

Development of a Problematic Mobile Phone Use Scale for Turkish Adolescents

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Abstract

The aim of this study was to evaluate the psychometric properties of the Problematic Mobile Phone Use Scale (PMPUS) for Turkish Adolescents. The psychometric properties of PMPUS were tested in two separate sample groups that consisted of 950 Turkish high school students. The first sample group ($n=309$) was used to determine the factor structure of the scale. The second sample group ($n=461$) was used to test data conformity with the identified structure, discriminant validity and concurrent scale validity, internal consistency reliability calculations, and item statistics calculations. The results of exploratory factor analyses indicated that the scale had three factors: interference with negative effect, compulsion/persistence, and withdrawal/tolerance. The results showed that item and construct reliability values yielded satisfactory rates in general for the three-factor construct. On the other hand, the average variance extracted value remained below the scale value for three subscales. The scores for the scale significantly correlated with depression and loneliness. In addition, the discriminant validity value was above the scale in all sub-dimensions except one. Based on these data, the reliability of the PMPUS scale appears to be satisfactory and provides good internal consistency. Therefore, with limited exception, the PMPUS was found to be reliable and valid in the context of Turkish adolescents.

Introduction

ADDICTION HAS COLLECTIVE COGNITIVE, behavioral, and physiological symptoms and, despite its adverse effects, an insistence on substance consumption, as described in *The Diagnostic and Statistical Manual of Mental Disorders (DSM-IV)*.¹ Addiction has been conceptualized as both physiological and psychological, and numerous studies have been conducted in this field. DSM-IV addiction criteria have been used to describe various behaviors and addictions, such as pathological gambling, excessive eating, and mobile phone and video game use.² These types of addictions have been characterized as behavioral addiction.³ Previous studies have indicated that some Internet users become addicted in the same manner as others become addicted to gambling, drugs, and alcohol.⁴⁻⁹ Whether or not the excessive use of various technologies can or should be called an "addiction," a number of scholars have argued that excessive use of technology can be considered problematic.¹⁰ It is thought that problem behavior associated with mobile phones is due to pre-existing factors that make it likely that the user will engage in such behavior despite the consequences. In the absence of any previous research in this area, the literature related to addiction and, in particular, psychological predictors of addiction, will be used

as a basis on which to develop scales to document and explain problem mobile phone behavior.¹¹

Today, the rate of mobile phone use and the acceptance of new technologies is higher for adolescents than for older adults.^{12,13} Adolescents use mobile phone technologies not only for talking or text messaging, but also for many other reasons, such as looking up information on the Internet, entertainment, passing the time, relaxation, taking photos, shooting videos, broadcasting their personality, and achieving a better social position.¹⁴ The use of features on the mobile phone, including reading online news and downloading songs, wallpaper, and ring tones, appears to have become an adolescent leisure phenomenon in recent years.¹⁵ In particular, the possession and use of the mobile phone by adolescents favors personal autonomy, provides identity and prestige in comparison with their peers, offers major technological innovations (tools for which adolescents demonstrate a special inclination and skill), and is a source of fun and entertainment. In addition, the use of mobile phones favors the establishment and maintenance of interpersonal relationships by taking advantage of technological resources, such as "missed calls", that have a clear social and affective function.¹⁶ For these reasons, adolescents may develop problematic mobile phone behavior.¹⁷ This behavior has been

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identified as problematic mobile phone usage^{11,16,18} or mobile phone addiction.^{15,16,19-21} Although researchers prefer to use different terminology related to mobile phone addiction, the term "problematic mobile phone use" will be used in this study.

In order to define mobile phone addiction, Leung used the addiction criteria developed by the American Psychiatric Association.¹⁵ The criteria are as follows: withdrawal, tolerance, preoccupation with the substance, loss of control over the substance, more use of substance than intended, continued consumption of the substance despite adverse affects, and loss of interest in other social, occupational, and recreational activities. In contrast, other studies^{11,20,22} have used criteria similar to those proposed by Griffiths and Hunt¹⁰ to describe mobile phone addiction, which have been used to identify addiction. These criteria consist of six factors, including salience, mood modification, tolerance, withdrawal symptoms, conflict, and relapse.

