Introducing Activity Tracking in Healthcare Settings: The Merit of Self-reflection

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Abstract. To investigate how healthcare buildings, especially hospitals, need to be designed to take up an active role in patient mobilisation and as such contribute to patient recovery, we are in need of a research approach to map patients' physical activity in relation to the (indoor) built environment. Tracking participants' physical activity is an important part of this as it allows to collect objective data on the kind, duration and intensity of movement which can then be discussed in relation to the built environment. The use of activity trackers can thus be considered a relevant method as part of a larger research approach. We illustrate how self-reflection can add to set up activity tracking through registering with and experiencing of wearing an activity tracker (Axivity). To conclude advantages and limitations of the self-reflection process are discussed in relation to the complex context of healthcare settings.

1 Physical Activity (Tracking) in Healthcare Environments

Whereas people are admitted to a hospital or care facility with the intention to heal, or at least improve their (physical) condition, healthcare organisations continuously face the challenge of avoiding physical decline amongst patients, especially older ones (Boltz et al. 2012; Stall 2012). When the care focuses on treating acute illness, little time remains to assist patients in walking or performing other forms of exercise. Yet, keeping patients, with diverse physical and cognitive capacities, active – from early mobilisation after severe surgery (Santos et al. 2017), even in the intensive care unit (Sosnowski et al. 2015), to long-term rehabilitation (Sjöholm et al. 2014) – has proven to be crucial in preventing physical decline.

In an urban context, research in the field of Physical Activity and the Built Environment (PABE) has shown the importance of the built environment in encouraging people to be physically active (Chaudhury et al. 2012; Mahmood et al. 2012; Keegan et al. 2014). On the scale of buildings, the design of the built environment in relation to physical activity has only recently become a research topic. So far no studies have been found that objectively measure physical activity on a building scale, yet related literature suggests the value of expanding current methods in this direction (Sjöholm et al. 2014). Simply adopting methods from PABE studies is not obvious for various reasons like

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the divergent physical abilities of fragile participants and the according difference in mobility options (Annemans et al. 2019).

As the overall aim of our study is to investigate how to design healthcare buildings, especially hospitals, to take up an active role in patient mobilisation and as such contribute to patient recovery, we are in need of adapted methods that allow to map patients' physical activity in relation to the built environment. Tracking participants' physical activity is an important part of this as it allows to collect objective data on the kind, duration, and intensity of movement which can then be discussed in relation to the built environment. In this text we elaborate on the process of preparing fieldwork with activity trackers in a healthcare environment. Due to the novelty of the application only little knowledge is available on which tracker would be most suitable. Also lacking is software to process the registered data and present them in a visually understandable manner suitable for the desired research approach in which a quantitative data support qualitative research. Insight into the experience of wearing the tracker, especially in a healthcare context, does not seem to be available. We start by motivating our choice for the device, the programming language, and the way of wearing the tracker. We then elaborate on self-reflection as a technique to balance registering with how wearing the activity tracker is experienced. In conclusion, we discuss how self-reflection has added to setting up the use of the tracker and which limitations this entails.

2 Activity Tracking: Registering and Experiencing?

In the last decade the market has been flooded by wearables and phone apps that allow to track various activity parameters like number of steps, duration, or intensity, whether or not linked to certain locations. Setting up a study in which activity tracking is part of the research approach, implies deciding about which device to use. This decision can be made based on various requirements regarding functionality, feasibility, and desirability. Whereas some decisions were already made by the study design (e.g., no need for real-time output), many other aspects are still to be decided on.

An important issue to resolve is whether to opt for a widely available commercial device (such as Fitbit or AppleWatch) or for a device specifically designed for research purposes. Concerns regarding confidentiality of the data, exclusion of fragile participants due to reduced reliability and validity of data when not moving according to the accepted standard, and limited or no access to raw data (Breslin et al. 2019), made us choose a non-commercial device with open access to registered data (Fig. 1).

