The Configuration of Older Users as Drivers of Innovation in the Design of Digital Technologies

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ABSTRACT

This paper develops hypotheses on the discovery of "users" in publicly funded development of digital technologies for people in old age, on the motivations behind, and on consequences for the products and people in old age. We reconstruct the involvement of users in two funding programmes, one on the European level and one on a national level (Germany). Based on this, we discuss resulting consequences by describing how older people are configured as users in technology development focusing on the concept of user-centred design (UCD) and what this configuration bears for the technologies developed as well as for the users. We describe that participation of older people in technology development projects is a complex task that is not beyond controversy within social science research on user participation. Finally, we briefly argue in favour of alternative technology development strategies and funding practices.

Keywords: Innovation Age; Digitization; Participation; Funding Policies; User-Centred Design (UCD); Solution-Centered Design.

Proposal Submitted 28 September 2020, Article Received 14 July 2021, Reviews Delivered 30 January 2022, Revised 23 May 2022, Accepted 10 June 2022, Available online 5 September 2022.

INTRODUCTION

In the contexts of digitization, older people are often considered late adopters. Supposedly, they are particularly excluded from the digitization process (Ehlers *et al.*, 2021). However, the last decade saw the development of various digital products and digitally supported services specifically designed for older people, including several smart home devices and active/assisted living (AAL) technologies. The development of these products was frequently supported by public funding programs, on national as well as supranational levels (Meyer *et al.*, 2011). This process integrated older people into technological development and design through different approaches and their participation has frequently become mandatory for receiving funding. Despite this funding policy and the application of various design approaches for the participation of older people in technology development, we argue that their integration might be misleading. The article describes these developments, critically discusses the form of participation of older people as users in technology innovation and asks for opportunities to reconfigure this role and for alternative technology development strategies.

The paper combines results from a systematic literature review (Merkel & Kucharski, 2019), a document analysis of European and national funding programs in the context of active/ambient assisted living, and integrates our observations as researchers who have been active in the field for several years. Furthermore, we confront the common practice to adopt "user-centred" (Norman & Draper, 1986), participatory and co-creative strategies of applied sciences into technology development processes with knowledge from social science research methods. We will mainly focus on the concept of user-centred design (UCD) as we argue that UCD and related concepts follow comparable strategies and methods and thus bear similar challenges that need to be considered. However, in this paper, we do not refer to UCD in all contexts, but specifically focus UCD in the field of ageing and technology development.

INVOLVEMENT OF OLDER USERS IN (DIGITAL) TECHNOLOGY DEVELOPMENT

Research on user involvement in the field of old age and digital technologies has continuously gained relevance as multiple scholars, mainly from the fields of gerontology, psychology, and sociology but also science and technology studies (STS) are critically engaged in the field (see, for instance Künemund & Tanschus, 2013; Endter, 2016; Peine & Neven, 2019; Wanka & Gallistl, 2021). Both the motivations for user involvement and the common practices have been analyzed in two recently

published reviews on user involvement in the field of ageing and (digital) technology (Merkel and Kucharski, 2019; Fischer *et al.*, 2020).

Merkel and Kucharski (2019) find that one of the main reasons for the involvement of older users is the association of user involvement with better outcomes in the sense that older persons are more likely to adopt and use technologies. However, even though this assumption is expressed in several studies, empirical evidence is scarce (Fischer *et al.*, 2020). Other arguments for user involvements are described by Beimborn *et al.* (2016) and cover ethical reasons, namely empowerment and democratisation (Beimborn *et al.*, 2016). Users should be "consulted about research that is conducted on them" (Walker, 2007; Beimborn *et al.*, 2016, p. 324) and have a right to influence the research processes actively. Furthermore, the participation of older people should help to counter negative age-related stereotypes and ageism (Peine *et al.*, 2014; Beimborn *et al.*, 2016; Endter, 2018; Wanka & Gallistl, 2018). Fischer *et al.* (2020) argue that mainly three motivators can be used to summarize purposes for user involvement: (1) soft motivators, such as learning about older people's lives or getting feedback on prototypes, (2) material motivators, such as achieving a better quality of design, and (3) normative motivators, such as empowering the users. Those motivators form the starting point of an analytical framework on user involvement of older users proposed by the authors. This model covers the purpose, nature, and consequences of involving older users. With respect to the consequences, the authors find that three aspects are relevant here: (1) learning, (2) adjusted design, and (3) an increased sense of participation (Fischer *et al.,* 2020). *Learning* encompasses a mutual process, as older persons learn about design and development processes and the technicians/designers about the life worlds of older persons, which might help to counter negative age stereotypes (Fischer *et al.*, 2020). Technology design can be *adjusted* because of user involvement and, consequently, might result in a better design quality. An *increased sense of participation* manifests, for instance, in positive feelings of older persons on participating and having a voice in the research and design process (Fischer *et al.*, 2020).

Various methods are used in the design process of a technical artefact to test the prototype and ensure that the requirements placed on it are met. Therein, UCD has become the key design approach. It aims at achieving a high degree of fit between the needs and requirements of the later users and the technical artefact by involving persons who represent the target group as good as possible.

