Older Adults Testing Assistive Technologies in Living Labs: Guidelines

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Abstract: Assistive technologies are a promising option for enabling older adults to live independently at home and therefore to meet the challenges of demographic change. An advantageous way to ensure acceptance and successful use by end users is a participatory involvement and testing in real-life environment. This position paper argues for the specific approach of Living Lab testings when testing assistive technologies with older adults at home. The procedure described is intended as a guideline to adequately consider the specifics of the test subjects, the older adults, and the special test setting in the real-life environment. Therefore, the guideline contributes to the quality of future testings.

1 INTRODUCTION

Due to demographic change, caused by the increase in life expectancy as well as the decline in the birth rate, the proportion of people aged 65 or over is steadily increasing in all industrialised countries (Vaupel, 2000), and due to the increasing number of people in need of assistance, the effects of the shortage of nursing staff (Afentakis and Maier, 2010; Mercay, Burla and Widmer, 2016) will become even worse. To live at home independently for as long as possible is preferred by many older adults (Hedtke-Becker, Hoevels, Otto, Stumpp and Beck, 2012; Marek and Rantz, 2000), and, apart from a hoped-for cost saving, it has positive effects on their quality of life (Sixsmith and Gutmann, 2013).

Assistive technologies have great potential to meet these challenges. However, many developed assistive technologies are not satisfactorily used to support older adults due to lack of acceptance and other barriers (Pelizäus-Hoffmeister, Birken, Schweiger and Sontheimer, 2018). Good acceptance and successful application to generate benefits requires testing of assistive technologies in a real-world environment. With that, fear of contact can be reduced, assistive technologies can be adapted to actual needs and support can be provided locally where it is needed (Liedtke, Welfens, Rohn and Nordmann, 2012; Pauli, Lehmann and Misoch, 2017a). A promising way to ensure acceptance and benefits of assistive technologies for older adults is the participatory involvement of end users and the testing of these technologies in their real-life environment. This can be realized within the framework of Living Labs.

A Living Lab is to be understood as an infrastructure which enables a user-centered research methodology (Eriksson, Niitamo and Kulkki, 2005), whereby users are observed in their interaction with new technologies. In this position paper, according to the European view (Schuurman, Evens and De Marez, 2009), a Living Lab is understood to be the real, domestic, everyday (living) environment of users as a testing environment for assistive technologies (European Network of Living Labs, 2019; Folstad, 2008; Franz, 2014; Lehmann, Hämmerle, Pauli and Misoch, 2019). The central focus is on the end user ("user-centred") and the real-world context is a precondition (Bergvall-Kareborn & Stahlbröst, 2009; Dell'Era and Landoni, 2014; Liedtke et al., 2012).

When working with test subjects 65+ and test in their natural living environment, there are some special aspects to consider. Conducting studies with persons must meet the criteria of good research

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practice (e.g. guideline "Securing Good Scientific Practice", Deutsche Forschungsgemeinschaft, 2013; "European Code of Conduct for Integrity in Research", ALLEA, 2018). But the elements of the research process must be adapted to the Living Lab setting and to the target group 65+ and researchers must be familiar with the special features of this group (Turnwald, Frerichs and Prilla, 2011).

2 AIM

The key points presented in the position paper have been developed and tested within the framework of various projects of the Institute for Ageing Research. The procedure is suggested as a guideline to support further research projects and to contribute to an internal quality control of testings involving people 65+ testing assistive technologies in Living Labs at home. The recommendations were elaborated in the context of the IBH Living Lab Active & Assisted Living consisting of research institutions, care and nursing facilities as well as technology and service providers in the Lake Constance region from Austria, Germany, and Switzerland. The project is funded by the Interreg V-programme “Alphenrhein-Bodensee-Hochrhein”.

