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On Developing Human Centric Digital Tweens

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Abstract

Purpose: The use of smart devices has increased greatly in the last ten years with users reaching out to the possibility to do more with them especially in the networking front. In this context there is a need to understand the connection between users' social demographic factors and their way to related to their smart devices.
Objective: This study was designed to evaluate the senso of belonging of a community in order to evaluate intangible benefits that employees may gain from a more immerse relationship with their devices.
Method: We used a dataset of 586 anonymous respondent of an existing survey designed for capturing the relationships that humans develop with their smart devices. In particular, we investigate the relationships with smart device and particular background variables of the respondents using a chi-square test.
Results: The study showed that there is a significant relationship between users' sex and smart device type and their dependency on smart device. Male tends to think that smart device (in general) enables them to connect with a larger community. At the same time, female using smart phones feels more connected more to large community than when using other smart devices.
Conclusion: This study provided several significant findings that confirm and strength previous literature works on the subject. In addition, socio demographics variables (like gender) as well as the type of smart device present a correlation between the smart device users and their tendency to stay in touch with a larger community.

Keywords
Smart device, Users behavior, human computer interaction, exploratory analysis, statistical methods.

1. Introduction

The more Industry 4.0 advance the more Humans, become part of a socio-technical production system and develop an intricate relationship with their (smart) tools and (smart) products.
In this scenario is intuitive to assume that the relationship between humans and their devices is complex. Therefore, if in Industry 5.0 we intend to shift our attention from efficiency towards a more human centric approach, we need to understand the relationship between humans and technology in a more sound and deeper manner.
Digital tweens will allow the possibility to develop a digital replica of complex equipment. It is reasonable to assume that operators will interact with them following a paradigm that is similar to the one that are currently using when interacting with smart devices in their everyday life. Consequently, a better understanding of the relationship between human and devices will foster a more collaborative enjoyable and productive interaction.

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A smart device, as the name implies, is a piece of electronic equipment that can communicate, share, and collaborate with the user and other similarly equipped gadgets over the internet. Also described as interactive electronic gadgets that respond to human directions and assist with everyday tasks. Smartphones, tablets, phablets, smartwatches, smart glasses, and other personal electronics are some of the most regularly used smart gadgets. The capacity to connect to a network and exchange and interact remotely is what defines many smart gadgets, which are tiny, portable personal electronics. For this reason, many television sets and freezers may be classified as "smart gadgets." People's lives have become more dependent on technology [1]. People utilize technology in many aspects of their lives, from jobs to school to socialize [2]. Consequently, smart device innovations have had a huge influence on people's lives, making them more productive and efficient.

Smart devices are also important for social relationships and contribute to the way we relate among individuals. Nowadays, if you want to be sociable, you don't have to go out with my friends every day or phone them every two hours. You can stay in touch with them using smart devices that are directly connected with social media sites.

While it is true that smartphones have made it easier to maintain interpersonal relationships and perform duties [3][4] experimental evidences show that people often neglect those they are physically interacting within favor of their smartphones and connecting to “online others” [5].

We consequently advance the following hypothesis to be investigated:

Hypothesis: My smart device enables me to be a part of a larger community.

The need to interact with other persons is a clear basic need for all the humans and the use of smart devices as a communication hub is fulfilling part of this need. While most people long to connect to a larger community for various needs like social networking, religious event, conferences and more, we know that the use of smart devices has made easier to connect with others seamlessly. Technology enablers of the majority of smart devices includes technologies like Bluetooth, WiFi, MMS, SMS, GPRS, GSM, 3G, 4G. This approach enables users connect to multiple devices and multiple users at the same time [6][7].

In this study, we look at the relationship between users’ socio demographics variables and their ability to connect to a larger community using their smart device

The rest of the paper is organized as follows. Section 2 reviews related works: their similarities and differences. Section 3 comprises of the method used in this paper as well as a brief overview of the data. Section 4 consists of the results obtained in this research analysis. Section 5 concludes the paper with a brief summary and discuss the future work.

2. Related Work

Barber and Santuzzi [8] in their work explored how college students’ urge to respond quickly to their smart devices in a bid to stay connected to their peeps. With the use of predictive validity design, they asserted that there is a strong correlation between the use of smart devices and the need to be part of a larger community. Several studies were conducted recently to access the communications established between friends and family via their smart devices in attempt to tag in/connect to the latest price/sales offerings in the ecommerce fronts [9][10][11].

