

Scrutinizing Smartphone-Induced Stressors: A Clustering Approach

Dr. Nidhi Singh¹, Dr. Sumit Kumar², Dr Ajay Manjhi³

^{1,2,3}TMS, University of Lucknow, Lucknow

Abstract

Smartphone usage has been increasing day by day and the pandemic had influenced more and more usage of it. This study investigates the stressors induced by Smartphone usage and the demographic factors affecting the stressors the most. The study contributes to this area of research by focusing on Personal Life Stressors, Nomo-Phobia Stressors, Social Interaction Stressor and Physical and Psychological Stressor induced by Smartphone usage. The study examined demographic factors and demographic segmentation was made according to which clusters impacting the identified stressors the most. Statistical Analysis was done on the data collected. The study found that the Occupation and Income are the two Clusters identified and these clusters have a significant impact on Techno-Invasion, Work-Home Conflict, Escape/Withdrawal, Felling Anxious/Lost, Physical and Psychological Symptoms and showed no significant impact on Techno-Overload, Compulsive Usage and Neglect work. Consequently, this study found that employees of private organization and House-wives are more affected and individuals are affected irrelevant of their income by Smartphone induced stressor the most.

Keywords: Smartphone; Occupation; Income; Personal Life Stressor; Nomo-Phobia Stressors; Social Interaction Stressor; Physical and Psychological Stressor

Introduction

The use of communication technology in today's society is growing daily. By using the phrase "communication technology," we imply using the internet on any device, including computers, laptops, and Smartphone. Both organizational and personal lives are affected by the use of information and communication technologies (ICTs). The relationship people have with technology and its effects have become far too important with the rise in ICT usage. ICT adoption, acceptance, self-efficacy, and other associated topics have thus been thoroughly examined through research in the field of information systems (IS) [1]. Smartphone addiction is a condition in which users are unable to manage their Smartphone use on their own and feel withdrawal and tolerance as a result of their excessive use, which disrupts their everyday lives [Error! Reference source not found.]. The expansion of social networks and the desire for users to stay connected to them for as long as possible have made Smartphone more addictive [4][18]. Hence it was found that smartphone usage had increased among people and on the basis of the literature the following objectives were framed:

1. Study the demographic segmentation of Smartphone usage
2. Study and identify stressors induced by usage of Smartphone among individuals

Literature Review

In essence, the question of whether these technologies are fostering social interaction or privatizing domestic life was investigated. It was found that although these technologies are ingrained in daily life, they are also causing social isolation and privatization of individuals' lives[14]. Youths find it very difficult to interact with each other since they prefer to live alone and feel free to chat on social networking sites, which make it impossible for them to work together when they are required to work in groups[10]. Technology has a significant impact on human social behavior since people prefer to sip coffee in cyber cafes instead of in actual cafes and engage in conversation with friends [16]. Additionally, it has been noted that cyberbullying has a huge impact and steers young people in the wrong directions [9]. The most time-consuming activities on a Smartphone are messaging on apps (e-mail, SMS, Messenger, Whatsapp, etc.) and Internet information searches for personal use, whereas voice and video calls and Internet information searches are the most time-consuming activities for work-related purposes [**Error! Reference source not found.**]. Further research revealed that respondents checked their phones an average of 34 times per day—not necessarily because they needed to, but just out of habit[**Error! Reference source not found.**]. Adolescents who become addicted to their Smartphone may experience a variety of issues. For instance, excessive Smartphone endangers physical health by disrupting sleep, impairing vision, creating shoulder, wrist, and cervical spine pain, and leading to additional issues from inactivity.”[**Error! Reference source not found.**][**Error! Reference source not found.**]. Subjective economic status, academic stress, parental support, and bullying victimization were all characteristics that were linked to a tendency towards Smartphone addiction among adolescents [**Error! Reference source not found.**]. The stressors thus identified are clubbed under four groups.

Personal Life Stressor

These are those stressors which invade the personal life due to constant connectivity; hence stressors identified are Techno invasion relates the aspect emerged as a stressor as a result of the telework phenomenon, which generated a fundamental shift in how individuals worked. As a result, there are certain to be new factors that need to be considered in studying job-related stress [6][25]. Tehno-oveload relates to utilizing communication technology after hours increases workload in the current environment, even on weekends [23][25]. Work- home conflict is an individual capability to manage the interface between responsibilities on and off the job, and is shown to be a source of strain [7][20][21][11].

