

# Reflections on Using a Diary App to Assess Emergent Technologies in Private Households

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## ABSTRACT

Voice assistants, such as Alexa, are sold in the three-digit million range every year. They are seen as plug-and-play solutions to make everyday life easier and more convenient. However, most emerging technologies are used, analyzed, and optimized in a business environment. Even though the sales market for household appliances is growing every year. In this research project, the use of voice assistants in private households were investigated regarding the possible adjustment of daily routines. The study was conducted by using a diary app. This paper describes the selection of the diary app used and reflects on its use from the perspective of the researchers and project participants. The selection criteria include the human-app interface, the type of data collection, the researcher dashboard, the possible interaction between researchers and project participants, the language and automated transcription, the data security, the provided technical support, the corporate culture, the professional impression, and the costs, which are particularly important for a research project. Finally, the weaknesses in the selection of the diary app are outlined.

## KEYWORDS

Diary Study, Mobile Diary App, Emergent Technologies, Private Households

## Introduction

Voice assistants used in everyday life are entertainment and communication technologies at the same time. They can be pure software solutions that can be implemented on a smartphone or laptop, such as Siri, or combined with

a manufacturer's own device, such as Google Home Nest or Amazon Alexa. They can be used to listen to the radio, watch TV, call up cooking recipes, ask questions and get answers, set the timer, tell jokes, and much more (Hoy, 2018). Although Statista (2023) recorded device sales of 131 million in 2022 and predicted sales of 122.5 million in 2027, Amazon has announced that layoffs will take place, and primarily in the Alexa voice assistant business unit (Amadeo, 2022). The envisioned business model

ended up not paying off. The sales revenues were not supposed to come from the sale of the hardware, but from the sale of other products using voice assistants. But customers remained reluctant and cautious. From Amazon's point of view, they continued with trivial tasks (see Hoy, 2018) that could not be transformed into money (Amadeo, 2022). From a business perspective, the customer's activities could be described somewhat disparagingly as trivial tasks, but they could also be seen from the perspective of routines, practices, rituals in which a technical device, in this case a voice assistant, is integrated in a meaningful way and in the sense of a well-engineered plug-and-play solution (Braun, 1993). In 2019, the focus of the research project was precisely on these routines, practices, rituals in everyday life (Mylan & Southerton, 2018; Shove, 2017; Reckwitz, 2002) and to what extent these routines can be changed by the existence and use of a voice assistant. Before that time these had only been studied to a limited extent (Lopatovska et al, 2019; Lau, 2018). Additionally, we have little knowledge about how mobile apps can support research on emerging technologies in home settings conducted as a remote study. In this paper, we would like to reflect on conducting a diary study on voice assistants by using a mobile app. Therefore, our research question is as follows: What are the advantages and disadvantages of using a mobile app to conduct a diary to assess emergent technologies in private households?

Our paper is structured as follows: Firstly, we describe the diary study research method, then secondly, we explain the diary study with voice assistants as part of the Swiss National Science Foundation (SNSF) project, thirdly, we specify the selection criteria for the diary app and, fourthly, we reflect on the implications for the researchers and project participants and discuss the limitations of our research project.

## Background

Diaries are usually characterised by four characteristics: regularity, personal/private, contemporaneous and a record/time structure (Alaszewski, 2006). In terms of detail, diaries may vary. For example, they may be rather a logbook, focusing more on recording activities, or they may be more complex including personal comments about activities, roles, and relationships (Alaszewski, 2006). Diary studies are designed to get a deeper and more realistic understanding of participants' daily lives (Bartlett and Milligan, 2015). They are a way of collecting timely information within the participants' natural environment, where the participants decide on their own what kind of data they collect and in which way they want to describe it (Bartlett and Milligan, 2015). In solicited (Bartlett and Milligan, 2015) or research-induced (Wagner et al, 2022) qualitative diary studies, participants can record events, motives, feelings, and beliefs in the form of photos, videos, texts, and drawings. This gives all people, regardless of their writing skills, the opportunity to record their experiences in such a study. The large amounts of data that are generated require careful handling. It is also

suggested to combine diary studies with other research methods, e.g., interviews or surveys, to complement the research in terms of rigour, richness, complexity, depth, among others (Bartlett and Milligan, 2015). However, if the aim is to gain an understanding of how participants see the wider world, then the diary should be semi-structured or unstructured (Bartlett and Milligan, 2015). Wagner et al (2022) think that due to increasing digitisation, also in the private context, the everyday life of individuals and groups in combination with entertainment and communication technologies is becoming increasingly complex. They think that qualitative diary studies have a great potential from an empirical point of view to capture exactly these media practices in everyday life and can therefore offer real and genuine data. Instead of paper and pencil, diary software solutions offer various advantages. For example, they can be integrated more easily into people's everyday media lives, they offer various ways of recording things (e.g., via video, audio, or text), and they ultimately also facilitate the research process (Bolger et al, 2003). Although Wagner et al (2022) believe that media use can only be studied in aggregate, without a specific focus on one technology, this study was conducted with a focus on the use of voice assistants to investigate whether and how new usage habits emerge.

