



A Preliminary Study on the Development of Smartphone Usage Behavior Scale for Young Adults

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Abstract. The definition of Problematic Smartphone Use (PSU) as an addictive behavior remains a topic of ongoing discussion. Although several studies have classified PSU as addictive behavior, it has not yet been formally recognized as a diagnosis in the DSM-5. To date, there is no PSU scale that specifically measures smartphone use from a behavioral perspective. This preliminary study aims to examine the relevance of the behavioral dimensions of mobile phone use proposed by Hooper and Zhou (2007) in the context of smartphone use. This study employs a qualitative approach using the Exploratory Factor Analysis (EFA) method. This research participant were 218 young adults aged 18-25 as they are prone to PSU. The results indicate a reduction from the initial six dimensions to three dimensions. Future research should perform Confirmatory Factor Analysis (CFA), as well as reliability and validity assessments, to ensure the model's accuracy.

Keywords: Smartphone usage, Behavior, Young adults.

1 Introduction

Ever since the discovery of smartphones, the smartphone and its consequences have been widely researched. This is proven by the vast literature studying the effects of smartphone usage on human life aspects (Xu & Long, 2020; Ross, 2020 ; Harris et al., 2020; Hidalgo-Fuentes, 2022; Sullivan & George, 2023;). While the utilization of smartphones can bring benefits to humans (Xu & Long, 2020; Ross, 2020), others said that smartphones bring more disadvantages (Harris et al., 2020; Hidalgo-Fuentes, 2022). There is a growing concern that excessive use of smartphones can cause addiction. This compulsive smartphone usage pattern was then termed *Problematic Smartphone Use*. Even though this topic has garnered interest from researchers, its classification as an addiction behavior is still being debated (Busch & McCarthy, 2021).

Although numerous scholars have defined PSU as a behavioral addiction (Panova & Carbonell, 2018; Yu & Sussman, 2020; Loleska & Pop-Jordanova, 2021), there hasn't been a diagnosis for PSU in the Diagnostic and Statistical Manual of Mental Disorder-5 (DSM-5-TR) (American Psychologist Association, 2022). Thus, the question, "Is

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Problematic Smartphone Use an addiction?" has yet to be answered. Furthermore, this question has been lingering for a while, even before the emergence of smartphones. The excessive use of mobile phones, predecessor of smartphones, was also signaled as an addictive behavior (Hooper & Zhou, 2007). To shed some light on this matter, Hooper and Zhou (2007) conducted a study to classify mobile phone usage behavior according to its underlying motivation. The study involved 184 first-year information system students and revealed six dimensions, namely addictive, compulsive, dependent, habitual, voluntary, and mandatory (Hooper & Zhou, 2007). Those dimensions were established by categorizing behavior based on motivation, as motivation serves as the underlying factor driving behavior (Hooper & Zhou, 2007; Bandhu et al., 2024).

Hooper and Zhou (2007) defined the dimensions as such; (a) addictive behavior refers to the usage of a mobile phone to a certain state that it has become the primary focus of a person to the exclusion of other activities or has started to negatively impact the individual's life; (b) compulsive behavior is defined as the inability to restrain mobile phone usage; (c) dependent behavior indicates the attachments an individual shows to mobile phone; (d) habitual behavior refers to the usage of the mobile phone as an automatic or unconsciously performed activities; (e) voluntary behavior is a deliberate use of mobile phone influenced by specific motivations also associated with positive outcomes; and (f) mandatory behavior is usage of mobile phone as an activity that needs to be done or followed.

