

Roland Toth

**Multidimensional
Measurement of Mobile
Media Use**

Multidimensional Measurement of Mobile Media Use

Roland Toth* \ roland.toth@fu-berlin.de

* Freie Universität Berlin and Weizenbaum Institute for the Networked Society

ISSN 2748-5587 \ DOI [10.34669/WI.WS/20](https://doi.org/10.34669/WI.WS/20)

EDITORS: The Managing Board members of the Weizenbaum-Institut e.V.
Prof. Dr. Christoph Neuberger
Prof. Dr. Sascha Friesike
Prof. Dr. Martin Krzywdzinski
Dr. Karin-Irene Eiermann

Hardenbergstraße 32 \ 10623 Berlin \ Tel.: +49 30 700141-001
info@weizenbaum-institut.de \ www.weizenbaum-institut.de

COPYRIGHT: This series is available open access and is licensed under Creative Commons Attribution 4.0 (CC BY 4.0): <https://creativecommons.org/licenses/by/4.0/>

WEIZENBAUM INSTITUTE: The Weizenbaum Institute for the Networked Society – The German Internet Institute is a joint project funded by the Federal Ministry of Education and Research (BMBF). It conducts interdisciplinary and basic research on the changes in society caused by digitalisation and develops options for shaping politics, business and civil society.

This work has been funded by the Federal Ministry of Education and Research of Germany (BMBF) (grant no.: 16DII121, 16DII122, 16DII123, 16DII124, 16DII125, 16DII126, 16DII127, 16DII128 – “Deutsches Internet-Institut”).

Abstract

Just like all types of media use, mobile media use is usually measured using retrospective, self-reported indications of quantity in the form of duration and frequency. This is not only problematic due to the fact that people misjudge their own use to a great extent, but also because theoretical approaches predominantly suggest that mere contact is not sufficient for the description of media use. This especially holds for mobile media use, as specific contact episodes are not easily distinguishable

anymore due to their short duration and high frequency. Mobile media use is rather characterized by circumstances surrounding the contact itself – they are used for countless purposes, in a habitual manner, and in various situations. In this paper, I am proposing a renewed, multidimensional measure of mobile media use that takes into account these characteristics in addition to well-known measures of quantity and suggest methods for assessing its convergent and content validity.

Table of Contents

1	Introduction	4
2	Theoretical background	4
3	The quality of mobile media use	5
3.1	Gratification diversity	6
3.2	Habitualization degree	6
3.3	Context diversity	6
4	Mobile vigilance	7
5	Model	7
6	Conclusion	8
7	Literature	9

1 Introduction

Media use is a crucial field of interest in social sciences, especially communication science, and is investigated as an independent (in most media effects research) or dependent (e.g., in the context of the Uses and Gratifications approach or selective exposure) variable in many theoretical frameworks. Other disciplines like psychology or medicine also increasingly employ media use for explaining issues like depression, obesity, or sleep quality (Aalbers et al., 2019; Kenney & Gortmaker, 2017; Mireku et al., 2019).

Contemporary mobile media like the smartphone shifted our understanding of media use dramatically, as we are using them virtually constantly, anywhere, and in more complex ways than other media. Just like the use of other media, mobile media use is usually measured with retrospective self-reports on its quantity (duration and frequency) in surveys. However, people considerably misjudge their

own mobile media use when compared to passive assessments. Moreover, it is questionable whether quantity is even sufficient for representing mobile media use anymore: “In a 24/7 media world, does it even matter how much time [...] people spend with media?” (Rideout, 2016, p. 139).

I argue for the consideration of quality dimensions in addition to the quantity dimensions in assessments of mobile media use. Specifically, I propose the quality dimensions *gratification diversity*, *habitualization degree*, and *context diversity*. The paper concludes with an empirical measurement model. It suggests investigating the feasibility of assessing these dimensions through retrospective self-reports and evaluating whether the multidimensional mobile media use measure is associated with a behavioral and cognitive variable that is closely linked to mobile media use itself.

