

Self-reported dependence on mobile phones in young adults: A European cross-cultural empirical survey

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Background and aims: Despite many positive benefits, mobile phone use can be associated with harmful and detrimental behaviors. The aim of this study was twofold: to examine (a) cross-cultural patterns of perceived dependence on mobile phones in ten European countries, first, grouped in four different regions (North: Finland and UK; South: Spain and Italy; East: Hungary and Poland; West: France, Belgium, Germany, and Switzerland), and second by country, and (b) how socio-demographics, geographic differences, mobile phone usage patterns, and associated activities predicted this perceived dependence. *Methods:* A sample of 2,775 young adults (aged 18–29 years) were recruited in different European Universities who participated in an online survey. Measures included socio-demographic variables, patterns of mobile phone use, and the dependence subscale of a short version of the Problematic Mobile Phone Use Questionnaire (PMPUQ; Billieux, Van der Linden, & Rochat, 2008). *Results:* The young adults from the Northern and Southern regions reported the heaviest use of mobile phones, whereas perceived dependence was less prevalent in the Eastern region. However, the proportion of highly dependent mobile phone users was more elevated in Belgium, UK, and France. Regression analysis identified several risk factors for increased scores on the PMPUQ dependence subscale, namely using mobile phones daily, being female, engaging in social networking, playing video games, shopping and viewing TV shows through the Internet, chatting and messaging, and

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using mobile phones for downloading-related activities. *Discussion and conclusions:* Self-reported dependence on mobile phone use is influenced by frequency and specific application usage.

Keywords: problematic mobile phone use, mobile phone dependence, behavioral addictions, young adults, cross-cultural research

INTRODUCTION

Mobile phones are now used worldwide as one of the main information and communication technologies (ICT). In particular, the International Telecommunication Union (ITU) emphasized that Europe has the highest penetration rate worldwide (ITU World Telecommunication/ICT Indicators Database, 2015). In the early 2000s, mobile phones were limited to calls and text/picture messaging. However, contemporary smartphones support various other functions, including (but not limited to) e-mailing and Internet access, short-range wireless communication, gaming, gambling, business, social networking, watching TV shows, photography, or geo-localization. Mobile phones have become the most used technology in human history. Currently, there are 2.08 billion users of 4G networks worldwide, and more than 5 billion are anticipated by 2019 (Statista: The Statistics Portal, 2016). According to international reports (ITU World Telecommunication/ICT Indicators Database, 2015; The Internet World Stats, 2016), the penetration rate of mobile communication currently approaches 100% in many countries, although there are major differences among some regions (e.g., the mobile broadband penetration rate in Africa remains below 20%).

Research over the last two decades has evidenced the benefits of mobile phone use in terms of communication between individuals or daily life organization (Geser, 2004; Walsh, White, & Young, 2008). Numerous studies have also demonstrated the efficacy of mobile phone interventions designed to promote healthy behaviors (Fjeldsoe, Marshall, & Miller, 2009) or provide self-help-based psychological interventions (Watts et al., 2013). It has also been suggested that ICT contributes to reducing social inequalities and to facilitating the integration process of social minorities (d'Haenens, Koeman, & Saeys, 2007). However, several studies have emphasized that mobile phone (over) use is also linked to a wide range of problematic behaviors, which led several scholars to coin the term "Problematic Mobile Phone Use" (PMPU) in the mid-2000s to describe the inability to regulate one's use of the mobile phone, which is associated with negative consequences in daily life (Bianchi & Phillips, 2005; Billieux, Van der Linden, & Rochat, 2008). Negative consequences include self-reported feelings of dependence and addictive use (Bianchi & Phillips, 2005; Billieux, Van der Linden, d'Acremont, Ceschi, & Zermatten, 2007), financial problems (Billieux et al., 2008), risky driving (White, Eiser, & Harris, 2004), banned use in prohibited areas (Nickerson, Isaac, & Mak, 2008), sleep interference (Thomé, Harenstam, & Hagberg, 2011), reduced physical activity (Kim, Kim, & Jee, 2015), cyberbullying (Nicol & Fleming, 2010), sexting (Dir, Cyders, & Coskunpinar, 2013), and phantom cell phone