Until now, most of the scales to measure problematic smartphone use are based on the adaptation of an already existing addiction scales. Whereas the best way to measure the behavior is by considering the context, function, and motivation for using a smartphone (Harris et al., 2020). This statement is consistent with the research conducted by Ellis et al. (2019), which compared a range of smartphone usage and 'addiction' scales alongside smartphone usage data obtained from Apple's Screen Time application. In the research, Ellis et al. (2019) stated that the majority of self-reported smartphone assessments demonstrated low accuracy in predicting objective smartphone behaviors, thus behavioral measurement should be conducted using objective data. However, measurement method using objective data has some limitations. One limitation is that researchers cannot obtain smartphone usage data from Android users, as Apple's Screen Time feature is exclusively available on iPhones. Meanwhile, previous research indicates that the behavior of Android and iPhone users differs (Ellis et al., 2019). Moreover, there is a possibility of ethical challenges, such as privacy concerns (Harris et al., 2020).

This scale is being developed as a solution to address the inaccuracies in measuring problematic smartphone use, as well as the practical and ethical challenges associated with objective data collection methods for smartphone usage. When obtaining objective behavior data for research is not possible, this scale can be utilized to assess smartphone use based on the types of behaviors shown. Therefore, this study aims to: (a) conduct a preliminary study into the relevance of behavioral dimensions of mobile phone use, as proposed by Hooper and Zhou (2007).

2 Research Method

Research suggests that young adults are particularly prone to problematic smartphone use as they do not feel comfortable living without smartphones. This can be explained by the younger generation's reliance on smartphones since they have been exposed to technology at a younger age (Busch & McCarthy, 2021). A cross-sectional study conducted by Csibi et al. (2021) showed that the 20-34 age groups reported the highest risk for smartphone-related addictive behavior. Other research found that the 16-25 age group and 26-35 age group exhibit problematic smartphone use risk (Kwon et al., 2017; de-Sola et al., 2017 as cited in Csibi et al., 2021). Therefore, this research will employ a cross-sectional quantitative method with a sample consisting of young adults aged 18–25 years.

The measurement instrument used in this study is a scale originally developed by Hooper and Zhou (2007) to measure behavior types of mobile phone users. This scale consists of six dimensions and 30 items, with Cronbach's alpha coefficients ranging from 0.525 to 0.842. Prior to data collection, the scale is translated into Bahasa Indonesia, and each item underwent content validity testing. Minor adjustments are necessary since the original scale developed by Hooper and Zhou was designed to measure mobile phone usage behavior, whereas mobile phones and smartphones differ in features and functionalities (Harris et al., 2020).

Data collection was conducted using Google Forms, and the questionnaire was distributed to individuals aged 18-25. The sampling technique is purposive sampling, as researchers set specified criteria for the sample. After collecting the data, the analysis was performed using Microsoft Excel, IBM Statistical Package for the Social Sciences 23.0 (SPSS), and Jeffrey's Amazing Statistics Program (JASP). The method chosen to perform analysis was Exploratory Factor Analysis (EFA) method. Since the previous study was conducted in 2007 and there is a difference in the object being measured (from mobile phones to smartphones), there is a possibility of changes in the dimensions from the original study by Hooper and Zhou. Therefore, EFA was preferred because it is focused on assessing new measurements (Nájera et al., 2023). Analysis then was continued with Confirmatory Factor Analysis (CFA), but this paper will only discuss EFA results since it's a preliminary study.

3 Result

As many as 218 respondents' answers were extracted from Google Forms to Microsoft Excel for data cleaning. Before conducting EFA, the outlier data were identified using the Mahalanobis Distance method, and multivariate normality was tested using Shapiro-Wilk test. Four outlier data were then deleted, thus resulting in 214 data eligible for analysis. The Shapiro-Wilk test indicated a violation of normality with $p < .05$, suggesting that the data were not normally distributed. Kaiser-Meyer-Olkin test and Bartlett's Test of Sphericity were used to determine whether data is adequate for EFA. The KMO value was 0.836, and Bartlett's test of sphericity was significant ($p < .05$), confirming the suitability of the data for factor analysis.