2 Theoretical background

The smartphone currently represents the pinnacle of mobile media and has drastically changed people’s ways of consuming content and communicating when it was introduced. It has become the most-used gateway to the Internet and digital media content for many sections of the population (Beisch et al., 2019) and its use can take countless forms with regard to content and functions. The shift in use patterns most obviously manifests in the phenomenon of permanent connectedness: In combination with quasi-constant mobile Internet connection, instant messengers, social networks, browsers, video platforms, and many other services can be used virtually *anytime* and *anywhere*.

In order to be able to conceptualize and measure such use, media use research needs to introduce new approaches. One of the most urgent issues is its

operationalization. Despite the complexity of mobile media devices, their use is mostly assessed via self-reported, retrospective measures of quantity – namely, duration and frequency (e.g. Guthrie, 2010) – just like the use of classic media. However, devices like the smartphone promote a mode of use where they are rarely (completely) turned off, uses are very short, but very frequent, and episodes of interpersonal communication are hard to distinguish from one another as they are part of incomplete, continuous conversations (Thulin et al., 2019; Vorderer & Kohring, 2013). This aggravates the retrospective and representative reproduction of behavioral episodes and giving satisfying answers, which is a burden for participants in surveys anyways, even more (Schwarz & Oyserman, 2001). Therefore, the results of such measurement methods diverge from

the results of more objective ones like logging/tracking to a concerning extent (Parry et al., 2021). This leads to methodological challenges in all fields of research where the use of such devices is of interest. Above all, it is debatable whether quantity is (still) sufficient for representing the quasi-constant use of mobile media even when measured accurately. Numerous theoretical approaches argue that media use is not only characterized through the *quantity* of mere contact between people and media, but also through the *quality* concerning the properties of this contact, the fulfilment of gratifications, and the embedment in users' lives (z.B. Hasebrink, 2003; Katz et al., 1973; Levy & Windahl, 1984; Scherer, 2017).

In summary, typical measurement instruments of mobile media use are affected by systematic measurement errors that result from low *convergent validity* (as there is divergence between self-reports and less error-prone methods) and *content validity* (as they do not encompass all crucial dimensions present in theory). Such measurement errors lead to distorted and incomplete representation of mobile media use itself and concepts related to it. As Vandewater & Lee (2009) stated, low convergent validity is not

a major problem for descriptive analyses like the investigation of population averages, but all the more for the modeling of associations with other variables of interest. This also applies to low content validity because the incompleteness of a measurement instrument can omit effects that might be relevant. This understanding in conjunction with the technological capabilities of mobile media devices and the way they are used requires an overhaul of the conceptualization and the measurement of their use.

A renewed, multidimensional measure of mobile media use has three obstacles to overcome. First, it needs to incorporate quality dimensions that are closely connected to the mediality and typical use patterns associated with mobile devices in order to represent them adequately. Second, it needs to be more feasible than the quantity dimensions of mobile media use alone regarding the assessment through self-reports, as this method is still vastly popular due to economic advantages. Third, this new measure needs to prove that it is conceptually more complete than mobile media use quantity alone. In what follows, I will propose an approach to overcoming all three obstacles.

3 The quality of mobile media use

In this section, I argue which quality dimensions of mobile media use are most relevant and should therefore be incorporated in a multidimensional measure of mobile media use, and why this is the case. As opposed to other media devices, mobile devices are specifically characterized through 1) the capability of satisfying numerous gratifications, 2) the potential for strongly habitualized use and 3) the enabling of virtually infinite contexts of use. Therefore, quality dimensions of mobile media use should complement the *amount of contact* with the device with the *extent* to which the *potential* of the device is actually being *exhausted*.

Against this background, I suggest three exemplary quality dimensions that should be included in the operationalization of mobile media use in addition to existing quantity dimensions: *gratification diversity*, *habitualization degree*, and *context diversity*. Considering the well-known problems of self-reported quantity, these quality dimensions might also suffer from divergence between self-reports and more valid assessments. For this reason, I am suggesting such assessments in order to allow for an examination.

