# Analysing digital multilocality between urban centres and rural peripheries: Combining and integrating digital and analogue research methods

Reto Bürgin, Heike Mayer, Alexander Kashev, Sigve Haug

## Abstract

The application of mixed methods in researching digitalisation and rural development has numerous benefits in terms of the integration of various data sources. In this paper, we present a novel, mixed methods approach that combines digital and analogue methods. We investigate multilocal work arrangements of knowledge workers in Switzerland who mainly work in a central urban area but occasionally withdraw to peripheral mountain regions in order to conduct their work in a concentrated and undisturbed environment. To analyse such multilocal work arrangements, we use a mixed methods approach that incorporates six integrated methods: geotracking, laptop and smartphone tracking, self-administered digital diaries, ethnographic walk-along observations and qualitative semi-structured interviews. Our study illustrates that mixed methods in digitalisation research provide in-depth insights, but that they also have limitations. Furthermore, we show how ethical standards can and should be used to create a basis of trust with the study participants and how this affects the recruitment of the sample.

## Erforschung von digitaler Multilokalität zwischen urbanen Zentren und ländlichen Peripherien durch die Kombination und Integration von digitalen und analogen Forschungsmethoden

**Zusammenfassung**

Die Anwendung von *Mixed Methods* bei der Erforschung von Digitalisierung und ländlicher Entwicklung hat zahlreiche Vorteile in Bezug auf die Integration verschiedener Datenquellen. In diesem Beitrag stellen wir einen neuen *Mixed Methods*-Ansatz vor, der digitale und analoge Methoden kombiniert. Wir untersuchten multilokale Arbeitsweisen von Wissensarbeitenden in der Schweiz, die hauptsächlich in einem zentralen städtischen Gebiet arbeiten, sich aber gelegentlich in periphere Bergregionen zurückziehen, um ihrer Arbeit in einem konzentrierten und ungestörten Umfeld nachzugehen. Um solche multilokalen Arbeitsweisen zu untersuchen, haben wir einen *Mixed Methods*-Ansatz verwendet, der sechs integrierte Methoden umfasst: *Geotracking, Laptop-* und *Smartphone-Tracking*, selbstverwaltete digitale Tagebücher, ethnographische *Walk Along*-Beobachtungen sowie qualitative halbstrukturierte Interviews. Unsere Studie zeigt, dass *Mixed Methods* in der Analyse zur Digitalisierung vertiefende Einblicke in ein zu erforschendes Phänomen gewähren, jedoch auch Ein-

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schränkungen damit verbunden sind. Zudem zeigen wir, wie hohe ethische Maßstäbe von digitalen Methoden eingesetzt werden können und sollten, um eine Vertrauensbasis zu Studienteilnehmenden zu schaffen und wie sich dies auf deren Rekrutierung auswirkt.

**Schlüsselwörter:** Mixed Methods ▪ digitale Methoden ▪ digitale Multilokalität ▪ Digitalisierung ▪ Forschungsethik ▪ qualitative Methoden ▪ quantitative Methoden

# 1 Introduction

In recent decades, digitalisation has changed the spatial and temporal aspects of knowledge work. The use of information and communication technologies and the internet allows people to work in multiple locations (Koroma/Hyrkkänen/Vartiainen 2014; Ojala/Pyöriä 2018) but still be connected to co-workers, supervisors and clients (Messenger 2019). Consequently, co-presence in offices has become increasingly obsolete for selected knowledge workers (Nadler 2014; Messenger 2019). Thus, multilocal work is not geographically limited and can also be performed in rural areas (Nadler 2014; Vesala/Tuomivaara 2015). In the case of Switzerland and in the context of our study, temporary work in the rural periphery (mountain areas in the Swiss Alps) has become increasingly popular for knowledge workers who mainly work in an urban centre (metropolitan areas) (e.g. Schilliger/Steiger 2020; Dreyfus 2021). This trend started even before the Covid-19 pandemic forced many workers to adopt such work practices.[1] In this article, we highlight the methodological opportunities and challenges involved in conducting research in the context of novel multilocal work practices with a specific focus on the interplay between urban centres and rural peripheries. More specifically, we present our research design and methods and discuss the lessons learned from implementing a mixed methods approach that integrates digital and analogue methods.

In our study, we were interested in exploring the digital multilocality of knowledge workers who work predominantly at their employers' premises or in their home offices in an urban centre but go to a periphery to work from time to time. In this respect, we were interested in how multilocal knowledge workers use information and communication

technologies in their work activities, how and why they use marginality for work and how they create urban-rural linkages using information and communication technologies.

To research aspects of digital multilocality, it was necessary to employ heterogeneous data sources to be able to analyse and compare the interaction of multilocal knowledge workers with information and communication technologies in different locations. In this regard, the use of a mixed methods approach allowed us to generate deeper insights into the phenomenon of digital multilocality through the combination and interaction of qualitative and quantitative research methods (cf. Tashakkori/Creswell 2007). We were thus able to bridge the qualitative/quantitative divide (Bathelt/Li 2020). Mixing qualitative and quantitative methods is deemed more suitable than only applying one single method (cf. Strijker/Bosworth/Bouter 2020). However, ethical considerations are seldom discussed, despite being a very important concern when conducting mixed methods research. In this regard, a major concern is informed consent so as to provide transparency and thus ensure the well-being of study participants (Teddlie/Tashakkori 2009; Hesse-Biber 2010; Preissle/Glover-Kudon/Rohan et al. 2015; Cain/MacDonald/Coker et al. 2019).

In our view, conventional methods are not fully adequate to examine multilocal work arrangements and people's interaction with information and communication technologies in different locations. We elaborated a mixed methods approach to collect microdata from a sample of six multilocal knowledge workers. We combined heterogeneous data sources that resulted from six different methods: geolocation tracking, laptop application tracking, smartphone application tracking, self-administered digital diaries, ethnographic walk-along observations and semi-structured qualitative interviews. These methods were truly mixed and built on one another during a two-phase research process. The study participants' interaction with information and communication technologies was tracked during five workdays in both the central and the peripheral workplace. We collected the data in summer and autumn 2019, a time that was not yet affected by changing work patterns due to the Covid-19 pandemic.

Our study shows that mixed methods enable deeper insights into work practices in different locations. A key element of our study is the integration of the qualitative and quantitative as well as the digital and analogue methods and the ways we were able to produce insights and results. In this regard, the division of the fieldwork into consecutive phases of data collection is important in order to better integrate the methods (Bryman 2007). In this paper, we report on the lessons learned from using such a methodological approach in terms of mixing quantitative and qualitative as well as digital and analogue methods,

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[1] Through our research, we came to describe such digital forms of work that are distributed between multiple locations as "digital multilocality". Such multilocal work arrangements between urban centres and rural peripheries allow reflection on digitalisation in rural areas in the context of work flexibility.

data processing and analysis, sample recruitment and the consideration of ethical standards. We show that strict adherence to ethical standards when using mixed methods (Teddlie/Tashakkori 2009; Hesse-Biber 2010; Preissle/Glover-Kudon/Rohan et al. 2015; Cain/MacDonald/Coker et al. 2019) and digital methods (Madge 2007; Anderson/Jirotka 2015; Tiidenberg 2018) can be beneficial rather than inhibiting, especially during the recruitment phase.