ringing (Kruger & Djerf, 2016). Importantly, the introduction of 4G and 5G technologies along with the constantly evolving functions of smartphones (e.g., facilitated use of social networks, video gaming, and gambling platforms) are structural factors susceptible to increasing the likelihood of deregulated or addictive use of the mobile phone (Jeong, Kim, Yum, & Hwang, 2016; Lee, 2015). Critically – and despite the wide variability in reported prevalence rates in previous studies, and scant evidence regarding its etiology and course (Billieux, Maurage, Lopez-Fernandez, Kuss, & Griffiths, 2015) – excessive smartphone use has recently been considered as a public health concern by the World Health Organization (2015).

Available studies, mostly from Asia, suggest that a wide range of demographic variables (e.g., age, gender, and socio-economic status) and psychological variables (e.g., personality traits, attachment styles, and psychopathological symptoms) act as risk or protective factors for the development of problematic or excessive mobile phone use (see Billieux, 2012; Billieux, Maurage, et al., 2015; Choliz, 2012; Lee, Chang, Lin, & Cheng, 2014; Long et al., 2016; Walsh et al., 2008). According to a recent model by Billieux, Maurage, et al. (2015), PMPU is considered a heterogeneous and multidetermined phenomenon, which can result in various negative consequences (e.g., addictive use, hazardous or dangerous use, and anti-social use) depending on specific motivations (e.g., being reassured by significant others, looking for social sharing or contact, and looking for stimulating/exciting activities). Addictive use of mobile phones, associated with a feeling of perceived dependence and deregulated use, is the facet of PMPU that received the most attention during the last decade (e.g., Billieux, Van der Linden, & Rochat, 2008; Fowler & Noyes, 2015; Lin, Chiang, & Jiang, 2015).

Although addictive use of mobile phones has received increased attention recently, available data on young adults in Europe are relatively scarce. The existing studies tend to examine adolescence including young adulthood and have been carried out in South European countries, such as Spain (e.g., Muñoz-Miralles et al., 2016) and Italy (Martinotti et al., 2011). According to some developmental psychologists (e.g., Arnett, 2000; Schwartz et al., 2015), adolescents and young adults engage in different risk behaviors, and emerging adults (aged 18 years until the late 20s) are more prone to problematic behaviors and substance use. These individuals have been found to have a higher risk of developing unhealthy or risky behaviors, including hazardous substance use and excessive video game involvement (Nelson & Padilla-Walker, 2013). However, there is a knowledge gap relating to how young adults use mobile phones given the rapid technological development described (United Nations Development Programme, 2014). This is particularly relevant in terms of socialization-related

processes in a generation of young people described as “digital natives,” who are reliant on visual (and mobile) communication, thrive on instant gratifications, and are likely to take risks due to technology misuse (Selwyn, 2009; Teo, 2013).

Previous studies concerning perceived dependence and addictive use of mobile phones in young adults have mainly come from Eastern continents, and suggest mobile phones are used primarily as a socialization tool (Chen, 2007), which in some cases can cause overattachment (Walsh et al., 2008) and be understood based on models of excessive and addictive behaviors (Griffiths, 2005; Orford, 2001). However, several specific theories have been developed to account for the addictive use of mobile phones. For example, Chen (2007) proposed an adaptation of theories (i.e., the “media dependency theory” and “psychological separation”) that consider the process of “identity development” as a key feature of mobile phone use and misuse.

The objectives of this study were twofold: (a) to explore mobile phone use and self-reported dependence on the mobile phone in young adults across a representative selection of European regions (i.e., the North, South, East, and West of Europe), and (b) to examine how socio-demographic factors, geographical differences, patterns of mobile phone use, and favored activities [e.g., social networking sites (SNS) and gaming] predict perceived dependence on mobile phone use.

