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Developing a shorter version of the Estonian Smartphone Addiction Proneness Scale (E-SAPS18)

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Abstract

The aim of this paper is to develop a shorter version of the Estonian Smartphone Addiction Proneness Scale based on previous works (e.g., Ching et al., 2015; Kwon, Lee, et al., 2013; Rozgonjuk, Rosenvald, & Täht, 2016). Seven hundred and sixty-seven people participated in the study (M_{age} = 26.10 ± 6.73 years; 22% male), for which they completed the Smartphone Addiction Scale (E-SAS-33; Rozgonjuk, Rosenvald, & Täht, 2016), the Estonian Internet Addiction Test (E-IAT; based on Young, 1998), and the Visual Analogue Scale (VAS; Kwon, Lee, et al., 2013). Exploratory factor analysis (maximum likelihood with geomin rotation) and confirmatory factor analysis (parameter estimation: maximum likelihood), an internal-consistency test, t- tests for mean comparisons, correlation analysis and experts' opinions were used to shorten the E-SAS-33 and validate a new version of the scale. The results of the analyses showed that the 18-item test with five subscales ("tolerance", "positive anticipation", "cyberspace-oriented relationships", "withdrawal", and "physical symptoms") has sound psychometric properties and that the content of the subscales is similar to the original. Among the results, statistically significant differences in E-SAPS18 scores were found in gender, age, level of education, smartphone main use and self-reported addiction. Furthermore, correlates suggest that smartphone addiction, social media use, and Internet addiction might share a similar underlying mechanism.

Keywords: Smartphone Addiction Proneness Scale; adaptation; validation; smartphone addiction

Introduction

Smartphones, as programmable digital devices, provide a level of functionlity comparable with personal computers (Raento, Oulasvirta, & Eagle, 2009). However, these digital technologies have the added benefit of allowing us to economize both time and money, to the extent that access to personal computers is quickly becoming irrelevant. In Estonia, contemporary smartphones, in addition to providing traditional phone call functions, may be used to conduct financial transactions, to check medical records, and even to participate in local and national elections – saying nothing of the use of smartphones as a resource for information and entertainment. According to Mawston (2015), the number of smartphone users around the world has surpassed 2 billion, meaning that a third of the Earth's population now has access to a device. Around 60% of the Estonian population now has access to a device, according to a recent national survey. The number is similar to the European mean smartphone usage ratio (Simisker, Kivilo, Aak, Jarv, & Kaal, 2014).

Smartphones have clearly brought us several advantages. However, during recent years, several detrimental aspects associated with smartphone use have been reported. For instance, excessive use of mobile digital technologies has been negatively linked to academic outcome and subjective well-being. A positive relationship has been reported with anxiety (Lepp, Barkley, & Karpinski, 2014), symptoms of stress, sleeping disorders, depression (Thomée, Härenstam, & Hagberg, 2011), and lower sleep quality (Yogesh, Abha, & Priyanka, 2014). Frequent smartphone users also tend to be in worse physical shape than those who use their smartphones less (Lepp, Barkley, Sanders, Rebold, & Gates, 2013). Moreover, according to Acharya, Acharya, and Waghrey (2013), the overuse of smartphones can cause headaches, irritability, anger, problems with concentration, and eye fatigue. It has also been reported that of all traffic accidents approximately 22% are caused by secondary activities, such as using digital technologies while driving or when crossing the road as a pedestrian (Klauer, Dingus, Neale, Sudweeks, & Ramsey, 2006). Indeed, the risk for drivers to be involved in traffic accidents is significantly higher if they engage in distracting activities, such as smartphone use, while driving (Dingus et al., 2016).

As such, even though smartphones provide us with many luxuries – which were unthinkable 50 years ago - there are clear issues with respect to smartphone use that must be addressed. The aforementioned detrimental effects of smartphone use mainly affect those who problematically overuse digital technologies; therefore, it is the topic of smartphone addiction proneness which is central to this paper.

Smartphone Overuse and Addiction

Many people casually consider themselves as "being addicted" when they enjoy something they do or when they feel they do something quite frequently. Yet, in clinical terms, addictions manifest themselves as issues with tolerance, withdrawal, dependence, and as social problems (Holden, 2001; Kwon, Lee, et al., 2013). Addictions can be divided into two categories: addictions caused by psychoactive substances (e.g., abuse of alcohol or drugs) and those which are behavioural (e.g., videogaming, shopping, and Internet addiction; Kim & Kim, 2002) - even though, in the past, the term 'addiction' has been primarily associated with substance abuse, the impact of technology on the everyday lives of most people has led to the association of addiction with behavioral concepts (Kim et al., 2006; Kim et al., 2016; Kwon, Lee, et al., 2013). Despite this development in conceptualizing addiction, there are no officially recognized diagnostic criteria for smartphone addiction (Noyan, Darçin, Nurmedov, Yılmaz, & Dilbaz, 2014). Accordingly, it has been debated whether or not smartphone addiction should be listed as a mental disorder in the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5; American Psychiatric Association [APA], 2013). Proponents for its inclusion base their arguments on the idea that uncontrollable and too frequent smartphone use may lead to social, behavioural, and emotional problems (Choliz, 2010). Conversely, as with Internet addiction, it is unclear if smartphone addiction indicates an underlying disorder or whether it is a discrete disease entity. This might also raise the question of causality in the context of comorbidity (Pies, 2009). As with Internet addiction, smartphone addiction might be a secondary manifestation of other psychological disorders, such as depression and anxiety. In addition, Billieux, Maurage, Lopez-Fernandez, Kuss, and Griffiths (2015) criticize the symptom-based addiction model because it could lead to the oversimplification of an individual's psychological processes, which might be accompanied by non-relevant standardized treatments. Altogether, the latest version of the DSM does not include smartphone addiction as a separate disorder (APA, 2013). This fact, of course, does not necessarily mean that no such behavioral disorder exists. It simply implies that, currently, the construct of this behavioral addiction remains unclear. Naturally, it will take time to understand the full impact of smartphones. Firstly, because the technology itself is relatively novel and, secondly, because the impact needs to be carefully observed in the context of our contemporary, increasingly globalized world. In fact, Tossel, Kortum, Shepard, Rahmati, and Zhong (2015) have emphasized that the term *smartphone addiction* might be somewhat misleading, as it is not a currently diagnosable disorder. Furthermore, it has been claimed that there is too little evidence to suggest that smartphone use (or overuse) has similar impacts on the neurological and psychological mechanisms as the impacts observed with other behavioral and substance-related disorders (Billieux et al., 2015). Therefore, rather than use the term *smartphone addiction*, the use of other terms such as *smartphone overuse, problematic smartphone use*, or *compulsive smartphone use* has been advised (Ching et al., 2015; Lepp et al., 2013).