Table 1. Test of normality

Shapiro-Wilk			
	Statistic	df	Sig.
H1	,905	214	,000
H2	,874	214	,000
H3	,864	214	,000
H4	,914	214	,000
H5	,894	214	,000
H6	,909	214	,000
D1	,828	214	,000
D2	,864	214	,000
D3	,880	214	,000
D4	,908	214	,000
D5	,879	214	,000
M1	,799	214	,000
M2	,894	214	,000
M3	,788	214	,000
M4	,791	214	,000
M5	,867	214	,000
A1	,907	214	,000
A2	,904	214	,000
A3	,871	214	,000
A4	,892	214	,000
C1	,909	214	,000
C2	,884	214	,000
C3	,910	214	,000
C4	,895	214	,000
V1	,883	214	,000
V2	,814	214	,000
V3	,916	214	,000
V4	,864	214	,000
V5	,766	214	,000
V6	,843	214	,000

Table 2. Kaiser-Meyer-Olkin Test

	MSA
Overall MSA	0.838

Tabel 3. Bartlett's Test

X ²	df	p
1286.83	153.00	< .00
6	0	1

Since the data is not normally distributed, the extraction method used was Principal Axis Factoring (Sürücü et al., 2024). In deciding several factors to retain, the most frequently used method is Kaiser Criterion or Eigenvalue > 1 . However, this method is considered less effective for determining the number of factors because it tends to overestimate (Lee, 2020; Sürücü et al., 2024). Hence, this research employs parallel analysis for factor retention, which was further supported by the scree plot. Based on the parallel analysis and the scree plot, the study identified three factors underlying the construct of smartphone usage behavior. Items with factor loading greater than 0.4 were maintained because factor loadings ranging from 0.3 to 0.4 are considered to be sufficient for the interpretation of structure (Hair et al., 2022). Items with cross loading are also removed, resulting in 18 items that adequately represent the construct.

Table 4. Factor Loadings

	Factor 1	Factor 2	Factor 3	Cronbach's Alpha
H4	0.732			0.820
C3	0.699			
C1	0.629			
H1	0.612			
A4	0.564			
A3	0.541			
H5	0.502			
A1	0.502			
D3		0.844		
D2		0.735		
D1		0.663		
D4		0.660		
H2		0.449		
V5			0.757	0.769
M 4			0.694	
M 1			0.589	
M 3			0.579	
V2			0.541	

Note. Applied rotation method is promax.

These new factors demonstrated validity, with discriminant values between factors remaining below 0.7 and the Cronbach's alpha value reached 0.835, indicating reliability. The model demonstrated an acceptable fit based on RMSEA (0.05), and TLI (0.927) while SRMR (0.038), and CFI (0.952) indicated a good fit.

Table 5. Factor Correlations Matrix

	Factor 1	Factor 2	Factor 3
Factor 1	1.000	0.460	-0.021
Factor 2	0.460	1.000	0.426
Factor 3	-0.021	0.426	1.000

Table 6. Fit Indices

RMSE A	SRM R	TLI	CFI
0.050	0.038	0.92 7	0.95 2

4 Discussion

The final model of this scale consisted of three factors and 18 items. Renaming the factors needs to be done since there have been changes from the previous six dimensions into the remaining three dimensions. The first factor is made of eight items, indicating addictive, compulsive, and habitual behavior. This factor is named Smartphone Fixation because it reflects a strong desire or urge to use a smartphone excessively and compulsively, to the point that it negatively impacts the individual's life. An individual who scores high in this dimension may indicate an unhealthy attachment to their smartphone. Authors don't use the term 'addiction' as labeling a behavior as an addiction needs to be done in caution, thus, the term 'fixation' is used. According to the Oxford Learner's Dictionary, fixation means a strong interest in something that is not natural.

