisting strong impulses, which could result in harmful behaviours that relieve negative affect in the short term but have detrimental long-term consequences. In the same vein, it may be hypothesized that indi- viduals who have a high level of urgency will have problems deferring their use of the

cellular phone, especially in intense emotional contexts. It could also tentatively be argued that the relationship between high urgency and dangerous use of the mobile phone may be explained by the fact that certain driving situations promote negative affect (e.g. driving downtown in rush hour traffic), which results in more difficulties preventing oneself from using the mobile phone. Thus, high-urgency people would tend to use their cellular phone more often (greater actual use of the mobile phone, occurrence of financial problems due to mobile phone use) because they feel compelled to provide for their needs as soon as possible. Similarly, dependence-related symptoms related to mobile phones (e.g. people become irritated when they have to switch off their mobile phone or feel lost when they have forgotten their mobile phone at home) are more likely to emerge in high-urgency people because they are more likely to use their mobile phone to satisfy certain strong impulses with the aim of relieving negative affect in the short term. Interestingly, this phenomenon is close to the traditional concept of craving in substance use disorders, which supports the view that behavioural addictions share some common features with chemical addictions (e.g. Marks, 1990). This assumption is supported by data highlighting that high urgency levels are related to alcohol abuse (Whiteside & Lynam, 2003) and tobacco craving (Billieux, Van der Linden, & Ceschi, 2007a).

It is now important to consider lack of perseverance, which also plays a prominent role in actual and problematic mobile phone use. Indeed, this component of impulsivity is related to the number and duration of the calls made daily and is also a significant predictor of the occurrence of financial problems due to mobile phone use. Recently, lack of perseverance has been hypothesized to be related to a greater occurrence of irrelevant thoughts and/or memories (Bechara & Van der Linden, 2005). Thus, it may be postulated that lack of perseverance may enhance actual use of the mobile phone because irrelevant thoughts or memories increase the potential occasions to use one. More specifically, it can tentatively be proposed that certain persons find that using a cellular phone helps them rid themselves of irrelevant thoughts (e.g. thoughts relating to a recent quarrel with a friend or to an appointment in the evening). In addition, the occurrence of irrelevant thoughts may lead to much longer calls because they provide new subjects of discussion. Consequently, it is not surprising that low perseverance is a significant predictor of financial problems due to mobile phone use. However, we were surprised not to find any relationship between lack of perseverance and the number of SMSs sent daily. Nevertheless, it is possible that SMSs are more likely to satisfy impulses in emotional contexts than in the neutral contexts (e.g. a few words to say something in accordance with the person's emotional state), which could explain why SMS occurrence is related to high urgency but not to low perseverance. Another interesting result is that low perseverance is a predictor of perceived dependence (the fact of responding 'yes' to the question: 'do you feel dependent on your mobile phone?') but not of dependence symptoms when assessed more indirectly (sample dependence items from the PMPUQ: 'I feel lost when I do not have my mobile phone'; 'It's painful for me to switch off my mobile phone'). Thus, it appears that the feeling of dependence on the mobile phone is in fact a measure of actual use of the mobile phone (participants who experience a feeling of dependence are probably those who use their cellular phone a lot) rather than a measure of real dependence-related symptoms (as assessed by the 'dependence' factor of the PMPUQ). Finally, low perseverance did not predict prohibited or dangerous use of the mobile phone. However, this result is not very surprising when one takes into account the fact that low perseverance is probably more related to actual use in general than to problematic use of the mobile phone in specific situations.