3.1 Gratification diversity

While media were able to satisfy certain needs and provide a limited set of gratifications for a long time, mobile media can satisfy virtually all of them with one device (e.g. Barkhuus & Polichar, 2011). One may check the news as part of their morning routine. On their way to work, they may use instant messaging to stay in touch with family and friends. During the day, they may listen to music while walking to a restaurant to grab lunch. On the train, they may watch a new upload on their favorite YouTube channel. At home, they may use the timer feature to check whether they are brushing their teeth sufficiently. The more diverse the gratifications typically obtained by using mobile media are, the more the multi-functionality of such devices is leveraged and the more relevant they are in users' lives. As such, it is not the *degree of fulfilment* of gratifications that is of interest here, but the *number of different* gratifications. The diversity of gratifications can be measured using the Experience Sampling Method (ESM) during or right after single use episodes in order to attenuate distortions due to retrospective recollection (Larson & Csikszentmihalyi, 2014).

3.2 Habitualization degree

Naab & Schnauber (2016) defined a habit “as an automatically initiated behavioral response stored in a mental script that an actor performs in repetitive, familiar situations” (p. 127). Specifying that process, they stated that it is based on “a mental link of the situational characteristics and an appropriate behavioral option. If a person experiences a certain situation associated with similar behavior more often, it is likely that the script is easily accessible and will be retrieved” (p. 127). Additionally, they identified that the repetition of a task is not sufficient for habit acquisition, but that rather the ease of its acquisition is essential (p. 128). Due to its high frequency and short duration, mobile media use often takes place in a habitualized manner (e.g., Oulasvirta et al., 2012). The more this is the

case, the more prevalent and integrated the device is in users' living environment, as they seize the opportunity of quasi-permanent use the device offers. As unconscious initiation is a necessary condition for habitualized behavior (Naab & Schnauber, 2016), it should be assessed as a quality dimension of mobile media use, too. It can be measured using the Response Frequency Measure (RFM) which evokes unconscious preferences under time constraints (Naab & Schnauber, 2016).

3.3 Context diversity

Mobile media use is characterized by the devices' property of mobility. While devices such as laptops already made a huge step towards mobility of media use in contrast to desktop PCs, they still need to be set up in order to be interacted with properly, making them rather *portable* than mobile (Beale, 2009). Truly mobile media fit into most pockets, feature considerable battery life, and allow for permanent connect-edness, availability and functionality independent of specific contexts, which is one of their most defining features (e.g., Do et al., 2011; Vorderer & Kohring, 2013). This shows in applications that actually rely on the variation of the context during use (e.g., *Google Maps*, *Pokémon Go!*, *Corona Warn App*) – different situations afford different attention potentials and demand certain kinds of media use. Considering these circumstances, it seems rather unthinkable not to consider the context of use a dimension of smartphone use: “If [...] media exposure varies strongly across occasions, it might be more useful to look at situational factors rather than interpersonal differences or structural effects in order to understand media use and effects” (Scharnow, 2018, p. 2). The more diverse and numerous use contexts are, the more relevant the device is in different life situations and the more the devices' mobility is being leveraged. Use contexts, just like gratification diversity, can be assessed using ESM. Via randomly activated questionnaires, users can indicate where and in what social situation they are (e.g. at home, at work, or at a restaurant) right on said device (Sandstrom et al., 2017).

4 Mobile vigilance

In order to investigate the plausibility and benefit of involving quality dimensions of mobile media use in its assessment from a theoretical and statistical perspective, it is necessary to consider a correlate of that use. Just like the quality dimensions of mobile media use could be derived from the mediality and typical use pattern of mobile devices, *online vigilance* represents a phenomenon that emerged from these very aspects (Reinecke et al., 2018). The authors describe online vigilance as a 1) cognitive orientation, 2) constant awareness, and 3) high motivation regarding online communication (p. 2).