This paper contributes to ongoing discussions on mixed methods but also on digital methods for social science research. On the one hand, it deals with the opportunities of a dialectic understanding between qualitative and quantitative perspectives, which allows researchers to be freer in their research procedure (Kuckartz 2014). The mixture of narrative and numeric data permits more precise explanations to understand the researched subjects and the motivations behind their actions (Teddlie/Tashakkori 2009). On the other hand, the combination of digital and analogue methods offers deeper insights into people's digital practices and socio-spatial realities.

## 2 Background of our study

Our research project is embedded in the context of the literature on flexible and multilocal working. Information and communication technologies allow knowledge workers to work in multiple locations (Koroma/Hyrkkänen/Vartiainen 2014; Ojala/Pyöriä 2018). They can fulfil their work tasks in different locations ranging from the city to the most remote rural places (Nadler 2014). Working in a more rural environment can also have positive effects such as increased work satisfaction, fewer interruptions and reduced stress levels (Vesala/Tuomivaara 2015).

These observations led us to the hypothesis that knowledge workers in Switzerland are able to temporarily work in a multilocal setting (urban and rural) and that they utilise different work patterns in urban centres to those used in the rural periphery.[2] We addressed this topic by utilising an eco-nomic geography perspective that builds on the concepts of marginality and urban-rural linkages[3]:

By focusing on marginality, we were interested in how the alternation of working in the central workplace and temporarily in the peripheral workplace influences work activities. Temporary work in a rural environment can have positive mental effects for workers and consequently increase well-being (Vesala/Tuomivaara 2015); it can also entice creativity (Grabher 2018; Hautala/Ibert 2018) or even encourage the radicalisation of new ideas (Sgourev 2021). We were interested in the following research questions: To what extent and why does the use of digital applications on the laptop and smartphone for work differ between workplaces in urban centres and in the rural periphery? How do multilocal knowledge workers utilise marginality in their work? What are the benefits and limitations of using marginality for work and why do the study participants decide to work in multilocal settings between centre and periphery?

Through our focus on urban-rural linkages, we examine the creation of such linkages (Mayer/Habersetzer/Meili 2016; Bosworth/Venhorst 2018), especially through the use of information and communication technologies (Weber/Freshwater 2016). Furthermore, we also examine temporary proximity created through information and communication technologies (Torre/Rallet 2005; Torre 2008) as well as aspects of the embeddedness (Jack/Anderson 2002; Bosworth/Willett 2011) of multilocal knowledge workers in the local economic and social structure of the periphery. The following research questions guided our study: To what extent and why do communication activities on digital devices, such as laptops and smartphones, differ between the urban and the rural? How do multilocal knowledge workers deal with distance and proximity during multilocal work arrangements using information and communication technologies? How and to what extent are multilocal knowledge workers embedded in the rural?

In addition to these research questions, we explored how different data sources can be combined to gain deeper insights into the interaction with digital technologies in different locations (e.g. Forman/van Zeebroeck 2019). We thus took into account that traditional methods in rural studies and economic geography are not sufficient to examine multilocal work and the use of information and communication technologies in different locations, and that we had to go beyond the classical quantitative and qualitative paradigms.

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[2] In our study we understand centres as larger metropolitan areas that are characterised by high levels of social, political and economy activities, which are the main areas of employment for knowledge workers (Florida 2005). A periphery in turn is understood as the counterpart to a centre and may be distant from it or located at its fringe, such as a mountain area (for further reading cf. Kühn 2015; Hautala/Ibert 2018).

[3] The two strands of literature rely on different conceptual approaches. Literature on marginality uses the concept of centre-periphery. Literature on urban-rural linkages uses the concept of urban-rural. In this methodological contribution, we use the terminology of centre-periphery, and treat this synonymously to urban-rural.

In recent years, digitalisation has fundamentally extended the repertoire of research methods and led to the emergence of digital methods.[4] This is particularly evident in the variety of digital technologies that can be utilised such as digital devices (e.g. smartphones, laptops, GPS devices, cameras) and software applications (e.g. statistics, geographic information system, GIS, automated data collection). New data sources include, for example, user generated digital records (logs, digital footprints) that document human interaction with digital devices. In this regard, people's behaviour, networks and mobility in space can be researched using GPS data on mobile phones (e.g. Christensen/Romero Mikkelsen/Sick Nielsen et al. 2011; Birenboim/Shoval 2017) and through specific communication applications on smartphones (e.g. Truong 2018; Buchal/Songsore 2019). Such methods make it possible to generate microdata, which would be difficult to collect using (traditional) analogue methods (Halfpenny/Procter 2015). Yet, digital methods require the application of ethical considerations such as informed consent, data privacy, confidentiality and data storage and sharing (Madge 2007; Birenboim/Shoval 2017; Tiidenberg 2018), something that we will explore in this paper. Furthermore, ethical considerations are also a general concern when conducting mixed methods research, especially in terms of informed consent and transparency (Teddlie/Tashakkori 2009; Hesse-Biber 2010; Preissle/Glover-Kudon/Rohan et al. 2015; Cain/MacDonald/Coker et al. 2019).

The emergence of digital methods also raises questions related to the benefits and limitations of mixing and integrating analogue and digital methods. Studies that combine different heterogeneous data sources are scarce in social science research (Halfpenny/Procter 2015). However, an innovative way to combine different data sources was provided by Crabtree, Tennent, Brundell et al. (2015) using the Digital Replay System (DRS). In their study, the fieldwork tracker software was used to collect digital records[5] (log files[6]) of people's interaction with digital technologies. The DRS software was utilised to combine these data with more traditional data (audio, video, transcripts). As the DRS

applications and fieldwork tracker were no longer available and because there is now better access to tracking applications and data, we created our own mixed method approach to collect microdata of people's work practices in different locations.

At a general conceptual level, conducting mixed methods research allows researchers to be more flexible and thus not locked in the conformism of specific quantitative or qualitative method domains (Kuckartz 2014). This is also reflected in the ways in which numeric and narrative based methods are mixed, whereby the positivism of quantitative methods and the constructivism of qualitative methods are integrated and thus stand in dialogue with each other. This dialectic perspective on both methodological paradigms allows explanations for human action to be developed (Teddlie/Tashakkori 2009), especially in the context of their socio-spatial realities (Leszczynski 2018). New digital technologies such as, for example, laptops, smartphones or tablets can be adopted by researchers and used to rethink and adapt existing research methods. This leads to the development of new forms of research practices and can potentially transform research methods (Halfpenny/Procter 2015).
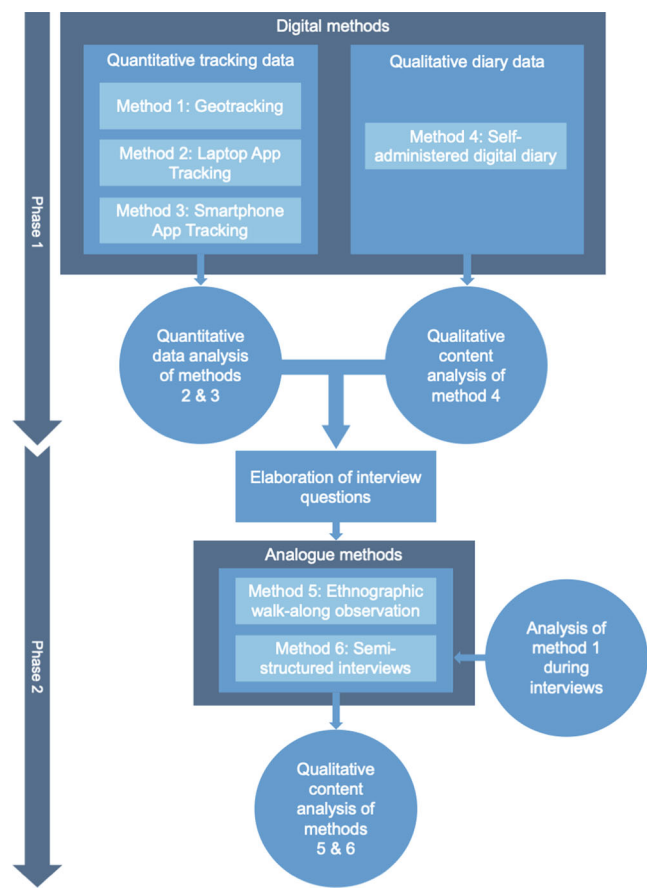