An additional question relates to whether smartphone addiction should be considered a behavioural addiction or as an addiction to the device, which adds further confusion to the construct. In the literature, emphasis is

placed on the activity rather than on the device; different scales that measure smartphone addiction (Kwon, Lee, et al., 2013; Ching et al., 2015; Lin et al., 2015) mainly measure the harmful aspects of *using* smartphones in a problematic manner. Even though there are some items in smartphone addiction (proneness) scales that do not explicitly ask about the addictive aspects of smartphone use as an activity, the construct as a whole could still be regarded as a proneness to behavioural addiction. The assertion is supported by the terminological debate discussed in the previous paragraph (Ching et al., 2015; Lepp et al., 2013).

Despite the critique, the term smartphone addiction is still widely used in scientific literature to describe and explain the problematic disturbances to everyday life associated with excessive smartphone use (e.g., Ching et al., 2015; Lin et al., 2015; Lopez-Fernandez, 2015). The use of *addiction* in this context may be explained and justified to some extent through the application of an addiction-related conceptual approach when studying the phenomenon. In fact, recently, Lin et al. (2015) were the first to develop a version of the diagnostic criteria for psychiatric assessment of smartphone addiction, including (a) eight potential symptoms, (b) three dysfunctions, and (c) exclusion criteria. In (a), the symptoms are similar to those of other behavioural addictions, such as tolerance, withdrawal, overuse, *et cetera* (to see full list, see Lin et al., 2015); the three dysfunctions in (b) are physical or psychological problems which result in smartphone overuse: using a smartphone in (physically) hazardous situations, and jeopardizing or losing significant functionality in relationships, in the workplace, or at school due to smartphone use; the exclusion criteria in (c) are associated with those individuals for which obsessive-compulsive disorder or bipolar disorder can better account for their behaviour.

Along with the symptoms and criteria prominent in smartphone addiction, there are additional reasons why studying the phenomenon is important. Even though Internet Addiction was not included in the DSM-5 (nor Smartphone Addiction), Internet Gaming Disorder was enlisted under *Conditions for further study* (APA, 2013). This shows that, to some extent, technological addictions are still considered to be of interest. Smartphones are relatively new technologies that might be used as platforms for Internet browsing, communication (texting, phone calls, video calls), social media use, gaming, and other applications that ought to bring ease to daily activities; therefore, they encourage problematic behaviour. Whether Internet addiction should be perceived as a disorder or not has been debated since the mid-nineties. It might be premature to exclude smartphone addiction as a condition that requires further study, as these devices can be used for numerous purposes yet unexplored, and the usage of smartphones has substantially increased during recent years (see Fox & Rainie [2014], for the rise of smartphone use during 2011-2014 in the U.S.). At this point, relatively little is known about the impact of smartphone use.

It should also be noted that the relevance of smartphone addiction research is present in publications in peer-reviewed and relatively influential journals in the field of addiction research (e.g., *Addictive Behaviours, Journal of Psychiatric Research, Journal of Behavioral Addictions*). Additionally, the smartphone addiction proneness scales devised in different cultures show similar components and have been replicated both in Asian (Ching et al., 2015; Kim, Lee, Lee, Nam, & Chung, 2014; Lin et al., 2014) and Western (Haug et al., 2015; Lopez- Fernandez, 2015) cultural settings. Furthermore, the literature on smartphone addiction and its relationship with mental health, academic outcomes, and other behavioural and psychological characteristics, such as personality traits, is expanding (e.g., Bian & Leung, 2015; Enez Darcin et al., 2016; Samaha & Hawi, 2016; Yu & Son, 2016). This means it would be reasonable to continue the research on smartphone addiction proneness as the influence of these technologies and relationships with human behaviour and other outcomes is relatively unknown. It might be that smartphone addiction proneness will be considered as a disorder or a condition for further study in the next editions of the DSM or ICD – by that time, there should be more convincing evidence to either propose or oppose the condition. Currently, however, the requirement for the research exists, and the development of (self-report) scales, such as that proposed in the current paper, should be regarded as necessary.

Measuring Smartphone Addiction Proneness with Self-Reports

Despite not being listed as a disorder in the DSM-5, some work has been done to study the association of these digital technologies with everyday life. The research on problematic aspects of smartphone use was preceded by studies on their technological predecessors, mobile phones. Many self-report scales were created in order to study problematic mobile phone use (e.g., Billieux, Van der Linden, & Rochat, 2008; Rutland, Sheets, & Young, 2007; Toda, Monden, Kubo, & Morimoto, 2004; see Billieux, 2012, for a review). Recently, however, research has

also been conducted on smartphone-specific measurement tools; the research is at best limited. The first and, according to scientific citations, most influential instrument to measure smartphone addiction was devised by Kwon, Lee, et al. (2013). The authors argued that because using the Internet in general and using the Internet on smartphones is, in essence, highly similar, the symptoms of smartphone addiction ought to be similar as well; however, this may not be the case. Using the Internet on a smartphone is different from using the Internet more generally. This is true for several reasons: pocket-sized smartphones have a small screen, various applications, increased availability of the Internet due to their mobility, and generally, smartphone usage is flexible in time and space (Nielsen & Fjuk, 2010). As such, Kwon, Lee, et al. (2013) devised the Smartphone Addiction Scale (SAS), based on the Internet Addiction Test (IAT; Young, 1998). As part of the process, items for Internet usage were adjusted accordingly to suit smartphone usage. The psychometric properties of the 33-item SAS, which covered six subscales, were well-established. Additionally, Kwon, Kim, Cho, and Yang (2013) devised a shorter version of the SAS, the SAS-SV. Together, these questionnaires have been adapted to several cultural settings (see Table 1).

As can be seen in Table 1, the questionnaires vary in length and the number of subscales used; however, their internal validity is sound, with Cronbach's α ranging from .87 to .97. Additionally, principal component analysis was used throughout their design processes. This should be kept in mind, as the range of explained variability of these scales ranges from 49.3% (Lopez-Fernandez, 2015) to 66.4% (Demirci, Orhan, Demirdas, Akpınar, & Sert, 2014).