UCD goes back to the psychologist Donald A. Norman, who in his work at the University of California San Diego dealt with design principles for user interfaces in the late 1980s. He first presented his concept together with Stephen W. Draper in the

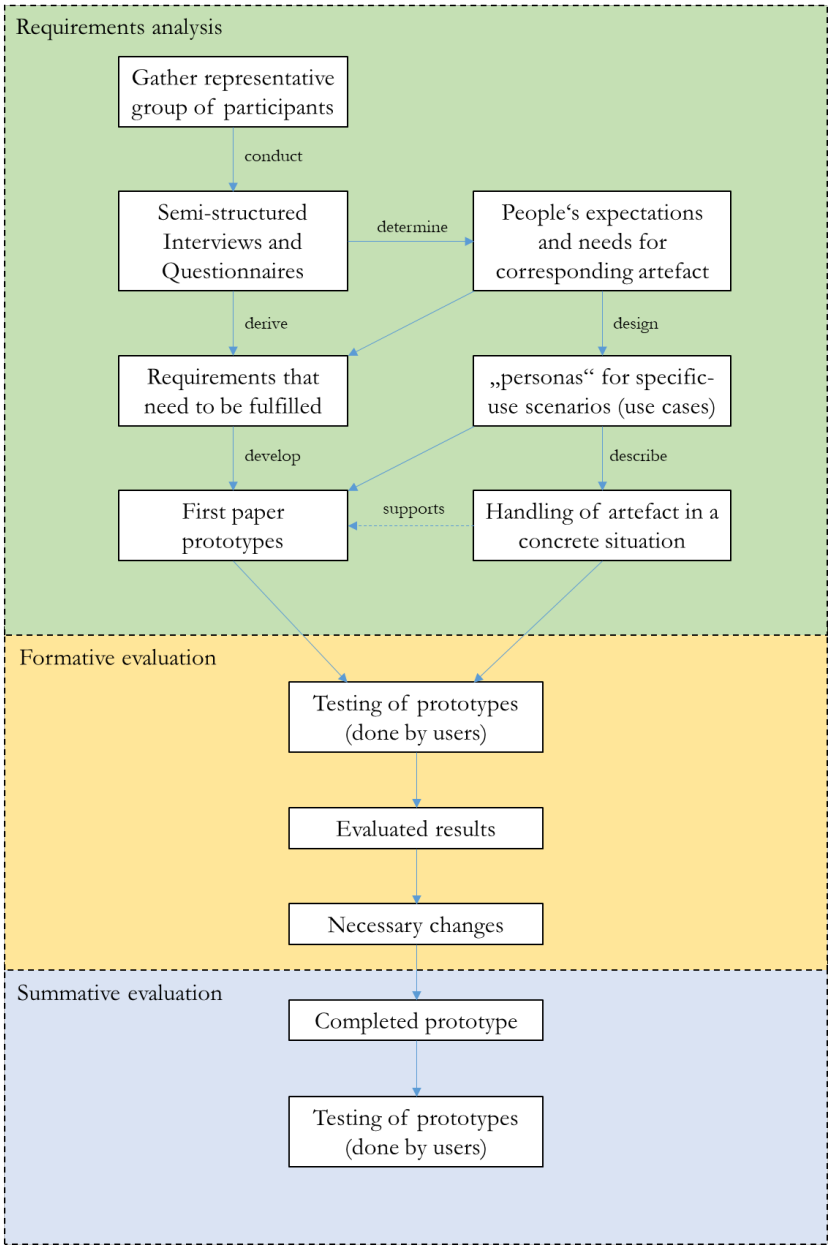
book "User-Centred System Design: New Perspectives on Human-Computer Interaction" (Norman & Draper, 1986). It is followed by "The Psychology of Everyday Things" (Norman, 1988), in which Norman further elaborates his approach regarding basic design principles.

Although it is explicitly stated that products should be designed with and for older users, it remains unclear how this should be practically achieved. Idealized, the design process of a technical artefact consists of various phases and methods that serve to test the prototype to see whether the requirements placed on it are met. The focus is on the usability and functionality of the artefact. UCD has established itself as a central design approach. It aims to achieve a high degree of fit between the needs and requirements of future users and the technical artefact by involving people who represent the target group as well as possible. According to Norman's claim, the consideration of future users takes place at various points in the development process. In the first phase, the requirements analysis, people are asked about their expectations and needs for the corresponding artefact by means of qualitative, semi-structured interviews and questionnaires. From the results of the survey, requirements are derived which the later device or system must fulfil. To bundle these and illustrate them vividly, so-called personas can be designed on empirical data, which are embedded in specific use scenarios (use cases) in which their handling of the artefact at disposal is described in more detail in view of a concrete situation. At the same time, first paper prototypes can be developed based on the requirements and evaluated by the test users.

After the context of use has been ascertained and the requirements for the technical artefact have been derived and defined, the second phase of the design process follows, in which the future product is conceptualized and designed. Here, the users have the task of testing the prototype designs in the form of paper prototypes or mock-ups (formative evaluation).