The second factor consists of five items which are uniform as they all pertain to dependency. This factor reflects the negative emotions shown by an individual when they don't have their phone nearby, thus named Emotional Dependency. It's important to note that while a person can show dependency on his or her smartphone, it's not necessarily an addiction because dependence is not a requirement for addiction (Köpetz et al., 2013). Nowadays, technological development makes human life more practical. There are tools and applications in smartphones, such as cameras, calculators, and digital payment, that make life more convenient. Such 'all in one' nature in smartphones turns people to rely on their devices to perform daily tasks.

The third factor is based on voluntary and mandatory behavior in using smartphones. The behavior is mostly rooted in social motivation such as the intention to communicate with others and may also derive from the sense of safety offered by smartphones. In

this digital era, having a smartphone is considered a necessity. As stated before, using smartphones can increase practicality in daily life. Not only that, smartphones also help people communicate more effortlessly without concern about distance and time. Therefore, this third factor is named Smartphone as Necessity. According to Hooper and Zhou (2007), voluntary and mandatory behavior usually produce a positive impact on human life, namely strengthening social bonds. However, there is a possibility that voluntary or mandatory behavior could evolve into smartphone fixation. If the voluntary or mandatory behavior is carried out regularly, these behaviors may turn into habits which lead to smartphone fixation.

In the previous research, Hooper and Zhou (2007) classified the six behavioral dimensions into two groups, which are behavior that is acceptable as a reason to use mobile phones and those that do not. Groups of behavior that were classified as acceptable were voluntary, mandatory, and dependent. Whereas groups of behavior that were considered unacceptable were habitual, addictive, and compulsive. In this recent study, items belonging to habitual, addictive, and compulsive states merged into one dimension with the same thing happening to voluntary and mandatory items. Interestingly, dependent behavior didn't undergo such drastic transformation and is still established as its own dimension. The three aforementioned behaviors merged possibly because recent research has found that habit and compulsivity are associated with the formation of addictive behavior (Grant et al., 2010; Sjoerds et al., 2014; Solly et al., 2025). Voluntary and mandatory behavior are combined because the two have overlapping motives.

Voluntary smartphone use is driven by personal will, whereas mandatory use is imposed by external requirements. This pattern aligns with the continuum between intrinsic and extrinsic motivation, as suggested by Deci et al. (1991) (Bandhu et al., 2024). According to intrinsic motivation theory, individuals engage in certain behaviors or activities because they find them engaging or fulfilling. In contrast, extrinsic motivation suggests that individuals participate in behaviors due to potential external incentives or obligations. This unique pattern observed in voluntary and mandatory behavior blurs the distinction between the two, potentially leading them to emerge as a single dimension.

The dependent dimension didn't show significant changes possibly because this dimension has already been well established theoretically. Also as stated earlier, and by Hooper and Zhou in the previous research, dependent behavior is different from addictive behavior and not a requirement for addictive behavior. Moreover, there are underlying differences between voluntary and mandatory behavior with dependent behavior as dependency is more likely to relate to emotional attachment rather than intrinsic or extrinsic motives (Gritti et al., 2023).

Table 7. Mobile Phone Usage Behavior Scale after EFA

Factors After EFA	No	Items	Item's Dimension as Proposed by Hooper and Zhou (2007)
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Smartphone Fixation	1.	I often start to use my smartphone, even though I might be uncertain about my intention to use it	Habitual	
	2.	I usually ignore the harmful consequences of spending too much time talking on the phone instead of attending to people around me	Compulsive	
	3.	I have to use my smartphone even when I know I can't afford it	Habitual	
	4.	I frequently use my smartphone at inappropriate times without thinking e.g. during lecture	Addictive	
	5.	I don't seem able to change my smartphone usage behavior even though people tell me I spend too much time on it	Addictive	
	6.	I feel others would be horrified if they knew of my smartphone usage habits	Addictive	
	7.	Sometimes I want to use my smartphone, but I do not have a clear idea why I want to use it.	Habitual	
	8.	My smartphone starts to disrupt my daily life.	Addictive	
	Emotional Dependency	9.	I feel anxious if i forget to take my smartphone with me	Dependent
		10.	I feel lost when I leave my smartphone at home	Dependent
11.		When I don't have my smartphone with me, I feel incomplete	Dependent	
12.		I feel anxious or nervous on days when i can't use my smartphone	Dependent	
13.		Using my smartphone is something I do without thinking	Habitual	
Smartphone as Necessity	14.	It is more efficient to use smartphone as opposed to other communication devices	Voluntary	
	15.	I have a smartphone so that my friends can keep in touch with me	Mandatory	
	16.	My parents wanted me to have a smartphone so they can keep in touch with me	Mandatory	
	17.	I have a smartphone to use in case of emergency	Mandatory	
	18.	Having a smartphone makes me feel safe while I am walking alone at night	Voluntary	