**Figure 1** Research design "Digital Multilocality"

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[4] Due to the variety of terminologies (e.g. e-research, digital research methods, methods for internet research, online research methods, digital methods), we use the term "digital methods" (Rogers 2013; Leszczynski 2018) for computer aided methods.

[5] Digital records are activities (e.g. movements, interactions) that were consciously and unconsciously recorded through the use of digital infrastructures and digital devices (Crabtree/Tennent/Brundell et al. 2015).

[6] Log files (logs) show activity on a digital device and traces of human interaction with it (e.g. timestamp, URL, GPS, user name) (Crabtree/Tennent/Brundell et al. 2015).

## 3 Research design: combining digital and analogue methods

Our research design integrated six closely connected methods. The methods built on one another sequentially and were not simply applied individually. To integrate the methods, the data collection was divided into two consecutive phases. The first phase consisted of the collection of microdata for the six study participants and involved a set of digital research methods. The second phase integrated the results of the digitally generated microdata and its analysis and utilised this for our analogue methods. Figure 1 gives an overview of the two phases and the methods applied in our approach, which are explained in more detail in the following.

In the first phase, digital work tracking methods that allowed automated data collection and a self-administered digital diary were applied. These data were collected during five[7] digital work tracking days, both in the central and the peripheral workplace. In this phase, geotracking was used in order to collect the participants' location data (e.g. Christensen/Romero Mikkelsen/Sick Nielsen et al. 2011; Birenboim/Shoval 2017). We used the geotracking application OwnTracks[8], which works on both Android and iOS. OwnTracks collects the time stamps of the participants' locations and movements. We also tested Google Maps but selected OwnTracks due to anonymisation and security reasons as no third parties are involved. The participants downloaded OwnTracks and installed it on their iPhones (all participants were iPhone users, which was pure coincidence). During a digital work tracking day, OwnTracks only had to be opened by the participants once and could then automatically run in the background. This data was collected automatically on a secure university server, to which only the research team had access.

Simultaneously, laptop application tracking was used to gain deeper insights about the ways in which the multilocal knowledge workers interact with their laptops during workdays in the centre and in the periphery. We were interested in how much time they spend on their laptops on a workday and what applications are used, for how long, when they were opened and when they were closed. We selected the tracking application ActivityWatch.[9] This application works on both Windows and Mac operation systems. The participants had to run it during their digital work tracking days.

The tracking data resulting from ActivityWatch were stored locally on the participants' laptops. After the tracking phase was completed, the participants had to transfer the data to the research team.

In parallel, smartphone application tracking was added because many work-related tasks are completed using smartphones (e.g. phone calls, e-mail, text, voice messages, video calls). We were interested in the duration of use of the applications on the smartphone. A special focus was on communication activities. We assumed that through such activities multilocal knowledge workers create urban-rural linkages when they get in contact with co-workers, supervisors and/or clients in the centre during their workdays in the periphery and vice versa. Unfortunately, the iPhone does not allow this kind of application use data to be exported – not even from the built-in application Screen Time. Therefore, the participants were asked to take screenshots of their battery usage (the duration of all applications used is presented within a period of 24 hours) after a completed digital work tracking day.

During this phase, we also included a qualitative digital method. Self-administered digital diaries were added to obtain subjective information about the individual workdays. The participants took notes and photos and stored them in the self-administered digital diaries, which they then shared with us digitally. During each digital work tracking day, the participants were asked to fulfil three tasks: first, take a picture of something inspiring during the workday; second, add a short-written description of the picture and explain the reasons why it was inspiring; third, write a short description of the work tasks of that day using keywords. We used the application Day One[10], which works on Windows and Mac as well as on Android and iOS. Day One allows written diaries and photographic diaries to be combined (Latham 2016). After the participants completed the digital work tracking days, they had to export the diary data and send it to us. Supplementing the quantitative digital work tracking data with written and visual materials helped us to gain a better impression of the multilocal work practices. We assumed that such self-administered digital diaries can enhance participation (Geoghegan 2019), as participants become more involved in the research process (Meth 2003).

The statistical analysis of the tracking data and the qualitative content analysis of the self-administered digital diaries formed the basis for the analogue part of our research design and for the qualitative methods that followed in the second phase. We chose ethnographic walk-along observations (Rose/Degen/Basdas 2010) to gather qualitative in-

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[7] This number was selected to obtain data from one working week and to keep the workload low for the study participants in order to reduce the likelihood of them dropping out.

[8] https://owntracks.org (24.02.2022).

[9] https://docs.activitywatch.net/en/latest/ (24.02.2022).

[10] https://dayoneapp.com (24.02.2022).

sights into the work practices during the study participants' transition from the centre to the periphery. During the walk-alongs, we were "talking whilst walking" (Anderson 2014) or in our case "talking whilst travelling" between workplaces. This allowed us to gain a better understanding and a direct impression of the participants' work behaviour in the multilocal context. Consequently, we gained a heightened sensitivity for the participants' working lives due to our involvement and attachment that went beyond a one-hour interview (see Dowler 2001). We recorded in our hand-written research notebooks the "unspoken aspects of work and workplaces" (McMorran 2012: 493).

During and also after these walk-alongs, we conducted qualitative semi-structured interviews. These interviews integrated the initial analyses of our quantitative tracking data and the qualitative data from the self-administered digital diaries. We also included spontaneously conceived themes from the ethnographic walk-along observation. During the interviews, we showed the participants the quantitative analysis of their own data and were able, on the one hand, to let the participants comment on and interpret their own digital work tracking data and, on the other hand, to ask precise follow-up questions about the data and the visual materials of the self-administered digital diaries. We developed our questionnaire not only based on the literature, but also based on the results from the digital methods gained in the first phase. We conducted the interviews in person and in the participants' native language (Swiss German). They lasted around 73 minutes on average and were recorded using the researcher's smartphone.

This data collection procedure was divided into two consecutive phases for which we used digital and analogue methods. The research design fruitfully combined quantitative and qualitative data; in this way we contribute to the bridging of the qualitative/quantitative divide (Bathelt/Li 2020). This "bridging" is specifically illustrated in the organisation of the fieldwork in two intertwined phases, ensuring that the qualitative and quantitative methods are not separated but brought into relation with one another. The quantitative and qualitative data collected using the digital methods in the first phase was augmented by the qualitative method of interviewing in the second phase of data collection. In particular, this involved showing the study participants their own quantitative tracking data and qualitative data from the self-administered digital diaries generated in the first phase. Participants were asked to comment and interpret their own quantitative and qualitative data during the qualitative interviews. In addition, in the interview, we were able to show participants the data collected from digital methods and ask them precise questions about their data.