While the results of the formative evaluation flow into the further development process, the summative evaluation – and thus the third phase – is about testing the completed prototype. Similar to the second phase, the participants perform a series of tasks with the prototype that are typical for later use. The aim is that the test persons complete the tasks with as few errors as possible – without difficulties or interruptions – in as short a time as possible and are satisfied with their own performance as well as with the operation of the device. In contrast to the formative evaluation, the results of the summative evaluation do not flow into the development process, as this is already considered completed. Rather, the summative evaluation serves to check whether the product meets the goals and expectations of the users. Figure 1 illustrates the three phases of a typical and idealized development process.

Figure 1: Development process based on Norman (1986)



Source: Source: Own representation based on Norman/Draper (1986) and Norman (1988).

In recent years UCD has become an umbrella term for a broad set of methods and agendas linked to the participation of users in different fields of innovation (Mackay *et al.* 2000; Karlsson *et al.*, 2012; Marcus, 2015). In addition to the more narrowly defined UCD approach, there are several approaches that address a broader group of users, such as human-centred design, design for all, or universal design. What they

have in common is the goal of making human-technology interface accessible for all users, regardless of prior knowledge and experience, age, and gender. However, UCD seems to be the dominant concept and especially in European and national funding programs on assistive technologies for older people – like for example AAL – it has become one of the main approaches to enable older people to participate in the design process (Merkel & Kucharski, 2019; Fischer *et al.*, 2020). In these contexts, UCD goes beyond Norman's classical conception by shifting the focus towards user driven technology development. Here, the participation of older people in the design process pursues different objectives. First, UCD – as it is for example mandatory in the German funding program on AAL – is a reaction to the lack of market success of the developed technologies (Greenhalgh *et al.*, 2016; Fachinger, 2018). To overcome the missing market penetration UCD should guarantee that needs and requirements of older users are met, and the products' acceptance increases (Compagna, 2012; Endter, 2021).

In contrast to this political agenda, the practical implementation of UCD reveals that these objectives cannot be achieved easily. Rather, it becomes clear how tricky the application of UCD is. Nevertheless, it plays a central role in publicly funded technology development in the field of ageing and technology.[1]

INVOLVEMENT OF OLDER USERS IN THE PERSPECTIVE OF PUBLIC FUNDING PROGRAMS

Vines *et al.* (2015) see funding bodies and governmental agencies as central actors influencing "what is researched, how it is researched, and what problems [research] seeks to address" (2015, p. 3). Drawing on that argument, we investigate public funding programs in Germany and the European Union to analyze how user involvement is framed and what exactly is understood by the term in practice. For Germany, we will concentrate on recent programs launched by the German Ministry for Research and Education (BMBF) and give a general overview based on our observations. On the European level, we will look specifically at the Active/Ambient Living Joint Programme (AAL-JP). Here, we obtained all official call texts as well as supplementary documents from the official website[2] starting with the first call in 2008. The call texts were then screened for information on user involvement (e.g., suggested methods, definitions of users).

[1] Another discourse relevant here surely is on knowledge production (e.g., Gibbons et al., 1994), however, a critical discussion of this concept of transdisciplinary research is beyond the scope of this paper.

[2] http://www.aal-europe.eu/stay-up-to-date/calls.

In Germany, the everyday life of older people has been identified as a suitable field of application for AAL and smart home technologies. However, it is not innovation and digitization that are brought to the fore within the funding policy activities, but the (statistical) factuality of an ageing population and the associated problems and challenges (BMBF, 2008). In the calls of the Federal Ministry of Education and Research's funding program, for example, a picture of demographic change is drawn up as a fundamental social change and challenge that requires political control and action. It is emphasized that demographic developments will lead to massive burdens on the social systems. At the same time, it is emphasized that the (future) need of older people for (outpatient) care and nursing can be met by adding technical assistance services. For this reason, the development of technical assistance systems is advantageous both for older people, as they can age in place, and for society, as they reduce the need for person-centered care and nursing associated with demographic change, as well as their costs, and at the same time strengthen Germany as an innovation and business location (BMI, 2012; BMBF, 2011).

UCD plays a central role within the German funding of "Altersgerechte Assistenzsysteme" [assisted living technologies] and thus in the political agenda to respond to demographic changes through technical innovations. Since 2011, projects funded within this funding line have had to work in a user-centred manner. This follows the recommendation of the AAL Expert Council, which the BMBF convened in 2009. In its recommendations ("Loccumer Memorandum"), the expert committee advocates the inclusion of potential users. It states:

> The success of technical assistance systems depends heavily on whether the needs, wishes and requirements of potential users are taken into account and incorporated into the development of technologies and services at an early stage. The participation of users is helpful for the preparation of requirements analyses, for testing and evaluating product concepts, for assessing operating concepts or for designing products, packaging, and operating instructions. (AAL-Expertenrat des BMBF, 2010, p. 4, translated by the authors)

Following the *Loccumer Memorandum*, the BMBF obliges the funded projects to implement UCD and to consider ethical, legal, and social issues. Accordingly, the Federal Government's research agenda for demographic change, published in 2011, states that:

> The focus of funding is not on individual technological results, but on the implementation of innovative solutions that also encompass social, ethical, legal, and other societal aspects and are mostly driven by user needs. The aim is to explore fundamental issues of social participation of older people and to develop innovative solutions, including new products and services for long and healthy aging. (BMBF, 2011b, p. 18, translated by the authors)

The mandatory recommendation of a specific design approach subsequently has a decisive influence on the projects and their working methods. Thus, a broad portfolio of methodological instruments for the implementation of the political requirement and an equally varied practice of UCD developed, oscillating between classic evaluation studies and market analyses on the one hand and participatory approaches on the other. Moreover, in most cases, software developers and engineers are assisted by social scientists who are responsible for the implementation of user participation.