Research carried out in Australia investigated the smartphone usage and a need to stay connected on among the adult [12]. In this work, the authors evaluated the participants preferred smart phone activities and their impact on smartphone usage. Their findings showed 73% of the participants activities were on social media use (a virtual community). This supports the findings made by a similar study conducted in Switzerland [13]. They employed the use of statistical method (Pearson Chi-Square test) to access the relationship between the measured variables.

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Winskel and his team performed an experiment on the use of smartphone and study behavior among students in Korea and Australia [14]. With the use of descriptive statistics and ANOVA tests, they accessed the relationship between smartphone usage, problematic smartphone use scores and GPA scores. Their findings showed average smartphone use and problematic smartphone use were found to be significantly higher for Korean compared to Australian students.

Melumad and Pham examined the type of relationship that digital consumers form with their smartphones [15]. Their findings showed in the stressful moments, consumers tend to seek out their smartphone.

3. Method

In our analysis, we investigate the the user's tendency to connect to a larger community using a smart device. Firstly, we observed the relation between each demographic variable (Age, Sex, Level of education, Type of education, Device Category) and users' tendency to connect with others . . We employed the Pearson Chi-square test of independence. We decided to use this statistical approach because our data set that meets its requirements, in particular :

- The simple random sampling was our chosen sampling method
- All responses are in the same sample set.
- All examined variables are categorical
- The categories are mutually exclusive and
- The expected frequency count for all category variables was 5 or higher.

In cases, where more than 20% of cells in a contingency table have expected frequency less than 5, we employed the Fisher's exact test to access whether there is a significant association between two categorical variables in the contingency table. In this research work as in most academic works, the significance factor or alpha value of 0.05 is chosen. We measure the strength of the association between the variables with the use of Cramer's V test.

3.1. Dataset

The dataset used in the study is a report of responses to a survey designed to investigate the relationship between people and their smart devices [22]. The dataset is publicly available and contains meta-information regarding the data collection procedure as well as all the raw information in an anonymous format [23]. The dataset can be used to evaluate and identify various human actions/behaviours toward their smart devices. Example of questions that have been asked include the perceptions and expectations towards their smart devices such as (i) "I miss my smart device when I'm away from it/not using it", (ii) "My smart device helps and supports me like a "friend", (iii) "I don't feel complete without my smart device".

The survey captured the respondents' demographic parameters which include: (i) age-group, (ii) sex, (iii) education level, (iv) education type, (v) work experience, (vii) country of residence, (viii) county of origin. The dataset was collected in May-July 2020 and is a sample of over 500 participants of various cultural allegiance and upbringing. The data have been analyzed using the pandas package available in Python.

4. Result and Discussion

In this Section we present our observations in this study. The sample (N = 574) consist of 394 (68.64%) of male, 174 (30.31%) of female and 6 (1.04%) who prefer not to say. One can dig deep to

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know more about the sociodemographic characteristics of the participants by consulting this paper [22]. We access the relationship between each demographic variable and large community connection (*My smart device enables me to be a part of a larger community*).

First, we examine the association between age group and large community connection. Null Hypothesis (H1-0): There is no significant association between the two categorical variables – age group and large community connection. Alternative Hypothesis (H1-1): There is a significant association between the two categorical variables – age group and large community connection.

Second, we examine the relationship between sex and large community connection. Null Hypothesis (H2-0): There is no significant association between the two categorical variables –sex and large community connection. Alternative Hypothesis (H2-1): There is a significant association between the two categorical variables – sex and large community connection. With a p-value of 0.0197, there is strong evidence to reject the null hypothesis which shows there is a relationship between sex and large community connection with a weak association (Cramer's Value =0.1436)

Next, we observed that 68% of these respondents lies in the "PhD" and "Professor" hence we created two subsets which holds "PhD" and "Professor" and "Others". After which we created the hypothesis to examined the connection between education level and large community connection. Null hypothesis (H3-0): There is no significant association between the two categorical variables –education level and large community connection. Alternative hypothesis (H3-1): There is a significant association between the two categorical variables – education level and large community connection. With a p-value of 0.3551, there is no indication to show there is a relationship between sex and large community connection hence the null hypothesis is accepted.