It has been suggested that the scale could be unidimensional. Based on the original SAS (Kwon, Lee, et al., 2013), Noyan et al. (2014), Lopez-Fernandez (2015), and Haug et al. (2015) have devised or adapted a 10-item SAS which may be used to measure a single dimension: excessive smartphone usage. This approach shares similarities with the multi-dimensional scales, as the items used are the same as in Kwon, Lee, et al. (2013) – ten of them, to be specific. Alternatively, this could be thought of as measuring the construct of smartphone addiction, and a longer questionnaire provides the possibility to measure its different facets. The latter solution could provide the information which is not covered by short versions of the SAS, and it is this information which could lead to a better understanding of the currently, theoretically, poorly-defined concept of smartphone addiction (Billieux et al., 2015).

Probably the most eminent aspects of an addiction are withdrawal, tolerance, and daily-life disturbance. In scales that measure smartphone addiction, withdrawal manifests a state of negative affect and dis-ease when using a smartphone is not possible (Kwon, Lee, et al., 2013). Tolerance, on the other hand, could be observed as a condition in which the need for using a smartphone increases with time. Daily-life disturbance is described as smartphone use related discomfort and disturbance in sleep and physical pain (e.g., in wrists or in the neck); Demirci et al. (2014) have also called this component *Physical symptoms* which is more self-explanatory. Some works (Ching et al., 2015; Demirci et al., 2014; Kim et al., 2014; Kwon, Lee, et al., 2013) have used other components, such as cyberspace-oriented relationships, according to which it is preferable to use cyberspace as a channel for communication instead of socializing face-to-face. Also, positive anticipation has been reported in several scales (Ching et al., 2015; Demirci et al., 2014; Kwon, Lee, et al., 2013). The shorter unidimensional scales, in essence, consists of single items from these components; yet, in unidimensional approaches, it would not be possible to reliably measure the impact of each component separately. Here, the use of multidimensional scales could potentially expand the understanding of multiple facets of smartphone addiction. Finally, it should be acknowledged that recent advances in technology, especially in terms of computation, provide additional possibilities to measure smartphone use and potential addiction, using specific smartphone applications (Lin et al., 2015; Montag et al., 2015). These applications can, for example, provide insight into smartphone usage frequency, usage time, and other characteristics associated with smartphone use. However, to distinguish between smartphone addicts and regular users, these methods are usually time-consuming. A self-report measure is in this example a time-efficient alternative to screen for potentially addicted individuals.

Aim of the Study

As the number of smartphone users grows, potential problems associated with their use may increase. To assess these problems, an instrument to measure their detrimental effects is needed. Therefore, the aim of this study is to devise a relatively short (yet informative and valid) test that might discriminate between normal smartphone users and those with symptoms of addiction proneness.

Table 1. *Smartphone Addiction Measurement Instruments Devised until 2015.*

Study	Name of the scale	Language	Sample	Dimensions	N of items	Total scale Cronbach α
Kwon, Lee, et al. (2013)	Smartphone Addiction Scale	Korean	197 adults	daily-life disturbance, positive anticipation, withdrawal, cyberspace-oriented relationship, overuse, tolerance	33	.97
Kwon, Kim, Cho, & Yang (2013)	Smartphone Addiction Scale Short Version	Korean	540 adolescents	excessive smartphone usage	10	.91
Lin et al. (2014)	Smartphone Addiction Inventory	Chinese	283 university students	compulsive behavior, functional impairment, withdrawal, tolerance	26	.94
Kim, Lee, Lee, Nam, & Chung (2014)	Korean Smartphone Addiction Proneness Scale	Korean	795 school students	disturbance of adaptive functions, virtual life orientation, withdrawal, tolerance	15	.88
Demirci, Orhan, Demirdas, Akpınar, & Sert (2014)	Smartphone Addiction Scale	Turkish	330 university students	disturbing daily life and tolerance, withdrawal symptoms, positive anticipation, cyberspace-oriented relationships, overuse, social network dependence, physical symptoms	33	.95
Noyan, Darçın, Nurmedov, Yılmaz, & Dilbaz (2015)	Smartphone Addiction Scale short version	Turkish	367 university students	excessive smartphone usage	10	.87
Lopez-Fernandez (2015)*	Smartphone Addiction Scale short version	French/ Spanish	144/281 university students	excessive smartphone usage	10	.88/.90
Ching et al. (2015)	Malaysian Smart Phone Addiction Scale	Malay	228 university students	cyberspace-oriented relationship, daily life disturbance, primacy, overuse, positive anticipation, withdrawal	33	.94
Haug et al. (2015)	Smartphone Addiction Scale for Adolescents	German	1519 vocational school students	excessive smartphone usage	10	.85

***Notes*:** * = The study by Lopez-Fernandez (2015) was conducted in two regions, Belgium and Spain. The values before the slash represent the results for Belgian sample, the values after the slash represent the results for Spanish sample, respectively. No slash implies that the values are the same for both regions.

The Estonian Smartphone Addiction Scale (E-SAS-33) is based on the Smartphone Addiction Scale by Kwon, Lee, et al. (2013), which has been translated into Estonian and adapted (Rozgonjuk, Rosenvald, & Täht, 2016). As shown in Table 1, little work has been done in Western cultures with respect to smartphone addiction, and the current work extends the literature in this respect. The aim of the current study is to develop a shorter version of

the E-SAS: the Estonian Smartphone Addiction Proneness Scale (E-SAPS18). In order to do that, we use both experts' opinions and statistical approaches.

Method

Participants and Procedure

We recruited participants mainly through public social media posts and university mailing lists; we also asked to share these posts and e-mails in order to recruit more participants. Prior to their participation, participants were provided with an informed consent form which specified the nature of the study and informed them that their participation was in accordance with the principals of confidentiality.

Seven hundred and sixty-seven adults (female 77.8%; M_{age} = 26.10 ± 6.73 years, age range: 18-71 years) participated in the study. The socio-demographics of the *participants* are presented in Table 3.

Measures

The survey consisted of five questionnaires that are briefly described bellow:

1) The overall socio-demographics contained questions regarding gender, age, education, etc.