5 Conclusion and direction for future research

This research found that the six dimensions of mobile phone usage behavior proposed by Hooper and Zhou (2007) have changed over time into three dimensions. EFA results showed that addictive, habitual, and compulsive behavior integrate into the first factor

named smartphone fixation. Dependent behavior didn't show significant change but was renamed as emotional dependency since items in the factor reflected emotional attachment to smartphones. Voluntary and mandatory behavior merge into factor three, later named smartphone as necessity. Future research needs to conduct Confirmatory Factor Analysis into the newly found dimensions to evaluate whether the data aligns with the hypothesized measurement model, as established by this research. Moreover, conducting validity and reliability tests is essential to ensure the accuracy of the model.

Disclosure of Interest The authors have no competing interests to declare that are relevant to the content of this article.

Reference

1. American Psychiatric Association. (2022). Substance-related and Addictive Disorder. In *Diagnostic and statistical manual of mental disorders* (5th ed. TR).
2. Bandhu, D., Mohan, M. M., Nittala, N. A. P., Jadhav, P., Bhadauria, A., & Saxena, K. K. (2024). Theories of motivation: A comprehensive analysis of human behavior drivers. *Acta Psychologica*, 244(August 2023), 104177. <https://doi.org/10.1016/j.actpsy.2024.104177>
3. Busch, P. A., & McCarthy, S. (2021). Antecedents and consequences of problematic smartphone use: A systematic literature review of an emerging research area. *Computers in Human Behavior*, 114(September 2020), 106414. <https://doi.org/10.1016/j.chb.2020.106414>
4. Csibi, S., Griffiths, M. D., Demetrovics, Z., & Szabo, A. (2021). Analysis of Problematic Smartphone Use Across Different Age Groups within the 'Components Model of Addiction.' *International Journal of Mental Health and Addiction*, 19(3), 616–631. <https://doi.org/10.1007/s11469-019-00095-0>
5. Ellis, D. ., Davidson, B. ., Shaw, H., & Geyer, K. (2019). Do Smartphone Usage Scales Predict Behavior? *International Journal of Human-Computer Studies*, 130, 86–92. <https://doi.org/10.1016/j.ijhcs.2019.05.004>
6. Grant, J. E., Potenza, M. N., Weinstein, A., & Gorelick, D. A. (2010). An Introduction to Behavioral Addictions. *Am J Drug Alcohol Abuse*, 36(5), 233–241. <https://doi.org/10.3109/00952990.2010.491884>
7. Gritti, E. S., Bornstein, R. F., & Barbot, B. (2023). The smartphone as a “significant other”: interpersonal dependency and attachment in maladaptive smartphone and social networks use. *BMC Psychology*, 11(1), 1–17. <https://doi.org/10.1186/s40359-023-01339-4>
8. Hair, J. F. J., Black, W. C., Babin, B. J., & Anderson, R. E. (2022). Multivariate Data Analysis (Eight Edition). In *Gedrag & Organisatie* (8th ed., Vol. 19, Issue 3). Cengage Learning
9. Harris, B., Regan, T., Schueler, J., & Fields, S. A. (2020). Problematic Mobile Phone and Smartphone Use Scales: A Systematic Review. *Frontiers in Psychology*, 11(May). <https://doi.org/10.3389/fpsyg.2020.00672>
10. Hidalgo-Fuentes, S. (2022). Problematic smartphone use and procrastination in the academic setting: a meta-analysis. *Electronic Journal of Research in Educational Psychology*, 20(57). <https://doi.org/10.25115/ejrep.v20i57.5629>
11. Hooper, V., & Zhou, Y. (2007). Addictive, dependent, compulsive? A study of mobile phone usage. *20th Bled EConference - EMergence: Merging and Emerging Technologies, Processes, and Institutions - Conference Proceedings*, 272–285.
12. Köpetz, C. E., Lejuez, C. W., Wiers, R. W., & Kruglanski, A. W. (2013). Motivation