Physical and Psychological Stressor

These identified stressors are those which effect the Physical and Psychological wellbeing due to Smartphone usage. Physical symptoms relates to Usage of communication technologies(Smartphone) leads to many issues some of which are identified physical maladies such as —. . . headaches, irritability, stomach or intestinal problems and heart related issues such as heart attack or high blood pressure”[3][25]. Psychological symptoms relates to Lack of autonomy, heavy workloads, performance pressures, performance monitoring, strained social relationships, worries about one's career and job future, feeling unqualified, spending excessive amounts of time in front of computers, and the worry that one won't be able to keep up with IT are some of the common causes of work stress that arise from working in an IT environment.[5][25].

Nomo-Phobia Stressor

This relates to no excess to Smartphone leads to different issues such as Feeling Anxious or lost was discovered that those who depend on Smartphone obsess over their device [2][25]. Withdrawal/Escapes relates to people who are dependent on their Smartphone and try to reduce their usage of them report feeling lost, restless, gloomy, melancholy, or irritated. They also report using their phones to avoid difficulties or to lift their spirits (e.g., feeling of isolation, anxiety, loneliness, and depression)[2][25].

Social Interaction Stressor

A response to an uncontrollable drive or desire to obtain, use, or experience a feeling, substance, or activity that prompts the individual to repeatedly engage in behavior that will ultimately cause harm to the individual and/or others is known as compulsive usage, one of the various stressors identified by previous research.[22][25]. Neglect work relates to use of the Internet can result in social isolation, disregard for family and academic duties, marital issues, and an excessive preoccupation with the site[8][15][**Error! Reference source not found.**][**Error! Reference source not found.**][25].

Research methodology

After doing extensive literature review it had been founded that work had been done to find the Smartphone usage among different users on the basis of the demographic profile but demographic segmentation has not been worked.

Proposed Hypothesis

Personal Life Stressor

H1a: Techno-overload induced by usages of Smartphone is not significantly different among the identified clusters.

H1b: Techno-invasion induced by usages of Smartphone is not significantly different among the identified clusters.

H1c: Work-Home Conflict induced by usages of Smartphone is not significantly different among the identified clusters.

Nomo-Phobia Stressor

H2a: Feeling Anxious/Lost induced by usages of Smartphone is not significantly different among the identified clusters.

H2b: Withdrawal/Escapes induced by usages of Smartphone is not significantly different among the identified clusters.

Physical and Psychological Stressor

H3a: Physical Symptoms induced by usages of Smartphone is not significantly different among the identified clusters.

H3a: Psychological Symptoms induced by usages of Smartphone is not significantly different among the identified clusters.

Social Interaction Stressors

H4a: Compulsive Usage induced by usages of Smartphone is not significantly different among the identified clusters.

H4b: Neglect Work induced by usages of Smartphone is not significantly different among the identified clusters.

Sampling technique

As we know probability sampling is considered as standard sampling technique but as the population frame is infinite hence, convenience sampling has been used to collect the sample data through online platform and people using Smartphone had been asked to response on Likert scale of 5 regarding the identified stressors, from Strongly Disagree to Strongly Agree. The sample comprised of 427 respondents and the reliability statistics of the data collected is

Reliability Statistics

Cronbach Alpha for all the parameters has shown an average scale or results, however overall Cronbach alpha value having higher than 0.70 is desirable for the reliability and it is concluded that the data can be used for further analysis.

Two-step cluster analysis has been carried out instead of the K-means clusters analysis in order to identify the crucial elements for defining the clusters. The validity classifications are evaluated using two metrics in combination: 1) Separation, or the proximity between members or conchoids of different clusters (the lower, the better); 2) Cohesion, or the proximity among members of the same cluster (the higher, the better).