Research has shown a positive relationship between problematic mobile phone use and shyness,⁶ loneliness,²³⁻²⁵ worrying,¹¹ sensation-seeking,¹⁷ depression,^{19,26} and socioeconomic status.¹⁴ In addition, other studies have shown a negative relationship with age,¹⁵ self-respect,^{11,27} and generally poor and negative self-esteem.^{14,28}

Takao et al.¹⁸ examined the correlation between problematic mobile phone use and personality traits reported in addiction literature. Their findings suggest that the measurements of these addictive personality traits would be helpful in the screening and intervention of potential problematic users of mobile phones. Billieux et al.²⁹ validated that point in a new questionnaire assessing problematic mobile phone use, called the Problematic Mobile Phone Use Questionnaire (PMPUQ), and investigated the relationships between the PMPUQ and the multi-faceted construct of impulsivity. In that study, 339 subjects were screened using the PMPUQ and the UPPS Impulsive Behavior Scale,³⁰ which assessed four distinct components associated with impulsive behaviors: "Urgency," which is defined as the tendency to experience strong impulses that are frequently under conditions of negative affects; lack of "Premeditation," which is defined as the tendency to think and reflect on the consequences of an act before engaging in the act; lack of "Perseverance," which is defined as the ability to remain focused on a task that may be boring or difficult; and "Sensation Seeking," which is defined as a tendency to enjoy and pursue activities that are exciting as well as openness for new experiences. The results of the study showed that the PMPUQ had an acceptable fit and assessed four different dimensions of problematic mobile phone use: prohibited use, dangerous use, dependence, and financial problems. Although each facet of impulsivity played a specific role in mobile phone use, urgency appeared to be the strongest predictor of problematic use. More specifically, the facet of impulsivity was associated with all aspects of "everyday" use of the mobile phone (number of calls, duration of the calls, and SMS sent or made in one day) as well as with several dimensions of problematic mobile phone use (dangerous use, dependence, and financial problems).

In this study, we first sought to examine the psychometric quality of the Problematic Mobile Phone Use Scale (PMPUS) in a sample of adolescent students, and in particular, the factor structure and scale reliability. Second, we wished to verify the convergent validity of this instrument by studying

the relationship between the three subscales. Finally, we verified the discriminant validity and concurrent validity of this instrument.

Methods

Participants and sampling

This study was based on a survey model that refers to a group of methods emphasizing quantitative analysis, where data for a large number of organizations are collected through methods such as mail questionnaires, telephone interviews, and published statistics. These data were analyzed using statistical techniques.³¹ Two separate sample groups were selected from the 2010 and 2011 classes of Turkish public high school students. The first sample group consisted of 309 adolescents (mean age=16.12 years-old; $SD=0.86$; female=173; male=136), and the second sample group consisted of 641 adolescents (mean age=16.01 years-old; $SD=0.90$; female=385; male=256). An exploratory factor analysis was conducted with the first sample group, and a confirmatory factor analysis (CFA) was conducted with the second sample group. In addition, the Beck Depression Inventory (BDI) and the UCLA Loneliness Scale (ULS) were conducted on the second sample group.

Instruments

Problematic Mobile Phone Use Scale. Previous studies have recommended various methods for developing a scale. This study followed steps recommended by DeVellis,³² Tavşancıl,³³ and Tezbaşaran.³⁴ First, existing measurement scales in the related literature within the scope of the theoretical definition were reviewed and examined.^{11,15,20,28} Subscales were determined as "losing control and receiving complaints," "anxiety and craving," "withdrawal/escape," "productivity loss," and "compulsion/persistence." In light of the existing scales, 34 items consisting of five subscales were selected. These items were sent to five experts in computer and instructional technology, psychological counseling, and guidance to determine whether the items' content and face validity were relevant. Based on the recommendations of the experts, two items were discarded and some adjustments were made. The edited items were re-examined in terms of grammar and syntax by a Turkish expert as well as a measurement and evaluation expert for clarity purposes. Based on these recommendations, a scale consisting of 32 items was prepared. Every item in the scale consisted of a five-point Likert-scale, which was used to rate the frequency of use, namely "1"=never, "2"="rarely," "3"="occasionally," "4"="often," and "5"="always." Researchers administered the scale to students who volunteered to be subjects after class in their free time, and official permission was granted for the administration of the scale.