In retrospect, we can see two major advantages resulting from a consecutive and integrated research design: firstly, this procedure enabled the integration of the methods and results (Bryman 2007) and, secondly, it helped us gain detailed and additional in-depth insights by generating different perspectives on digital multilocal work practices (Watkins/Gioia 2015; Kern 2018).

## 4 Insights from one participant

In the following, we illustrate the research design presented above by showcasing the data we gained from one of the six participants. This is interesting for various reasons. First, the insights we gain from our study participant illustrate the variety of qualitative and quantitative data gained from different sources. Second, we highlight the two consecutive

**Table 1** Sample

| Participant ID | Profession | Employment status | Industrial branch of the firm | Primary location of employment | Average multilocality frequency |
|---|---|---|---|---|---|
| 1 | Virtual assistant | Freelance entrepreneur | Secretarial and writing services | Centre | 1-2 days per week |
| 2 | Product manager digital public services | Corporate employee | Logistics | Centre | 2 days per week in the centre |
| 3 | IT specialist | Freelance entrepreneur | IT services, telecommunications | Centre and periphery | 1 week every two months |
| 4 | Innovation manager | Corporate employee | Commerce, telecommunications | Centre and periphery | Two to three times per month for three to four days each |
| 5 | Data & artificial intelligence solution specialist/lecturer | Corporate employee | IT services | Centre | Every weekend |
| 6 | Specialist for Human Resources and organisational development | Corporate employee | Logistics | Centre | At least ten to fifteen times per year |

phases of data collection and how they are applied in the fieldwork. Third, the data illustrate how digital and analogue methods are integrated to gain deeper insights about the work practices of multilocal knowledge workers.

For our study, we recruited a sample of six multilocal knowledge workers who work in central and peripheral workplaces. Table 1 gives an overview of the study participants of our research project.

To illustrate the application of our mixed methods approach and the integration of the digital and analogue methods in this paper, we highlight the case of participant 4. This multilocal knowledge worker shows a high frequency of multilocal work practices in the centre and in the periphery. This is in part due to the family being located in both places. Participant 4 is also an experienced multilocal worker and has to change workplace regularly because of employment in different firms located in the centre and in the periphery.

Through the application of our mixed methods approach, we augment digital geotracking data with analogue qualitative data from interviews. By projecting the movement lines on a GIS-based map, it is possible to visualise precisely which places participant 4 visited and thus also to recognise movement patterns. However, these digital geotracking data do not provide information about the reasons for the corresponding movements and the places visited. We obtained this qualitative information during the walk-alongs and interviews when we showed interviewees images of their geotracking map. Thus, participant 4 was able to explain the reasons behind the movement patterns as illustrated on the maps and tell us more about the places that were visited. In this regard, for example, participant 4 mentioned in the interview while looking at the map: "Look, I can extremely check off my work dots by the way." Furthermore, participant 4 was also able to explain in more detail what places were visited for leisure by showing this on the map: "That is perhaps such a leisure time axis. [...] Or, for example, we went there one, one evening for dinner or something. Yes. I think I met a friend there, back there too, in the Morteratsch [place in the Engadine]. Go swimming and hang out a bit. That can be good, yes." These comments illustrate that the geotracking data were augmented with qualitative data from the interview. Thus, based on this procedure, we were able to gain insights about everyday work and leisure practices. The data illustrate that the three places of home, work and leisure are geographically further apart in the periphery than in the centre. This is also acknowledged by participant 4 who explains during the interview that there are "many short paths" in the centre, but in the periphery there are "beautiful long paths" and "in the Engadine, it is just really stretched". This seems to indicate greater spatial separation of activities in the periphery (Figure 2).

Data we gained on participant 4's differential use of laptop and smartphones in the different locations further illustrate our integration of digital and analogue methods. The statistical analysis of the quantitative digital work tracking data of the laptop shows that participant 4 works less (17:05 minutes on average) on the laptop during workdays in the periphery compared to the centre (Table 2). The laptop tracking data make it possible to identify different types of work activities based on the different use of applications. Thus, participant 4 carries out more activities in the centre using applications for documents (06:50 minutes), browser (07:01 minutes), miscellaneous that could not be assigned to the other categories (01:03 minutes), communication (02:33 minutes) and media (14 seconds), and showed more lockscreen times (27 seconds). In contrast, participant 4 used more applications for e-mail at the workplace in the periphery (01:03 minutes on average).

The data resulting from the digital work tracking show
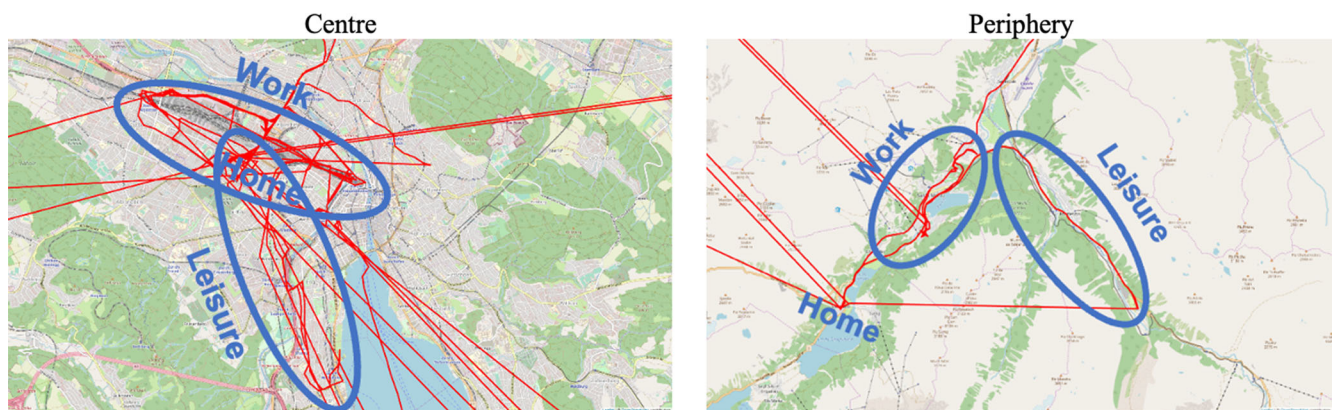


**Figure 2** Geotracking of participant 4. The coloured lines show participant 4's movements in the centre and in the periphery during digital work tracking days
Note: The maps we showed the participants during the interviews were in a rawer format and looked slightly different.