This method's main advantage is that it takes into account a variety of cluster validity criteria, so if they differ, there's no need to make an arbitrary decision. The following formula can be used to calculate the optimal number of clusters (K) in a data set using the silhouette coefficients.:

$$S_i = \frac{(b_i - a_i)}{\text{Max}(a_i, b_i)}$$

where a_i is a measure of separation (i.e., the i th object's average distance from all other objects in a distinct cluster) and b_i is a measure of cohesiveness (the average distance between the i th object and all other objects in the same cluster). The silhouette coefficient has a range of values from -1 to 1, although positive values (i.e., $b_i > a_i$) and values around unity (i.e., $a_i = 0$) signify a high-quality clustering solution. An overall assessment of the goodness of a clustering can be obtained by averaging the silhouette coefficients for every point [26]

Findings and Analysis

Cronbach alpha value 0.846 as compared with 0.70. So, it can be concluded that the data is reliable can be used for further analysis. Checking the underlying assumptions, such as data sufficiency or sample adequacy, which determines if the acquired data is significant enough to perform factor analysis or not, is crucial before conducting a factor analysis. Additionally, the KMO value should be higher than 0.60. The KMO value for the present sample is more is 0.80. which is much higher than the suggested value of 0.6; as a result, the data collected is adequate for factor analysis.

With the help of dimension reduction techniques total 9 factors having factor loading 0.7 under 4 dimensions have been identified. Techno overload, Techno-invasion, Work from Home Conflict, Physical

Symptoms, Psychological Symptoms, Compulsive, Feeling lost/anxious, Withdrawal/Escape, Neglect work. AVE average variance extracted for all component have higher than 0.5 and higher than their correlations this indicates the higher discriminant, and convergent validity of the measurement scale. To identify the critical elements for clustering silhouette coefficients have been measured the results are shows in table 1 and figure 4.

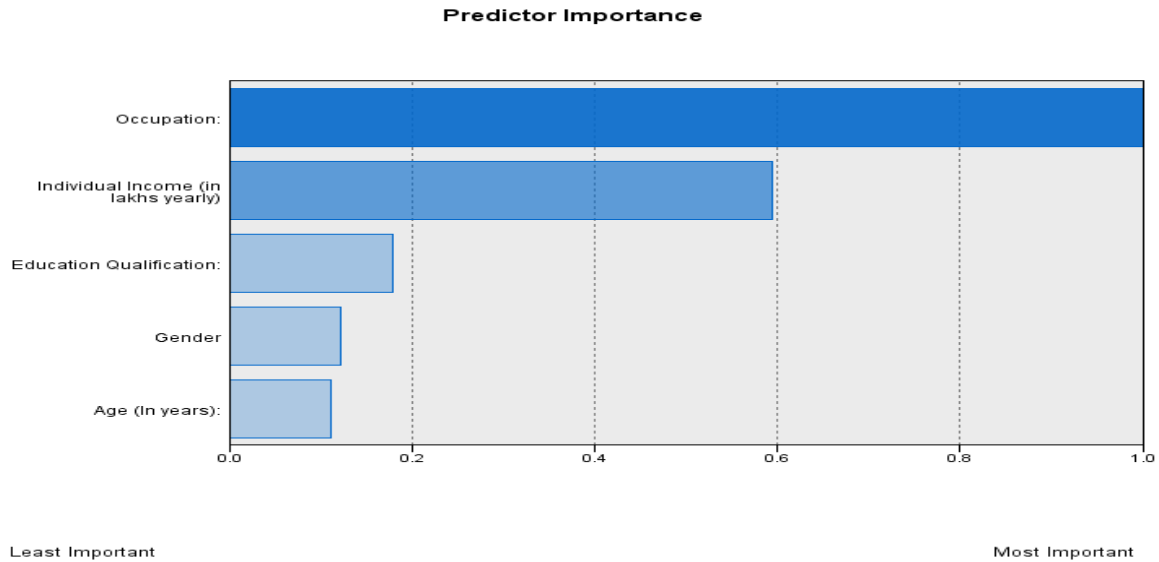


Figure 1: Predictor Importance

Table 1: Cluster Predictor

| Inputs | Importance | Cluster1 | Cluster2 |
|---------------|------------|--------------------------|---------------------------|
| Size (%) | 427 | 338 (79%) | 89(21%) |
| Occupation | 1.00 | Privet Job (64%) | Housewife's (50%) |
| Income | 0.59 | 6-10 laks(55%) | Lessthan1laks (70%) |
| Qualification | 0.18 | Post Graduate (74%) | Post Graduate (49%) |
| Gender | 0.12 | Male(61%) | Female(80%) |
| Age | 0.11 | Between 25-35years (69%) | Between 25 -35years (30%) |

From the above table 1 and Figure 1 it is evident that only two important factors occupation and Individual income of the individuals have salute index above the 0.5. Remaining others three variables have below it. Therefore it was conclude that only two demographic factors have highly ability to form separate groups. There was only two clusters have been segregated.