2) Questions regarding smartphone use. Participants were asked about what they usually use their smartphone for (*Social media*; *Phone calls*; *Internet*; *E-mails*; *SMS*; *Games*; *Photos*; *Other*) and their subjective evaluation for smartphone addiction, or agreement with the statement "I have smartphone addiction" (1 = *strongly disagree* … 5 = *strongly agree*; *M* = 2.70, *SD* = 1.19).

3) Visual Analogue Scale (VAS). Kwon, Lee, et al. (2013) implemented a 5-item VAS in order to assess the subjective severity of smartphone addiction. Each item from VAS was in accordance with a relevant subscale of the SAS. In this paper, we used a translated version of the VAS, used by Kwon, Lee, et al. (2013). A slider was used on a scale from 1 to 100 to estimate the subjective severity of symptoms of smartphone addiction. The items in the current study differ from those of Kwon, Lee, et al. (2013) in two ways. Firstly, Kwon, Lee, et al. (2013) used a 10-point scale; whereas, in this paper a slider with a scale that ranged from 0 to 100 was used. Secondly, the items that corresponded only to five factors in the E-SAPS18 were included in the VAS. The following items were used (see Table 3 for means and standard deviations):

1. How much does smartphone usage disrupt your everyday life? (0 = *not at all* … 100 = *very severely*)

2. How much are you anticipating the usage of your smartphone? (0 = *do not anticipate at all* … 100 = *anticipating a lot*)

3. How poorly are you feeling yourself when you cannot use your smartphone? (0 = *not at all poorly* … 100 = *very poorly*)

4. How positively do you evaluate the relationships initiated through smartphone? (0 = *very positive* … 100 = *not at all positive*)

5. How does the usage of your smartphone grow in time? (0 = *does not grow at all* … 100 = *grows very fast*)

4) Estonian Internet Addiction Test (E-IAT). The original IAT was devised by Young (1998), and it has since been one of the most frequently used instruments to measure Internet addiction (Ching et al., 2015). The IAT is a self-report questionnaire that consists of 20 items which measure the frequency of Internet addiction symptoms on a 5-point Likert scale (1 = *not at all* … 5 = *always*; *M* = 43.44, *SD* = 10.98 for the sample of this study). The scores of all items are summed to a single index of Internet addiction; hence, the theoretical range of scores varies from

20 to 100; the higher the score the more problematic the Internet use. The Estonian IAT was adapted by Raudsepp (2012). The E-IAT was shown to be psychometrically sound (Cronbach α for the scale was .88; Cronbach's α = .89 for the sample of the current study).

5) Estonian Smartphone Addiction Scale (E-SAS-33). Smartphone addiction was assessed with the SAS devised by Kwon, Lee, et al. (2013). The original 33-item self-report instrument used a 6-point Likert scale (1 = *strongly disagree* … 6 = *strongly agree*) to estimate the extent of symptoms of smartphone addiction; it is believed that the higher the score the more addicted the person. It was devised and validated in a sample of 197 adults (64 male, 133 female) from Korea, with ages ranging from 18 to 53 years (*M* = 26.06; *SD* = 5.96). The instrument was internally consistent and had verified concurrent validity (Cronbach's alpha = 0.97); also, the questionnaire and its subscales were significantly correlated with E-IAT and Visual Analogue Scales. The subscales of the scale included "daily-life disturbance", "positive anticipation", "withdrawal", "cyberspace-oriented relationship", "overuse", and "tolerance".

The Estonian Smartphone Addiction Scale with 33 items, or the E-SAS-33, is based on the Korean SAS. However, one of the aims of this research was to devise a shorter questionnaire that still addresses similar content areas as in the Korean SAS; therefore, firstly the 33-item scale was adapted to Estonian, and we used the same sample for the current study to develop a shorter version of the scale.

All 33 items which were selected from the Korean SAS (Kwon, Kim, et al., 2013) were translated into Estonian by a professional English-Estonian translator and were reviewed by a professional Estonian philologist. The questionnaire was then translated back into English by another professional translator, and the back-translated English version was reviewed by a native English-speaking psychology professor in order to estimate the content and the similarities between the original and the back-translated items. The scores of items were summed, with theoretical range from 33 to 198 (*M* = 73.78, *SD* = 19.11), Cronbach's alpha for the scale was .91 and correlation with E-IAT was .62 (Rozgonjuk, Rosenvald, & Täht, 2016). Similar to the original scale by Kwon, Lee, et al. (2013), six subscales were identified using factor analysis for the E-SAS-33 (Cronbach's alphas for subscales are presented in parentheses): "Tolerance and daily-life disturbance" (.86), "Cyberspace-oriented relationships" (.77), "Positive anticipation" (.75), "Withdrawal and overuse" (.75), "Importance" (.71), and "Physical symptoms" (.68).

Statistical Analysis

SPSS v22.0 and Mplus 7 were used for statistical analyses. To assess the construct validity of the E-SAPS18, exploratory factor analysis (in Mplus) with maximum likelihood factoring for extracting factors was used in this paper. For rotation of factor-solution geomin rotation was used. This last decision was based on the theoretical expectation of correlated factors (Kwon, Lee, et al., 2013). We also applied confirmatory factor analysis on a gender-balanced sample (matching the number of male participants by randomly assigning matches from the female group) to measure how well the variables represent the number of constructs. We used the following four measures of model fit: the chi-square index (χ^2), the comparative fit index (CFI), root mean square error of approximation (RMSEA), and standardized root mean square residual (SRMR). The homogeneity of the E-SAPS18 and its subscales were tested with Cronbach α. The concurrent validity was analyzed with Pearson correlation coefficients between the E-SAPS18, the E-IAT, the subscales of E-SAPS18, and the VAS. Intergroup differences in the E-SAPS18, overall smartphone usage habits, and socio-demographics were analyzed with independent samples t-tests and one-way ANOVAs with Scheffe's *post hoc* tests.

Results

The Reliability and Factor Structure of E-SAPS18

The original scale (E-SAS-33) contained 7 items which had factor loadings lower than .4. At first these 7 items were left out from further analysis. In order to shorten the scale, the 26 items of the initial version of the E-SAS-33 were reviewed by mental health specialists (a psychiatrist specialising in addiction disorders, and a clinical psychologist) who advised the selection of items that were relevant in terms of addiction. Exploratory factor analysis (maximum likelihood factoring with geomin rotation) with parallel analysis showed that the five factor

solution fits to describe correlations between 18 indices remained in the questionnaire. Fit indices of the five factor model were: χ^2 = 131, *df* = 73, *p* < .001. RMSEA = .032 (95% CI: .023 and .041), CFI = .99, and SRMR = .016.