**Table 2** Type of activities on laptop in the central and the peripheral workplaces of participant 4

| | Centre | | Periphery | | |
|---|---|---|---|---|---|
| Type of activity | Average time per day | Percent | Average time per day | Percent | Delta |
| Documents | 01:48:27 | 57.39 % | 01:41:37 | 59.13 % | 00:06:50 |
| Browser | 00:34:36 | 18.32 % | 00:27:35 | 16.05 % | 00:07:01 |
| E-mail | 00:33:08 | 17.54 % | 00:34:11 | 19.89 % | 00:01:03 |
| Miscellaneous | 00:07:39 | 4.05 % | 00:06:36 | 3.84 % | 00:01:03 |
| Communication | 00:03:07 | 1.65 % | 00:00:34 | 0.33 % | 00:02:33 |
| Lockscreen | 00:01:32 | 0.81 % | 00:01:05 | 0.63 % | 00:00:27 |
| Media | 00:00:26 | 0.24 % | 00:00:12 | 0.12 % | 00:00:14 |
| Total | 03:08:55 | | 02:51:50 | | 00:17:05 |

Note: "Miscellaneous" was not further analysed during the interviews because the data are too heterogeneous. Also "Lockscreen" was not further analysed as differences are small and not very meaningful.

that the activities differ between centre and periphery, but the data do not provide information about the reasons for the differences. Therefore, we presented the quantitative data to participant 4 in the qualitative interview for comments. When shown the quantitative laptop tracking data, participant 4 was initially very surprised about the amount of time spent on the laptop. This was especially due to the fact that participant 4 assumed a longer working time on the laptop during workdays in the periphery and commented on this "[...] man, this is not much for me on the computer". This reaction illustrates how the practice of showing quantitative data to participants allows quantitative and qualitative data to become integrated. The quantitative data showed that participant 4 worked more with the laptop in the centre than in the periphery. In this regard, participant 4 explained that in a central workplace one is more distracted by "a kind of a marathon of interruptions" from co-workers and teamwork, which may lead to slightly higher lockscreen times. Participant 4 also explained that more activities are undertaken with document applications in the centre because, for example, more presentations are prepared with PowerPoint and discussed with the team. The reason why participant 4 works less on the laptop during the workdays in the periphery is that more analogue work is done, for example, with pen and paper or sometimes pursuing a thought during a hike. In sum, the quantitative digital data provided a descriptive basis, which could then be analysed and deepened by the analogue qualitative data gained through the interview. In this way it became apparent that the quantitative data collected in the first phase of data collection could be augmented with qualitative data. The advantage of this procedure is that the participant had the possibility to comment on her/his own quantitative data. Here the qualitative data depend on the quantitative statistical analysis. As with geotracking, the advantage of dividing the fieldwork into two phases became apparent: the quantitative data from the first phase could be processed and then used in more detail during the qualitative second phase.

We were also able to illustrate the digital work tracking data of the laptop for participant 4 on chronological timelines (Figure 3). In this representation, we see that the workday in the centre is more closely tailored to the times between 8 am and 6 pm and there are fewer gaps (breaks). Furthermore, the more saturated the colour, the more similar the work activities are between the digital work tracking days in the corresponding location. The timeline of the centre shows a slightly greater saturation here, which suggests that the workdays at the central workplace are stricter and less freely arrangeable. The communication activities on the laptop also prove this, as more interruptions can be detected in the periphery (Figure 4). We see from these timelines that there are different working patterns in the central and in the peripheral workplaces.

The statistical analysis of the smartphone data (Table 3) shows that participant 4 uses the smartphone on average for longer time periods in the periphery than in the centre (01:05:56 hours). In addition, in the periphery participant 4 undertakes on average longer activities of communication (27:08 minutes), media consumption (16:28 minutes), social media (15:46 minutes), e-mail (07:10 minutes), browser (16:08 minutes), media creation (6 seconds), work organisation (03:12 minutes), travel (02:02 minutes), personal (6 seconds) and documents (01:14 minutes), but shorter use of miscellaneous applications (23:08 minutes) and finances (16 seconds). Here, too, the quantitative smartphone data were augmented by the analogue qualitative interviews, when the quantitative tracking data were shown to the participants for qualitative interpretation and comments. Participant 4 was surprised about the high overall use of the smartphone, and commented loudly, "Oh my god". This reaction basically illustrates that quantitative data can be linked to qualitative data collection. In this example, the quantitative smartphone tracking data elicited a reaction by
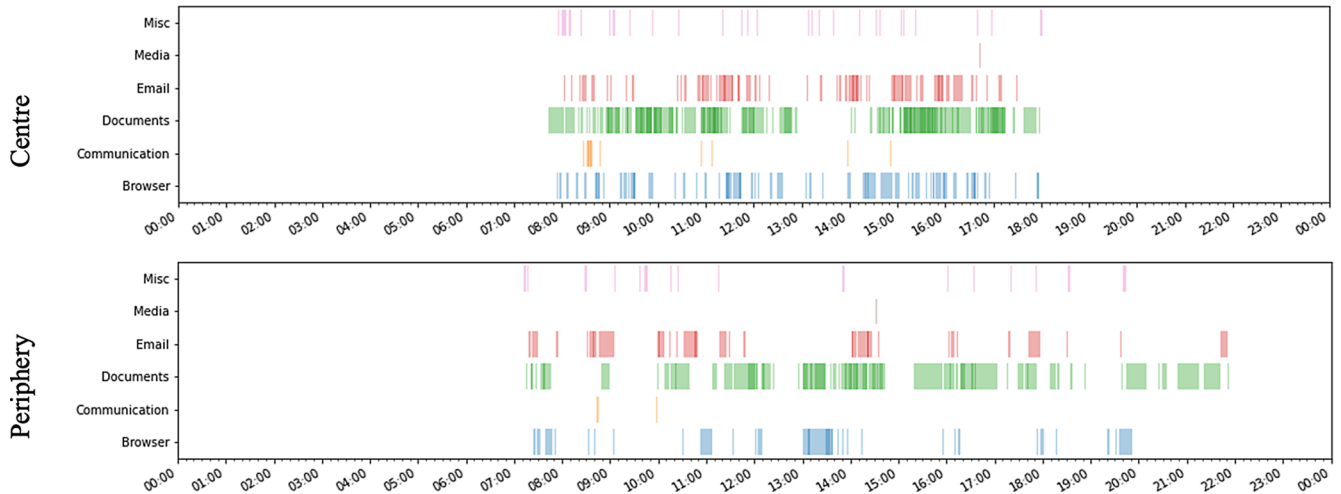
**Figure 3** Timeline of types of activities on the laptop during workdays in the centre and in the periphery undertaken by participant 4
Note: The saturation of the colours shows similarities of work activities between digital work tracking days in the corresponding location
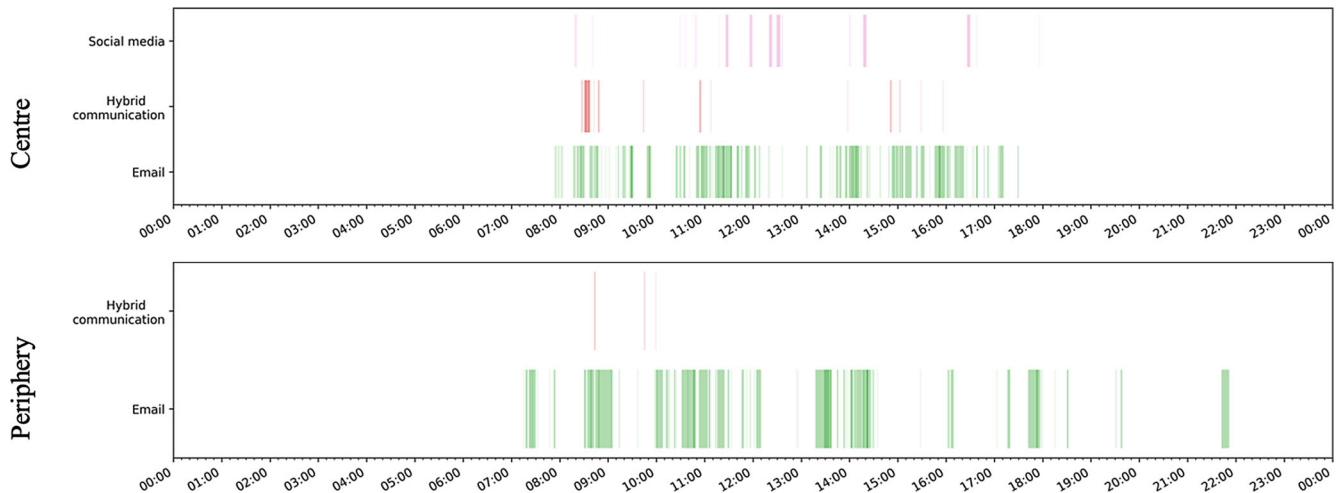


