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Cellulographics©: A novel smartphone user classification metrics

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ABSTRACT

Despite the worldwide surge in smartphone use, there are no classification metrics based on its use. In this article, a comprehensive concept called '*Cellulographics*' is introduced for characterization of smartphone users, which includes behavioral classification based on user characteristics like smartphone experience (SE), smartphone use skill (SUS), smartphone internet experience (SIE), smartphone use periods (SUP), smartphone screen time (SST), smartphone use frequency (SUF), smartphone use activities (SUA), and smartphone use location (SUL). This concept can be applied to any field of study without limitations, where smartphone use is involved.

Introduction

Market segmentation is the key component of marketing (Smith, 1956). Companies strive to understand the customers and their needs to serve and to develop their marketing strategies (Cooil et al., 2008). Typically, marketers use geographic, demographic, psychographic, and behavioral variables for segmentation (Fig. 1). Geographic segmentation is the oldest type of segmentation (Tynan & Drayton, 1987), followed by demographics, which can be traced from John Graunt's quantitative analyses of the "Bills of Mortality" published in 1662 (Smith & Keyfitz, 2013; Timæus, 2014). But the term '*Demography*' was first coined by a Belgian statistician, Achille Guillard in 1855. The behavioral segmentation became popular in 1960 when researchers proposed classifications based on brand loyalty (Cunningham, 1956), benefits (Haley, 1968), usage (Twedt, 1964), etc. Later in the 1970s, Demby (1971) proposed psychographic segmentation. Since the beginning scientists believed that conventional segmentations were inadequate for designing a marketing strategy (Yankelovich, 1964). Therefore, a few more classifications like *Technographics* (El-Gohary & Eid, 2013) and *Webographics* (Grossnickle & Raskin, 2001) emerged. These researchers emphasized that customers have been migrating to the online environment and that websites were important consumer interfaces.

Cellulographics©: the new metrics

The traditional segmentations are eventually becoming obsolete because consumers are migrating to smartphones for their daily online activities. Smartphones are versatile, portable, and accessible round the clock (Budiu, 2015). The processing power of present-day's smartphones surpasses that of desktops in the past, thus, allowing users to perform practically any task with ease. In terms of users, the Worldwide market share of mobile phones (54.98%) is far greater than desktops (42.54%) and tablets (2.47%) (Statcounter.com, 2022), and Worldwide, smartphone subscription is expected to grow to 7216 million users by 2026 (Statista, 2021). Excluding tablets, only mobile devices generate 54.4% of website traffic globally (Statista.com, 2022b). Similarly, 80% of social media browsing occurs through smartphones, it's even higher for specific platforms like Facebook (95.1%), Twitter (86%), LinkedIn (60%), etc. (Broadbandsearch.net, 2022). Mobile commerce contributes significantly (72.9%) to worldwide e-commerce retail sales (Statista.com, 2022a). From the above discussion, it is evident that smartphones are emerging as versatile devices enabling the user to perform various activities, yet there are no classification metrics based on smartphone usage to date. To cover this gap '*Cellulographics*' has been proposed and defined as below.

Definition

Cellulographics is a term developed for behavioral classification of smartphone users based on diverse characteristics such as

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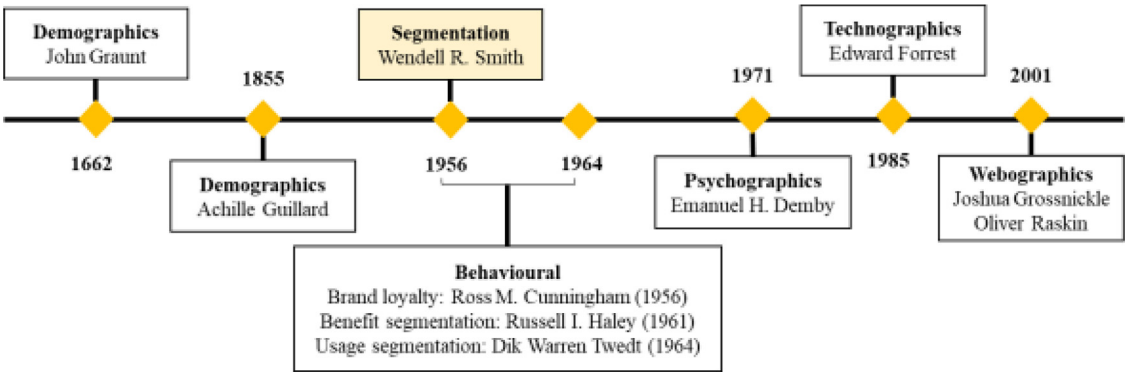