The AAL-JP was initiated in 2008 by 20 European countries as well as Israel, Norway, and Switzerland (Decision No 742/2008/EC), based on the European Commission's action plan "Ageing Well in the Information Society" formulated in 2007 (Chicot *et al.*, 2018). The central aim of the action plan was to focus the development activities of information and communication technologies (ICT) on the demographic change. The rationale was that ICT can help to cope with the ageing of European societies and may result in a "triple-win": Improving health for Europe's citizens, supporting the sustainability and efficiency of the health and social care systems, and the expansion to new markets (European Parliament and of the Council, 2008). Since then, calls are published on a yearly basis and with differing foci in the field of age and technologies. To apply for the very first call published in 2008 "ICT based solutions for Prevention and Management of Chronic Conditions of Elderly People" (AAL-JP, 2008) a necessary condition was the integration of at least one end user partner organization in the consortium. According to the call text, the term "end user" is defined as either primary end users – those individuals who will be using the products or services –, secondary end users – persons or organizations in direct contact with primary users –, or tertiary end users such as organizations and institutions that are in indirect contact with the products and services such as insurance companies (Ambient Assisted Living (AAL) Joint Programme, 2008). The second call was published in 2009 and focused on the "advancement of social interaction of elderly people" (Ambient Assisted Living (AAL) Joint Programme, 2009). The call text was introduced with a statement that the AAL-JP aims for products and services "addressing identified wishes and needs of the end users" (Ambient Assisted Living (AAL) Joint Programme, 2009, p. 3). Furthermore, it encourages a direct involvement of end users and sees end user involvement as an "essential component of activities from the outset and throughout the life of the project." (Ambient Assisted Living (AAL) Joint Programme, 2009, p. 8). This is explained in more detail in a section on requirements that proposals need to meet:

> Applying technologies to fulfil the needs of elderly persons and their partners, family or friends, requires specific attention to user acceptance, user interface and usability design in order to meet the expectations, cognitive capabilities and eSkills of the end-users (whether primary or secondary end users). Importantly development and use of new ICT should not lead to exclusion and widening of the digital divide. To fulfil these requirements, involvement of end users during the

> whole process is essential. The solutions should be validated in 'real end user' situations for a well-defined user case study. (Ambient Assisted Living (AAL) Joint Programme 2009, p. 12).

With the 2010 call on independence and participation in the "self-serve society" (Ambient Assisted Living (AAL) Joint Programme 2010) end user involvement was regulated within the annex of the call, which described it as "mandatory and essential" for the first time (*ibid.*, p. 21). In addition, a framework for "end user involvement" was provided. It explained how an innovation culture should be realized where "the design of new solutions is done with and for the older persons" (*ibid.*). The framework focused on the innovation process and broke it down into three parts, (1) the exploratory and creative phases, (2) the development phases, and (3) business model development (*ibid.*). The framework remained unchanged until today – except that in later versions, the words "with" and "for" were not underscored anymore and that since 2014, with the call "Living actively and independently at home", a link was added to the framework's description pointing to several documents on user integrations (Nedopil *et al.*, 2013a, 2013b; Youse GmbH, 2013). These documents aim to explain potential benefits of user involvement, as well as to introduce and present methods and techniques for application in projects funded within the AAL-JP. Here, it is argued that focusing on the users – the report draws mainly on the concept of UCD – might result in "superior products that are often more successful" (Nedopil *et al.*, 2013b, p. 13). As the most important aspect, the authors see that "user integration […] allows a user-friendly product to be created." (*ibid.*). According to the authors, a user-friendly product or service is hence more successful, more likely to be accepted by the users, and, in turn, might save the developers money as mistakes during the development process are avoided. The report distinguishes four iterative phases of user involvement: (1) understanding the user, (2) conceptualization, (3) testing, and (4) business model development. Like the initial framework on user involvement defined in the call text, integration of users particularly in the first phase is understood as observing or asking them (without further methodological elaboration). During the second phase, more details on the role of users are given. Here, users are seen as "experts of their daily routines" (*ibid.*, p. 16). It is argued that listening to them – and not researchers and technicians – could prevent a "frustrating product experience" (*ibid.*). The report suggests working with lead users, characterized as having a "strong drive to improve their current situation and often already having ideas for solving a particular need" (*ibid.*). During the testing phase, "users can help innovators detect real errors" (*ibid.*, p. 17).