**Figure 4** Timeline of communication activities on laptop during workdays in the centre and in the periphery undertaken by participant 4
Note: The saturation of the colours shows similarities of work activities between digital work tracking days in the corresponding location

participant 4. However, when looking at the quantitative smartphone tracking data, participant 4 explained that the smartphone is also a "gap filler", because it is not possible to meet someone spontaneously in the periphery, for example for a coffee. Furthermore, participant 4 explained the higher usage in the periphery by the need to keep in touch with other contacts: "I have much less exchange with people. In the Engadine, of course, I have much less density in everyday life and less input from outside. And we are so used to being able to feed in one thing after another. Information comes in, something funny comes in, some phone calls come in and then you are more on it, yes". This is corroborated by the researcher's notes from the analogue and qualitative ethnographic walk-along observation: dur-

ing the train journey, participant 4 made phone calls and worked on the laptop. This confirms that the smartphone is important as soon as participant 4 becomes spatially distant from co-workers.

As was the case for the laptop tracking analysis, the smartphone tracking analysis provides a descriptive overview of smartphone use at the central and the peripheral workplaces. However, these quantitative data needed to be further elaborated through our qualitative interview. We can conclude from this quantitative data that the greater distance to the central workplace increases the use of the smartphone, especially of applications such as communication, social media and e-mail, which allow participant 4 to get in touch with other people.

Table 3 Type of activities on smartphone in the central and the peripheral workplaces of participant 4

| Type of activity | Centre | | Periphery | | |
| --- | --- | --- | --- | --- | --- |
| | Average time per day | Percent | Average time per day | Percent | Delta |
| Communication | 01:41:40 | 37.70 % | 02:08:48 | 38.38 % | 00:27:08 |
| Miscellaneous | 01:15:20 | 27.94 % | 00:52:12 | 15.55 % | 00:23:08 |
| Media consumption | 00:26:20 | 9.77 % | 00:42:48 | 12.75 % | 00:16:28 |
| Social media | 00:17:50 | 6.61 % | 00:33:36 | 10.01 % | 00:15:46 |
| E-mail | 00:16:50 | 6.24 % | 00:24:00 | 7.15 % | 00:07:10 |
| Browser | 00:16:40 | 6.18 % | 00:32:48 | 9.77 % | 00:16:08 |
| Media creation | 00:05:30 | 2.04 % | 00:05:36 | 1.67 % | 00:00:06 |
| Work organisation | 00:05:00 | 1.85 % | 00:08:12 | 2.44 % | 00:03:12 |
| Travel | 00:03:10 | 1.17 % | 00:05:12 | 1.55 % | 00:02:02 |
| Finances | 00:00:40 | 0.25 % | 00:00:24 | 0.12 % | 00:00:16 |
| Personal | 00:00:30 | 0.19 % | 00:00:36 | 0.18 % | 00:00:06 |
| Documents | 00:00:10 | 0.06 % | 00:01:24 | 0.42 % | 00:01:14 |
| Total | 04:29:40 | | 05:35:36 | | 01:05:56 |



This view inspires me, frees me and I always have a bit of a feeling in the Engadine that I experience the seasons much more intensely! Here, life = work and work = life

Figure 5 Entry in participant 4's self-administered digital diary

The self-administered digital diaries provided us with more personal insights into participant 4's workdays with qualitative data. In addition, they allowed the participant to reflect upon their work experiences. During workdays in the periphery, this participant took pictures of landscapes (mountains) while in the centre pictures of the work desk environment or specific work events were chosen. The following entry in participant 4's self-administered digital diary provides information about the peripheral work environment and the participant's own words about the work-life balance during workdays in the periphery (Figure 5).

The participant chose a picture with an expansive view of the natural mountainous landscape. In order to under-

stand the picture and the description in this entry and thus why life and work are more closely aligned in the periphery, we showed participant 4 this entry during the interview and asked for an explanation. This allowed participant 4 to reflect as follows: "Now you can fully rely on me [laughs]. Yes, I believe when you get up in the morning and you [...] you don't feel like you have to enlist like in the army at eight o'clock. [...] But it just starts like 'I could do something so beautiful to this content', thinking up in your mind and then and then you think: 'Ah OK, now I'll ask the person if they are here, then they can mirror my idea, if it's correct for them'. And then you get much more from A to B to C, instead of perhaps already knowing the result. And

it also has a lot to do with recreational activities in free time, because maybe you don't have to go to the office in the classical way. And then you have the feeling of, well, [...] this is my working world, so to speak, that's where I sit down and now the working hours start and now I start working. And then I have to work until ah [sighs] no later, after work I can finally go to Lake Zurich, like that. There is no such thing as that there [in the mountains]. [...] It could be that it has something to do with the fact that I don't have a fixed room there, an office, an assigned workplace, no fixed working hours that someone dictates to me. That I have freedom there."

This sequence shows that the qualitative data (visual material and written text) we gained from digital methods can be further deepened using qualitative interviews. The topics such as flexible working time ("don't feel like you have to enlist like in the army at eight o'clock", "no fixed working hours"), clearer and more efficient workflows ("from A to B to C"), leisure ("recreational activities in free time") or free choice of workplace ("don't have a fixed room") could be linked to the material from the diary entry. Here, the notes from the ethnographic walk-along observation can help to better understand the free choice of workplace: during the walk-along, it turned out that participant 4 knew how to use the infrastructure on the train by putting the laptop on the ski racks and thus converting them into a standing desk, something that this participant has obviously perfected to their needs. Furthermore, this example shows that not only quantitative data but also qualitative data collected with digital methods can be augmented by utilising qualitative interviewing. The beginning of the quote above reflects the combination of the methods very well when participant 4 reacts with "Now you can fully rely on me [laughs]". The qualitative data from the self-administered digital diary (descriptions and pictures) already give much detail on the participant's workdays. Here, too, showing these entries and thus confronting interview participants with data from the self-administered digital diary and asking for their interpretation added more detail to the diary data and enhanced the study's rigour.

The example of participant 4 showcases the wealth of data and the benefits of integrating different methods. Utilising only one method would have left more room for interpretation but would not have offered an analytical insight. For example, the individual analysis of the qualitative diary data would not have provided clear evidence that the free working style is reflected in leisure time due to several breaks during the workday in the periphery. We learned from our mixed methods approach that the integration of quantitative and qualitative as well as digital and analogue methods can thus allow more accurate descriptions and generate greater analytical understanding, which also strengthens the accuracy of the data and our interpretation.