Fig. 1. Axivity AX3 (23 × 32.5 × 8.9 mm) (left) and axis alignment (right) ©www.axivity.com

According to these considerations we opted for the Axivity AX3, a 3-axis accelerometer with an internal memory and real time clock which allows to record data for prolonged periods (up to 14 days at 100 Hz). The device is suited for activity recognition and research in human movement science (Axivity 2015).

The producer of the trackers suggests wearing the device on the upper thigh or hip with the positive X pointing towards the ground. When wearing only one tracker at either place the focus lies on physical activity estimation (intensity, duration and frequency). Recent research has shown, however, that combining the data of two devices attached directly to thigh and lower back, allows to estimate physical activity and detect posture (sitting, standing, lying) (Duncan et al. 2018).

In a healthcare context, what is considered physical activity can vary significantly between participants and settings. Whereas at an intensive care unit sitting up can already be considered physical activity, in a rehabilitation context the intensity and duration of the activity may become more relevant. Therefore, it is important that the retrieved data allow to distinguish between different types and intensities of movement (walking, running, standing, sitting and lying). The programmed software should allow to visualise these differences in order to reflect on them in a dialogue between researcher and participant.

So far, the AX3 software (Omgui version 1.0.0.28) was used to configure the devices and download the logged data. Although an experienced eye can identify different bodily positions by interpreting the graphs generated by this software, this visualisation is nowhere near what could be used in dialogue with participants. Therefore, some additional programming on the data needs to be done. Since the AX3 is an open source device, we have substantial control over the configuration and processing of the data, yet the actual implementation of the programming requires a significant level of technological expertise and computer programming skills (Duncan et al. 2018). What exactly should be shown, which data are needed to be able to show this, and how these data can be registered through one or more devices has not been fully investigated but will need to be covered in a pilot study with participants in the field.

Given that patients in a healthcare setting often already find themselves in stressful and unfamiliar situations, we aim to limit the pressure put on them due to research participation. We thus pursue an approach in which they do not sacrifice comfort or feel restricted in their comings and goings. Therefore, we wanted to set up a research approach in which conscious programming allows to use as few trackers as possible, and the location and application of the trackers is closely considered based on the participating patients' bodily and mental comfort. The best way to gain insight into all of this and continuously make adaptations seemed to be to wear the trackers ourselves.

3 Self-reflection as a Technique to Set up Activity Tracking

Using the self as a starting point for research is not new. The term "autoethnography" has been used for various approaches to research in which self-reflection and writing are used to document and study personal experiences in order to understand cultural experience (Ellis 2004). Autoethnographers acknowledge how personal experience influences the research process and thus research outcomes and use the view from within as a strength rather than a weakness of the approach (Ellis et al. 2011). Usually the autoethnographer

does not live through the experiences because of the research but rather recalls them in hindsight in function of the research aim (Freeman 2004).

Our use of self-reflection shows similarities but also important differences with how it would be used in a truly autoethnographic study. Similarly, the first author – henceforth the researcher - reflects on her personal experience, both bodily and mentally and regarding the development and use of technical skills and writes about this. Yet, rather than pursuing to understand cultural experience, we aimed solely at gaining first-hand insight into how it feels to wear the tracker, which physical and mental impact this has on the wearer, and how this can inform the choice for a type of tracker, the placement of the device, and the programming of the visual output.

Autoethnographic studies on the use of wearables tracking physical activity have recently been developed in the field of experiential computing (e.g., Prasopoulou 2017) and sport management (e.g., Baker et al. 2017). In these studies the authors reflect on wearing activity trackers and position their findings in relation to approaches and outcomes in their respective fields. In the former, Prasopoulou explores what reflection through memoires on the entanglement of data in daily lives can contribute to information systems research. In the latter, Baker and colleagues aim to show the benefits of collaborative self-study about wearable fitness technology and physical activity for sports management studies. These studies focus solely on how wearing the tracker and following up on the generated data is experienced. No reflective studies are found that focus on processing the data retrieved by the trackers, programming the (visual) representation of what is being measured, or technical opportunities for new measures based on the positioning of the trackers. Since decisions concerning these subjects are made in dialogue with the experience of wearing the tracker, it seems valuable to reflect on all of them.