Beck Depression Inventory. The BDI is one of the most widely used instruments that assesses the severity of depressive symptoms. It includes a somatic or physical subscale and a psychological or affective subscale. The purpose of the inventory was to objectively quantify depression signs, but not to diagnose depression. The BDI can be used for both adults and adolescents 13 years of age and older. The somatic or physical subscale included a variety of elements (e.g., loss

of pleasure, crying, loss of energy, etc.). The affective subscale also included several elements (e.g., pessimism, past failures, guilt feelings, etc.).³⁵

The inventory consisted of 21 items in a four-point scale, and each item was scored from zero to three to obtain a total score. Questions of the BDI assessed the typical symptoms of depression, such as mood, pessimism, sense of failure, self-dissatisfaction, guilt, punishment, self-dislike, self-accusation, suicidal ideas, crying, irritability, social withdrawal, body image, work difficulties, insomnia, fatigue, appetite, weight loss, bodily preoccupation, and loss of libido. According to the scale, the higher the score, the higher the depression level and the severity of depression.³⁶ This study used the 1978 revision and Turkish adaptation of BDE by Hisli.³⁷ The Chronbach's alpha reliability coefficient (of scale) was determined to be 0.80.³⁸

UCLA Loneliness Scale. This scale was developed in order to determine the perception of loneliness degree.³⁹ The scale consisted of 20 four-point Likert-scale type items, such as "I am unhappy doing so many things alone," "I have nobody to talk to," "I cannot tolerate being so alone," "I lack companionship," and 10 of which were reverse coded. Higher scores indicated more intense feelings of loneliness. The validity and reliability of the Turkish version has been evaluated by Demir.⁴⁰ The Chronbach's alpha reliability coefficient of scale was determined to be 0.94.

Analyses

The Statistical Package for the Social Sciences (SPSS) version 13.0 (IBM) was used to conduct bivariate and univariate analyses related to independent variables. Based on the duration of daily mobile phone use, group differences were analyzed by univariate analysis of variance (ANOVA). A principal component analysis was performed with Kaiser's criterion (Eigenvalue > 1), followed by a varimax rotation. The internal consistency of the overall scale and subscales was measured by Chronbach's alpha coefficient. CFA was performed with LISREL.⁴¹ Convergent and discriminant validity were evaluated by composite reliabilities, and average variance extracted (AVE) was determined by utilizing the results of the CFA. Correlation analyses were performed to study the relationship between PMPUS and other variables investigated in the study.

Factor analysis assumes that there is multicollinearity between the groups and that the variables are normally distributed.⁴² Before the analyses were performed, the data were tested to see whether they had a univariant normal distribution in each of the samples. In both study groups, the data showed a univariant normal distribution, because the skewness and kurtosis values were within the range of -1.0 and +1.0.⁴³ Furthermore, variable correlations were tested to determine whether there were multiple correlation problems. The results showed that correlation values were 0.90 and under, indicating that there were no multicollinearity problems.⁴⁴

Findings

Exploratory factor analysis

First, analyses of sampling adequacy were conducted on the 32 item PMPUS to determine whether it was suitable for

factor analysis. Bartlett's test of sphericity indicated a chi-square value of 4907.05 ($p < 0.000$), and the Kaiser-Meyer-Olkin measure of sampling adequacy indicated a value of 0.938. When a basic screen-plot test and eigenvalue > 1.0 criteria were used, five factors were generated from the PMPUS. The screen plot suggested that three factors should be extracted.⁴⁵ The three factors, which were rotated through the varimax procedure, explained 55.5 percent of the variance (Table 1). Factor 1 (eight items) accounted for 36.6 percent of the variance and measured the interference with Negative Effect. Factor 2 (five items) accounted for 13.0 percent of the variance and measured salience and Compulsion-Persistence. Factor 3 (five items) accounted for 5.9 percent of the variance and measured overindulgence in Withdrawal-Tolerance.