## 5 Lessons learned

### 5.1 Experiences from the mixing of methods

A central component of our mixed methods research design lies in the combination of digital and analogue methods (Crabtree/Tennent/Brundell et al. 2015). We learned that dividing the digital and analogue research methods into two consecutive phases of fieldwork can be fruitful. The methods related to geotracking, laptop application tracking, smartphone application tracking and self-administered digital diaries provided a wealth of data. Apart from the self-administered digital diaries, the digital methods allowed automatic data collection by the participants themselves, with prior instructions and tutorials by the researchers. However, the data collected through digital methods are not self-explanatory, which could lead to misinterpretations without follow-up qualitative research. This is exactly where analogue methods such as the ethnographic walk-along observations and the qualitative interviews come into play. In contrast to the digital methods, which were applied by the participants themselves, the analogue methods are based on direct contact and interaction between us as researchers and the sample participants. Therefore, the analogue methods allow researchers to directly confront the study participants with their data gathered from the first phase of fieldwork. Such a process allowed the contextualisation of the data gained from digital methods and more precise insights in the work practices of the study participants.

Furthermore, and also based on the latter, we learned that the bridging of the qualitative/quantitative divide is essential in such a mixed methods research design, particularly to enhance rigour (Bathelt/Li 2020). While qualitative and quantitative methods each have their strengths, their weaknesses can be overcome through their integration. Therefore, we learned that the practice of mixing or "bridging" both is essential and should be given special attention. This must be done carefully, consciously and, very importantly, actively by the researchers. In our study, we found it very fruitful to split our fieldwork into two consecutive phases of data collection for the sake of combining qualitative and quantitative methods in practice. This allowed us to analyse the quantitative data before we started the qualitative data collection. Even though the two phases were temporally separated from each other, they still built on one another. We also want to emphasise that our experience demonstrated that qualitative data such as that gained from the self-administered digital diaries in the first phase of data collection can

also be augmented with the same practice during qualitative interviews in a subsequent phase of data collection.

## 5.2 Data processing and analysis

The data analysis presented above illustrates the need for diverse methodological knowledge. The mixed methods approach requires different competencies for data collection and analysis due to the heterogeneous nature of the data. Therefore, we built a research team that combined different methodological competencies. Two team members are data science experts and familiar with quantitative statistics and programming. The other two are human geographers and familiar with qualitative methods.

The data analysis involved various steps that were dependent on these different yet complementary competencies. The geotracking data from OwnTracks were displayed in a map section that shows the movement of the study participants. We created one map section showing the movement in the centre and one showing the movement in the periphery. The raw tracking data resulting from ActivityWatch were processed using Jupyter notebooks and required programming skills. The processing of the tracking data into Python using Jupyter notebooks was relevant to sort the data but also to handle the data according to ethical considerations. Jupyter notebooks are suitable for this task but also require knowledge of programming. The data were sorted by workdays in the central and in the peripheral workplaces. In a next step, the data were cleaned from artefacts and highly sensitive data such as the window titles. After this step, the cleaned data were classified into categories. We identified nine different activity types: browser, documents, e-mail, communication (non-e-mail), programming and development, work organisation, lockscreen, media, miscellaneous.[11] In the next step, the periods of user activity were filtered and individual and overall statistics were created. A similar data procedure and analysis were used for the smartphone tracking data. The battery screenshots were transcribed into Microsoft Excel. In the next step, the raw smartphone tracking data from Excel were imported into Python for analysis with Jupyter notebooks. Descriptive statistics were possible using Microsoft Excel. However, we decided to process the data using Python and Jupyter notebooks in order to analyse and display the smartphone tracking data in the same way as the laptop tracking data. In doing so, the data were cleaned from artefacts and categorised for the statistical analysis. The data (text and pic-

tures) from the self-administered digital diaries from Day One were imported into the analysis software MAXQDA12 and coded (cf. Cope/Kurtz 2016). The same procedure was also applied to the recordings from the qualitative semi-structured interviews. These interviews were transcribed in the original language (Swiss German) and parts that were used in publications were transcribed in English. The field-notes from the ethnographic walk-along observations were added. This qualitative material was analysed according to a qualitative content analysis (cf. Mayring 2015).

We learned that the heterogeneity of the data requires different evaluation techniques and different methodological knowledge and competences proved to be necessary. Through a heterogeneous team constellation, different methodological competences could be combined. In addition, conducting research in such a diverse research team requires regular consultation among team members, and the careful planning, organisation and implementation of the fieldwork.

## 5.3 Recruitment of the sample

Finding willing and suitable participants who would take part in our study was a major challenge. This was primarily due to the fact that our research design demanded significant commitment and willingness from the study participants. In addition, participants had to fulfil a set of criteria in order to qualify to take part. First, they needed to primarily work in an urban agglomeration at the employers' premises or in a home office while also being able to work in a multilocal manner in a Swiss mountain region. Second, because there is no fixed definition of how many days someone has to work in different places to be classified as a multilocal worker, we decided that they should spend at least one working week (five days) every three months (thus in every season of the year) in a Swiss mountain region. Daily and weekly commuters were thus excluded, as well as people who work by chance during their holidays. Third, the study participants had to work with a laptop and a smartphone in their daily work activities. Fourth, it was necessary that the participants' employers allow them to be tracked for ten workdays and that the participants were willing to collaborate with the research team.

Generally and in Switzerland in particular, there is no register of multilocal knowledge workers. We therefore had to use a snowball method to find study participants. Initial expert interviews indicated that co-working spaces in the mountains would be good places for recruitment. Therefore, we got in contact with all co-working spaces in the Swiss mountain regions (at the time of recruitment in 2019: n=12) that participate in the Swiss national co-working association "Coworking Switzerland". As a result, we were

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[11] The category "miscellaneous" combined work activities that did not fall into any other category. These heterogeneous data were not statistically analysed and were excluded from the interviews.

able to recruit two participants. At the same time, we were also in contact with the "Work Smart Initiative", which is supported by a number of large employers in Switzerland and which aims to promote location-independent work. We were able to recruit two participants from this network. We also got in touch with the association of digital nomads in Switzerland. They allowed us to post our call for study participants on their Facebook site. One participant was recruited from this outreach effort. The final participant was recruited from private contacts of the research team. Our initial goal of recruiting between 10 and 12 participants was not fulfilled and we had to settle for a total of six participants.

In this study, we learned that the recruitment of study participants is much more difficult when digital methods are used than when traditional methods are involved. This has to do in particular with the fact that the data collected are very sensitive which can deter potential study participants. Moreover, the phenomenon of multilocal working between centres and peripheries is still new, at least this was the situation before Covid-19 at the time when we planned and implemented the study. The criteria of the sample could therefore not be too restrictive, which is why we did not impose any restrictions regarding profession, employment status, business size or industrial branch of the firm where participants were employed.

Despite the small number of study participants, the amount of data collected was large. Even though we can only make statements about six multilocal knowledge workers, we can highlight interesting patterns that emerged from the data and generate in-depth insights about a novel phenomenon.

## 5.4 Taking ethical considerations seriously to elaborate a basis of trust

Conducting mixed methods research requires careful consultation concerning ethical considerations. While this topic is seldom addressed in mixed methods studies, we focused on it from the very beginning of our research project. However, due to the nature of the digital and analogue methods applied in this study, we learned that the ethical considerations of mixed methods research and those of digital methods go hand in hand.