The psychometric properties of the scale, along with the items, are presented in Table 2. The scale showed good internal reliability (Cronbach's α = .87). The subscales of this solution are: F1: "tolerance", F2: "positive anticipation" F3: "cyberspace-oriented relationships", F4: "withdrawal", and F5: "physical symptoms". These subscales are comparable to those of Kwon, Lee, et al., 2013. The subscale "Overuse" was not used because one of the items (*e6*) loaded to "tolerance" and does, indeed, fit conceptually as a symptom of tolerance; the factor loadings of other items were too low to be included in the model. Table 2 presents the factor solution along with reliability statistics, means and standard deviations of subscales.

Table 2. *Factor Analysis of E-SAPS18*.

		Factor				
	Item	**F1**	**F2**	**F3**	**F4**	**F5**
e1	Always thinking that I should shorten my smartphone use time (32)	.60				
e2	Having tried time and again to shorten my smartphone use time, but failing all the time (31)	.71				
e3	Feeling the urge to use my smartphone again right after I stopped using it (30)	.65				
e4	The people around me tell me that I use my smartphone too much (33)	.77				
e5	Missing planned work due to smartphone use (1)	.64				
e6	Using my smartphone longer than I had intended (29)	.60				
e7	There is nothing more fun to do than using my smartphone (10)		.88			
e8	My life would be empty without my smartphone (11)		.46			
e9	Using a smartphone is most fun thing to do (13)		.44			
e10	Feeling that my smartphone buddies understand me better than my real life friends (23)			.81		
e11	Feeling that my relationships with my smartphone buddies are more intimate than my relationships with my real-life friends (21)			.75		
e12	Preferring talking with my smartphone buddies to hanging out with my real-life friends or with the members of my family (26)			.50		
e13	Won't be able to stand not having a smartphone (14)				.84	
e14	I will never give up using my smartphone even when my daily life is already greatly affected by it (17)				.58	
e15	Feeling impatient and fretful when I am not holding my smartphone (15)				.53	
e16	Feeling pain in wrists or at the back of the neck while using smartphone (4)					.69
e17	Experiencing lightheadedness or blurred vision due to excessive smartphone use (3)					.61
e18	Feeling tired and lacking adequate sleep due to excessive smartphone use (5)					.45
	Subscale M	14.9	4.2	4.3	6.7	6.0
	Subscale SD	6.1	1.9	2.0	2.9	2.8
	Cronbach's α	.82	.71	.74	.76	.68

Notes: Extraction method: Maximum Likelihood. Rotation method: Geomin. Factor loadings below .40 are not displayed. F1= "tolerance", F2 = "positive anticipation", F3 = "cyberspace-oriented relationships", F4 = "withdrawal", F5 = "physical symptoms".* significant at *p* < .05; ** significant at *p* < .01; *** significant at *p* < .001.

Additionally, confirmatory factor analysis (CFA) was conducted to test if this five-factor model fits to the data. Firstly, the sample for the analysis was balanced by genders by randomly selecting a subsample from the female sample to match the amount of male participants (*N* = 170 for both groups, *N* = 340 for the whole sample for CFA). We used maximum likelihood as the parameter estimation method. The fit indices obtained from the

analysis provided further evidence for the fit of a five-factor solution, even when balanced by gender, χ^2 = 269, *df* = 125, *p* < .001. RMSEA = .058 (95% CI: .049 and .068), CFI = .93, and SRMR = .056. Figure 1 illustrates the results of CFA.