CRITICAL DISCUSSION OF USER-CENTRED DESIGN IN TECHNOLOGY DEVELOPMENT PROCESSES

When comparing the reasons for including older users in (digital) technology development mentioned in the literature with call texts and additional material of the funding programs, it seems that the central aim for user involvement is what Fischer *et al.* (2020) call material motivators. Consequently, the intended outcome of user involvement is mainly adjusted design leading to better market success. However, from a social science research methods perspective, many shortcomings, blind spots, and misunderstandings must be mentioned. Firstly, requirements analyses require some sort of theoretical or empirical representativity of study participants. In a quantitative paradigm this could be achieved by a random sample from population registers, making sure that not only individuals with, for example, strong interest in technology or better education take part in this requirement analysis, but most frequent patterns of competencies, life situations etc. are captured in the sample. In a qualitative paradigm, theoretical sampling might be an option, making sure that as many different life worlds and perspectives are covered as necessary for the theoretical problem which is being reconstructed from some first cases. Both strategies are – to our knowledge – rarely used. Self-selection or convenience sampling clearly dominate. Hence, results of the requirement analyses are biased in unknown ways already at the sampling stage (e.g., Grates *et al.*, 2018). Secondly, in a quantitative paradigm we would expect – for example – theories and hypotheses guiding the development (or at least selection) of valid and reliable measurement instruments and research designs. In a qualitative paradigm, we may favor the recording of social practices as they occur in everyday life to identify patterns that individuals involved are not necessarily aware of. What we usually observe in technology development for older adults, however, are rather naïve assumptions on user as experts that can be asked for their expertise using guideline questionnaires or *ad hoc* focus group discussions, instead of theoretical or empirical representativity (Beimborn *et al.*, 2016; Wanka/Gallistl, 2020). From our point of view, the assumption that users are "experts" is misleading. E.g., physicians, psychologists, sociologists, judges, and social workers will not simply rely on the diagnoses and solutions provided by those concerned, but use information provided as data to be carefully analyzed (while considering, for example, other data and sources of information, different methods and measurements, and of course theoretical knowledge about the phenomenon at hand). By contrast, in most UCD contexts requirements will extracted from what the sampled individuals have perceived, or suspect to be the problem, what might significantly differ from a professional assessment. For example, it has been shown that older individuals have developed coping strategies so that problems professionals might identify by observing the case are not mentioned in an interview

setting because the individual workaround exists: the problem is not cognitively present, although existent (Pelizäus-Hoffmeister, 2013). And as we know from the example of hearing aid usage, existing problems may be played down, withheld, or even completely denied, especially when stigmatization as "old" is feared (e.g., Vestergaard & Andersen-Ranberg, 2013). To summarize our criticism: Starting from individual "users" is an unprofessional and probably misleading strategy.

The shortcomings of convenience sampling and research methods are not limited to the requirement analyses. We also see these in formative and summative evaluations of the products. Nevertheless, exactly these procedures are frequently recommended, for example by Nedopil *et al.* (2013b) who recommend convenience sampling (e.g, "personal contacts might come in handy", 26) and generally data collection methods scratching the surface (e.g., "Self-Documentation" or "Walt Disney Method"). Data analysis and interpretation are widely regarded unnecessary. In our view, a funding program suggesting such a methodological repertoire (or even makes them mandatory), tends to mislead innovation processes. These procedures do not satisfy scientific criteria, neither quantitative nor qualitative, but what is more important: they also do not allow for generalizations of requirements or technological solutions.

Similar problems frequently arise where scenarios, personae, and use cases are the starting points for technology development. Starting from these – as alternatives for requirement analysis with user involvement –, again requires theoretical or empirical representativity of scenarios, personae, and use cases. It is our impression that frequently stereotypes of old age are merged to sketch these scenarios, typically addressing negative aspects of aging.[3] Hence, these negative aspects of aging are inscribed into the products developed, what might further contribute to the weak marketability. We rarely find any projects that aim at positive aspects, for example, self-fulfillment, wisdom, or enhancement of capabilities, except in some medical and rehabilitation settings of research. It is – at least implicitly – assumed that senior citizens are a homogeneous group, impaired and in need of help, living alone etc., not a heterogeneous group with certain abilities that can be trained, supported, or improved.

Other important aspects to consider in this context are generational and social change. Older people today – both in cases of scenarios and user involvement – might be very different from older people tomorrow, for example in terms of education, health, experience with technology, and lifestyle (DiDuca *et al.*, 2006). And these individuals as well as their environments change over time. For example, we have

[3] Cf. Künemund & Tanschus (2013); Endter (2021). Of course there are some approaches that draw on a more complex methodological design (see e.g., Waycott *et al.*, 2012; Vines *et al.*, 2015), these still seem to be the exception rather than the norm.

found that the acceptance of fall detection technologies increases with age, namely when falls become a prominent concern (Künemund & Tanschus, 2014). Patterns of sociodemographic characteristics, experience with technology and technology acceptance are not stable but differ between cohorts, change over time, and of course change with the availability of specific technologies.

Furthermore, within the framework of various ethnographic observations, it has been shown that the involvement of the users in the development of the technology should not disturb the overall process (Endter, 2021). Thus, it is already clear at the beginning of the participation how it should proceed and what results should emerge. Participation should take place, but it must not interfere, this is how the observation could be reduced to a formula. Thus, the users only appear when it makes sense and is helpful for the course of the project. It is also evident that both the decision at *which* point in time of the design process participation takes place, as well as *how* it takes place and *who* is involved, are an expression of a specific power relationship in which older people are involved, but do not participate (Endter, 2016; Endter, 2020).