- and Self-Regulation in Addiction: A Call for Convergence. *Perspect Psychol Sci*, 8(1), 3–24. <https://doi.org/10.1177/1745691612457575>
13. Lee, S. H. (2020, December 17). [*Exploratory Factor Analysis (EFA) – Part 3 (Kaiser Criterion, Scree Plot, Parallel Analysis & MAP)*] [Video]. YouTube. https://youtu.be/K_1ReSJXXm8
 14. Loleska, S., & Pop-Jordanova, N. (2021). Is Smartphone Addiction in the Younger Population a Public Health Problem? *PRILOZI*, 42(3). <https://doi.org/10.2478/prilozi-2021-0032>
 15. Oxford University Press. (n.d.). *Fixation*. Oxford Learner's Dictionaries. Retrieved April 1, 2025, from https://www.oxfordlearnersdictionaries.com/definition/american_english/fixation
 16. Panova, T., & Carbonell, X. (2018). Is smartphone addiction really an addiction? *Journal of Behavioral Addictions*, 7(2). <https://doi.org/10.1556/2006.7.2018.49>
 17. Ross, F. (2020). Hearing Aid Accompanying Smartphone Apps in Hearing Healthcare . A Systematic Review. *Applied Medical Informatics*, Vol. 42, N(November).
 18. Sjoerds, Z., Luijckes, J., van den Brink, W., Denys, D., & Yücel, M. (2014). The role of habits and motivation in human drug addiction: A reflection. *Frontiers in Psychiatry*, 5(JAN), 1–5. <https://doi.org/10.3389/fpsy.2014.00008>
 19. Solly, J. E., Albertella, L., Ioannidis, K., Fineberg, N. A., Grant, J. E., & Chamberlain, S. R. (2025). Recent advances in understanding how compulsivity is related to behavioural addictions over their timecourse. *Current Addiction Reports*, 12(1). <https://doi.org/10.1007/s40429-025-00621-2>
 20. Sullivan, B. M., & George, A. M. (2023). The Association of Motives with Problematic Smartphone Use: A Systematic Review. *Cyberpsychology*, 17(1). <https://doi.org/10.5817/CP2023-1-2>
 21. Sürücü, L., Yıkılmaz, İ., & Maşlakçı, A. (2024). Exploratory Factor Analysis (EFA) in Quantitative Researches and Practical Considerations. *Gümüşhane Üniversitesi Sağlık Bilimleri Dergisi*, 13(2), 947–965. <https://doi.org/10.37989/gumussagbil.1183271>
 22. Xu, H., & Long, H. (2020). The Effect of Smartphone App-Based Interventions for Patients With Hypertension: Systematic Review and Meta-Analysis. *JMIR mHealth and uHealth*, 8(10), e21759. <https://doi.org/10.2196/21759>
 23. Yu, S., & Sussman, S. (2020). Does smartphone addiction fall on a continuum of addictive behaviors? In *International Journal of Environmental Research and Public Health* (Vol. 17, Issue 2). <https://doi.org/10.3390/ijerph17020422>

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