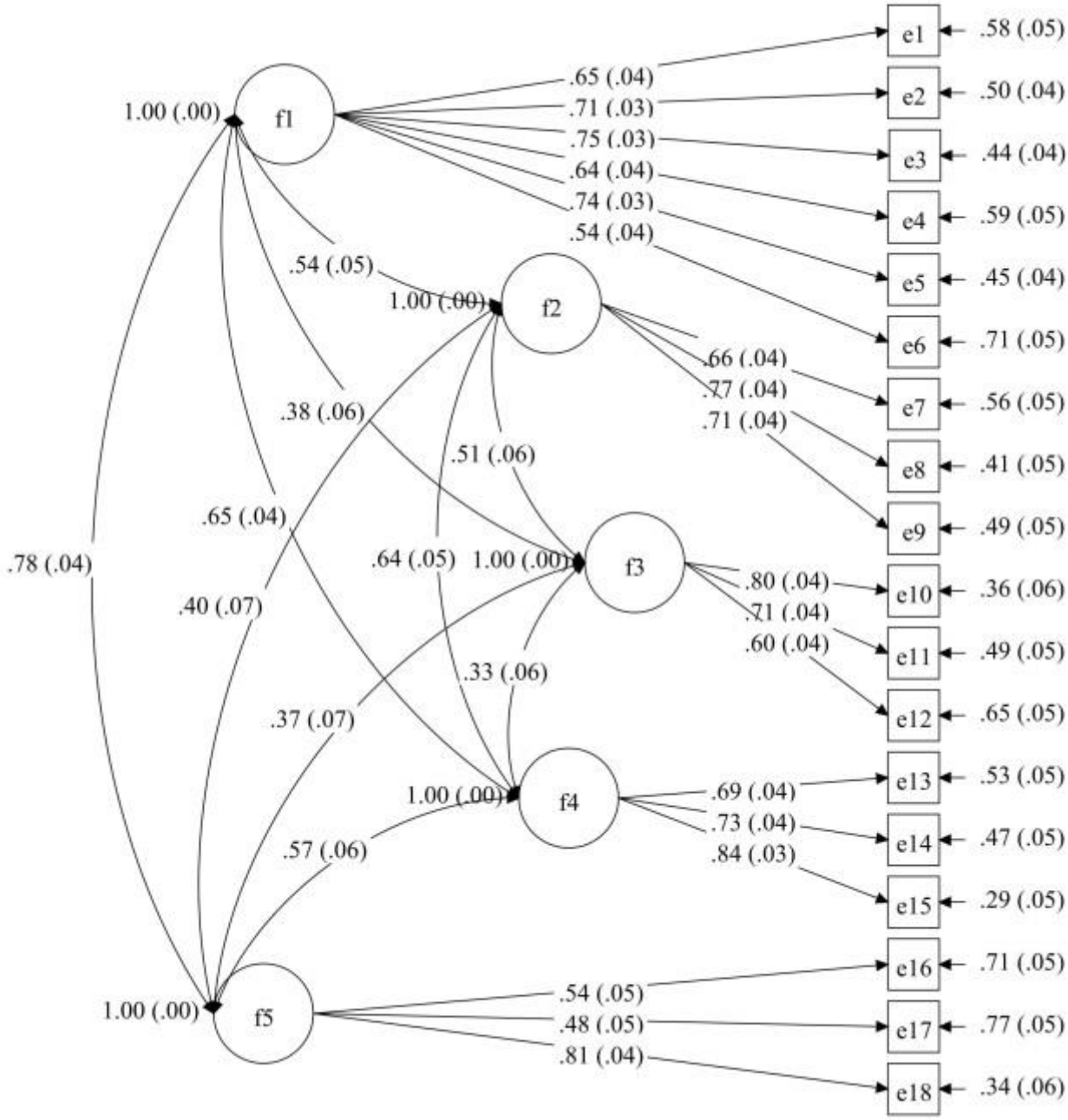

Figure 1. The results of confirmatory factor analysis of E-SAPS18 performed on half of the sample. Confirmatory factor analysis balanced by gender. Parameter estimation method: maximum likelihood. N = 340. Fit indices: χ^2 = 269, df = 125, p < .001. RMSEA = .058 (95% CI: .049 and .068), CFI = .93, and SRMR = .056. Both the factor names (f1 to f5) and corresponding items (e1 to e18) can be found in Table 2.

Concurrent Validity of E-SAPS18

The scores of the E-SAPS18 were summed, with a theoretical range from 18 to 108 (*M* = 38.06, *SD* = 9.62). The Pearson correlation coefficient between the E-SAPS18 and E-IAT was *r* = .59, *p* < .001. The correlations between the subscales and the Visual Analogue Scale (VAS) are shown in Table 3. As can be seen in Table 3, the correlations between the total VAS score, and the subscales and total score of the E-SAPS18 yield medium-to-very-high effect sizes. However, in some cases, the correlations between single VAS items and their corresponding E-SAPS18 subscales are not the highest in comparison with other VAS items. The lowest

correlation, though statistically significant, was between VAS item and its respective factor of cyberspace-oriented relationships.

Table 3. *Correlations Between VAS Item Scores and E-SAPS18 Subscales*.

	***M* (*SD*)**	**F1 tolerance**	**F2 positive anticipation**	**F3 cyberspace-oriented relationships**	**F4 withdrawal**	**F5 physical symptoms**	**E-SAPS18 total score**
VAS1: How does the usage of your smartphone grow in time?	24.13 (22.10)	**.50*****	.26***	.27***	.28***	.42***	.46***
VAS2: How much are you anticipating the usage of your smartphone?	33.31 (24.84)	.57***	**.33*****	.31***	.45***	.41***	.58***
VAS3: How positively do you evaluate the relationships initiated through smartphone?	47.02 (21.90)	-.01	.05	**-.08****	.12***	-.01	-.11**
VAS4: How poorly are you feeling yourself when you cannot use your smartphone?	30.50 (26.46)	.51***	.30***	.28***	**.58*****	.36***	.58***
VAS5: How much does smartphone usage disrupt your everyday life?	26.36 (25.01)	.57***	.19***	.23***	.19***	**.45*****	.38***
VAS total	32.27 (15.08)	.70***	.34***	.33***	.46***	.53***	.63***

Notes: *N* = 767. VAS = *Visual Analogue Scale*; F1 to F5 = subscales of E-SAPS18. * significant at $p < .05$; ** significant at $p < .01$; *** significant at $p < .001$. Correlations in **bold** represent the relationships between VAS items with their respective subscales.

One-way ANOVAs were used in order to analyze the group differences in the E-SAPS18 scores. The means of the E-SAPS18 score by socio-demographic characteristics, main use of smartphone and self-reported addiction are presented in Table 4.

Clear intergroup differences can be observed between the extent of agreement with the self-reported smartphone addiction statement "*I have smartphone addiction*" and the E-SAPS18 mean score. In other words, there is a statistically significant group difference in E-SAPS18 mean score between the levels of agreement with self-reported smartphone addiction, $F(4,762) = 96.825$, $p < .001$. The more the participants agreed with the statement, the higher was their E-SAPS18 score. Additionally, we tested the differences in E-SAPS18 score for those who either strongly agreed or strongly disagreed with the statement and found the difference to be large, $t(179) = 14.34$, $p < .001$, $d = 2.8$.

There were statistically significant differences in gender, female participants having higher E-SAPS18 scores than men, $t(765) = -3.057$, $p = .002$. Additionally, differences in the E-SAPS18 score could be observed in age groups ($F(5,766) = 3.517$, $p = .004$), level of education ($F(4,766) = 4.070$, $p = .003$) and main use of smartphone ($F(7,759) = 19.934$, $p < .001$). *Post hoc* analysis showed that E-SAPS18 scores were highest among those participants who

reported social media use as the main activity they carried out using their smartphone. Statistically significant differences were between social media use and other means of communication that could be conducted via smartphone (phone calls, e-mailing, SMS; see Table 4).

Table 4. *The Characteristics of the Study Participants*.