The most recent studies related to voice assistants and the qualitative diary method that have been conducted are still limited: So, examined Harrington et al (2022) which and how health questions are asked by older people in relation to different resources, such as websites or Google Home, in a 5-day paper diary study. Bleakley et al (2022) studied how people who stutter engage with voice assistants in their daily routines. The 10–11-day diary study was conducted by using Microsoft Form. In other words, the combination of multi-week diary studies investigating the use of voice assistants in private households is rather rare.

## Diary Study on Voice Assistants

At the beginning of the project, the original research method to be used was participant observation, but this was set aside for two reasons: on the one hand, the diary study had to be carried out in spring 2021, i.e., during the Corona pandemic, when protective measures were in force and could change quickly and unpredictably, and on the other hand, after trying out the voice assistant at home, the project team members, could not imagine that participants in the diary study would allow to be observed or accompanied for a few hours or a whole day by a researcher, regardless of whether they knew him/her or not (Alaszewski, 2006). As a result, it was decided to conduct the study on the use of a voice assistant in everyday life with the help of the diary method using a mobile app. Consisting of an interdisciplinary team of 20 researchers, VA-PEPR (Voice Assistants - People, Experiences, Practices and Routines) is an interdisciplinary four-year research project (01.2020 – 12.2023) funded by the Swiss National Science Foundation (SNSF). By looking into how voice assistants impact our everyday practices and routines in the home, the project targets to generate novel

insights into the emerging issues associated with voice assistants use in Switzerland and beyond. In this section, we give an overview of the project and the ethnographic phase, the decision to apply digital remote ethnography, the selection process of the diary app and explain the implementation process.

The broad aim of the VA-PEPR project is to contribute to a deeper understanding of this new technology by focusing on the home environment, user experience and ethical issues. To that end, one of the aspects we investigate is how people experience voice assistants in their homes and private lives and if/how they develop new practices and routines around their use of voice assistants in the context of Switzerland. The relevant data to answer this question is generated mainly by the first phase of the project — Ethnographic Study — in which we conducted in-home studies by using Indeemo mobile diary app (Indeemo, n.d.) and weekly Zoom interviews with exploratory qualitative approach.

For this ethnographic in-home study phase, we initially considered visiting participants in their homes and conducting face-to-face semi-structured interviews in the privacy of their everyday environments which was going to allow us to partially immerse ourselves into their everyday lives. However, the two reasons mentioned earlier led to a modification of our method. We decided to conduct the in-home studies remotely by asking participants to keep a solicited diary through a mobile diary app. Overall, 31 participants in 20 households completed the in-home studies. Their ages ranged from 17 to over 70 years. We divided the participants into four consecutive groups which they selected according to their availability. In total, the diary study ran from March 5th through May 28th in 2021 for four cohorts.

### Selection of the Diary App

We approached six companies we found through desk research to learn more about mobile diary apps and their services. A three-member mobile diary team explored and evaluated these services, however, when available other team members were also involved in the process. The diary team had introductory and walk-through online meetings with these companies which were highly useful to understand what one could expect from such service, what the app allows and how we can benefit from it for our in-home studies. With these meetings it became obvious that these apps were developed targeting mainly for-profit organisations to realise remote market research. However, the team generated criteria to evaluate and compare the companies and their services, then selected the most convenient one for our academic study. These criteria tackle the questions around interface design and performance, forms of diary tasks, researcher dashboard, two-way interaction, language and transcription, data security, tech support, the company approach, professionalism, and cost efficiency.

Based on these criteria, the mobile diary team reduced the options to two — one of which was Indeemo — and had a test run from both participant's and researcher's end with the wider team. After discussing the feedback

and reviews, we selected Indeemo as the diary app for the in-home studies. At this stage, we highly recommend having a real test environment, especially from participant's end to simulate and understand their app experience during the diary study, however, not all companies provide real test environment.

Instead of collecting data with a mobile diary app, we also considered some free online platforms such as WhatsApp, Facebook/Instagram, Slack and HumHub which would allow access to participants' daily routines (e.g., Bjørner and Schröder, 2019; Kaufmann and Peil, 2020; Kümpel, 2021; Moilanen et al., 2020; Scott, 2022). However, these free platforms were lacking either one or more of the criteria in table 1, e.g., tech support service, data security, researcher dashboard, mobile app, or bulk data export.