In their seminal essay, Vorderer & Kohring (2013) argue that a possible explanation for the phenomenon of permanent connectedness that is now so typical for mobile media use is the avoidance of ostracism, “a sense of being ignored and excluded by others” (p. 191). Online vigilance may be a mechanism for reducing ostracism and is ultimately closely associated with permanent connectedness as a result. Though, such vigilance can obviously also lead to negative consequences

investigated in the context of similar concepts like Entrapment (Hall & Baym, 2012).

Online vigilance represents a psychological consequence of (and, arguably, reason for) mobile media use for communication, which is by far the most common and relevant area of use of these devices (z.B. Montag et al., 2015). However, the multifunctionality and relevance of mobile media devices such as the smartphone and their entanglement in everyday life warrants considering vigilance irrespective of the exact motive for or consequence of use. The fixation and dependence on these devices does not necessarily need to be based on communication only. For this reason, I am using the term *mobile vigilance* instead. In accordance with Reinecke et al. (2018) (p. 2), mobile vigilance is therefore a 1) cognitive orientation, 2) constant awareness, and 3) high motivation regarding mobile media use in general. It should therefore not only be closely associated with the quality dimensions of, but mobile media use as whole. It can be measured via ESM, as Reinecke et al. (2018) suggested regarding online vigilance (p. 24).

5 Model

In summary, I suggest implementing not only the *quantity*, but also the *quality* of mobile media use in its operationalization. Figure 1 shows a model that allows for the quantitative validation of this approach.

As a first step, the dimensions of media use should each be investigated with regard to their *convergent validity*. Surveys are economically feasible, relatively easy to implement, and will most probably remain the most-used data collection method in the social sciences for a long time. Hence, the possibility of assessing the suggested quality dimensions of media use with this method with satisfactory validity needs

to be evaluated in order to allow for their implementation. Also, the mobile operation systems iOS and Android allow for viewing aggregated use data (e.g., the duration of use in the foreground and background) of the device itself and single apps through integrated functions or dedicated apps in order to be able to control and limit use (David et al., 2018; Google, 2020a, 2020b). Most probably, such monitoring has an influence on the salience of one’s mobile media use and therefore on the precision of self-reports.

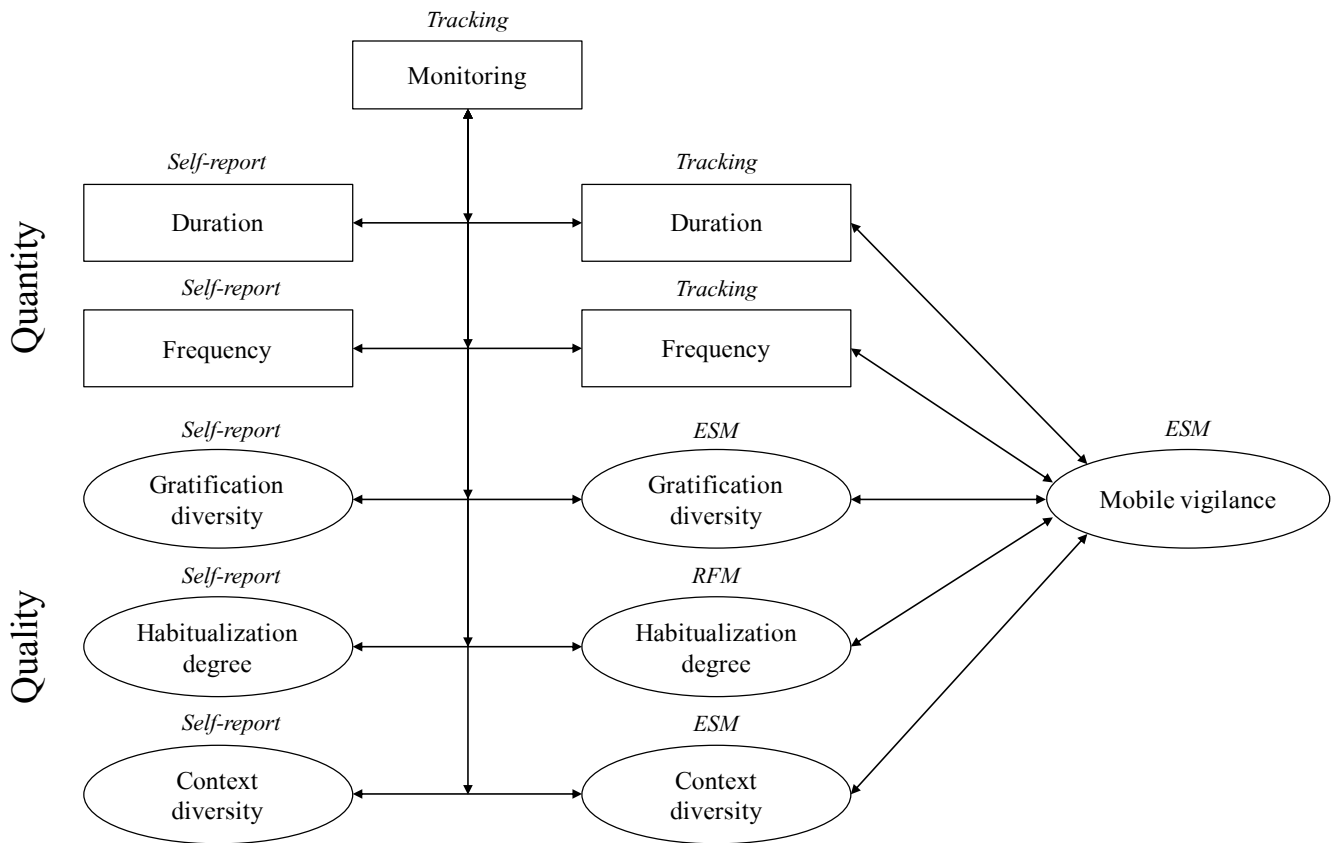
As a second step, this multidimensional measure of mobile media use needs to be investigated with