METHODS

Participants and procedure

The study surveyed a convenience sample of 2,775 young adults (aged between 18 and 29 years) recruited via announcements in several European universities. In line with cross-cultural design proposals by Ember and Ember (1998), the study was first based on geographical regions and second on inter-country comparisons, using primary and synchronous data collection (i.e., collected simultaneously between February and June 2015 in all countries), and modest sample sizes (i.e., approximately 200 participants per country, and 500 per region, see below). The survey study was advertised via university communication systems in the Faculties of Psychology and Social Sciences, and through paper-based materials (e.g., flyers, brochures, and QR codes) as well as online

forums (e.g., through virtual learning environments and academic Facebook accounts).

First, the participants were grouped into four subsamples in accordance with geographical regions delineated by the United Nations Statistics Division (United Nations, 2014): *Northern Europe* (NE; i.e., 12.8% of the total participants: Finland and UK), *Southern Europe* (SE; i.e., 14.6%: Spain and Italy), *Eastern Europe* (EE; i.e., 11.1%: Hungary and Poland), and *Western Europe* (WE; i.e., 61.5%: France, Belgium, Germany, and Switzerland). Second, the participants were grouped by individual country. Socio-demographic variables for the study sample are reported in Table 1.

Measures

The data were collected through an online survey (conducted with *Qualtrics*). Some data collected are not related to the current study and will be presented elsewhere. The sections of interest for the current study are the following: (a) socio-demographics, (b) usage patterns, and (c) the dependence subscale of a short version of the Problematic Mobile Phone Use Questionnaire (PMPUQ; Billieux et al., 2008) translated into the respective European languages. A subset of the sample completed this subscale (i.e., 77% of the entire sample, which corresponds to the sample used in this study), as the survey was composed of sequential sections making it possible to leave the survey after having completed the items related to demographics and usage patterns. A pilot study was conducted at the Catholic University of Louvain (UCL) to test the feasibility of the online study (e.g., relevance of the items selected and length of the survey), and issues were shared and resolved with the help of the whole team of co-authors involved in the current research project. Translations were performed using standard translation-back translation procedures (i.e., from French to English, German, Finnish, Spanish, Italian, Polish, and Hungarian; Brislin, 1970).

The variables examined in the socio-demographic section included: gender, age, relationship status (single or not), education level (secondary education or higher), and occupation status (undergraduate or not). Patterns of mobile phone use were assessed by: having an Internet contract, using mobile phones (i.e., type of mobile phone used); average minutes per day spent using technology (outside work/study) on a typical weekday or weekend day, weekly duration of use (per minute); number of days per week engaged in leisure activities, whether or not mobile phones were used on a

Table 1. Socio-demographic characteristics by European regions

Geographic area	NE (n = 500)	SE (n = 425)	EE (n = 478)	WE (n = 1,372)	Entire sample (N = 2,775)
<i>Socio-demographic characteristics</i>					
Female (%)	69	76.5	70.7	73.8	72.8
Age [M (SD)]	22.77 (2.65)	23.04 (3.16)	23.03 (2.68)	22.11 (2.81)	22.53 (2.84)
Student (%) ^a	92.8	75	71.8	89.2	84.5
Single (%) ^a	42.3	69.3	57.5	63.9	57.9
Secondary education (%) ^a	80.1	73.3	56.2	52.3	57.4

Note. NE: Northern Europe; SE: Southern Europe; EE: Eastern Europe; WE: Western Europe.

^aThe reported values are the ones obtained after removing missing values (less than 20% per variable).

daily basis; monthly mobile phone payment; functions/applications used during the last year [i.e., e-mailing (e.g., *Gmail*), texting and chatting (e.g., *WhatsApp* and *Line*), social networking (e.g., *Facebook* and *Twitter*), searching information (e.g., timetables and weather), reading (e.g., press and eBooks), blogging (e.g., *WordPress*), watching TV and video shows (e.g., *YouTube*), downloading (e.g., apps: mp3s, gadgets, and gaming applications), gaming (e.g., *Candy Crush Saga* and *Angry Birds*), gambling (e.g., sports betting), cybersex (e.g., *Youporn* and *Pornhub*), and shopping (e.g., *eBay* and *Amazon*)].