3 RECRUITMENT– ACQUISITION OF TEST SUBJECTS

The selection of suitable test subjects is essential in Living Lab testing. For technical and organisational reasons, the number of test subjects in Living Lab testing is limited (Scherhaufer and Grüneis, 2015), so that the samples are usually small but time-consuming to supervise.

As recruiting suitable Living Lab test subjects can be time-consuming, enough time must be planned for this phase. Recruiting tests subjects 65+ can be difficult as the older population group is highly inhomogeneous (Doyle, Bailey, Scanaill and van den Berg, 2014; Yang and Lee, 2010). In addition, a higher dropout rate is to be expected due to increased morbidity and mortality in persons 65+ (Hoag, 1981; Menning, 2006). Test subjects must be willing to test assistive technology in their natural living environment for a predefined time and be willing and able to communicate their experiences (Ogonowski, Ley, Hess, Wan and Wulf, 2013). In order to test assistive technologies in the real-life environment of the end users, these must also be willing to invite researchers and technicians into their homes several times and accept to integrate a new assistive technology into their personal interior design.

3.1 Selection of Test Subjects

Selection of test subjects is guided by the research question and the development-stage the assistive technology is at. If the usability of the assistive technology is investigated and initial testing of the assistive technology (e.g. a prototype) is done with the aim of discovering possible problems, a smaller, rather heterogeneously composed sample is chosen (Nielsen, 2012; Pauli et al., 2017a). The resulting range of age, affinity for technology, socio-economic and cultural background should take different perspectives into consideration. If proof of effectiveness of the assistive technology is to be investigated, the sample should be representative of future users. The goal is not population representativeness, but to include persons relevant to the research subject (Kelle and Kluge, 2010). This can refer to socio-demographic variables as well as individual aspects of physical or psychological impairments to get enough test cases. For example, testing a fall sensor with people who are not at risk of falling is hardly meaningful, as it cannot be assumed that the system can be tested at all.

When describing the sample, inclusion and exclusion criteria must be stated. A basic description of sociodemographic variables (age, gender, educational level, etc.) should be provided. If possible, variables should be collected that are already known for the general population or target group through population-based or other representative studies in order to estimate representativeness, when this is crucial for interpretation (Von Geibler et al., 2013). In addition, specific characteristics of the test subjects in relation to the research goal must be collected. In order to be able to compare different Living Lab testings, it is useful to collect a so-called core data set, e.g. gender, age, nationality, language, marital status, educational level, type of housing, household size, residential area, physical and mental restrictions, technical experience, existing technical equipment, previous test experience, user group (primary users are end users; secondary users are relatives or professional carers; tertiary users are organizations, communities). These data can be used for secondary analyses, but only if prior consent has been obtained.

3.2 Recruitment Strategy

The recruitment strategy should be described and justified in detail at the beginning of the study. Selective samples can be the result of a specific recruitment strategy. Often well-integrated, educated and technology-oriented people are recruited (Classen, Oswald, Doh, Kleinemas and Wahl, 2014; Hämmerle, Pauli, Lehmann and Misoch, 2018; Kubiak, 2015; Lehmann, Pauli and Misoch, 2017) and further participants recruited via multipliers will have a similar social status. The recruitment of older adults for testing of assistive technology is particularly susceptible to bias e.g. selection bias (Kleist, 2010), and especially to volunteer bias that can lead to a non-representative sample (Lehmann et al., 2017; Von Unger, 2014). In their overview, Rosenthal and Rosnow (1975) stated that volunteer test subjects are more likely to be women and more highly educated. In contrast, experience in testing assistive technologies shows that men and/or people with an affinity for technology are more likely to participate. Experience also shows that people with a lower educational level or migration background are usually difficult to reach and motivate (Pauli, Misoch and Lehmann, 2017b). To be able to interpret the test results, a description of the procedure and recruitment strategy is extremely important. Some participatory research projects offer approaches on how to deal with this, e.g. by showing test subjects the relevance of their contribution (Hackl, 2014), or by emphasizing their "profit" in sense of a direct benefit (Scherhaufer and Grüneis, 2015).