The reliabilities of the PMPUS dimensions were assessed by Chronbach's alpha coefficient and the item-total correlations from each dimension. In this case, acceptable criteria were ≥ 0.70 for Chronbach's alpha coefficients.^{46,47}

CFA of PMPUS

A model fit evaluation was performed with CFA. In order to perform the CFA, LISREL 8.7 was used, and the model parameters were estimated using maximum likelihood.³⁴ LISREL 8.7 provides a full range of goodness-of-fit measures. The three types of overall model fit measures that are useful in CFA are represented by absolute, incremental, and parsimonious fit.⁴⁸

In this study, in order to evaluate the absolute fit, χ^2 (minimum fit function test), root mean square error of approximation (RMSEA), goodness-of-fit index (GFI), and standardized root mean square residual (SRMR) were used. The adjusted goodness-of-fit index (AGFI), normed fit index (NFI), Tucker-Lewis index (TLI), and comparative fit index (CFI) were used as incremental fit measures.

The results showed that the probability levels of all χ^2 statistics were less than 0.01, indicating a rather poor absolute fit.⁴⁹ The χ^2 level is generally meaningful in large samples.⁵⁰ For this reason, rather than only using χ^2 values, a ratio of the calculated χ^2 to the degree of freedom is recommended. It is desirable that this ratio (χ^2/df) is lower than five.^{51,52} The results showed that χ^2 values ($\chi^2 = 477.23$, $SD = 126$, $\chi^2/df = 3.78$, $p = 0.000$) were significant. In fit indexes, GFI (0.97), AGFI (0.90), NFI (0.95), TLI (0.96), and CFI (0.97) values were all higher than 0.90, which indicated good fit presence.^{46,53,54} In addition, it is desirable for RMSEA (0.066) and SRMR (0.052) values to be lower than 0.08.^{51,55} The values determined in this study indicated acceptable compliance. The item-factor loading estimates, estimated error variances, and t values are shown in Table 2.

Convergent validity

In order to calculate the convergent validity, item reliability, and construct (composite) reliability, the AVE values were calculated as recommended by Fornell and Larcker.⁵⁶ Item reliability indicates the amount of variance in an item due to the underlying construct rather than to error. An item reliability of at least 0.50, a significant t value, or both, is considered to be evidence of convergent validity.⁵⁷ As seen in Table 3, all t values of the items were significant and all item reliabilities were greater than 0.50, with the exception of one item.

TABLE 1. EXPLORATORY FACTOR ANALYSIS (VARIMAX ROTATION) OF PROBLEMATIC MOBILE PHONE USE SCALE ITEMS (N=309)

Item No.	Item	Factor 1	Factor 2	Factor 3	Communality
17	I can't do my homework or study because of mobile phone use.	0.782	0.145	0.239	0.690
22	I am often late for appointments because I'm engaged on the mobile phone when I shouldn't be.	0.763	-0.048	0.205	0.626
24	I find myself occupied on my mobile phone when I should be doing other things, and it causes problems.	0.743	0.132	0.340	0.685
21	Using a mobile phone causes a decline in my school success.	0.738	0.057	0.180	0.580
15	I can't concentrate on learning because of sending and receiving text messages, or playing games with my mobile phone.	0.723	0.258	0.287	0.671
14	I worry about mobile phone charges.	0.659	0.128	-0.071	0.456
23	There are times when I would rather use the mobile phone than deal with other more pressing issues.	0.652	0.084	0.263	0.500
13	I feel pain in my head, eyes, thumbs, and hands because of using my mobile phone.	0.516	-0.001	0.418	0.441
27	I immediately answer calls and reply to text messages.	0.033	0.780	0.149	0.632
26	I always carry my mobile phone.	-0.013	0.762	0.119	0.595
25	I never turn off my mobile phone during the day.	0.011	0.754	0.014	0.569
28	I frequently check my missed calls and text messages.	0.304	0.683	0.177	0.590
29	I use my mobile phone any time I can.	0.271	0.519	0.377	0.485
6	I tried to cut down on mobile phone use, but failed.	0.157	0.008	0.773	0.622
5	Others complain about my using my mobile phone too much.	0.238	0.293	0.670	0.591
8	I think life without mobile phones is boring and futile.	0.203	0.354	0.592	0.516
7	I say to myself "just a few more minutes" when using my mobile phone. (talking, sending, or receiving text messages, playing games, watching TV, and so on).	0.344	0.106	0.464	0.345
1	When I can't use a mobile phone, I am exasperated.	0.193	0.396	0.447	0.393
Chronbach's α		0.82	0.79	0.75	0.84

F1, Negative Effect; F2, Compulsion-Persistence; F3, Withdrawal-Tolerance.