4 Balancing Registering and Experiencing

Given that the research context and participants addressed are likely not the first audience the producers of the trackers had in mind, we wonder to what extent the trackers are suited to be used under the given circumstances. To start understanding the method from within, in line with the self-reflection technique, the researcher wore the trackers at different spots on her body starting with the thigh and hip as suggested by the Axivity guidelines and exploring new spots like the upper and lower back. During the 24 to 48 h periods of wearing the trackers she noted down any thoughts she had related to the research approach in general and to the trackers in particular. These thoughts could be anything from feelings of (dis)comfort, over concerns, to new ideas for the research set-up. Based on the researcher's reflections we illustrate the experience of wearing an activity tracker as a test for a research project. Our findings show how these reflections cover registering and experiencing, and diverse interactions between these.

Many thoughts are related to bodily (dis)comfort. How and where the tracker is applied seems to play an important role in this. As we aim for an application with the highest guarantee of uninterrupted wear and demanding as little effort as possible from participants and healthcare staff, we first opted to stick the tracker to the body with a waterproof plastic band-aid so it would not need to be removed when taking a shower.

To allow insight into what could be registered with one compared to two trackers, the researcher always registered through a combination of trackers worn at the same time on the thigh, hip, and upper or lower back. Some of these applications are more suitable to withhold than others. Notes about bodily experiences refer to how and where the tracker is applied:

> *"This feels sweaty, very greasy also, I really don't feel clean even though I just took a shower."*
>
> (09/03/2019, tracker worn between the shoulders with a plastic band-aid)

> *"Tracker on the hip: hurts! Putting on pants with a waistband at that spot is not a good idea when you are going to sit down a lot. Should I take it off?"*
>
> (08/03/2019, tracker worn on the hip with plastic band-aid)

These two thoughts illustrate that a combination of aspects defines how wearing the tracker is experienced. The tracker on the upper back is not only continuously being felt because of the location between the shoulder blades (both while moving as when lying down), apparently this is also a location sensitive to perspiration which adds even more to the feeling of discomfort and raises a continuous awareness of the tracker's presence. Whereas the location on the hip usually is not perceived as uncomfortable, this can be the case if one wears rather tight jeans when sitting. This highlights how unpredictable parameters (choice of clothes) can impact the wear of the tracker beyond our control.

Wearing an activity tracker also has a mental impact. Even a tracker that does not give you any real-time feedback about your activity level, like the ones you consciously decide on using, raises your sensitivity towards physical activity. Just by wearing the tracker you become curious "*how well you do*". As illustrated below this could influence people's behaviour.

> *"I almost forgot I am wearing this tracker today, let me quickly write down what I have done so far. This doesn't seem to be a very active day, I should go for a run tonight."*
>
> (21/05/2019, tracker worn on the lower back with paper band-aid)

Apart from the activity levels, being aware of the research aim made the researcher concerned about the research outcomes. This resulted in stubbornly leaving the tracker on despite feeling reluctance to wearing it any longer (as illustrated above) or in a raised awareness of how the trackers' presence relates to what can be registered and processed.

> *"Did I feel the tracker move? If it shifts a little the X-axis might not be vertical anymore. Will that affect the registered data? Or maybe it is a good thing, it will allow me to assess how exact the measures are."*
>
> (21/05/2019, tracker worn on the thigh, with paper band-aid)

Although why someone worries might differ between people, we can imagine participants being insecure about what is and is not allowed while wearing the tracker, whether they are active enough, or how they will be judged when the outcomes are discussed.

The combination of the above mentioned aspects defines how (long) participants are willing to wear the tracker (see Fig. 2). It also allows to compare the obtained results with the desired research outcome. By having experienced the wear first-hand, the researcher at least has a reference frame of at what point and why people could decide to quit participation. This is expected to help setting a realistic timeframe and weigh decisions regarding physical and mental comfort, optimal registration, and concessions towards the programming.