Cluster1: For the cluster First it was concluded that majority share of this cluster belongs to post graduate male of 25-35 age groups and earnings in between 6-10 Lakhs. We can terms this cluster as highly paid job workers.

Cluster2: Another cluster with the size of 20% of the total sample comprising of Post graduate young house wife's earnings below 1 Lakhs. It was termed as Housewife's.

Study is attempted to gauge the influences of different demographic of individuals on the identified factors of stress induced by the uses of the Smartphone.

Table 2: Personal Life Stressor

| Factors | Cluster | N | Mean | Std | t-value | d.f | sign |
|--------------------------|---------------------|-----|------|-----|---------|-----|------|
| Techno Overload | Highly Earning Male | 338 | 3.7 | 0.7 | 1.904 | 425 | .058 |
| | House wife's | 89 | 3.5 | 0.7 | | | |
| Techno invasion | Highly Earning Male | 338 | 3.7 | 0.8 | -2.580 | 425 | .010 |
| | House wife's | 89 | 3.9 | 0.8 | | | |
| Workhome conflict | Highly Earning Male | 338 | 3.1 | 0.7 | -3.069 | 425 | .002 |
| | House wife's | 89 | 3.4 | 0.9 | | | |

The table shows that the value of t statistics is not significant at 5 % level of significance this indicates that there is no possibility to reject the developed Null hypothesis. Therefore it was concluded that techno overload stressor induces due to uses of Smartphone was not perceived significantly differently among the two clusters.

Table reveals that t-statistics for the both Techno invasion, work from home conflict, was significant at 5% level of significance. This confirm that there is no possibilities to accept the null hypothesis, therefore the formulated alternate hypothesis was accepted and concluded that level of both the stressors was induced differently for the both the cluster.

Table 3: Nomo phobia stressor

| Factors | Cluster | N | Mean | Std | t-value | d.f | sign |
|----------------|---------------------|-----|------|-----|---------|-----|------|
| Anxious | Highly Earning Male | 338 | 3.3 | 1.1 | 2.735 | 425 | .006 |
| | House wife's | 89 | 3.0 | 0.7 | | | |
| Escape | Highly Earning Male | 338 | 3.8 | 0.7 | -4.426 | 425 | .000 |
| | House wife's | 89 | 4.2 | 0.6 | | | |

Table reveals that t-statistics for the both Anxious, Escape, was significant at 5% level of significance. This confirm that there is no possibilities to accept the null hypothesis, therefore the formulated alternate hypothesis was accepted and concluded that level of both the stressors was induced differently for the both the cluster.

Table 4: Physical & Psychological Stressor

| Factors | Cluster | N | Mean | Std | t-value | d.f | sign |
|------------------------------|---------------------|-----|------|-----|---------|-----|------|
| Physical symptom | Highly Earning Male | 338 | 3.2 | 0.9 | -2.739 | 425 | .006 |
| | House wife's | 89 | 3.5 | 1.0 | | | |
| Psychological symptom | Highly Earning Male | 338 | 3.5 | 0.9 | -6.958 | 425 | .000 |
| | House wife's | 89 | 4.2 | 0.7 | | | |

Table reveals that t-statistics for the both Physical and Psychological symptoms, was significant at 5% level of significance. This confirm that there is no possibilities to accept the null hypothesis, therefore the formulated alternate hypothesis was accepted and concluded that physical and psychological symptoms perceived induces among both of the stressors was induced differently for the both the cluster.