Next, we observed that 58% of these respondents belong to the Informatics, Computer science & Computer (ICC) group hence we created two subsets to manage this distribution with one subset for only respondents in ICC and the other for other groups. We created two hypotheses to evaluate the association between these variables – education type and large community connection. Null hypothesis (H4-0): There is no significant association between the two variables. Alternative hypothesis (H4-1): There is a significant association between the two variables. There was strong evidence to accept the null hypothesis with a p-value of 0.24

Finally, we accessed the relationship between device category and large community connection. We created two subsets for the device category. The first subset is for computers, smartphones and smart watches/bracelets and the second subset for other smart devices. Null hypothesis (H5-0): There is no significant association between the two variables (device category and smart device dependency). Alternative hypothesis (H5-1): There is a significant association between the two variables. We accept the alternative hypothesis based on the result of the chi-square test that produced a p-value of 0.001. The association that exists between the variables is weak given that the Cramer's value is 0.18.

S/N	Hypothesis	Description	Result
1	H1-0	There is no significant relationship between age and user's ability to connect with a large community	Accepted
2	H2-0	There is no significant relationship between sex and user's ability to connect with a large community	Rejected
3	H3-0	There is no significant relationship between education level and user's ability to connect with a large community	Accepted
4	H4-0	There is no significant relationship between education type and user's ability to connect with a large community	Accepted

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5	H5-0	There is no significant relationship between device category and user's ability to connect with a large community	Rejected

After accessing the Hypothesis 1: The respondent's age, education level and type doesn't play a significant role in user's smart device dependency. Respondent's sex and device category played a significant role however their relationship is weak.

5. Conclusion

This study provided several significant findings that strengthen the smart device dependency literature. With most related works focused on the smart phone use dependency and its impacts to the user's work ethics [16][17] as well as academic performance [18][19]. This paper entails the use of smart device including smart phones and the need for the users to connect with a large community. Findings indicate that there is a relationship between the need to connect with a large community and user's sex. This confirms previous studies carried out recently.[20] [21]. The user's education type and education level doesn't play a significant role for the user's need to socialize with other. One of the limitations in this work is the failure to handle the data imbalance. Data imbalance is a state where a variable has uneven observations distribution. Will the application of data preprocessing techniques like normalization improve the findings? This can be addressed in further study. Further investigation in this study will examine the user's segmentation on their tendency to use their smart device to connect a large community. The application of AI in future study could improve the analysis. With the use of machine learning algorithms like logistics regression, decision tree classifier, we could combine all independent variables and see how they influence the users on the target class in an instance as well as get the most important features in this dataset. Device category plays a significant role in user's ability to connect with a large community especially those with smartphone, smart wristwatches and brackets. Industry 5.0 could look into this finding and see how the user dependency factor in these interest devices can be check/monitored. Future study could investigate the smart device features that spurs user's dependency as well as time of usage.

6. References

[1] B. Auxier and M. Anderson, Social Media Use in 2021, Pew Research Center (April,2021). Retrieved on February 09 2021 via https://www.pewresearch.org/internet/wp-content/uploads/sites/9/2021/04/PI_2021.04.07_Social-Media-Use_FINAL.pdf

[2] P. K. Chopdar, J. Paul, N. Korfiatis, M. D. Lytras, Examining the role of consumer impulsiveness in multiple app usage behavior among mobile shoppers, Journal of Business Research, Vol 140, 2022, Pages 657-669, ISSN 0148-2963, https://doi.org/10.1016/j.jbusres.2021.11.031.

[3] D. Derks, D. van Duin, M. Tims, and A. B. Bakker. Smartphone use and work–home interference: The moderating role of social norms and employee work engagement. Journal of Occupational and Organizational Psychology, 88(1), 2015, 155–177.

[4] E. E. Kossek, and B. A. Lautsch, Work–family boundary management styles in organizations: A cross-level model. *Organizational Psychology Review*, *2*(2), 2021, 152–171.

[5] J. S. Mendoza, B. C. Pody, S. Lee, M. Ki, and I. M. McDonough. The effect of cellphones on attention and learning: The influences of time, distraction, and nomophobia. *Computers in Human Behavior*,*86*, 2018, 52–60.

[6] M. Sapacz, G. Rockman, and J. Clark. Are we addicted to our cell phones? *Computers in Human Behavior*, *57*, 2016, 153–159.