To assess perceived dependence on mobile phones, the five-item dependence subscale of the short PMPUQ (Billieux et al., 2008) was employed. The five items comprise: (a) “It is easy for me to spend all day not using my mobile phone”; (b) “It is hard for me not to use my mobile phone when I feel like it”; (c) “I can easily live without my mobile phone”; (d) “I feel lost without my mobile phone”; and (e) “It is hard for me to turn my mobile phone off.” Items were scored from 1 “I strongly agree” to 4 “I strongly disagree” (except three items that were reverse scored: 2, 4, and 5), and scores ranged from 5 to 20, with higher scores indicating higher perceived dependence on the mobile phone. The Cronbach’s α of the “dependence subscale” across all countries and languages demonstrated acceptable to excellent internal reliability (reliability coefficients ranged from $\alpha_{\text{Italian}} = .76$ to $\alpha_{\text{French}} = .88$). The structural validity was tested for each translation of the PMPUQ by obtaining fit indices from confirmatory factor analyses (CFAs) using maximum likelihood and testing fit based on a three inter-related-factor model (the PMPUQ comprised three scales, although this study only used the perceived dependence subscale). These models for each version resulted in acceptable to good models, based on conventional fit indices (root mean square error of approximation, comparative fit index, Tucker–Lewis index: structural validity – minimum RMSEA_{English} = .05 and maximum RMSEA_{Italian} = .1; maximum CFI_{German} = .92 and TLI_{German} = .91, and minimum CFI_{Polish} = .74 and TLI_{Polish} = .69).

Data analysis

Comparisons of actual mobile phone use and perceived dependence on mobile phone use across European regions were tested with ANOVA using Scheffé’s post-hoc significance criterion. Additional Kruskal–Wallis (H) or chi-square (χ^2) tests were used to further specify cross-cultural differences, based on the dependent variable type (continuous or categorical). Student’s (t) and Mann–Whitney (U) tests were used to determine whether mobile phone dependence was influenced by specific usage patterns. Pearson’s correlation coefficient (r) was used to explore the relationship between mobile phone usage patterns and dependence. It was also decided to determine the proportion of highly mobile phone-dependent individuals, as reflected by maximum scoring on all items of the dependence subscale of the short PMPUQ items (i.e., an overall score of 20). A multiple linear regression analysis conducted with a step-forward method was performed to identify potential predictors of mobile phone dependence (24 independent predictors were entered, including

5 socio-demographic variables, 2 geographical variables, and 17 variables related to mobile phone usage patterns). SPSS 21 software was used.

Ethics

The Ethical Committee of the Psychological Sciences Research Institute (UCL) approved the study protocol. Participants provided informed consent and voluntarily participated following the assurance of confidentiality and anonymity.

RESULTS

Mobile phone use

Most participants had Internet contracts (see Table 2) and owned a smartphone [$\chi^2(3) = 26.28, p < .001$]. Regarding actual use, time spent on mobile phones during an average weekday was around 3 hr [$H(3) = 132.13, p < .001$], similar to weekends [$H(3) = 115.97, p < .001$]. Weekly time devoted to mobile phone use was between 14 and 43 hr [$H(3) = 132.11, p < .001$]. Use of the mobile phone on a daily basis was estimated almost every day [$H(3) = 108.42, p < .001$]. Regardless of regional differences, approximately 67% of mobile phone owners reported having used them on a daily basis.

Perceived dependence on mobile phone use

At the international level, the short version of the PMPUQ dependence subscale positively correlated with actual mobile phone use (min/weekday: $r = .26, p < .001$; min/weekend day: $r = .36, p < .001$; days/week: $r = .14, p < .001$). The most frequent activity was e-mailing (64.1%), followed by social networking (62.6%), text messaging and chatting (60.6%), searching (52.7%), reading (31%), and gaming (19.5%). Irrespective of the regions, preferred activities were messaging/chatting and social networking for mobile phone use (see Table 3). Cross-cultural comparisons revealed that dependence was less prevalent in the Eastern European region in comparison to all other regions.

