

MSc Thesis proposal — A study of the relationship between device and brain activity

Erik Bjäreholt
(dat13ebj@student.lu.se, erik@bjareho.lt)

May 17, 2020

Student: Erik Bjäreholt (dat13ebj@student.lu.se)
Thesis supervisor: Markus Borg
Thesis examiner: Elizabeth Bjarnason
Start date: 10 June (realistic?)
End date: 30 September (realistic?)

Contents

1	Background	3
2	Problem description, research goals and questions	3
3	Methodology	3
4	Scientific contributions	3
5	Resources	3
6	References	4

1 Background

People spend more time than ever using computing devices (TODO: reference). As services, entertainment, and work, moves online this trend is expected to continue. Studies

Data on how people spend their screen time, and how that varies with demographics, is not publicly available (TODO: reference).

Furthermore, how different computer activities affects the user behaviorally and neurologically is of interest for many areas of research, including:

- the impact of "screen time" for adolescents (TODO: reference)
- attention span among media multitasking adults (TODO: reference)
- depression

There are companies (RescueTime, etc.) who offer automated time tracking as a service. These services generally function by having the user install a program on their device which tracks the active application and sends the data to their servers for storage and analysis. The user can then view their data in a dashboard on the service providers website. These services are marketed towards teams and professionals, who generally want to keep track of individual and team productivity.

However, by collecting detailed and non-anonymized behavioral data on the user these services bring significant privacy concerns, especially in cases where the data is shared with a team or an employer.

With the advancement of Brain-Computer Interfaces, the relationship between device and brain activity is becoming even more tightly connected.

Functional brain imaging methods such as EEG, fNIRS, fMRI...

As a starting point for the thesis, the
Something something [2].

2 Problem description, research goals and questions

- What about measuring flow?
- What about measuring attention/distractibility?

3 Methodology

4 Scientific contributions

- The open source automated time-tracker ActivityWatch.
- Relationships between device activity and brain activity, as measured by EEG.

5 Resources

- Data collected with ActivityWatch

6 References

References

- [1] Tsung-Sheng Chang and Wei-Hung Hsiao. “Time Spent on Social Networking Sites: Understanding User Behavior and Social Capital”. In: *Systems Research and Behavioral Science* 31.1 (2014). _eprint: <https://onlinelibrary.wiley.com/doi/pdf/10.1002/sres.2169> pp. 102–114. ISSN: 1099-1743. DOI: 10.1002/sres.2169. URL: <https://onlinelibrary.wiley.com/doi/abs/10.1002/sres.2169> (visited on 05/13/2020).
- [2] Davide Fucci et al. “A Replication Study on Code Comprehension and Expertise using Lightweight Biometric Sensors”. In: *2019 IEEE/ACM 27th International Conference on Program Comprehension (ICPC)*. 2019 IEEE/ACM 27th International Conference on Program Comprehension (ICPC). ISSN: 2643-7171. May 2019, pp. 311–322. DOI: 10.1109/ICPC.2019.00050.
- [3] Chiungjung Huang. “Time Spent on Social Network Sites and Psychological Well-Being: A Meta-Analysis”. In: *Cyberpsychology, Behavior, and Social Networking* 20.6 (June 1, 2017). Publisher: Mary Ann Liebert, Inc., publishers, pp. 346–354. ISSN: 2152-2715. DOI: 10.1089/cyber.2016.0758. URL: <https://www.liebertpub.com/doi/10.1089/cyber.2016.0758> (visited on 05/13/2020).
- [4] Young-Ho Kim et al. “TimeAware: Leveraging Framing Effects to Enhance Personal Productivity”. In: *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*. CHI ’16. San Jose, California, USA: Association for Computing Machinery, May 7, 2016, pp. 272–283. ISBN: 978-1-4503-3362-7. DOI: 10.1145/2858036.2858428. URL: <https://doi.org/10.1145/2858036.2858428> (visited on 05/13/2020).
- [5] Young-Ho Kim et al. “TimeAware: Leveraging Framing Effects to Enhance Personal Productivity”. In: *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*. CHI ’16. San Jose, California, USA: Association for Computing Machinery, May 7, 2016, pp. 272–283. ISBN: 978-1-4503-3362-7. DOI: 10.1145/2858036.2858428. URL: <https://doi.org/10.1145/2858036.2858428> (visited on 05/13/2020).
- [6] Ji Peng Koh. “Brain computer interface via EEG signals”. In: (2018). Accepted: 2018-04-23T02:21:24Z. URL: <https://dr.ntu.edu.sg/handle/10356/73955> (visited on 05/13/2020).
- [7] D. J. McFarland and J. R. Wolpaw. “EEG-based brain–computer interfaces”. In: *Current Opinion in Biomedical Engineering*. Synthetic Biology and Biomedical Engineering / Neural Engineering 4 (Dec. 1, 2017), pp. 194–200. ISSN: 2468-4511. DOI: 10.1016/j.cobme.2017.11.004. URL: <http://www.sciencedirect.com/science/article/pii/S246845111730082X> (visited on 05/13/2020).
- [8] John Rooksby et al. “Personal tracking as lived informatics”. In: *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. CHI ’14. Toronto, Ontario, Canada: Association for Computing Machinery, Apr. 26, 2014, pp. 1163–1172. ISBN: 978-1-4503-2473-1. DOI: 10.1145/