Table 1: Criteria for the Selection of a Diary App

Criteria	Points Investigated
<b>Interface design and performance</b> <i>User experience</i>	How user friendly is the interface? How well does the app perform?
<b>Forms of diary tasks</b> <i>Flexible tasking-answering</i>	What type of questions can we ask? (open-ended, yes-no, sample photo or a link included, mini questionnaire). Can participants answer with photos, audios, videos, texts, emojis, add hashtags, record screen, share location? Can they upload spontaneous entries independent of the pre-defined tasks?
<b>Researcher dashboard</b> <i>The browser-based dashboard</i>	How much does the dashboard allow researchers to have control on the project and tasks, monitoring participant activities? Can they work on the data through the dashboard during the diary period? What is data export formats? Does the cost vary depending on the number of researchers who have access to the dashboard and on their access level, such as having full access, analysis access or observer access?
<b>Interaction between researchers and participants</b>	For a better moderation of the project, does the app provide instant private communication with participants? Can researchers send individual reminders for an incomplete task?

<b>Language and automated transcription</b>	Is the app fully available in German? Is automated transcription of video/audio entries provided? Note: In our case, none of the companies were able to transcribe the Swiss German dialect — daily language spoken in the German-speaking part of Switzerland. It is not recognized by computer-assisted translation services. As we tried during the brief trial periods, the transcriptions were significantly incomplete or incorrect.
<b>Data security</b>	Is there a technology and information security statement? Has the information security management system of the company been assessed and registered against the provisions of ISO/IEC 27001:2013? Is the company GDPR compliant?
<b>Tech support</b>	How fast can participants receive tech support in German when/if they have a problem with the app?
<b>Company approach</b>	Does the company have a full grasp of the key differences between academic research and business-oriented market research? Do the company representatives understand the project's needs or simply focus too much on marketing their service?
<b>Professionalism</b>	Based on the meetings and the communication between company representatives and the team, how reliable, accessible, and competent is the company?
<b>Cost efficiency</b>	Considering all the above, is the service cost efficient?

## Practical Aspects from a Researchers' Perspective

### Setting up a Test Environment

Ideally, a pilot study is carried out to test and improve the diary design (Bartlett & Milligan, 2015; Bolger et al., 2003; Saaidzadeh et al., 2021). However, we could not do this, because first, Indeemo is a commercial company, thus we did not have the full control of the process. Secondly, we had limited resources. Yet, we strongly suggest a wide test environment with the same time frame as the planned study to test the engagement level and see if the tasks deliver the information needed.

### Managing the Project on Indeemo

Managing the diary project on Indeemo platform was rather intuitive. The interface design of the platform we used to register participants and modify tasks was not as user-friendly as we expected. For instance, at the time of our study, moving participants between groups was not possible with a simple drag and drop or move feature. Instead, the entry must be deleted and recreated. This

makes a difference if there are more than one study groups and participants need to be moved among groups.

### Having Only One Administrator

Our contract with Indeemo provided one researcher with full admin access (can modify tasks, analyse, engage with participants), two researchers with researcher access (only analyse and engage), and 10 researchers could observe through dashboard which we found reasonable. We did not anticipate that only one researcher having administrator access would complicate collaboration within the sub-team. Once we started to register participants, to adjust diary tasks and requirements on the platform, the communication within the sub-team increased overwhelmingly. Every detected minor addition and modification had to be made by the administrator, placing a huge dependency and burden on one person. We suggest that such issues, which should also be well organized among researchers, be discussed, and clarified with the company.

### Using the Mobile App

In traditional ethnography, to do field work, ethnographers sometimes have to change their lifestyles, e.g., have to work irregular hours (Zimmermann and Wieder, 1977). To engage with participants, respond the entries and questions with minimum delay, the contact person in our study had to work irregular hours. He was able to do this via his phone since the mobile app provides separate log ins for researchers and participants. He later reported that this was highly practical for him since the participants were mostly active in the evenings and on the weekends.

### Downloading the Data

As mentioned in previous sections, participants' diary entries are available to the researchers through the dashboard. However, we could not download any kind of data, at least not until the end of the project. This aspect is also important for data analysis, as it does not allow one to analyse the data continuously from the beginning. (Pope et al., 2000). Only then we requested a bulk download from Indeemo, and Indeemo provided the data in separate files filtered for each medium and participant. This was an inconvenience in archiving and categorising the data on our end since we conducted four consecutive diary studies in one Indeemo project and had to wait until the last study ended. Moreover, the file labels did not allow us immediate sorting/filtering based on participants. We had to identify it first, because it was anonymized and then give an appropriate file name according to our anonymization table.

## **Practical Aspects from a Researchers' Perspective**

### **Availability of Tech Support**

We were ensured that Indeemo tech support would be available with short response time (4-5 hours at the weekends, shorter during the weekdays) and respond to participants in German to maintain a smooth diary experience.