Fig. 1. Major seminal works on segmentation/classification.

smartphone experience (SE), smartphone use skill (SUS), smartphone internet experience (SIE), smartphone use periods (SUP), smartphone screen time (SST), smartphone use frequency (SUF), smartphone use activities (SUA), and smartphone use location (SUL). These terms are explained below (Fig. 2).

Smartphone experience (SE)

It is the total number of years an individual has been using a smartphone. This criterion is crucial because the length of usage, familiarity, compatibility of the innovation with past experiences, existing values, needs, expertise, background, and prior knowledge can either inhibit or promote smartphone use (Al-Ghaith et al., 2010; Dey et al., 2013;Maes et al., 2006; Taylor & Levin, 2014).

Smartphone use skill (SUS)

It is an individual's self-assessment of the ability and proficiency to use the smartphone. Due to the differences in culture, social environment, personal characteristics, technological context, etc., information communication and technology (ICT) skills may vary among users (Haenssgen, 2018; Vimalkumar et al., 2020). Researchers have revealed that mobile phone efficacy, skills, and competence can affect the extent of technology use, perception, motivation, and impact (Campbell & Kwak, 2010; Dey et al., 2013; Liu et al., 2014). For example, specific smartphone skills are essential to access mobile financial services (Kiconco et al., 2020).

Smartphone internet experience (SIE)

It is an individual's internet experience through a smartphone. Marketers consistently attempt to provide a seamless mobile internet experience to the users (Asunmaa et al., 2002). Several advantages including mobility, lightweight, long battery life, instant-on capability, high-definition touch screen, and interactivity are leading to higher smartphone dependency and gratifications (Leung & Zhang, 2016). Uninterrupted internet access through smartphones encourages mobile lifestyle to receive directions while navigating unfamiliar locations, fill dead time by paying a bill or messaging while waiting for public transport, perform time-critical tasks like online meetings or using the internet for entertainment, or playing games (Gilbert & Han, 2005). The user engagement has reached a level where researchers have warned that pedestrian and driver behavior can be described as risky due to their mobile internet use (Byington & Schwebel, 2013; Maier et al., 2020). However, the type of smartphone internet experience is dependent on the efficiency and skill of the user (Liu et al., 2014; Turgut & Kursun, 2020).

Smartphone use periods (SUP)

It is the time of the day when the user indulges in smartphone use, like in the morning (6:01–12:00 h), afternoon (12:01–18:00 h), evening (18:01– 0:00 h), and night (01:00 –6:00 h) (MAEN). Throughout the day, the use of mobile touch screen devices is interspersed within our daily activities (Toh et al., 2019), but researchers believe that differences may exist in total daily duration, a number of