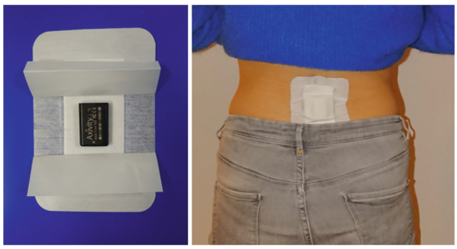

Fig. 2. Final positioning and application of the tracker

5 Discussion and Conclusion

As mentioned, activity tracking is a commonly used method to gain a good understanding of people's physical activity in relation to the built environment on an urban scale. Given the proven benefit of being physically active for patients, we wanted to explore how this method could be applied, or needed to be adapted to be applicable, in healthcare environments, being aware of the specificities of the population and setting. To be able to set up a research approach that is most suited for this context, without bothering patients with unnecessary preparatory testing we made use of self-reflection to gain insight into the experience of wearing the tracker. Additionally, the researcher reflected on how this experience relates to the process of working with the trackers (positioning, application) and registered data (programming). Whereas previous self-reflective studies on the use of activity trackers focussed on the experience of wearing and living with the tracker (Baker et al. 2017; Prasopoulou 2017), we considered it valuable to discuss this in relation to the experience of taking care of the registration. It is precisely this combination that defines how the research approach comes into being as a continuous dialogue between bodily, mental, and technical aspects. Below advantages and limitations related to each of these aspects are discussed.

The fact that the researcher has experienced wearing the tracker herself -has felt when it could be (un)comfortable, has been curious, and has worried about it- makes her not only more aware of issues future participants could face during the research but also provides a common ground to discuss these. This will hopefully benefit the broader research approach in which the (visualised) output of the trackers will be discussed with participants in order to gain a better understanding of the relation of physical activity and the built environment. This does not mean that the researcher's experience of wearing

the tracker can be generalised. The researcher is not, and does not claim to be, a patient staying in a healthcare environment. Her experiences will thus be far from those of future participants. As such making use of self-reflection does not allow to develop a method specifically adapted to bodily difference like the way of moving, with a walker or in a wheelchair, or regarding diverse cognitive capacities. In this respect, the set-up of the research is clearly unfinished. Whereas at least a test with a wheelchair user is on the agenda, this one extra test will not be enough. It will be of key importance to approach each participant with an open mind-set and a continuous willingness to make adaptations to the method throughout the research process.

Apart from bodily and mental aspects also practical and technical decisions, play a role in how the activity trackers will be used in the research on patients' activity. Being aware of and meticulously documenting why and in which situation decisions are made, which can be considered part of self-reflection, helps not to lose sight of the broader context. Using self-reflection allows us to rapidly identify and react to possible technical problems resulting from adaptations made for experiential reasons. As far as we experienced, having the same person wear the tracker, know what she wants to get out of it, and be in charge of the programming, made her very motivated to stretch opportunities for adaptation to their limits to find a maybe not so obvious solution. A downside of this combination is that it requires quite some skills from one person. She experienced that it is very hard to ignore a personal preference for one part, and make the others subordinate to it. Additionally, being so closely involved with the aim and set-up op the research approach makes it almost impossible to judge how both process and outcome would be perceived by an outsider, which participants will be at the start of the research. Once again this will most probably ask for an extra round of adaptation once the research in the field starts.

With the study's overall aim in mind – to investigate how to design healthcare buildings, especially hospitals, to take up an active role in patient mobilisation and as such contribute to patient recovery – we started from the need for adapted methods that allow to map patients' physical activity in relation to the built environment. Self-reflection on tracking one's physical activity allows us to develop at least one part of a research approach aiming to do so. The combination of advantages and limitations of the self-reflection process to develop a tracking method, provides us with a nuanced understanding of what it means to do research and to participate in research with activity trackers. This seems especially valuable in a complex context as a healthcare setting.

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