Furthermore, specific activities were associated with increased levels of dependence, namely social networking [“yes”: $M = 12.34$ and $SD = 3.7$, “no”: $M = 9.66$ and $SD = 3.76, t(2, 147) = 15.46, p < .001$]; messaging and chatting [“yes”: 12.14 (3.8), “no”: 10.24 (3.9), $U = -10.32, p < .001$], e-mailing [“yes”: 12.06 (3.8), “no”: 10.2 (3.9), $U = -9.82, p < .001$], searching for information [“yes”: 11.99 (3.71), “no”: 10.94 (4.08), $U = -6.23, p < .01$], gaming [“yes”: 12.52 (3.79), “no”: 11.22 (3.99), $t(2, 147) = 6.38, p < .001$], and watching TV and video shows [“yes”: 12.62 (3.79), “no”: 11.03 (3.88), $t(2, 147) = 8.76, p < .001$]. These results illustrate that watching TV, followed by gaming shows, and social networking appear to exhibit the greatest potential for perceived dependence on mobile phone use.

Table 2. Mobile phone use by European regions
Young European adults (N = 2,775)

Sample	NE (n = 500)	SE (n = 425)	EE (n = 478)	WE (n = 1,372)	Relationship among regions
<i>Patterns of mobile phone use</i>					
Internet contract at home (%) ^a	98.9***	94.3***	99.6***	99.6***	NE > [EE = WE] > SE
Monthly payment (%)	77.2***	94.6***	64.1***	81.9***	SE > WE > NE > EE
MP (%) ^a	4.8***	3.6***	15.7***	13.6***	EE > WE > NE > SE
SP (%) ^a	95***	96.4***	80.3***	77***	SE > NE > EE > WE
Min/weekday MP/SP [M (SD)] ^b	109.25 (118.94)***	232.76 (384.07)***	137.44 (423.41)***	104.16 (122.53)***	SE > [EE = NE = WE]
Min/weekend day MP/SP [M (SD)] ^b	109.99 (126.39)***	206.93 (223.21)***	106.2 (213.67)***	109.27 (131.05)***	SE > [NE = WE = EE]
Weekly minutes MP/SP [M (SD)] ^b	1,142.41 (1,222.51)***	2,357.85 (3,181.14)***	1,322.66 (3,422.31)***	1,108.59 (1,265.41)***	SE > [EE = NE = WE]
Days/week MP/SP [M (SD)] ^b	6.3 (2.62)***	7.37 (1.6)***	5.53 (2.82)***	6.26 (2.7)***	[NE = WE] > SE > EE
Daily use MP/SP (%) ^a	79.7***	79.2***	48.1***	64.2***	[NE > SE > EE] > WE

Note. MP: mobile phone without Internet; SP: smartphone; NE: Northern Europe; SE: Southern Europe; EE: Eastern Europe; WE: Western Europe.
^aChi-square test (χ^2). ^bKruskal–Wallis test (*H*).
 ****p* < .001.

Proportion of highly dependent users and their profile

To estimate the proportion of highly dependent mobile phone users among young European adults, the present authors relied on maximum scoring on the short PMPUQ dependence subscale (N = 46 out of 2,775; see Methods section). Results were ordered from the highest to the lowest proportion by valid percentages: (a) Belgium (3.9%; n = 14 out of 358); (b) UK (3.5%; n = 2 out of 57); (c) France (3.4%; n = 9 out of 261); (d) Italy (2.5%; n = 5 out of 202); (e) Spain (1.7%; n = 2 out of 118); (f) Switzerland (1.4%; n = 1 out of 73); (g) Finland (1.3%; n = 4 out of 307); Hungary (1.3%; n = 3 out of 235); (h) Germany (1.2%; n = 4 out of 330); and (i) Poland (1%; n = 2 out of 208).

Highly dependent mobile phone users were mainly young female adults (89.1%), using smartphones (100%), usually paying monthly as contract type option (95.6%), and using them almost daily (90.9%). They estimated their daily smartphone usage to be close to 6 hr (weekday: M = 348.33 and SD = 294.24, weekend: M = 365.83 and SD = 219.27). Almost all of them (95.7%) used smartphones for online leisure activities [87% e-mailing, 87% chatting, 80.4% social networking (using Facebook), 52.2% searching information, 45.7% viewing TV shows, 43.5% reading, 37% using Instagram, 32.6% playing casual video games, 23.9% using Twitter, 23.9% online shopping online, 13% downloading files, 10.9% playing strategic video games, 6.5% using dating sites, 4.3% blogging, 2.2% playing solo video games, and 2.2% betting in sports games]. Their favorite online activity on their smartphones was: messaging and chatting (47.8%) and social networking (using Facebook; 32.6%). When asked to select the most important online activity via any technology (i.e., computer, tablet, and mobile phone), the majority selected social networking (65.2%).