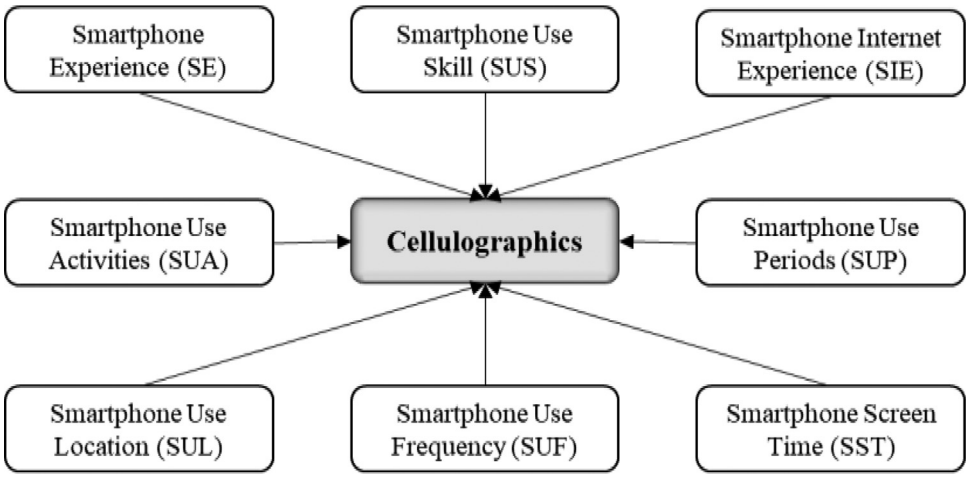

Fig. 2. Conceptual model.

uses, and usage length across the day. Past studies revealed that the number of phone uses in the afternoon and evening differs from both in the morning and at night (Andrews et al., 2015) or least phone use was observed from midnight to early morning (Deng et al., 2019). Individuals indulged in excessive use to fill "empty moments" while commuting, lectures, and mornings/evenings at home (Oulasvirta et al., 2012). Some authors classified users based on their usage pattern and activities at different use periods like "night communicators", "evening learners", etc. (Zhao et al., 2016).

Smartphone screen time (SST)

It is the time measured in hours or minutes per day, spent by an individual on smartphone. Researchers believe that screen time is one of the effective methods for determining the degree of technology usage (Rosen et al., 2013). These days, even preschool children have screen time of more than an hour per day and mobile phones contribute to more than 90% (Susilowati et al., 2021). Digital-screen time exposure is now an important criterion (Kaur et al., 2021) and researchers link it with health (Wang et al., 2020), problematic smartphone use (Horwood et al., 2021), mobile stickiness (Hsu & Tang, 2020) working memory abilities (Toh et al., 2021), customer experience (McLean et al., 2018), etc.

Smartphone use frequency (SUF)

It is the number of user sessions in a specific period or the number of times an individual checks his or her smartphone. SUF is also one of the important criteria to access technology usage (Rosen et al., 2013) and previous studies indicate that SUF is closely associated with problematic smartphone use (Elhai et al., 2018), smartphone addiction (Andrade et al., 2020), rumination and boredom proneness (Wang et al., 2020), poor common executive function (EF) but enhanced shifting-specific abilities (Toh et al., 2021), etc. Recent studies have recommended examining SUF under their future research directions (Gentina & Rowe, 2020). Some researchers calculated frequency, duration, and occurrence of smartphone use sessions and found that on average participants had 24 sessions of 7 minutes each per day and the occurrences of sessions were more on weekdays than weekends (Deng et al., 2019).

Smartphone use location (SUL)

It is the location from which an individual uses the smartphone or accesses the internet through it, such as home, office, leisure place, etc. The biggest advantage of a smartphone is mobility (Cilliers et al., 2018), but social context and location influence users' interaction with their phones (Do et al., 2011). It is quite logical that individuals will use smartphones more when they are idle or waiting in a queue at a bus stop or a food shop or for coordination while traveling than in cinema or library. Further, phone engagement sessions are longer in the comfort of home than at work (Heitmayer & Lahlou, 2021). In this context, different researchers have tried to propose a locational taxonomy, but they lack business context (Zheng et al., 2010) or are too raw about private contexts (Liao et al., 2007). However, locational categories (shopping, movie and shows, work and education, recreation and amusement, food and drink, and sports and exercise) proposed by Exler et al. (2016) are quite balanced.

Smartphone use activities (SUA)

A smartphone is a versatile device, it can be used for a variety of work or leisure activities (Leung & Zhang, 2016). Based on typical daily media and technology usage, researchers have enlisted various types of smartphone activities (Cheever et al., 2014; Rosen et al., 2013), however, the one proposed by Elhai et al. (2016) is quite comprehensive and includes a total of 11 activities, which include voice/video calls, email, texting/instant messaging, internet/websites, social networking sites, games, music/podcasts/radio, watching video/tv/movies, taking pictures or videos, maps/navigation and reading books/magazines.