The composite reliability of each construct is one of the principal measures used in assessing the measurement model, and the commonly used higher value for acceptable composite reliability is 0.70.⁵⁸ The composite reliability values calculated for each sub-scale in this study were 0.70 and above (Table 3).

TABLE 2. CONFIRMATORY FACTOR ANALYSIS: MAXIMUM LIKELIHOOD ESTIMATES (N=641)

No.	Factor loading estimates	t values	Estimated error variances
17	0.53	13.85	0.72
22	0.20	4.92	0.96
24	0.85	25.65	0.27
21	0.84	25.29	0.29
15	0.65	17.40	0.58
14	0.51	12.91	0.74
23	0.53	13.83	0.72
13	0.71	19.82	0.50
27	0.52	12.82	0.73
26	0.53	12.65	0.72
25	0.67	17.39	0.55
28	0.77	20.59	0.41
29	0.68	17.54	0.54
6	0.69	18.36	0.52
5	0.71	19.21	0.50
8	0.59	15.06	0.65
7	0.56	14.39	0.69
1	0.57	14.68	0.68

An AVE value of 0.50 and above is an indicator of convergent validity.⁵⁹ AVE values were calculated for all three dimensions and found to be lower than 0.50 (Table 3). Inter-correlations between three dimensions of the PMPUS are shown in Table 3, and all of them were found to be significant ($p < 0.01$). In addition, there were moderate levels of relationship between the subscales.

Discriminant validity

Two separate applications were administered for discriminant validity in this study. First, we determined whether the AVE value was larger than the squared correlation of two dimensions as recommended by Fornell and Larcker.⁵⁶ The results indicated that this condition was achieved in two dimensions, but not in one dimension (Table 3). Second, the duration of students' daily mobile phone use in terms of hours was set as a criterion, and a one-way ANOVA was conducted

TABLE 3. CONSTRUCT RELIABILITIES, AVERAGE VARIANCE EXTRACTED, SQUARED CORRELATIONS, AND CORRELATIONS BETWEEN SUBSCALES

Subscales	Construct reliability	AVE	NE	CP	WT
Negative Effect (NE)	0.83	0.40	-	0.12	0.40
Compulsion/Persistence (CP)	0.77	0.41	0.35	-	0.30
Withdrawal/Tolerance (WT)	0.76	0.39	0.66	0.55	-

Note: The values above diagonally indicate squared correlations. AVE, average variance extracted.

TABLE 4. STUDENTS' PROBLEMATIC MOBILE PHONE USE SCALE MEAN SCORES AND DAILY MOBILE PHONE USAGE DURATION ONE-WAY ANALYSIS OF VARIANCE RESULTS

Daily mobile phone usage duration	n	\bar{X}	SD		Sum of square	Df	Mean square	F	p
A. Between 1 and 2 hours	207	34.63	8.27	W.G.	11919.56	2	5959.78	58.32	0.000**
B. Between 3 and 4 hours	206	38.33	10.42	B.G.	65200.44	638	102.20		
C. 5 hours and above	228	44.93	11.27	Total	77120.01	640			
Total	641	39.48	10.98						

** $p < 0.01$.

W.G., within group; B.G., between group.

to determine whether the mean scores of the PMPUS and this criterion showed a significant difference (Table 4).

Table 4 shows that there was a significant difference in students' PMPUS mean scores compared with the duration of daily average mobile phone use [$F_{(2-638)} = 58.32$; $p < 0.01$]. The effect size was 0.155, and according to Cohen,⁶⁰ this value has the greatest impact. In addition, Cohen suggested that values of 0.01, 0.06, and 0.14 be used to indicate small, medium, or large associations between the variables, respectively.

A Dunnett C analysis was performed to determine the source of the difference between all binary comparisons (C-A, C-B, and B-A), and significant differences were found. These results could be interpreted as indicative of discriminant values, which demonstrated that high duration of mobile phone use increased individuals' mobile phone use.