Predictors of perceived dependence

Multiple linear regression analysis showed that the variance inflation factor (VIF) and tolerance index supported the absence of multicollinearity (i.e., VIF_{max} = 1.37 and tolerance_{min} = 0.73). The Durbin–Watson coefficient indicated a lack of autocorrelation between adjacent residuals (0 < 1.99 < 4). The best model explained 24.2% of variance in the dependence subscale [R² = .242; F(8, 2105) = 83.99, p < .001], and emphasized that it is best predicted by (a) using the phone on a daily basis, (b) increased social networking, (c) female gender, (d) not necessarily monthly payment as type of contract, (e) online shopping, (f) viewing TV shows, (g) downloading-related activities, and (h) messaging and chatting (see Table 4).

DISCUSSION

The objectives of this study were to investigate the cross-cultural patterns of mobile phone use in European youth and determine potential predictors associated with perceived dependence on mobile phones. Taking the findings as a whole, this study supports the idea that mobile phones are ubiquitous among young adults (as most participants had a

Table 3. Activities on mobile phones by European regions

ICT users	Mobile phone/smartphone users (N = 2,775)				
	NE (n = 500)	SE (n = 425)	EE (n = 478)	WE (n = 1,372)	Relationship among regions
E-mailing (%) ^a	69.2**	68.2**	63.8**	61.2**	NE > SE > EE > WE
Messaging and chatting (%) ^a	65.6***	79.3***	52.5***	55.9***	SE > NE > WE > EE
Blogging (%) ^a	3	1.9	3.3	2.1	
Watching TV shows (%) ^a	38***	38.8***	25.9***	21.1***	SE > NE > EE > WE
Downloading (%) ^a	8.4***	24.2***	10***	7***	SE > EE > NE > WE
Reading (%) ^a	47.6***	28.9***	32.2***	25.1***	NE > EE > SE > WE
Searching (%) ^a	55.2**	47.3**	46.7**	44.7**	NE > SE > EE > WE
Gaming (%) ^a	26***	25***	8.4***	20.5***	NE > SE > WE > EE
Gambling (%) ^a	4.6***	0.7***	0.2***	0.2***	NE > SE > [EE = WE]
Cybersex (%) ^a	5	5.2	3.8	2.9	
Shopping (%) ^a	9.6***	13.4***	4.6***	10.1***	SE > NE > WE > EE
Social networking (%) ^a	64.6***	72.2***	69.2***	56.6***	SE > EE > NE > WE
Short PMPUQ dependence [M (SD)] ^b	11.43 (3.68)***	12.52 (3.26)***	10.77 (3.73)***	11.43 (3.68)***	SE > [NE = WE] > EE

Note. PMPUQ: Problematic Mobile Phone Use Questionnaire; NE: Northern Europe; SE: Southern Europe; EE: Eastern Europe; WE: Western Europe.

^aChi-square test (χ^2), ^bKruskal–Wallis test (H).

p < .01. *p < .001.

Table 4. Socio-demographic, patterns of mobile phone use, and activities regressed on potential mobile phone dependence

Mobile phone and smartphone users who completed the PMPUQ-SV dependence subscale (N = 2,775)						
PMPUQ-SV subscale	Predictor	B	SE B	t	β	p
Dependence	Intercept	9.59	3.23	29.65		<.01
	Daily use	2.06	0.18	11.48	.26	<.01
	Social networking	1.23	0.18	6.8	.14	<.01
	Gender	-0.73	0.09	-8.46	-.16	<.01
	Monthly MP/SP payment	-0.92	0.19	-4.78	-.1	<.01
	Online shopping	1.01	0.26	3.88	.08	<.01
	Viewing TV shows	0.47	0.18	2.62	.06	.01
	Downloading	0.57	0.25	2.25	.05	.02
	Messaging and chatting	0.37	0.18	0.04	.04	.04