Concluding remarks

This article introduces a new classification metric called 'Cellulographics' based on smartphone use. This concept applies to any field of study without limitations, where smartphone use is involved. For example, *medicine* (health issues due to smartphone use like insomnia, disturbance or complications in sleep quality, physical and mental fatigue, auditory illusions, ocular issues, muscle pain and stiffness, musculoskeletal ergonomic issues, daily dysfunctions, etc.), *psychology* (smartphone addiction, stress, anxiety, mood swings, irritability, tolerance, nomophobia, fear of missing out, textiety, textaphrenia, ringxiety, smartphone dependencies like, feeling lost and lonely in the absence of smartphones, anxiously waiting to send or receive messages, uneasiness when they are unable to view messages, seeking attention or sensation, depression, impulsive behavior, pain intolerance, aggression, withdrawal, cognitive issues, etc.), *sociology* (phubbing, child neglect, child's smartphone use and problematic parenting by parents excessively indulged in smartphone, choosing smartphone use over personal interactions, intentional use of smartphones in potentially dangerous situations like driving or walking in traffic, seeking reassurance from friends and family, establishing online relationships, work-life-conflict, etc.), *business management* (user experience and engagement, online shopping, smartphone advertising, online reviews, social media, virality, consumers' purchase intention, mobile wallets, financial transactions through smartphones like blockchain, cryptocurrencies, mobile banking, ticket bookings, work-related smartphone use, brand loyalty, use of smartphone for work and non-work tasks, electronic service quality, electronic word of mouth, mobile marketing, content generated by smartphone users, etc.), *computers* (human-computer interactions, technology adoption, information search and dissemination, click-through behavior and data quality on smartphones, smartphone multitasking, smartphone operating systems, trust, security and privacy behaviors of smartphone users, etc.). Moreover, the concept is very flexible to be coupled with device-related characteristics like hardware or software specifications of smartphone or service provider characteristics like Internet connection speed, data plan, network quality, etc.

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References

Al-Ghaith, W., Sanzogni, L., & Sandhu, K. (2010). Factors influencing the adoption and usage of online services in Saudi Arabia. *The Electronic Journal of Information Systems in Developing Countries*, *40*(1), 1–32. doi:10.1002/j.1681-4835.2010.tb00283.x.

Andrade, A. L. M., Scatena, A., Martins, G. D. G., Pinheiro, B. O., Becker da Silva, A., Enes, C. C., et al. (2020). Validation of smartphone addiction scale-short version (SAS-SV) in Brazilian adolescents. *Addictive Behaviors*, *110*, 106540. doi:10.1016/j.addbeh.2020.106540.

Andrews, S., Ellis, D. A., Shaw, H., & Piwek, L. (2015). Beyond self-report: Tools to compare estimated and real-world smartphone use. *PLoS One*, *10*,(10) e0139004. doi:10.1371/journal.pone.0139004.

Asunmaa, P., Inkinen, S., Nykänen, P., Päivärinta, S., Sormunen, T., & Suoknuuti, M. (2002). Introduction to mobile internet technical architecture. *Wireless Personal Communications*, *22*(2), 253–259. doi:10.1023/A:1019976708673.

Budiu, R. (2015). Mobile user experience: Limitations and strengths. Retrieved July 30, 2020, from https://www.nngroup.com/articles/mobile-ux/

Byington, K. W., & Schwebel, D. C. (2013). Effects of mobile Internet use on college student pedestrian injury risk. *Accident Analysis and Prevention*, *51*, 78–83. doi:10.1016/j.aap.2012.11.001.

Campbell, S. W., & Kwak, N. (2010). Mobile communication and civic life: Linking patterns of use to civic and political engagement. *The Journal of Communication*, *60*(3), 536–555. doi:10.1111/j.1460-2466.2010.01496.x.

Cheever, N. A., Rosen, L. D., Carrier, L. M., & Chavez, A. (2014). Out of sight is not out of mind: The impact of restricting wireless mobile device use on anxiety levels among low, moderate and high users. *Computers in Human Behavior*, *37*, 290–297. doi:10.1016/j.chb.2014.05.002.