regard to its *content validity*. In order to quantify content validity, I propose checking its *criterion validity* instead, which is the strength of its relationship with the associated concept of mobile vigilance. Both the quantity and quality dimensions of mobile media use should be employed as predictors for mobile vigilance in order to identify whether the quality dimensions are able to add considerable predictive power. If that is the case, the conceptual association between mobile media use and mobile vigilance allows for the conclusion that the multidimensional

measure of mobile media use is of higher content validity than the quantity dimension alone.

After performing both steps, it is possible to assess whether surveys are able to capture the suggested quality dimensions of mobile media use sufficiently and whether these dimensions are adding to a more complete measurement of mobile media use. Following that, specific implementations of this new measure, for example, as a latent formative variable, need to be investigated.

Figure 1: Operationalization of mobile media use with quantity and quality dimensions, the control of potential differences between different measurement methods and the validation through mobile vigilance.



6 Conclusion

The smartphone profoundly impacted how we are using media. Hence, asking for the quantity of mobile media use is ultimately not sufficient anymore. We already know that these metrics hardly match actual use quantity when compared to passive observation

and that quantity does not comprehensively represent mobile media use to begin with. An improvement of measures of mobile media use is highly relevant in communication science, other social sciences, and associated disciplines like psychology and even medicine.

Not only do invalid measures hinder descriptive investigations of mobile media use itself, but also the evaluation of its relationships with other variables of interest and, in extension, theoretical implications for said variables.

I am suggesting three specific quality dimensions of media use – *gratification diversity*, *habitualization degree*, and *context diversity* – that are closely associated with use patterns introduced by the most popular and important mobile media device, the

smartphone. First, these dimensions should be investigated with regard to their feasibility as self-reported survey measures. Second, they should be investigated with regard to the degree that they add predictive power to mobile vigilance, which is a persistent focus on and attention to mobile media and a symptom of the embedding of these devices in everyday life. The results shall encourage researchers to use this extended mobile media use measure in order to increase the validity of the measures themselves and the associations with other variables of interest.