### **Having to Type on the Small Screen**

Some of the participants asked if the app has a web-based or desktop application so they could easily type long text entries on a computer keyboard, as they found typing on the phone's small screen inconvenient. However, at the time of our study, the diary app was only available as smart phone app for the participants. It was surprising for us that many participants preferred writing instead of video recording, although the option of uploading a video instead of notes was provided.

### **Lack of Audio-Only Recording**

The diary app lacked an audio-only recording feature, meaning our participants were not able to simply record audio diaries. Instead, they had to use the video recording while covering the camera or holding it to a surface. Such technical drawbacks should be well explained to the participants before the study. We explained this at the onboarding workshops, however, based on participants' statements in the interviews and post-study questionnaire, many participants did not find this option convenient and indicated this as a flaw of the app. Only 4 out of 31 participants recorded such videos and 19 out of 151 videos were recorded this way.

## **Discussion**

In this paper we have tried to reflect on the application of a diary study using a mobile app. This method was applied in the context of households using voice assistants to explore the daily life of household members, their associated rituals, and routines, and their changes. One result is a detailed description of the selection criteria (table 1) used to select the diary app, emphasizing the importance of a test environment. This might help to put oneself in the shoes of the participants, anticipate any challenges, in terms of their user experience, and offer suitable workarounds in advance. One example is that there seemed to be no possibility to create an audio file without video. The workaround was to cover the camera so that the participant could not be seen on the video. Depending on the sensitivity of the participants, this could have an impact on the type (video yes/no) or extent of data collection.

The role of the moderator goes hand in hand with the challenge of facilitating the continuous participation of the participants. However, the research team has no influence on private or professional emergency situations that could affect the diary study over the time. Indirectly, however, this could be compensated on the one hand by a sufficiently large number of participants and on the

other hand a pre-selection could be made, e.g., of technology-savvy, less time-sensitive and patience-aware participants, who would have better prerequisites to contribute qualitatively and quantitatively to the diary study (Bleakley et al, 2022). It is important to note that voice assistants are not a mature technology (Sun, Li & Yu, 2022), so the amount of functionality that is used depends on the commitment, in terms of time and money, of the users. When it comes to ongoing monitoring and reporting, the Researcher Dashboard is quite important because it can be used to make an initial assessment regarding the quality and quantity of the data collected. If these data do not meet the researchers' expectations, one can intensify the moderation, revise the diary tasks, or precisely address these impressions in the weekly interviews.

When it comes to the practical findings from the researcher's point of view, the research team should schedule enough time to test not only the functions but also the processes. An example of this is that participants who switch between diary groups due to time constraints cannot be moved using drag and drop functions but must first be deleted in the previous group and re-entered in the new group by hand. This is also related to another finding, namely that at least two admin roles are needed in the research team, which have more rights and can change more within the software solution. This is not a shortcoming in the software solution, but a question of budget and a decision of the research team, because it implies higher costs. It is also important to recognize that features of the software solution have an impact on the data analysis process. In this case, the data download was only possible at the end of the project, not after the completion of each participant group. This means that the quantity and quality of the contributions can be checked selectively, but it is not possible to start analyzing the data systematically from the very beginning. Here, it would also have been possible to create separate projects for each group of participants, but these would also have an impact on the project budget.

## **Conclusion**

By reflecting on our experiences in conducting a remote/mobile diary study on the use of voice assistants in everyday life, we sought to highlight the considerations and lessons learned in this endeavor.

More importantly, these findings could extend the existing diary study model, e.g., the one by Jarrahi et al (2021) including the aspect of a diary app. At the same time, they could also be used for the further development of existing software solutions.

However, there are also some weaknesses related to this kind of remote/mobile diary study. For example, the app was selected based on defined criteria, however, the decision-making process was not systematically documented, such as with a factor-rating method. Another weakness is that most of the data analyzed so far relates to the weekly interview, but not the mobile diary data itself. This data analysis might bring out more experiences, dependencies, and insights. Additionally, using the diary app method is generally very time-consuming to use. At

the same time, it also generates a lot of data, which should ultimately be analysed and therefore becomes a further time and cost factor. One could also critically ask whether this part of the research project could not have been conducted without diary entries and only with the weekly interviews, possibly more intensively. In addition, not all diary data, such as photos, videos, or audio files, can be analysed without sufficient contextual information. It often takes explanatory words, not short diary entries, to understand the relevance of the technology and the practices derived from it. From a research perspective, each data format also requires its own data analysis methods, which, depending on the interdisciplinary project team, are not necessarily available or time-consuming to adopt and are therefore rather unlikely to be used. Nevertheless, we might expect to see more use of this method for emergent technologies that are not a plug-and-play solution yet but are perceived as one or are expected to evolve into one.

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