Cilliers, L., Viljoen, K. L. A., & Chinyamurindi, W. T. (2018). A study on students' acceptance of mobile phone use to seek health information in South Africa. *Health Information Management Journal*, *47*(2), 59–69. doi:10.1177/1833358317706185.

Cooil, B., Aksoy, L., & Keiningham, T. L. (2008). Approaches to customer segmentation. *Journal of Relationship Marketing*, *6*(3–4), 9–39. doi:10.1300/J366v06n03_02.

Cunningham, R. M. (1956). Brand loyalty, what, where, how much? *Harvard Business Review*, *34*(1), 116–128.

Demby, E. H., King, C. W., & Tigert, D. (1971). Psychographics: Who, what, why, when, where and how. In *Proceedings of the attitude research reaches new heights, attitude research conference*.

Deng, T., Kanthawala, S., Meng, J., Peng, W., Kononova, A., Hao, Q., et al. (2019). Measuring smartphone usage and task switching with log tracking and self-reports. *Mobile Media & Communication*, *7*(1), 3–23. doi:10.1177/2050157918761491.

Statcounter.com. Desktop vs mobile vs tablet market share worldwide. (2022). Retrieved February 18, 2022, from https://gs.statcounter.com/platform-market-share/desktop-mobile-tablet

Dey, B. L., Binsardi, B., Prendergast, R., & Saren, M. (2013). A qualitative enquiry into the appropriation of mobile telephony at the bottom of the pyramid. *International Marketing Review*, *30*(4), 297–322. doi:10.1108/IMR-03-2012-0058.

Do, T. M. T., Blom, J., & Gatica-Perez, D. (2011). Smartphone usage in the wild: A large-scale analysis of applications and context. In *Proceedings of the 13th international conference on multimodal interfaces - ICMI '11*. New York, USA: ACM Press.

El-Gohary, H., & Eid, R. (2013). About the Contributors. *E-marketing in developed and developing countries: Emerging practices* (pp. 341–349). Hershey, Pennsylvania, USA: IGI Global.

Elhai, J. D., Levine, J. C., Dvorak, R. D., & Hall, B. J. (2016). Fear of missing out, need for touch, anxiety and depression are related to problematic smartphone use. *Computers in Human Behavior*, *63*, 509–516. doi:10.1016/j.chb.2016.05.079.

Elhai, J. D., Tiamiyu, M., & Weeks, J. (2018). Depression and social anxiety in relation to problematic smartphone use: The prominent role of rumination. *Internet Research*, *28*(2), 315–332. doi:10.1108/IntR-01-2017-0019.

Exler, A., Schankin, A., Braith, M., & Beigl, M. (2016). Preliminary investigations about interruptibility of smartphone users at specific place types. In *Proceedings of the UbiComp adjunct - ACM international joint conference on pervasive and ubiquitous computing* (pp. 1590–1595). New York, NY, USA: ACM. doi:10.1145/2968219.2968554.

Gentina, E., & Rowe, F. (2020). Effects of materialism on problematic smartphone dependency among adolescents: The role of gender and gratifications. *International Journal of Information Management*, *54*, 102134. doi:10.1016/j.ijinfomgt.2020.102134.

Gilbert, A. L., & Han, H. (2005). Understanding mobile data services adoption: Demography, attitudes or needs? *Technological Forecasting & Social Change*, *72*(3), 327–337. doi:10.1016/j.techfore.2004.08.007.

Statista.com. Global mobile retail commerce sales share 2016-2021. (2022). Retrieved February 18, 2022, from https://www.statista.com/statistics/806336/mobile-retail-commerce-share-worldwide/

Grossnickle, J., & Raskin, O. (2001). *Handbook of online marketing research*. New York: McGraw-Hill.

Haenssgen, M. J. (2018). The struggle for digital inclusion: Phones, healthcare, and marginalisation in rural India. *World Development*, *104*, 358–374. doi:10.1016/j.worlddev.2017.12.023.

Haley, R. I. (1968). Benefit segmentation: A decision-oriented research tool. *Journal of Marketing*, *32*(3), 30–35.