The role of lack of premeditation should also be discussed, since this component of impulsivity is related to both the duration of calls and prohibited use of the mobile phone. Thus, it may be postulated that the 'myopia' concerning potential aversive consequences is related to longer calls due to the absence of any consideration that prolonged calls could result in a significant waste of time and/or money. However, it is surprising that this component of impulsivity did not predict the occurrence of financial problems due to mobile phone use. Nevertheless, it could be supposed that financial problems are probably more related to the inability to prevent oneself from using the mobile phone in certain situations (e.g. when experiencing negative affect or when intrusive thoughts occur in working memory), although increased duration of the calls due to lack of premeditation would logically have an effect on non-problematic expenditure related to mobile phones. Secondly, lack of premeditation predicts prohibited use of the mobile phone but is unrelated to dangerous use of the mobile phone. This result may be explained by the fact that phoning while driving is generally not considered to be a risky behaviour (White, Eiser, & Harris, 2004), whereas the potential negative consequences of prohibited use are easily conceivable (e.g. banishment from a public place, social disapproval, fines etc.). In other words, low premeditation may possibly be a predictor of prohibited use because the related potential negative outcomes are concrete (which is not the case with the risks arising from mobile phone use while driving). Similarly, lack of premeditation has also been associated with the use of substances having tangible consequences for health (e.g. nicotine) (Miller et al., 2003).

Furthermore, high levels of sensation seeking result in more dangerous use of the mobile phone. Thus, it may be assumed that, for individuals with a high level of sensation seeking, phoning while driving may promote exciting hedonic sensations in certain demanding situations (e.g. situations in which the driver needs to concentrate). Indeed, it may be postulated that in such situations (as opposed to non-demanding driving situations), the consciousness of the risks arising from the situation is likely to create intense excitement. In this context, it has already been shown that sensation seeking is positively related to self-related measures of risky driving (e.g. Schwebel, Severson, Ball, & Rizzo, 2006). Interestingly, the sensation seeker's preference for dangerous and exciting activities has also been shown to predict drug and alcohol abuse (Miller et al., 2003).

Another strong predictor of actual and problematic mobile phone use is the time since acquisition of the mobile phone. Indeed, individuals who have owned mobile phone for a longer time make greater actual and problematic use of it. This phenomenon is not surprising when one considers mobile phone use as a potential behavioural addiction in which dependence-related symptoms are reinforced with time. In other words, it can be assumed that symptoms of mobile phone addiction increase over time. It should be mentioned that the increase of problematic mobile phone use over time seems to be related to exposure and not simply to the age of participants, as there are no positive correlations for age with actual mobile phone use and time since the mobile phone was acquired.

It remains to discuss the role of gender differences in actual and problematic use of the mobile phone. Concerning actual use, our results emphasized that females sent more SMSs than males, which is in accordance with the previous findings (e.g. Geser, 2006). However, no gender difference was found concerning the number and duration of the calls made in 1 day. As for problematic mobile phone use, the results showed that females tend to be more addicted than males, whereas males tend to use mobile phones more frequently in dangerous situations. Based on our previous explanations, it is not surprising that females have higher dependence-related symptoms with regard to the mobile phone, given that they

tend to have higher levels of urgency. Moreover, this result is in accordance with the past studies that highlighted a greater occurrence of self-reported experiences of negative affect in women than in men (e.g. Fujita, Diener, & Sandvik, 1991). In the same vein, we think that men's higher rate of dangerous use of the mobile phone may be related to their more elevated sensation seeking level. Indeed, this assumption backs up studies highlighting the more frequent occurrence of risky driving behaviours in men than in women (Lonczak, Neighbors, & Donovan, 2007).

Although anxiety and depression were not related to the number and duration of the calls made in 1 day or to problematic use of the mobile phone, a positive relationship between these two factors and the number of SMSs sent daily was found. The absence of a relationship between calls (number and duration) and depressive symptoms is not very surprising since depressed people frequently tend to be isolated (Joiner, 1997), whereas anxious persons might be reluctant to use mobile phones because being reachable at any time and place may represent a potential stressor. However, it is possible that people who are socially anxious and/or have poor self-confidence find it easier to send an SMS than to phone, which could explain the positive relation between the occurrence of anxious and/or depressive symptoms and the tendency to use SMS technology.

This study emphasized that a multi-component view of impulsivity can contribute to a better understanding of problematic mobile phone use. However, further studies should be conducted to more systematically investigate the underlying psychological mechanisms by which the various components of impulsivity predict actual and problematic mobile phone use. In addition, it could be useful for further studies investigating financial problems relating to mobile phone use to consider the socio-economic status of their sample. To conclude, the present findings support the view that both chemical and non-chemical addictions share common features, which could be of interest for clinicians dealing with behavioural addictions.

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