While the political guidelines clearly advocate the implementation of UCD, professionals in the field criticize that this can often not be realized, or only to a limited extent. A usability consultant, for example, speaks of a "farce" (field note, 11.03.2014, Endter, 2021). A social scientist involved in the implementation wonders: "You have to ask yourself why you are actually doing all this. I always find the comparison to others quite good: I do crap, but the others do much bigger crap." (*ibid.*). Such statements reflect the ambivalence associated with the participation of older people: on the one hand, there is the requirement of the funding agency to involve older people so that the technologies are developed more in line with their needs, thus increasing their willingness to use them and improving the chances of the technologies being disseminated on the market. On the other hand, it shows how complex and time-consuming the integration of older people in technology development projects is and how there is still a lack of suitable formats, methods, and the necessary experience on the part of the project actors to make this process successful. At the same time, the limitations of user participation become visible: who, how, by whom and for what is involved is not decided by the older test users.

Against this background, it becomes clear that user participation is less a manifestation of the participation process of older people than of the powerful practices of establishing controllable users.[4] Neven (2010; 2015) asks why more and more older people should be involved in technology development and suggests that the outcomes of participation should be scientifically evaluated rather than continuing

[4] In a similar vein, Künemund and Tanschus (2013) have suspected that some scenarios might be constructed to demonstrate the abilities of the technology.

current practice, which has also been stressed by Merkel and Kucharski, who argue that not only the outcomes but also the process of user involvement should be evaluated (Merkel & Kucharski, 2019). Wanka and Gallistl (2020) also demand a revision of the funding programs which envision other participation formats of older people.

TIPPING POINTS OF USER INVOLVEMENT

It becomes clear that the participation of older people in technology development projects is a complex task that is not beyond controversy within social science research on user participation. Still, user involvement and associated concepts such as participatory design, or co-creation are considered "*sine qua none* in gerontechnology design" (Peine & Neven, 2019, p. 16). On the one hand, the view that older persons should be integrated into the design and development process of digital technologies has become more and more popular and, as shown, has also been acknowledged by policymakers responsible for public funding strategies. Beimborn *et al.* specifically refer to funding agencies and, more explicitly, to the AAL-JP when they state that "older people are increasingly involved in development processes, for instance in the evaluation of products, in selected decision or via empirical surveys on users' preferences" (2016, p. 323).

On the other hand, several aspects have been criticised in this regard, covering the intentions of user involvement as well as the realization. In view of the intentions, we showed that multiple aspects might influence the decision on integrating users. With respect to public funding programs, however, the main considerations seem to be in view of acceptance and, consequently, profitable products. Beimborn *et al.* (*ibid.*) point out that one of the major desired outcomes are devices better adjusted to the users which will be more successful on the market. Other motivators, such as empowering the users by giving them a voice during the innovation process seem to play a minor role. This might be an explanation to the "interventionist logic" (Peine & Neven, 2019) of technology in the field of ageing. Here, ageing is seen as a problem or challenge that can be overcome by the means of technology. Furthermore, it is criticised that in the context of technology development, older people are mostly imagined as a group of people who are distant from technology (Peine *et al.*, 2017), whereby this view is often accompanied by a paternalistic approach to older people (Wanka & Gallistl, 2021). Mackay *et al.* conclude that the practice of user participation has little in common with the humanistic, democratic, and utopian ideal of participatory design; rather, users are considered "a 'good thing'" (2000, p. 738) because their participation would lead to an improvement of the technical artefact. Hagen *et al.* (2018) speak of an acceptance bias of user-centred approaches that aim

to achieve acceptance through the means of participation – a bias that also often affects the role of non-technical researchers in technology development projects (Endter, 2015; Lassen *et al.*, 2015; Beimborn *et al.,* 2016). Peine and Neven (2019) identify a development within gerontechnology research projects that would promote the use of participatory methods but view them exclusively as a method for eliciting user needs for design and development (Peine *et al.*, 2014). Compagna comes to a similar conclusion stating that the integration of users is "a necessary condition for success" (2018, p. 177) but emphasizes that this does not necessarily mean that user involvement is successful. The use of participatory methods in the context of age and technology would promote specific problems – such as paternalistic access or the exclusion of older people who are difficult to reach – which are given far too little consideration in the current discussion of methods (*ibid.*). It seems that older persons are reduced to a rather passive than active role during the development process. Despite being seen experts of their life world, their role during the development process seems to be as supporters of researchers and technicians. A circumstance that is exacerbated by the lack of professionalization and institutionalization of participatory methods in the context of age and technology (Merkel & Kucharski, 2019; Endter, 2016). In this context, the involvement of older people is a thoroughly critical and challenging situation for the projects. This is especially true in the phase of the summative user tests, since at this point the development process of the prototype is largely completed.

This set of conditions leads the projects into an ambivalent situation: they must (1) involve people who represent the target group as accurately as possible and (2) ensure a stable, permanent participation of these people over a longer period and multiple tests, whereby the tests may be physically demanding, emotionally stressful and/or cognitively challenging for the test persons. At the same time, the project members must ensure that (3) the participation of the test persons does not jeopardize the success of the project. Even if the design of the artefact has been completed, the attestation of a lack of age-appropriate design and usability can become a problem for the project, as it firstly calls into question a successful introduction on the market, secondly casts doubt on the external presentation of the artefact as age-appropriate and thirdly impairs the proof of success vis-à-vis the funding body.