Heitmayer, M., & Lahlou, S. (2021). Why are smartphones disruptive? An empirical study of smartphone use in real-life contexts. *Computers in Human Behavior*, *116*, 106637. doi:10.1016/j.chb.2020.106637.

Horwood, S., Anglim, J., & Mallawaarachchi, S. R. (2021). Problematic smartphone use in a large nationally representative sample: Age, reporting biases, and technology concerns. *Computers in Human Behavior*, *122*, 106848. doi:10.1016/j.chb.2021.106848.

Hsu, T. H., & Tang, J. W. (2020). Development of hierarchical structure and analytical model of key factors for mobile app stickiness. *Journal of Innovation and Knowledge*, *5*(1), 68–79. doi:10.1016/j.jik.2019.01.006.

Kaur, N., Gupta, M., Kiran, T., Malhi, P., & Grover, S. (2021). Development and evaluation of the digital-screen exposure questionnaire (DSEQ) for young children. *PLoS One*, *16*,(6) e0253313. doi:10.1371/journal.pone.0253313.

Kiconco, R. I., Rooks, G., & Snijders, C. (2020). Learning mobile money in social networks: Comparing a rural and urban region in Uganda. *Computers in Human Behavior*, *103*, 214–225. doi:10.1016/j.chb.2019.09.005.

Leung, L., & Zhang, R. (2016). Predicting tablet use: A study of gratifications-sought, leisure boredom, and multitasking. *Telematics and Informatics*, *33*(2), 331–341. doi:10.1016/j.tele.2015.08.013.

Liao, L., Fox, D., & Kautz, H. (2007). Hierarchical conditional random fields for GPS-based activity recognition. *Springer Tracts in Advanced Robotics*, *28*, 487–506. doi:10.1007/978-3-540-48113-3_41.

Liu, X., Liu, X., & Wei, R. (2014). Maintaining social connectedness in a fast-changing world: Examining the effects of mobile phone uses on loneliness among teens in Tibet. *Mobile Media and Communication*, *2*(3), 318–334. doi:10.1177/2050157914535390.

Maes, A., Geel, A. V., & Cozijn, R. (2006). Signposts on the digital highway: The effect of semantic and pragmatic hyperlink previews. *Interacting with Computers*, *18*(2), 265–282. doi:10.1016/j.intcom.2005.05.004.

Maier, C., Mattke, J., Pflügner, K., & Weitzel, T. (2020). Smartphone use while driving: A fuzzy-set qualitative comparative analysis of personality profiles influencing frequent high-risk smartphone use while driving in Germany. *International Journal of Information Management*, *55*, 102207. doi:10.1016/j.ijinfomgt.2020.102207.

McLean, G., Al-Nabhani, K., & Wilson, A. (2018). Developing a mobile applications customer experience model (MACE)-implications for retailers. *Journal of Business Research*, *85*, 325–336. doi:10.1016/j.jbusres.2018.01.018.

Broadbandsearch.net. Mobile Vs. desktop internet usage. (2022). Retrieved February 18, 2022, from https://www.broadbandsearch.net/blog/mobile-desktop-internet-usage-statistics

Oulasvirta, A., Rattenbury, T., Ma, L., & Raita, E. (2012). Habits make smartphone use more pervasive. *Personal and Ubiquitous Computing*, *16*(1), 105–114. doi:10.1007/s00779-011-0412-2.

Rosen, L. D., Whaling, K., Carrier, L. M., Cheever, N. A., & Rokkum, J. (2013). The media and technology usage and attitudes scale: An empirical investigation. *Computers in Human Behavior*, *29*(6), 2501–2511. doi:10.1016/j.chb.2013.06.006.

Rosen, L. D., Whaling, K., Rab, S., Carrier, L. M., & Cheever, N. A. (2013). Is facebook creating "idisorders"? The link between clinical symptoms of psychiatric disorders and technology use, attitudes and anxiety. *Computers in Human Behavior*, *29*(3), 1243–1254. doi:10.1016/j.chb.2012.11.012.

Smith, D. P., & Keyfitz, N. (2013). Natural and political observations mentioned in a following index, and made upon the bills of mortality. In K. W. Wachter & H. Le Bras (Eds.), Mathematical Demography (pp. 11–20). Springer Berlin Heidelberg. doi:10.1007/978-3-642-35858-6_2.