Concurrent validity

Correlations between PMPUS, BDI, and the ULS were calculated to determine the PMPUS concurrent validity. A correlation coefficient of 0.24 between PMPUS and the BDI as well as 0.13 between PMPUS and the ULS were found to be significant ($p < 0.01$). These results could be due to the large sample size ($n = 641$).

Discussion

Four principal aims of this study were analyzed. The first was to evaluate the validity and factorial structure of the scale as well as the reliability. The second aim was to verify the convergent validity of the PMPUS instrument by studying the relationship between the three subscales. The third aim was to verify the discriminant validity of this instrument, and the fourth aim was to verify the concurrent validity. The construct validity of the scale was examined through exploratory and CFA. After exploratory factor analysis of the 32 item scale, 14 items were excluded. Some of the items excluded had a loading value under 0.40,⁶¹ and other items belonged to two factors (overlapping/contaminated) with item factor loading values of 0.10 and below.^{44,62,63} The three-factor structure (Factor-1: Negative Effect; Factor-2: Withdrawal/Tolerance; and Factor-3: Compulsion/Persistence) explained 55.5 percent of the variance. CFA and the three-factor structure were investigated and provided high fit values. These findings were similar to those obtained by Koo.²⁰ The study results showed that the mobile phone addiction scale consisted of three dimensions: Withdrawal-Tolerance (including seven items illustrating how adolescents used the mobile phone to escape from loneliness as well as feeling down and isolated), Life Dysfunction (including six items characterizing that continued consumption of the substance

despite adverse effects), and Compulsion-Persistence (including seven items characterizing the formidable influence of a feeling from the inside), which consisted of a total of 20 items. The results of our study also showed similarities with the study conducted by Leung.¹⁷

Scale reliability was measured by internal consistency of items with Chronbach's alpha coefficient. For internal consistency-based factor total scores and general total scores, the Chronbach's alpha values ranged from 0.76 to 0.83. In addition, we found that item reliability and construct reliability values were satisfactory for the three-factor structure obtained. The AVE value was found to be lower than the acceptable level in all subscales, and the correlation among sub-dimensions was found to have a moderate level of significance.

The AVE value for discriminant validity was satisfactory for two dimensions, but was not satisfactory for one dimension. In addition, the duration of students' daily average mobile phone use was set as a criterion, and according to this criterion, the PMPUS mean scores were measured to investigate whether they differed significantly. Based on this analysis, all dual comparisons showed significant differences, which was similar to the findings of Takao et al.¹⁸

Correlations between PMPUS and the BDI as well as PMPUS and the ULS were calculated for concurrent scale validity purposes, and the correlations were found to be significant. Several studies support these findings. A study of 12-18-year-old Finns found that depression scores were significantly higher and self-rated health was significantly lower for frequent mobile phone users.⁶⁴ Moreover, Ha et al.⁶⁵ found that excessive use of a phone caused students to have depression in a study of 595 Korean students. Sanchez-Martinez and Otero⁶⁶ also reported a significant association between intensive mobile phone use and depression in 13-20-year-old adolescents. Augner and Hacker⁶⁷ found a moderate relationship between depression and mobile phone addiction in a study of 196 young adults, and Takao et al.¹⁸ found a relationship between loneliness and mobile phone addiction. However, some limitations of this study should be noted. First, the relationship identified in this study is correlational and not causal. Second, all data were collected with self-reported questionnaires that are influenced by social desirability. Therefore, studies using behavioral problematic mobile phone use measurements, observational data, and other reported methodologies that assess behaviors could be very useful in further research on this topic.

In conclusion, the PMPUS exhibits, with a few exceptions, acceptable levels of reliability, convergent validity, concurrent validity, and discriminant validity in the context of Turkish adolescents. Although the results of this study are supportive of the psychometric properties of the PMPUS, we

have not yet established the diagnostic potential of the scale, and further studies are needed to determine the diagnostic usefulness of this approach.

The present study focused on mobile phone use in a sample of adolescents. A subsequent longitudinal study would provide perspective and generate data on changes in the PMPUS and cognition over time. In addition, replication of this study on groups with different demographic characteristics is another possibility for further research.

Disclosure Statement

No competing financial interests exist.

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