Note. Gender was coded -1 for female gender and 1 for male gender. MP: mobile phone without Internet; SP: smartphone; PMPUQ-SV: short version of the Problematic Mobile Phone Use Questionnaire.

smartphone), but the results also demonstrated important cultural differences in usage patterns and self-reported mobile phone dependence. Furthermore, the proportion of highly dependent individuals was higher in specific countries (i.e., Belgium, UK, and France) where mobile phones were used for maintaining communication purposes (i.e., messaging, chatting, or social networking via Facebook). Finally, the study demonstrated that specific usage patterns and preferences related to communication, along with being female, were predictors of an increased perceived dependence on using the mobile phone.

The findings demonstrated that participants differed regarding the type of mobile phone technology use across European regions. For example, smartphones were used more in South Europe, and traditional mobile phones in East Europe, whereas congruently the time spent using both smartphone and mobile phone was higher in South Europe. Other cultural differences regarding usage patterns included preferences for solitary activities in North European

countries (i.e., managing e-mails, reading, searching for information, and gaming) and preferences for interpersonal activities in South European countries (i.e., messaging, chatting, and social networking; see Karapanos, Teixeira, and Gouveia (2016), for similar results in Portugal), which is consistent with other previous findings obtained in Sweden (Kongaut & Bohlin, 2016) and Spain (Cambra & Herrero, 2013). Therefore, it appears that in South European countries, mobile phones are an important vehicle often used to foster and maintain interpersonal communication, whereas in North European countries, these tools appear to be used more for professional/academic or leisure purposes. When it comes to perceived dependence on the mobile phone, it appeared that young adults from Northern and Western European countries exhibited relatively similar heightened levels of self-reported dependence in comparison to Eastern and Southern European regions. Further analyses revealed that South Europe is the region in which the proportion of highly dependent individuals is the highest.

However, young adults perceived their dependence on using mobile phones differently across countries. For instance, countries with a higher proportion of highly dependent mobile phone users included Belgium, UK, and France, where the proportions of problematic use were three times higher than in mobile phone users from Germany and Poland. To the best of the authors' knowledge, there are few studies examining the proportion of potentially highly mobile phone-dependent individuals, and no cross-cultural studies in young European adults. In this study, potentially excessive mobile phone users tended to be female heavy smartphone users, and used smartphones for communicative purposes. This finding could be congruent with the fact that mobile social networking applications seem to be a significant predictor of mobile addiction (Salehan & Negahban, 2013), and that this potential addictive behavior appears to have significant influence on interpersonal relationships and loneliness (Bian & Leung, 2014; Wang, Wang, & Wu, 2015).

Similar to what was recently stated with regard to the term "Internet addiction" (Starcevic & Aboujaoude, 2016), it appears that the term "mobile phone dependence" could be an increasingly inadequate construct. Individuals are not "dependent" to the mobile phone per se, but rather on one or more of the activities that can be performed with this technology (e.g., gaming, social networking, etc.), or, under certain circumstances, on another behavior for which the mobile phone acts as the primary medium (e.g., some individuals characterized by an insecure attachment style use their mobile phone excessively to maintain affective relationships, see Billieux, Philippot, et al., 2015; Lu et al., 2011). It is worth noting that in this study, dependence on using the mobile phone was not assessed via items directly transposed from the substance abuse literature, as the evidence supporting excessive mobile phone use as an addictive behavior is scarce (Billieux, Maurage, et al., 2015; Cutino & Nees, 2016). Accordingly, the present authors relied on items assessing perceived dependence and loss of control over mobile phone use (Item 2), which allowed the capturing of potentially PMPU without necessarily considering it within the addictive disorders spectrum. Indeed, as noted by Billieux, Schimmenti, Khazaal, Maurage, and Heeren (2015), the multifaceted nature and heterogeneity of PMPU are usually neglected in favor of simplistic symptomatic descriptions.