- 2556288.2557039. URL: <https://doi.org/10.1145/2556288.2557039> (visited on 05/13/2020).
- [9] John Rooksby et al. “Personal Tracking of Screen Time on Digital Devices”. In: *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*. CHI ’16. San Jose, California, USA: Association for Computing Machinery, May 7, 2016, pp. 284–296. ISBN: 978-1-4503-3362-7. DOI: 10.1145/2858036.2858055. URL: <https://doi.org/10.1145/2858036.2858055> (visited on 05/13/2020).
 - [10] Maarten H. W. Selfhout et al. “Different types of Internet use, depression, and social anxiety: The role of perceived friendship quality”. In: *Journal of Adolescence* 32.4 (Aug. 1, 2009), pp. 819–833. ISSN: 0140-1971. DOI: 10.1016/j.adolescence.2008.10.011. URL: <http://www.sciencedirect.com/science/article/pii/S0140197108001218> (visited on 05/13/2020).
 - [11] Dhavan Shah et al. “Nonrecursive Models of Internet Use and Community Engagement: Questioning Whether Time Spent Online Erodes Social Capital”. In: *Journalism & Mass Communication Quarterly* 79.4 (Dec. 1, 2002). Publisher: SAGE Publications Inc, pp. 964–987. ISSN: 1077-6990. DOI: 10.1177/107769900207900412. URL: <https://doi.org/10.1177/107769900207900412> (visited on 05/13/2020).
 - [12] Martin Spüler. “A high-speed brain-computer interface (BCI) using dry EEG electrodes”. In: *PLoS ONE* 12.2 (Feb. 22, 2017). ISSN: 1932-6203. DOI: 10.1371/journal.pone.0172400. URL: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5321409/> (visited on 05/13/2020).
 - [13] Kaveri Subrahmanyam et al. “The impact of computer use on children’s and adolescents’ development”. In: *Journal of Applied Developmental Psychology*. Children in the Digital Age 22.1 (Jan. 1, 2001), pp. 7–30. ISSN: 0193-3973. DOI: 10.1016/S0193-3973(00)00063-0. URL: <http://www.sciencedirect.com/science/article/pii/S0193397300000630> (visited on 05/13/2020).
 - [14] Yu Zhang et al. “Multi-kernel extreme learning machine for EEG classification in brain-computer interfaces”. In: *Expert Systems with Applications* 96 (Apr. 15, 2018), pp. 302–310. ISSN: 0957-4174. DOI: 10.1016/j.eswa.2017.12.015. URL: <http://www.sciencedirect.com/science/article/pii/S0957417417308291> (visited on 05/13/2020).
 - [15] Zotero / *Your personal research assistant*. URL: <https://www.zotero.org/start> (visited on 05/13/2020).