[7] E. M Al-Mukhaini, W. S. Al-Qayoudhi, and A. H. Al-Badi. Adoption of social networking in education: A study of the use of social networks by higher education students in Oman. *Journal of International Education Research (JIER)*, *10*(2), 2014, 143–154.
[8] L. K. Barber, & A. M. Santuzzi. Telepressure and college student employment: The costs of staying connected across social contexts. Stress and Health, 33(1), 2017, 14–23. https://doi.org/10.1002/smi.2668.
[9] V. Apaolaza, P. Hartmann, C. D'Souza, and A. Gilsanz,. Mindfulness, compulsive mobile social media use, and derived stress: The mediating roles of self-esteem and social anxiety. yberpsychology, Behavior, and Social Networking, 22(6), 2019, 388–396. https://doi.org/10.1089/cyber.2018.0681
[10] C. J. Budnick, A. P. Rogers, and L. K. Barber. The fear of missing out at work: Examining costs and benefits to employee health and motivation. Computers in Human Behavior, 104(October 2019), 106161. https://doi.org/10.1016/j. chb.2019.106161.
[11] A. Dhir, Y. Yossatorn, P. Kaur, and S. Chen. Online social media fatigue and psychological wellbeing—a study of compulsive use, fear of missing out, fatigue, anxiety and depression. International Journal of Information Management, 40 (February), 2018, 141–152. https://doi.org/10.1016/j.ijinfomgt.2018.01.012
[12] T. Linden, S. Nawaz, and M. Mitchell. Adults' perspectives on smartphone usage and dependency in Australia. Computers in Human Behavior Reports, 3, 2021, https://doi.org/10.1016/j.chbr.2021.100060
[13] S. Haug, R. Paz Castro, M. Kwon, A. Filler, T. Kowatsch, and M. P. Schaub. Smartphone use and smartphone addiction among young people in Switzerland. Journal of Behavioral Addictions, 4(4), 2015, 299–307. https://doi.org/10.1556/2006.4.2015.037
[14] H. Winskel, T Kim, L. Kardash, and I. Belic. Smartphone use and study behavior: A Korean and Australian comparison, Heliyon, Vol. 5, Issue 7, 2019, e02158, ISSN 2405-8440, https://doi.org/10.1016/j.heliyon.2019.e02158.
[15] Check
[16] J. Billieux, A. Schimmenti, Y. Khazaal, P. Maurage, and A. Heeren. Are we over pathologizing everyday life? A tenable blueprint for behavioral addiction research. J. Behav. Addict. Volume 4, Issue 3, 2015. Pp 119-123.
[17] D. Derks, A. B. Bakker, M. Gorgievski. Private smartphone use during worktime: A diary study on the unexplored costs of integrating the work and family domains. Comupters in Human Behavior, 114, 2021, https://doi.org/10.1016/j.chb.2020.106530
[18] F. D. Alosaimi, H. Alyahya, H. Alshahwan, N. Al Mahyijari, and S. A. Shaik. Smartphone addiction among university students in Riyadh, Saudi Arabia. Saudi Medical Journal, 37, 2016, 675–683.
[19] Y. F Chen, and S.S. Peng. University students' internet use and its relationships with academic performance, interpersonal relationships, psychosocial adjustment and selfevaluation. CyberPsychology & Behavior, 11, 2008 467–469.
[20] E. Gentina, and F. Rowe. Effects of materialism on problematic smartphone dependency among adolescents: The role of gender and gratifications, International Journal of Information Management, Volume 54, 2020, https://doi.org/10.1016/j.ijinfomgt.2020.102134.
[21] C. Chen, K. Z.K. Zhang, X. Gong, S. J. Zhao, M. K.O. Lee, L. Liang. Examining the effects of motives and gender differences on smartphone addiction, Computers in Human Behavior, Volume 75, 2017, pp 891-902, ISSN 0747-5632, https://doi.org/10.1016/j.chb.2017.07.002.check
[22] Toivonen, Heidi and Lelli, Francesco, "Agency in Human-Smart Device Relationship: an Exploratory Study" (2021). PACIS 2021 Proceedings. 145. https://aisel.aisnet.org/pacis2021/14
[23] Lelli, Francesco; Toivonen, Heidi, 2021, "A Survey for investigating human and smart devices relationships", https://doi.org/10.34894/TRAONY , DataverseNL, V1