Table 5: Social Interaction stressor

| Factors | Cluster | N | Mean | Std | t-value | d.f | sign |
|-------------------|---------------------|-----|------|-----|---------|-----|------|
| Compulsive | Highly Earning Male | 338 | 3.3 | 0.9 | -.329 | 425 | .742 |
| | House wife's | 89 | 3.4 | 1.1 | | | |
| Neglect | Highly Earning Male | 338 | 3.1 | 0.8 | -.114 | 425 | .910 |
| | House wife's | 89 | 3.1 | 1.0 | | | |

Table reveals that t-statistics for the both compulsive and neglect symptoms, was insignificant at 5% level of significance. This confirm that there is no possibilities to reject the null hypothesis, therefore the formulated null hypothesis was accepted and concluded that compulsive and neglect stressor was not perceived significantly different among both of the clusters.

Results and Conclusion

A smart phone is merely a miniature computer with almost limitless possibilities. It wouldn't be incorrect to claim that the human race and other elements of existence have been significantly impacted by Smartphone. In fact, it has had an impact on practically every aspect of society. As identified the stressor induced by Smartphone usage are **Personal Life Stressor** whose components are Techno-Overload, Techno-Invasion and Work-Home Conflict, Nomo-Phobia Stressor are Feeling Anxious/Lost and Withdrawal/Escape, Physical and Pschycological Stressors are Physical Symptoms and Pschycological Symptoms and Social Interaction Stressor are Compulsive Usage and Neglect Work. On the basis demographic the segmentation that resulted in the form of Cluster are Cluster1 comprised of Occupation which showed inclination towards Private job employees and housewife and Cluster2 comprised of Income between 6-10 Lakhs and less than 1 Lakhs. The result as hypothesized showed that in Personal Life Stressor there is perceived significant among Cluster1 and Cluster2 with respect to Techno-invasion and Work home Conflict but no perceived significance with Techno-Overload which means Occupation and income of the individual leads to invasion and conflict with respect to Smartphone usage. As hypothesized Nomo-Phobia Stressor perceived significant among Cluster1 and Cluster2 with respect to Anxious and Escape means Occupation and income of the individual leads to isolation with Smartphone and not having Smartphone or battery going to die effects individual. Physical and Pschycological Stressor perceived significant among Cluster1 and Cluster2 with respect to Physical symptoms and Pschycological Symptoms means Occupation and income of the individual leads health issues as occupation and income are inter-related to each other. Similarly it was found that Social Interaction Stressor perceived no significance among Cluster1 and Cluster2 with respect to Compulsive Usage and Neglect Work which means Occupation and Income leads to this stressor. So it's concluded that Occupation and Income are demographic factors which lead to Stressor induced by Smartphone as compared to other demographic factors age, gender and education. An individual occupation and income leads to Stressors.