As an alternative, we would like to point to problem-centred, or even better: solution-centred design (Künemund, 2018; Künemund & Fachinger, 2018). The idea is to not start with a user, not even from a user perspective, but with a problem that needs to be solved, for example falls or cognitive decline. A multidisciplinary (in our case: gerontological) evaluation of a problem should review and discuss the literature and evidence first, or perform detailed qualitative research, if such evidence should be non-existent. At target here are causes of the problem. In the example of falls,

geriatrics, psychology, sociology, and social work will most probably mention very different causes like heart insufficiency or medication (e.g., Benzodiazepine), cognitive decline (e.g., declining ability to focus two or more issues at the same time, like remembering what one is looking for and watching the step), lack of social support (e.g., necessity to perform exhausting tasks), or inadequate housing conditions (e.g., slipping carpets). Given such an evaluation of potential causes, it should be discussed which of these causes can be addressed with technology in order to identify a starting point for technology development. As a second step, prior to starting any technology development or involving any user, potential solutions targeting these causes should be discussed with regard to potential consequences and side effects by means of thought experiments. For example, if the problem identified is cognitive decline, and the potential solution are reminder devices (e.g., pillboxes with reminder functionality), psychologists will (hopefully) intervene by pointing out that cognitive decline is slowed down by training prospective memory tasks, not by avoiding them, and that the potential solution might accelerate cognitive decline. We regard these two steps as starting technology development from gerontology and its interdisciplinary knowledge on aging instead from user stories or personas based on prejudices, negative images of aging, small and biased samples of potential users, or static representations from survey research. Users later will have to be involved in the evaluation of the technology developed (formative and summative evaluation in figure 1), but we should start from an evaluation of a theoretical problem (reconstructed from detailed qualitative research, when interdisciplinary scientific knowledge is non-existent) instead from anecdotical evidence. This implies multidisciplinary teams and research prior to any technology development, and of course prior to any user participation (which should match the necessary methodological standards, of course). Additionally, the funding programs should be adjusted to this problem-solving oriented approach, for example by providing starting grants to strengthen research on causes of problems to be solved instead of funding technology development starting from "users".

CONCLUSION

In this article, we argued against a naïve integration of older people in technology development processes, as it does not achieve goals like empowerment of the users or individual self-determination in old age systematically and might be misleading in terms of marketability products as well as problem solving. Current practices of user integration, and possibly the idea of UCD or participatory design itself are insufficient, as are co-creative settings. The main reason for our judgement is the missing scientific evaluation of a problem that needs to be solved, including causes and consequences.

Furthermore, forms of participation which may disturb, delay, or even terminate the innovation process, are overlooked, older users that are less educated or facing cognitive or physical limitations, are mostly not involved, and – finally – a scientifically based evaluation seems to be an exception, not the rule. Main problems here are convenience sampling, and *ad hoc* research methods, which most frequently do not satisfy methodological standards of sociology and gerontology. Moreover, we argue that funding programs enable and possibly encourage researchers to apply such misleading strategies: Although they encourage researchers and developers to apply UCD and similar concepts, they do not provide any specific recommendations. However, even if they do so, as is the case with the AAL-JP, the methods suggested focus on market success rather than user needs in terms of the problems to be solved.

We propose to focus more on the starting points of research and design projects: Understanding and evaluating problems. While users can play a role here, we underline that they do not have to – and user involvement could even be counterproductive. Instead, it should become standard to include methodological skilled gerontologists or social scientists with a focus on old age and aging. And a proper interdisciplinary analysis of a problem to solve should become a prerequisite for any application for funding. To be clear, that is no argument against participatory research and design, which can and should be applied in later stages of the research and development processes. Hence, alternative funding measures are needed, if the aims of the funding were self-determination in old age, independent living, and empowerment of people in old age.

While our paper argues based on observations made in the field of gerontechnology, our conclusion cannot be transferred the UCD in general. Still, we think that some of the arguments can also be considered in the overall discussions on UCD, which is also expressed by other researchers (Vines *et al.*, 2015).

REFERENCES

Ambient Assisted Living (AAL) Joint Programme (2008). *Call for Proposals 2008 AALK-2008-1: ICT based solutions for Prevention and Management of Chronic Conditions of Elderly People*. Ambient Assisted Living (AAL) European Programme. http://www.aal-europe.eu/wp-content/uploads/2012/07/aal-2008-1-call-text.pdf

Ambient Assisted Living (AAL) Joint Programme (2009). *Call for Proposals AAL-2009-2: CT based solutions for Advancement of Social Interaction of Elderly People*. Ambient Assisted Living (AAL) European Programme. http://www.aal-europe.eu/wp-content/uploads/2012/07/aal-2009-2-call-text.pdf

Ambient Assisted Living (AAL) Joint Programme (2010). Call for Proposals 2010AAL-2010-3: ICT-based Solutions for Advancement ofOlder Persons' Independence and Participation in the"Self-Serve Society". Ambient Assisted Living (AAL)

European Programme. http://www.aal-europe.eu/wp-content/uploads/2013/02/call-3-full-text-with-eligibilty-criteria-5-ed-10-vi.2010.pdf

Beimborn, M., Kadi, S., Köberer, N., Mühleck, M., & Spindler, M. (2016). Focusing on the Human: Interdisciplinary Reflections on Ageing and Technology. In E. Dominguez-Rue & L. Nierling (eds.), *Ageing and Technology: Perspectives from the Social Sciences* (p. 311-333). Transcript Verlag.