7 Literature

- Aalbers, G., McNally, R. J., Heeren, A., Wit, S. de, & Fried, E. I. (2019). Social media and depression symptoms: A network perspective. *Journal of Experimental Psychology: General*, *148*(8), 1454–1462. <https://doi.org/10.1037/xge0000528>
- Barkhuus, L., & Polichar, V. E. (2011). Empowerment through seamfulness: Smart phones in everyday life. *Personal and Ubiquitous Computing*, *15*(6), 629–639. <https://doi.org/10.1007/s00779-010-0342-4>
- Beale, R. (2009). What does Mobile Mean? *International Journal of Mobile Human Computer Interaction (IJMHCI)*, *1*(3), 1–8. <https://doi.org/10.4018/jmhci.2009070101>
- Beisch, N., Koch, W., & Schäfer, C. (2019). ARD / ZDF-Onlinestudie 2019 : Mediale Internetnutzung und Video-on-Demand gewinnen weiter an Bedeutung. *Media Perspektiven*, *23*(9), 374–388. http://www.ard-zdf-onlinestudie.de/files/2019/0919_Beisch_Koch_Schaefer.pdf
- Larson, R., & Csikszentmihalyi, M. (2014). The Experience Sampling Method. In M. Csikszentmihalyi (Ed.), *Flow and the Foundations of Positive Psychology: The Collected Works of Mihaly Csikszentmihalyi* (pp. 21–34). Springer Netherlands. <https://doi.org/10.1007/978-94-017-9088-8>
- David, M. E., Roberts, J. A., & Christenson, B. (2018). Too much of a good thing: Investigating the association between actual smartphone use and individual well-being. *International Journal of Human-Computer Interaction*, *34*(3), 265–275. <https://doi.org/10.1080/10447318.2017.1349250>
- Do, T. M. T., Blom, J., & Gatica-Perez, D. (2011). Smartphone usage in the wild: A large-scale analysis of applications and context. *ICMI'11 - Proceedings of the 2011 ACM International Conference on Multimodal Interaction*, 353–360. <https://doi.org/10.1145/2070481.2070550>
- Google. (2020a). *Apps*. <https://play.google.com/store/apps/collection/cluster?clp=ggEJCgd-BcHAgVXNl:S:ANO1ljLddc8&gsr=Cgy-CAQkKB0FwcCBVc2U%3D:S:ANO1ljLL-v7w&hl=de>
- Google. (2020b). *Verwendung eines Android-Geräts mit „Digital Wellbeing“ verwalten*. <https://support.google.com/android/answer/9346420?hl=de>
- Guthrie, G. (2010). *Basic Research Methods : An Entry to Social Science Research*. Sage Publications Pvt. Ltd.