Recruitment can be done via groups in which older adults are organised, which work with older adults, or in which they are overrepresented. For example, educational institutes for older adults, community services for older adults, senior citizens' meetings, senior citizens' representatives at regional or local level, church associations, social networks or media such as newspapers or radio (Eisma, Dickinson, Goodman, Syme, Tiwari and Newell, 2004; Ogonogwski et al., 2013). Recruitment via test subjects who already recommend the testing to others and thus act as multipliers is very promising (Hess and Ogonowski, 2010; Leonardi, Doppio, Lepri, Zancanaro, Caraviello and Pianesi, 2014; Ogonowski et al., 2013; Pauli et al., 2017a).

3.3 Recruitment Interview

One interview changes the daily routine of a test person (Misoch, 2019; Porst and Briel, 1995). Testing in the daily living environment of the end user additionally entails an intrusion into the privacy of the test subjects, which is why sensitive relationship building is essential for Living Lab testing (Ogonowski et al., 2013). At least one (recruitment) interview with the interested person should take place prior to test enrolment in order to gather socio-demographic data and needs and to establish a first personal contact (ibid.). A personal interview and a visit to the private or institutional residential environment (Hämmerle et al., 2018) is preferable to contact by telephone (Ogonowski et al., 2013). However, since Living Labs usually require large amounts of time and financial resources (Schuurman et al., 2009), this is not always possible.

The recruitment interview forms the basis of successful recruitment. The information and consent of the test persons should be understood as a communicative action process that starts even before the actual consent (Schweizerische Akademie der Medizinischen Wissenschaften [SAMW], 2015). The process of information and consent should be fair and characterized by dialogue, so that people become aware of what participation in the testing means (ibid.) In the target group 65+, special attention should be paid to preparation and sufficient time resources for the interview.

During the recruitment interview, the end users must be informed about the general conditions of the testing, the aim of the testing and the requirements. Test subjects highly appreciate accurate and detailed information about the course of the testing (Meurer, Stein and Stevens, 2013). This verbal information should be recorded in a written test information document, in accordance with the rules and templates of the respective national or regional ethics commissions, with details of the objective, duration, procedure, rights, obligations, voluntary nature, benefits, risks, possibilities of discontinuation, confidentiality, compensation, liability, assurance of data protection, financing and contact persons. This is required by the ethics committees and strengthens the commitment of the test subjects.

Should a test subject not wish to participate, the reasons should be clarified as detailed as possible. It should be determined what the concerns are in order to be able to make statements about the group of non-participants, and to understand the motivation for participation (Meurer et al., 2013). If possible, the group of non-participants (e.g. persons not reached, persons inquired about, or persons who left after the recruitment interview) and the reasons for not taking part should be described. The proportion of non-participants should be indicated, and these data should be considered when interpreting the results

(Kleist, 2010). It can be assumed that the response behaviour of participants and non-participants differs (Groves, 1989; Koch and Blohm, 2015) and can thus influence validity and reliability (Haunberger, 2011).

In some cases, concerns can be clarified, intercepted and even eliminated in a recruitment interview. It is important to address the expectations of the test persons. If unrealistic expectations are mentioned by the test persons, they should be corrected in order to avoid subsequent dropouts. Test subjects must be able to decide to take part in the testing voluntarily and without any pressure (König, 2011), as well as having the option to terminate participation at any time without any disadvantages.

3.4 Informed Consent

The written consent of the test subject at the beginning of the test phase is indispensable (Gebel et al., 2015). It must be written in accordance with national ethical guidelines and regulations and communicated to the test persons in an understandable way.

For test persons 65+, special attention must be paid to the formal design of the written consent form. Attention should be paid to layout, understandable language and brevity, without neglecting the correct factual content. Guidelines on wording are usually provided by national ethics committees or professional associations. For the group of older test subjects as well as for particularly limited test subjects, it is also advisable to follow scientific recommendations for layout as well as formulation of questions and instructions (Brandt et al., 2018; Lang, 2014).