We strictly followed ethical considerations during the research process because we worked with highly personal and sensitive digital data (Madge 2007; Anderson/Jirotka 2015; Tiidenberg 2018). We learned that although effort is involved in following ethical considerations of mixed methods and digital methods (e.g. writing letters of consent), this can be a key factor in the success of such a study. This advantage is highlighted in the development of high levels

of trust between the research team and the study participants. This trust was also based on the transparency of our research design, which was ensured by giving clear and detailed information on confidentiality, privacy and anonymisation (Teddlie/Tashakkori 2009; Hesse-Biber 2010).

We aimed to be transparent from the beginning and to clearly explain the study's risks and benefits to the study participants. We therefore developed a lengthy letter of consent that outlined what data would be collected and how it would be processed. Gaining informed consent was important (Madge 2007; Birenboim/Shoval 2017; Tiidenberg 2018). During the recruitment phase, we provided a fact sheet that indicated the aim of the study, the methodology, data procession, data use, funding information, information on the research team and details of compensation.[12] After their declaration of interest, we sent participants a personal informed consent letter with more detailed information on data accessibility and storage, data security and the privacy policy of the tracking applications. Each member of the research team and the participants signed the informed consent letter. In addition, we followed up with a debriefing (Teddlie/Tashakkori 2009) by phone to explain the details of our study design and the methodological steps.

Confidentiality was taken seriously in terms of data protection by using secure data servers for data storage (Kinsley 2013; Tiidenberg 2018). Interestingly, it turned out that we as researchers were more concerned about data security and protection than the participants themselves. For example, we offered the study participants the option of having their data collected through a face-to-face handover. However, this was not necessary for any of the participants, as they all sent us their sensitive and personal data by email or their company's cloud software. This may again be due to the good basis of trust.

Furthermore, confidentiality was also addressed by taking data privacy seriously (Teddlie/Tashakkori 2009; Tiidenberg 2018). Therefore, the collected data were anonymised at the beginning of the data processing procedure and also for publication. This also meant that information on the pictures from the self-administered digital diaries was anonymised by blurring, for example the participants' names in notes or any firm logos that appeared on the laptop screen. Anonymisation provides trust and thus encourages willingness to participate.

At a more general level, we learned that providing transparency (Preissle/Glover-Kudon/Rohan et al. 2015; Cain/MacDonald/Coker et al. 2019) on our research interest to our study participants was a key element for the realisa-

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[12] A voucher from the Switzerland Travel Centre AG was offered.

tion of a mixed methods research project of this sort. This transparency enabled us to clarify our purpose and provide detailed information on the research aims and process from the beginning. Fears or insecurities could thus be discussed and clarified, allowing the well-being of the study participants to be ensured throughout the research process (Teddlie/Tashakkori 2009).

## 6 Conclusions

This paper aimed to show that research on digitalisation and urban-rural development can benefit from a mixed methods approach combining digital and analogue methods. Mixed methods generated more explanatory power (Elliot/Purdam 2015). However, based on our mixed methods approach, we suggest putting more emphasis on the integration of the different methods (Bryman 2007). In this regard, we point out that the integration should especially concern the timing of the field research. This is because consecutive phases of data collection, in which different methods are applied, can provide more analytical insights.

Our research extends the knowledge of mixed methods in terms of the integration of digital and analogue research methods. The descriptive quantitative tracking data and the descriptions and visual material resulting from the self-administered digital diaries provide a wealth of information, but this can lead to misinterpretations. Through the analogue methods, an analytical element was added because we confronted the study participants with the data gained through our digital methods. This allowed us to be more precise about (multilocal) work practices because study participants had to go beyond subjective perceptions and interpret factual data.

Furthermore, we want to add to the call for bridging the qualitative/quantitative divide (Bathelt/Li 2020) by highlighting that using a mixed methods approach can indeed enhance rigour and add more precision to the study results. Nevertheless, our study also wants to draw attention to the fact that simply conducting both qualitative and quantitative research in a research project does not represent a mixed methods approach. Only by integrating the two methods – by utilising for example the quantitative data in the generation of the qualitative data – it is possible to utilise the benefits of each approach. Therefore, we argue in favour of a research practice that aims at "bridging" the methods. Showing the quantitative data to the participants during the interviews represented our practice of "bridging".

Careful consideration of ethical standards is required when conducting mixed methods research and in particular when using digital methods that may collect sensitive microdata. Our study shows that ethical considerations are not only important in data collection and analysis. As such, in the recruitment phase, strict and careful adherence to ethical considerations can be beneficial. Our research thus contributes to the debate by demonstrating that ethical considerations should be central to the planning, implementation and evaluation of field research. In doing so, we address the call for more transparency in mixed methods research (Cain/MacDonald/Coker et al. 2019) by not only putting emphasis on its importance but also by arguing that transparency can be beneficial for conducting mixed methods research.

On a general methodological level, the study innovatively applied a mixed methods approach that allowed us to be more flexible in our research procedure. We were not conformistically limited to one method domain. Our study employed a more dialectic understanding of quantitative and qualitative perspectives. This helped us to develop our explanations as well as to understand human action by combining the constructivism from qualitative research with the positivism from quantitative research. This research illustrates the benefits that result from placing quantitative and qualitative methods in dialogue with each other. It thus demonstrates that sequential mixed designs need not necessarily rely on a succession from quantitative positivism to qualitative constructivism or vice versa. For example, the use of the qualitative self-administered digital diary in the first phase of fieldwork shows that such chronological sequences can contain both qualitative and quantitative methods and do not need to be separated from each other.

Furthermore, the use of digital technologies allowed the investigation of the socio-spatial realities, processes and digital practices of human beings in space (Leszczynski 2018). In this regard, our study illustrates how such digital practices can be studied in more depth, also using analogue methods. This may sound paradoxical. Yet the analogue methods allowed us to deepen the digital data and to reflect on them. The mixture of digital and analogue methods thus shows that people's behaviour can be analysed to gain deeper insights into human interaction with digital technologies.

However, our mixed methods approach also has limitations. The data collected can only provide a snapshot of multilocal work arrangements and cannot fully capture them – particularly with regard to the widespread changes in work practices resulting from the Covid-19 pandemic. In addition, our study depends heavily on the participants, as is reflected in the fact that we had to trust them to carry out the tracking conscientiously and correctly. Furthermore, laptops and smartphones are also used for private purposes, which we were not able to filter out. There is also the question of whether the participants worked differently when they knew they were being tracked. This uncertainty is dif-

ficult to avoid and thus must be accepted to some degree. In addition, the use of methods that collect highly sensitive and personal data, as well as the number of methods used, has an impact on the recruitment of study participants. We therefore recommend not overloading mixed methods approaches.

Future research could extend and refine our exploratory mixed methods approach. For example, one single application that combines all tracking methods could simplify the data collection. Furthermore, data sources could be added and others removed. Nevertheless, digital methods are a good way to conduct field research at a distance, even in times of Covid-19.

Our study illustrates that mixed methods and the collection of heterogeneous data are very useful in the study of digitalisation and digital multilocality in rural areas. Methods can be viewed as individual pieces of a puzzle. By using mixed methods, we can try to get as close as possible to creating a complete picture of the puzzle. The key to solving the puzzle in the context of our study is then the integration of various methods, the unification of heterogeneous methodological knowledge, a suitable sample of participants and the strict consideration of ethical standards. Clearly, the "mix" must be subjected to profound reflection and adapted to different research purposes.

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