- Hall, J. A., & Baym, N. K. (2012). *Calling and texting (too much): Mobile maintenance expectations, (over)dependence, entrapment, and friendship satisfaction*. *New Media and Society*, *14*(2), 316–331. <https://doi.org/10.1177/1461444811415047>
- Hasebrink, U. (2003). Nutzungsforschung. In G. Bentele, H.-B. Brosius, & O. Jarren (Eds.), *Öffentliche Kommunikation* (pp. 101–127). Westdeutscher Verlag GmbH. https://doi.org/10.30965/9783846744772_008
- Katz, E., Blumler, J. G., & Gurevitch, M. (1973). Uses and Gratifications Research. *Public Opinion Quarterly*, *37*(4), 509–523. <https://doi.org/10.1086/268109>
- Kenney, E. L., & Gortmaker, S. L. (2017). United States Adolescents' Television, Computer, Videogame, Smartphone, and Tablet Use: Associations with Sugary Drinks, Sleep, Physical Activity, and Obesity. *Journal of Pediatrics*, *182*, 144–149. <https://doi.org/10.1016/j.jpeds.2016.11.015>
- Levy, M. R., & Windahl, S. (1984). Audience Activity and Gratifications. A Conceptual Clarification and Exploration. *Communication Research*, *11*(1), 51–78. <https://doi.org/10.1177/009365084011001003>
- Mireku, M. O., Barker, M. M., Mutz, J., Dumontheil, I., Thomas, M. S. C., Rösli, M., Elliott, P., & Toledano, M. B. (2019). Night-time screen-based media device use and adolescents' sleep and health-related quality of life. *Environment International*, *124*, 66–78. <https://doi.org/https://doi.org/10.1016/j.envint.2018.11.069>
- Montag, C., Błazzkiewicz, K., Sariyska, R., Lachmann, B., Andone, I., Trendafilov, B., Eibes, M., & Markowitz, A. (2015). Smartphone usage in the 21st century: Who is active on WhatsApp? *BMC Research Notes*, *8*(1), 4–9. <https://doi.org/10.1186/s13104-015-1280-z>
- Naab, T. K., & Schnauber, A. (2016). Habitual Initiation of Media Use and a Response-Frequency Measure for Its Examination. *Media Psychology*, *19*(1), 126–155. <https://doi.org/10.1080/15213269.2014.951055>
- Oulasvirta, A., Rattenbury, T., Ma, L., & Raita, E. (2012). Habits make smartphone use more pervasive. *Personal and Ubiquitous Computing*, *16*(1), 105–114. <https://doi.org/10.1007/s00779-011-0412-2>
- Parry, D. A., Davidson, B. I., Sewall, C. J. R., Fisher, J. T., Mieczkowski, H., & Quintana, D. S. (2021). A systematic review and meta-analysis of discrepancies between logged and self-reported digital media use. *Nature Human Behaviour*, *5*(11), 1535–1547. <https://doi.org/10.1038/s41562-021-01117-5>
- Reinecke, L., Klimmt, C., Meier, A., Reich, S., Hefner, D., Knop-Huelss, K., Rieger, D., & Vorderer, P. (2018). *Permanently online and permanently connected: Development and validation of the Online Vigilance Scale (Vol. 13)*. <https://doi.org/10.1371/journal.pone.0205384>
- Rideout, V. (2016). Measuring time spent with media: The Common Sense census of media use by US 8- to 18-year-olds. *Journal of Children and Media*, *10*(1), 138–144. <https://doi.org/10.1080/17482798.2016.1129808>
- Sandstrom, G. M., Lathia, N., Mascolo, C., & Rentfrow, P. J. (2017). Putting mood in context: Using smartphones to examine how people feel in different locations. *Journal of Research in Personality*, *69*, 96–101. <https://doi.org/10.1016/j.jrp.2016.06.004>
- Scharkow, M. (2019). The Reliability and Temporal Stability of Self-reported Media Exposure: A Meta-analysis. *Communication Methods and Measures*, *13*(3), 198–211. <https://doi.org/10.1080/19312458.2019.1594742>
- Scherer, H. (2017). Connecting Media Use to Media Effects. In P. Rössler, C. A. Hoffner, & L. Zoonen (Eds.), *The International Encyclopedia of Media Effects* (pp. 1–12). <https://doi.org/10.1002/9781118783764.wbieme0016s>
- Schwarz, N., & Oyserman, D. (2001). Asking questions about behavior: Cognition, communication, and questionnaire construction. *American Journal of Evaluation*, *22*(2), 127–160. [https://doi.org/10.1016/S1098-2140\(01\)00133-3](https://doi.org/10.1016/S1098-2140(01)00133-3)

- Thulin, E., Vilhelmson, B., & Schwanen, T. (2019). Absent Friends? Smartphones, Mediated Presence, and the Recoupling of Online Social Contact in Everyday Life. *Annals of the American Association of Geographers*, 110(1), 166–183. <https://doi.org/10.1080/24694452.2019.1629868>
- Vandewater, E. A., & Lee, S. J. (2009). Measuring children's media use in the digital age: Issues and challenges. *American Behavioral Scientist*, 52(8), 1152–1176. <https://doi.org/10.1177/0002764209331539>
- Vorderer, P., & Kohring, M. (2013). Permanently online: A challenge for media and communication research. *International Journal of Communication*, 7(1), 188–196. <https://ijoc.org/index.php/ijoc/article/view/1963>