Socio-demographics	N (%)	E-SAPS18 mean ± SD	*p*
Gender			.002
a.Male	170 (22.2 %)	33.33 ± 9.95[b]	
b.Female	597 (77.8 %)	36.20 ± 11.09[a]	
Age			.004
a. 18 – 20 years	132 (17.2 %)	38.56 ± 11.29[d]	
b. 21 – 25 years	314 (40.9 %)	36.18 ± 10.24	
c. 26 – 30 years	173 (22.6 %)	35.19 ± 10.31	
d. 31 – 35 years	75 (9.8 %)	31.60 ± 9.61[a]	
e. 36 – 40 years	38 (5.0 %)	32.97 ± 11.14	
f. >41 years	35 (4.6 %)	31.94 ± 10.61	
Level of education			.003
a. Basic education	22 (3%)	44.45 ± 15.06[bcd]	
b. Secondary education	379 (49.4 %)	35.38 ± 10.62[a]	
c. Bachelor's degree	229 (29.9 %)	35.94 ± 10.72[a]	
d. Master's or Doctoral degree	123 (16 %)	34.01 ± 10.64[a]	
Main use			< .001
a. Social media	335 (43.7%)	40.27 ± 11.03[bde]	
b. Phone calls	253 (33.0 %)	30.08 ± 8.73[a]	
c. Internet	77 (10.0 %)	34.10 ± 9.22	
d. E-mails	35 (4.6 %)	31.80 ± 9.28[a]	
e. SMS	18 (2.3 %)	34.72 ± 9.24[a]	
f. Games	10 (1.3 %)	36.10 ± 12.51	
g. Photos	9 (1.2 %)	37.67 ±10.09	
h. Other	30 (3.9 %)	37.07 ± 9.19	
Self-reported addiction			< .001
a. Strongly disagree	135 (17.6 %)	25.38 ± 5.86[bcde]	
b. Disagree	247 (32.2 %)	32.49 ± 7.95[acde]	
c. Unsure	147 (19.2 %)	36.81 ± 8.09[abde]	
d. Agree	192 (25 %)	43.15 ± 10.37[abce]	
e. Strongly agree	46 (6 %)	50.46 ± 11.36[abcd]	

***Notes*:** Scheffe *post hoc* test: [a, b] = notes with similar letters were significantly different in their respective category (in all statistically significant cases $p < .01$).

Discussion

The aim of this study was to develop a shorter version of the Estonian Smartphone Addiction Proneness Scale (E-SAPS18) based on the Smartphone Addiction Scale by Kwon, Lee, et al. (2013). In order to evaluate the internal consistency and reliability, concurrent and construct validity, and dimensionality of the E-SAPS18, both experts' opinions and quantitative approaches were used.

The Structure of E-SAPS18

The results showed that an 18-item Estonian Smartphone Addiction Proneness Scale has five subscales with reasonable psychometric properties. The subscales of the E-SAPS18 were similar to those of previous studies which used 33 items in their inventories. There were two main differences between the original 33-item scale and the current 18-item scale; in the latter one, only five subscales were identified: (1) "Tolerance", (2) "Positive anticipation", (3) "Cyberspace-oriented relationships", (4) "Withdrawal", and (5) "Physical symptoms". The subscale "Overuse" (Kwon, Lee, et al., 2013; Ching et al., 2015) was not used; instead, one of the items (*e6* in Table 2) loaded to "Tolerance" and other items had either factor loadings which were too low to be included or were, according to expert opinions, not referring to symptoms of addiction. The second difference between the longer and shorter scales relates to terminology. The E-SAPS18 uses the term "Physical symptoms"; whereas, in other works the term "Daily-life disturbances" is used. We propose that, as these items inquire as to the physical discomfort associated with smartphone use, it is reasonable to use the term "Physical symptoms"; however, it should be emphasized that we are talking conceptually about a manifestation of daily-life disturbances.

An important topic concerns itself with whether or not smartphone addiction proneness ought to be conceptualized as a uni- or multidimensional scale. In this study, we identified five subscales based on the frequency of occurrence of self-reported, problematic, smartphone-overuse-symptoms, as measured with the E-SAPS18; yet, the means in our analyses were reported for the whole scale. This demonstrated that even though it is theoretically possible to measure smartphone addiction as a unidimensional construct (as carried out by other studies in Table 1), smartphone addiction most likely consists of many symptomatic dimensions.

The Reliability of E-SAPS18

According to the analyses, the internal consistency of the E-SAPS18 is very good (Cronbach's $\alpha = .87$). Even though this value is lower than that found in other, similar studies presented in Table 1, one must take into account the trade-off when the number of questionnaire items is decreased (Kline, 2013); in other words, as the E-SAPS18 consists of 18 items that address five content areas, the statistic could still be high with respect to its internal consistency.

The internal validity (Cronbach's α-s) for subscales of the E-SAPS18 ranged from .68 to .82. According to the accepted rule of thumb, these results are acceptable in terms of their reliability (Kline, 2013). The lowest Cronbach's α was for the subscale *Physical symptoms*; this subscale has also been shown to have lower internal consistency in the study by Demirci et al. (2014; Cronbach's $\alpha = .57$). These results allow us to consider the E-SAPS18 as a reliable instrument for measuring the propensities for smartphone addiction.

The Validity of the E-SAPS18

According to a nationwide survey in Estonia, around 85% of respondents used the Internet on their smartphones (Simisker et al., 2014). This means that Internet addiction might be a suitable proxy for checking concurrent smartphone addiction. In addition, several applications used in smartphones (such as social networking apps, games, etc.) require use of the Internet. Both the scores of the E-SAPS18 and the Estonian Internet Addiction Test (E-IAT) were highly and significantly correlated in this study. Therefore, it may indeed be the case that Internet addiction is a suitable proxy for checking concurrent smartphone addiction. These results are in accordance with the study by Ching et al. (2015), in which the correlation between SAS and IAT was $r = .65$, $p < .01$.

To check the concurrent validity of the E-SAPS18, three other measures were used: the Visual Analogue Scale (VAS), extent of agreement with a self-reported addiction statement, and self-reported main use of smartphone. The VAS items were significantly correlated with their corresponding factors in the E-SAPS18. As the findings show, the relationships between the VAS total score, the E-SAPS18 subscales and the E-SAPS18 total score are medium-to-very-high. These results are in accordance with Kwon, Lee, et al. (2013). However, it should be noted that on a single item level, not all VAS items showed sound relationships with their respective subscales. The smallest correlation was between the VAS item that asked about initiating online relationships and the E-SAPS18 subscale "cyberspace-oriented relationships". A potential explanation for this could be that the VAS item

addressed the idea of *initating new* relationships, while the items in the subscale referred to *existing* relationships. The difference could be reflected in the low effect size. A similar explanation may be applicable in other cases where correlations were low – it may have been that single items in the VAS were not suitable for validation; however, the results on the total score level provide evidence that, in terms of concurrent validity, the E-SAPS18 is a psychometrically valid instrument. Similarly, there were statistically significant relationships between the E-SAPS18 scores and self-reported addiction and smartphone use measures. These results provide additional evidence for the validity of the scale.

Intergroup Differences in the E-SAPS18 Scores

According to the extent of agreement with the self-reported smartphone addiction statement, those who totally agreed and totally disagreed with the statement differed in their E-SAPS18 score to a large extent. The association was such that participants who agreed more with having smartphone addiction had higher E-SAPS18 scores. To some extent this finding may indicate that people can be well-aware of their addictive tendencies toward smartphone use.