References

1. Agarwal, R. (2000) "Individual Acceptance of Information Technologies," in: Framing the Domains of IT Management: Projecting the Future through the Past, R.W. Zmud (ed.), Pinnaflex, Cincinnati pp. 85-104.
2. Bianchi, A., & Phillips, J. G. (2005). Psychological predictors of problem mobile phone use. *CyberPsychology & Behavior*, 8(1), 39-51.
3. Brillhart, P.E. (2004). Technostress in the Workplace: Managing Stress in the Electronic Workplace. *Journal of American Academy of Business*, Cambridge, 5, 302-307
4. Cha, S. S., & Seo, B. K. (2018). Smartphone use and smartphone addiction in middle school students in Korea: Prevalence, social networking service, and game use. *Health Psychology Open*, 5(1), 1-15. doi:10.1177/2055102918755046
5. Cohen S. (1982). Sound Effects on Behaviour. *Psychology Today*, 15(38-49). Retrieved from <http://repository.cmu.edu/psychology/286>.
6. Cooper, C. L., Dewe, P. J., and O'Driscoll, M. P. (2001). *Organizational Stress*, Thousand Oaks, CA: Sage Publications.
7. Frone, M.R., Russell, M. and Cooper, M.L. (1992). "Antecedents and outcomes of work-family conflict: testing a model of the work-family interface", *Journal of Applied Psychology*, Vol. 77, pp. 65-78.
8. Griffiths, M.D. (2000), Does Internet and computer "addiction" exist? Some case study evidence. *Cyber Psychology & Behavior*, 3, 211-218.
9. Hinduja, S. and Patchin, W.J. (2010). *Cyberbullying Research Summary*, Cyberbullying and Suicide. *Cyberbullying Research Center*, visit <http://www.cyberbullying.us>.
10. Jefferies, D. (2013). Is technology and the internet reducing pupils attention spans? *The guardian*.
11. Kim, J.-H. Characteristics Linked to Korean Adolescents' Propensity for Smartphone Addiction. *Environ. Res. Public Health Int. J.* 2021, 18, 11668. This link points to a 10.3390/ijerph 182111668.
12. The Korean smartphone addiction proneness scale for youth and adults was developed by the Korean Information Society Agency and published in Seoul, Korea in 2011.
13. Lim, O. L.S. (2019). Daily Smartphone Use for Work and Its Effect on Work-Life Conflict among Integrators, *Journal of Cognitive Sciences and Human Development*. Vol. 5(2).
14. McGrath, S. (2012). The impact of new media technologies on social interaction in the household. *S0303H Electronic Culture and Social Change (New Media Technologies in the Household)*.
15. Morahan-Martin, J. (2008), Internet abuse: Emerging trends and lingering questions. In A. barak (Ed.), *Psychological aspects of cyberspace: Theory, research, applications* (pp. 32-69). Cambridge University Press.
16. Nables, Reynoldsburg and O.H. (n.d.). Negative Effects of Technology on Society. *Teen Ink-Magazine*. <http://www.teenink.com/notification/academic/article/482544/negative-effect-of-technology-on-society> [accessed on 11, July 2014].
17. Nestian, A., Silviu, T. & Turnea, E-S. (2020). Using Mobile Phones at Work in Personal and Professional Information Processes.
18. Ng, C.M.; Leung, K.C.; Leung, S.F. The Associations between Cell Phone Use and Depressive Symptoms, Physical Pain, and Daytime Sleepiness in Hong Kong Secondary School Students; Wu, L.H.; Lam, H.Y.; Lam, L.K.; Nip, P.Y.; Ng, C.M. *Behav. Addict.* 2020, 101, 105975. [Cross Reference] [PubMed]

19. Noë, B., Turner, L. D., Linden, D. E. J., Allen, S. M., Winkens, B., & Whitaker, R. M. (2019). Identifying indicators of smartphone addiction through user-app interaction. *Computers in Human Behavior*, 99, 56-65. doi:10.1016/j.chb.2019.04.023
20. O’Driscoll, M. P., Ilgen, D. R., & Hildreth, K. (1992). Time devoted to job and off-job activities, interrole conflict, and affective experiences. *Journal of Applied Psychology*, 77(3), 272–279.
21. O’Driscoll, M.P. (1996). “The interface between job and off-job roles: enhancement and conflict”, in Cooper, C.L. and Robertson, I.T. (Eds), *Well-being in Organizations: A Reader for Students and Practitioners*, Wiley, Chichester, pp. 149-76
22. O’Guinn, T. C., & Faber, R. J. (1989). Compulsive buying: A phenomenological exploration. *Journal of Consumer Research*, 16(2), 147–157.
23. Raita, E., Ma, L., Rattenbury, T., & Oulasvirta, A. (2011). Smartphone use is becoming commonplace due to habits. 16(1), 105–114 in *Personal and Ubiquitous Computing*. Publication: 10.1007/s00779-011-0412-2
24. Salanova, M., Peiro, M.J. and Schaufeli, B.W.(2002).Self-efficacy specificity and burnout among information technology workers: An extension of Job demand control model. *European Journal of work and organizational psychology*(11),11-25.
25. Singh, N., & Medhavi, S. (2021). Factors implicated in smartphone usage distressing individual. *International Journal of Engineering and Management Research*, 11. doi.org/10.31033/ijemr.11.3.24
26. Tan P-N, Steinbach M, Kumar V (2006) Cluster analysis: basic concepts and algorithms. Introduction to data mining. Addison-Wesley, Reading
27. Tegtmeier, P. A Scoping Review on Physical Stress and Smart Mobile Devices. 2018 *Work* 59, 273–283.
28. Widyanto, L., and McMurrin, M. (2004), The Internet addiction test's psychometric features. 7(4), 43-50; *CyberPsychology & Behaviour*
29. Young, K. (1996), *CyberPsychology & Behaviour*, 3, 23. Internet addiction: The advent of a new clinical illness