3.5 Data Handling / Data Protection

In order to ensure the anonymous evaluation and use of personal data, each test person is assigned a specific code which links individual data with each other but gives no indication of the test person (König, 2011). Only with a separate file, a so-called code list, collected data can be linked with the personal data. This code list is to be stored separately and independently from other (personal) data (König, 2011).

The currently valid basic data protection regulation is valid throughout Europe and should be complied with (Akiki, 2019). Data protection and data security must be observed (Bölscher, 2000; Epiney, Civitella and Zbinden, 2009; Federrath and Pfitzmann, 2000; Kühling, Klar and Sackmann, 2018; SAMW, 2015). Test subjects must be informed of the contents and procedures and must be given written assurance that their data (interviews, questionnaires, technical data) will be treated confidentially. To protect the privacy of the test subjects, their addresses will never be passed on to third parties without their explicit approval. Wherever possible, contact will only be made via the assigned researcher (Hämmerle et al., 2018).

4 IMPLEMENTATION– DATA COLLECTION AND SUPPORT

4.1 Economy of Data Collection

Economic test procedures with a reasonable test duration should be selected and breaks should be considered. The researchers in the field should be familiar with the respective dialects so that the test subjects can speak in their usual language. Situational factors should be considered (Kothgassner and Bertacco, 2011), for example, the test atmosphere should be made pleasant by eliminating sources of interference (such as conversations from other people) and allowing enough time (Felnhofer, Kothgassner, Hauk, Kastenhofer and Kryspin-Exner, 2013).

4.2 Relationship Building / Trust

At the beginning of the testing, the focus is on building up a trusting relationship (Ogonowski et al., 2013), which starts with the initial contact and enables a long-term commitment. Social skills are needed for building relationships both among researchers and test subjects. Establishing a motivating atmosphere and close interaction with the test subjects is seen as essential for the success of the research (Eisma et al., 2004). Regular contact shows an appreciative attitude towards the test subjects, enables to address concerns, take statements seriously (Pauli et al., 2017a), and recognize difficulties at an early stage. By including all statements, even when not relevant to the testing, a good feeling is conveyed (Ogonowski et al., 2013). Researchers should achieve reciprocity (Smith, 2013) by telling something about themselves. A relationship based on trust requires a clearly defined contact person whose tasks and functions are transparent and who remains the same throughout the testing, if possible (Georges, Schuurman, Baccarne and Coorevits, 2015; Hess and Ogonowski, 2010; Ogonowski et al., 2013). This proves to be very important especially for people 65+.

Efficient complaint management must be ensured by a clear contact person for problems and questions. It also makes sense to inform test subjects regularly about the status of the testing, for example by a newsletter (Ogonowski et al., 2013).

To establish trust, as many individual areas as possible should be considered (Smith, 2013). For example, trust in the institution itself, in the software used, in the individual researchers or in other test subjects. As trust usually comes through many small steps, trust in the individual areas can again be ensured or demonstrated by various factors. For example, the qualifications of the researchers or their reputation can be a condition for trust in them.

4.3 Motivation

In order to avoid dropouts, motivation must be maintained throughout the entire test period, which can last several months (Smith, 2013). Motivation depends largely on the expectations of the test subjects (Meurer et al., 2013) and the reliability of the research team, which is why the expectations and the reliability should be actively managed (Ogonowski et al., 2013). People who have decided to participate are usually impatient and want to start testing a new assistive technology immediately (Hess and Ogonowski, 2010). In order to avoid disappointment and a lack of motivation, particularly regarding prototypes that are not yet marketable, it is essential to communicate clearly what can be expected from the assistive technology at the respective stage of development (Georges et al., 2015). Unrealistic announcements regarding the use of the assistive technology should be avoided, and longer time horizons should be preferred.