Independently of the socio-cultural context (i.e., the countries in which the participants resided), this study also successfully identified several risk factors associated with an increased perceived dependence on mobile phones. First, and unsurprisingly, actual time spent using a mobile phone was related to self-reported dependence (e.g., see Lee et al., 2014). Second, the involvement in specific types of activities (i.e., social networking, shopping, viewing videos, gaming, and downloading) also appeared as important predictors of perceived dependence on the mobile phone. This is consistent with recent findings (Balakrishnan & Shamim, 2013; Cheng & Leung, 2016; Demirci, Orhan, Demirdas, Akpinar, & Sert, 2014; Jeong et al., 2016; Salehan & Negahban, 2013), and more largely with the view that social networking and video games are activities characterized by an augmented addictive potential (Andreassen,

Billieux, et al., 2016). The fact that downloading was found to be a risk factor was arguably more unexpected and should be further investigated in future studies. Nevertheless, it is likely that heavy mobile phone users are also those who are more frequently involved in downloading new applications or web-related content. Finally, it was found that females reported higher perceived dependence on the mobile phone than males, similar to what was demonstrated in previous studies (e.g., Billieux et al., 2008; Geser, 2004; Leung, 2008; López-Fernández, Losada-Lopez, & Honrubia-Serrano, 2015). This relationship between female gender and perceived dependence is probably partly related to the fact that females tend to value interpersonal communication more than males (Andreassen, Pallesen, & Griffiths, 2016; Van Deursen, Bolle, Hegner, & Kommers, 2015). Another potential explanation is the fact that females in Western societies are more prone to experience negative affective states (Nolen-Hoeksema, 2001), and that excessive mobile phone use is, in specific cases, a dysfunctional coping strategy displayed to face and alleviate adverse emotional states (Billieux et al., 2008; Demirci, Akgonul, & Akpinar, 2015). This is in accordance with a recent study that found social anxiety predicted the degree of mobile phone use in a sample of young adults predominantly represented by the female gender (Sapacz, Rockman, & Clark, 2016). Based on Arnett's theory (2000), when faced with life changes, some young Western adults make use of dysfunctional coping mechanisms [e.g., excessive gaming, which starts in early adolescence and may be maintained thereafter (Gentile, 2009) or decreasing face-to-face socializing (Drouin, Kaiser, & Miller, 2015)].

Despite this study's strength in producing novel findings, it is not without limitations. First, it relied on convenience samples in both continental region and individual countries, which may affect the overall generalizability of the present findings. Furthermore, although the regions are recognized by international organizations, their regrouping is somewhat heterogeneous from a cultural perspective (e.g., the UK and Finland being in the same continental region, but being very different culturally). However, this study included data from 10 countries, and is thus representative of European cultural diversity. However, these comprise only 19% of the total number of countries in Europe, although 10 countries sampled in this study comprise the largest populations. Overall, this study increases the understanding of cross-cultural commonalities and differences by assuming an open and unprejudiced perspective concerning the nature and size of cross-cultural differences (van de Vijver, 2009). Second, all the data were based on self-report questionnaires administered via specific academic environments that are prone to biases (e.g., social desirability bias, recall biases, and non-representativeness), and which may have affected the external validity of the findings. Moreover, self-report questionnaire methodologies assume that respondents are aware of and willing to report their behaviors, which is an assumption that has previously been questioned in the field of mobile phone-related research (Boase & Ling, 2013). In addition, it has to be kept in mind that for the first time, this study used a short version of the dependence subscale from the PMPUQ. The results demonstrated that its internal

consistency and structural validity significantly varied across cultures and languages. Consequently, further studies are thus required to psychometrically establish the cultural invariance of the short version of the PMPUQ used in this study.

Future cross-cultural research into PMPU needs to address issues to improve methodological shortcomings noted in this study (e.g., cross-national comparison and improved psychometric instruments in cultural adaptation questionnaires), as well as patterns of PMPU (e.g., number of apps downloaded, number of groups in *WhatsApp*, etc.), and concurrent individual and contextual factors (e.g., substance use and social support). This study emphasized for the need of improved knowledge concerning the use and misuse of mobile phones in young European adults, and also identified specific risk factors for self-reported dependence, which opens up new avenues in terms of improved prevention practices and evidence-based regulation policies at the public health level.

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