It has been found that women tend to be more prone to problematic smartphone use in comparison to men (Deursen, Bolle, Hegner, & Kommers, 2015). It might be that women are more socially oriented (Lee, Chang, Lin, & Cheng, 2014) and, therefore, that they tend to use social media more (Duggan & Brenner, 2013). Our results confirm these findings, as women were found to have higher E-SAPS18 scores than male participants. It can also be observed from Table 4 that when smartphones are mainly used for social media, E-SAPS18 scores are the highest. These findings are consistent with previous studies (e.g., Demirci et al., 2014). Yet, it ought to be emphasized that the sample was imbalanced in terms of gender, which may have biased both the results of the analysis and the subsequent interpretation.

It is interesting to note that participants who reported social media use as their main use for smartphones, scored, on average, the highest in the E-SAPS18 compared to those who reported using their smartphone mainly for phone calls, SMSing, or e-mailing. These findings are helpful in understanding who the excessive users of smartphones are, in terms of what they do on their phones and what might drive them to use their devices. Further studies should investigate these relationships more closely.

There were no differences in E-SAPS18 scores across educational levels, with the exception of participants whose highest educational achievements were at the level of basic education. In these cases, the E-SAPS18 scores tended to be higher than in other groups. This result is consistent with Kwon, Lee, et al. (2013), who suggest that the lower the educational level the higher the SAS score. The authors explained that people with lower education usually have less self-control; a lack of self-control has also been found to be a risk factor for computer gaming addiction (Kim, Namkoong, Ku, & Kim, 2008).

In light of previous results, differences in E-SAPS18 scores across age groups should not come as a surprise. Younger people tended to score higher in the E-SAPS18 than older participants. These findings indicate that young and lower-educated people are potentially the at-risk groups with respect to the development of addictive behaviours (especially in the case of smartphone addiction proneness). However, this interpretation should be made with caution, as the sample has described separately the differences in the E-SAPS18 mean score between levels of education and age groups. The relatively small number of participants with basic education could not allow us to distinguish between the effects of age over education (or vice versa) if analyzed together. Therefore, it would be wise for future studies to address the effects of digital technology use in children and adolescents, and also regarding the level of education.

Diagnosing Smartphone Addiction

As earlier discussed, there are no official diagnostic criteria for smartphone addiction. Lin et al. (2015) have provided one possible description of these criteria, including (a) eight potential symptoms, (b) three dysfunctions, and (c) exclusion criteria. It will probably take time until the definition of pathological smartphone addiction is officially introduced to the DSM and *International Classification of Diseases* (ICD) – even though at this

point, there is still some controversy surrounding the concept. Until then, instruments such as the E-SAPS18 might be useful in order to screen for individuals prone to problematic smartphone use.

Kwon, Lee, et al. (2013) provided no threshold with which higher scores indicate smartphone addiction. Yet, such a score would be extremely useful in diagnosis. Otherwise, it is difficult – if not impossible – to estimate the prevalence of smartphone addiction proneness in a given population. Some numbers, however, are provided from studies of mobile phone addiction. Eduardo et al. (2012) in their meta-analysis have found that, potentially, the proportion of mobile phone use addicts ranges from between 0 to 38 per cent. These findings from mobile phone use addiction studies clearly illustrate that the need for specifications and further research in the domain are necessary. In order to estimate the prevalence of smartphone addiction, therefore, specifications in the construct and addiction criteria, valid and norm-referenced instruments, and justified cut-off points are needed. However, suggesting a cut-off value is not within the scope of this study.

The Contribution and Limitations of the Study

Haug et al. (2015) have adapted the first Smartphone Addiction Scale for use in Western culture; however, the authors adapted a unidimensional version of the scale. In order to have a more extensive, multidimensional understanding of smartphone addiction proneness, the E-SAPS18 was devised by adapting the principles introduced by Kwon, Lee, et al. (2013). The E-SAPS18, therefore, is the first Smartphone Addiction Proneness Scale that covers several dimensions of the construct, while being considerably shorter than the original versions.

Previous studies have mainly examined smartphone addiction in adolescents or university students. Even though the sample size in this study is relatively large and also includes participants outside university, it should be noted that one has to interpret the results with caution, as the sample was not initially balanced by gender, and the sampling method applied might call for prudence in terms of generalization of the results to the wider population. Even though the sample was balanced by gender in confirmatory factor analysis, ideally a gender-balanced and more representative sample ought to be used in following studies to confirm the effects described in this study. However, as the majority of the results are congruent with the findings of previous research (carried out in other contexts – of which some also had similar problems; e.g., Ching et al., 2015; Kwon, Lee, et al., 2013; Kim, Lee, Lee, Nam, & Chung, 2014), the knowledge extracted from this paper contributes to the general understanding of the construct of smartphone addiction proneness.

In order to measure potential smartphone addiction, self-report measures were used. As shown by Lin et al. (2015), people do not estimate their actual smartphone usage accurately. It would be necessary to contrast the results of the E-SAPS18 with actual smartphone use in order to provide validating evidence for the questionnaire. The advantage of using the E-SAPS18 (compared to app-based data) is that the E-SAPS18 provides qualitatively meaningful information about the symptoms of addiction. Also, screening for potential smartphone addiction with the E-SAPS18 is less time-consuming.

Finally, it should be mentioned that the characteristics of smartphones, such as their model, make, size of the screen, energy consumption, etc., were not addressed nor accounted for in this study. It might be that these characteristics contribute to the emergence of different symptoms (e.g., when a person has a smaller phone it might be more difficult to operate, which may lead to problems with vision). It should be considered whether or not study participants had unlimited or limited Internet access also, as this may have defined the frequency of their Internet and social media use. This study focused on smartphones; yet, some people might use the same functionality in tablets (or *phablets*).

Conclusion

The development of a shorter and multidimensional instrument for measuring smartphone addiction was undertaken in this study. Analyses and expert suggestions have led to the conclusion that the E-SAPS18 is a psychometrically sound instrument, and it could be used to screen people who may potentially be addicted to smartphone use. This is the first questionnaire in a Western culture that addresses five dimensions (“tolerance”,

"positive anticipation", "cyberspace-oriented relationships", "withdrawal", and "physical symptoms") of smartphone addiction.

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