Smith, W. R. (1956). Product differentiation and market segmentation as alternative marketing strategies. *Journal of Marketing*, *21*(1), 3–8.

Statista.com. (2022). Share of global mobile website traffic 2015-2021. Retrieved February 18, 2022, from https://www.statista.com/statistics/277125/share-of-website-traffic-coming-from-mobile-devices/

Statista. (2021). Number of smartphone subscriptions worldwide from 2016 to 2026. Retrieved July 10, 2021, from https://www.statista.com/statistics/330695/number-of-smartphone-users-worldwide/

Susilowati, I. H., Nugraha, S., Alimoeso, S., & Hasiholan, B. P. (2021). Screen time for preschool children: Learning from Home during the COVID-19 pandemic. *Global Pediatric Health*, *8*, 1–6. doi:10.1177/2333794X211017836.

Taylor, D. G., & Levin, M. (2014). Predicting mobile app usage for purchasing and information-sharing. *International Journal of Retail & Distribution Management*, *42*(8), 759–774. doi:10.1108/IJRDM-11-2012-0108.

Timæus, I. M. (2014). Demography. *Wiley statsref: Statistics reference online* (pp. 1–5). John Wiley & Sons Ltd. doi:10.1002/9781118445112.stat06091.

Toh, S. H., Howie, E. K., Coenen, P., & Straker, L. M. (2019). From the moment I wake up I will use it…every day, very hour": A qualitative study on the patterns of adolescents' mobile touch screen device use from adolescent and parent perspectives. *BMC Pediatrics*, *19*(1), 30. doi:10.1186/s12887-019-1399-5.

Toh, W. X., Ng, W. Q., Yang, H., & Yang, S. (2021). Disentangling the effects of smartphone screen time, checking frequency, and problematic use on executive function: A structural equation modelling analysis. *Current Psychology*. doi:10.1007/s12144-021-01759-8.

Turgut, Y. E., & Kursun, E. (2020). Mobile internet experiences of the children in Turkey and European countries: A comparative analysis of internet access, use, activities, skills and risks. *Eurasian Journal of Educational Research*, *20*(88), 1–24. doi:10.14689/ejer.2020.88.10.

Twedt, D. W. (1964). How important to marketing strategy is the "heavy user"? *Journal of Marketing*, *28*(1), 71–72.

Tynan, A. C., & Drayton, J. (1987). Market Segmentation. *Journal of Marketing Management*, *2*(3), 301–335.

Vimalkumar, M., Singh, J. B., & Sharma, S. K. (2020). Exploring the multi-level digital divide in mobile phone adoption: A comparison of developing nations. *Information Systems Frontiers*. doi:10.1007/s10796-020-10032-5.

Wang, J., Li, M., Zhu, D., & Cao, Y. (2020). Smartphone overuse and visual impairment in children and young adults: Systematic review and meta-analysis. *Journal of Medical Internet Research*, *22*(12), 1–17. doi:10.2196/21923.

Wang, Y., Yang, H., Montag, C., & Elhai, J. D. (2020). Boredom proneness and rumination mediate relationships between depression and anxiety with problematic smartphone use severity. *Current Psychology*. doi:10.1007/s12144-020-01052-0.

Yankelovich, D. (1964). New criteria for market segmentation. *Harvard Business Review*, *82*(2), 83–90.

Zhao, S., Ramos, J., Tao, J., Jiang, Z., Li, S., Wu, Z., et al. (2016). Discovering different kinds of smartphone users through their application usage behaviors. In *Proceedings of the 2016 ACM international joint conference on pervasive and ubiquitous computing* (pp. 498–509). New York, NY, USA: ACM. doi:10.1145/2971648.2971696.

Zheng, V. W., Zheng, Y., Xie, X., & Yang, Q. (2010). Collaborative location and activity recommendations with GPS history data. In *Proceedings of the 19th international conference on world wide web, WWW '10* (pp. 1029–1038). doi:10.1145/1772690.1772795.