In general, intrinsic motivation, such as general interest or the desire to learn something, seems to be more relevant than extrinsic motivation (Leonardi et al., 2014). This is why social activities are important for strengthening the sense of community. A financial incentive to participate does not seem necessary (Hess and Ogonowski, 2010; Leonardi et al., 2014) and is also undesirable in research projects due to selection mechanisms. Otherwise, there would be the possibility that financially poor people would participate only because of the financial incentive (Grün and Haefeli, 2009) and possible risks would not be sufficiently considered by them (Denny and Grady, 2007). Moreover, it could lead to an overrepresentation of people with financially weaker resources.

4.4 Building a Sense of Community

Real-life meetings, where the test persons can meet other test subjects, the entire testing team and other stakeholders, have proven to be a good way to create a sense of community (Ogonowski et al., 2013; Pauli et al., 2017a) and increase commitment (Hämmerle et al., 2018). Aims should be: Community feeling, exchange among test subjects and with the testing team, information about the testing, presentation of results, and the collection of opinions and emotional situation of the test subjects (Hämmerle et al., 2018). As in the entire research project, voluntariness is essential (SAMW, 2015). There should be enough time for informal exchange (Ogonowski et al., 2013). As an alternative to the real, very resource-intensive meetings, a virtual forum can be offered on a homepage so that test subjects can support each other, and the researchers are thus relieved (Ogonowski et al., 2013).

4.5 Involvement of Other Stakeholders

In addition to the primary users (end users), other stakeholders such as secondary users (relatives or professionals and service organisations), tertiary users (politics or institutions) and research or industry partners must be considered. The participation of these different user groups and stakeholders can be very challenging, as different interests and objectives collide, which cannot always be satisfactorily considered (Ogonowski et al., 2013).

5 COMPLETION – TERMINATION OF TESTING

5.1 Dealing with Dropouts

Several factors can cause test subjects to drop out (Georges, Schuurman and Vervoort, 2016). As the probability of dropouts is high, particularly due to rapidly changing (health) conditions of older adults (Hämmerle et al., 2018; Hoag, 1981), dealing with dropouts at the beginning of the testing is essential. As Living Lab testing takes a long time, it is necessary to define the procedure to be followed when a dropout occurs, how to handle the data collected so far, and the possibility of re-recruitment. With the consent of the test subject, the data collected so far should continue to be available for analysis. Re-recruitment does not necessarily have to take place. However, depending on the research question and

assistive technology, it should be examined whether the number of test subjects is still sufficient to answer the research question.

5.2 Exit Strategy and Compensation

An exit strategy at the end of the testing regarding the termination of testing and whereabouts of the assistive technology should be defined at the beginning of the testing. The assistive technology may be given to the subjects free of charge, sold to them at a preferential price, or can be removed. Compensation can also be defined as part of the exit strategy. However, the compensation does not have to be in financial form, as non-monetary motivated participation seems to work in general (Hess and Ogonowski, 2010; Leonardi et al., 2014). Experience from own testings shows that "compensation" by offering a social event (e.g. a final event with all test subjects and the researchers) is valued by the test subjects.

5.3 Feedback of Test Results

If possible, the testing results should be communicated to all test subjects in an adequate form (Hämmerle et al., 2018; SAMW, 2015, Chapter 10). The form in which this takes place should be communicated early on.

6 CONCLUSIONS

The position paper argues that special considerations and requirements are needed when dealing with older adults as test subjects in Living Labs at home and summarizes the experiences gained so far. It can serve as a guideline to secure the planning and implementation of Living Lab studies at home with older adults qualitatively. The contact with the test subjects is divided into three phases and enables other researchers to find answers to relevant topics quickly. It would be desirable, in the sense of quality assurance, that future Living Lab testings, especially with older adults in their homes, are based on these recommendations.

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