Chicot, J., Domini, A., & Fisher, R. (2018). *Case Study Report: Active and Assisted Living Programme (EU). Mission-oriented R&I policies: In-depth case studies.* European Commission, Directorate-General for Research and Innovation. https://jiip.eu/mop/wp/wp-content/uploads/2018/09/EU_AAL_ChicotDominiFisher.pdf

Compagna, D. (2012). Lost in translation? The dilemma of alignment within participatory technology developments. *Poiesis & Praxis*, 9(1-2), 125-143. https://doi.org/10.1007/s10202-012-0118-1

Compagna, D. (2018). Partizipation und Moderne: Nutzerorientierte Technikentwicklung als missverstandene Herausforderung. In H. Künemund & U. Fachinger (eds.), *Alter und Technik* (p. 177-206). Springer Fachmedien Wiesbaden.

Ehlers, A., Heß, M., Frewer-Graumann, S., Olbermann, E., & Stiemke, P. (2021). *Digitale Teilhabe und (digitale) Exklusion im Alter.* Expertise zum Achten Altersbericht der Bundesregierung. https://www.achter-altersbericht.de/fileadmin/altersbericht/pdf/Expertisen/Expertise-FFG-Dortmund.pdf

Endter, C. (2015). Seh' ich was, was Du nicht siehst?–Aushandlungen von Partizipation in einem Technikentwicklungsprojekt am Beispiel der eigenen Forscherinnenposition: Auf der Suche nach den Tatsachen: Proceedings der 1. Tagung des Nachwuchsnetzwerks "INSIST", 22.-23. Oktober 2014, 15-23.

Endter, C. (2016). Skripting Age – The Negotiation of Age and Aging in Ambient Assisted Living. In L. Nierling & E. Domínguez-Rué (eds.), *Ageing and Technology: Perspectives from the Social Sciences* (p. 121-140). Transcript Verlag; Knowledge Unlatched.

Endter, C. (2018). How older people matter—Nutzer- und Nutzerinnenbeteiligung in AAL-Projekten. In H. Künemund & U. Fachinger (Hrsg.), *Alter und Technik: Sozialwissenschaftliche Befunde und Perspektiven* (S. 207-225). VS Verl. für Sozialwiss.

Endter, C. (2020). User participation as a matter of care: the configuration of older users in the design of assistive technologies. *Tecnoscienza*, 11(2, Special Issue "When Theory Meets Practice"), S. 93-116.

Endter, C. (2021). Assistiert Altern. Die Entwicklung digitaler Technologien für und mit älteren Menschen. Springer VS Verlag, Reihe Altern und Gesellschaft.

Decision No 742/2008/EC, L 201 *Official Journal of the European Union,* 49 (2008).

DiDuca, D, Partridge, C, & Heres, J. (2006): ICT use and the elderly – Cohort, lifestage or just irrelevant? In. B. Anderson, M. Brynin, J. Gershung, & Y. Raban (eds.), *Information and communication technologies in society* (p. 88-103). Routledge.

Fachinger, U. (2018). Altern und Technik: Anmerkungen zu den ökonomischen Potentialen. In H. Künemund & U. Fachinger (eds.), *Alter und Technik* (p. 51-68). Springer Fachmedien Wiesbaden.

Fischer, B., Peine, A., & Östlund, B. (2020). The Importance of User Involvement: A Systematic Review of Involving Older Users in Technology Design. *The Gerontologist*, 60(7), e513-e523. https://doi.org/10.1093/geront/gnz163

Federal Ministery of Education and Research (FMER) (2008). *Selbstbestimmt Leben: Altersgerechte Assistenzsysteme für ein gesundes und unabhängiges Leben—AAL*. Federal Ministry of Education and Research. [Press release]. https://www.bmbf.de/foerderungen/bekanntmachung.php?B=337

FMER (2011). Das Alter hat Zukunft.: Forschungsagenda der Bundesregierung für den demografischen Wandel. Federal Ministry of Education and Research.

FMER/AGE/AEEIF (2011). Loccumer Memorandum: Technische Assistenzsysteme für den demografischen Wandel – eine generationenübergreifende Innovationsstrategie [Press release]. Federal Ministry of Education and Research, Association of German Engineers, Association of Eletrical, Electronic & Infromation Technologies

FMER (2018). *Technik zum Menschen bringen | Forschungsprogramm zur Mensch-Technik-Interaktion*. Die Neue Hightech Strategie Innovationnen für Deutschland. http://www.technik-zum-menschen-bringen.de/dateien/service/forschungsprogramm-technik-zum-menschen-bringen-barrierefrei.pdf/download

FMIC (2012). Jedes Alter zählt: Die Demografiestrategie der Bundesregierung. Federal Ministry oft the Interior and Community

Gibbons, M., Limoges, C., Nowotny, H., Schwartzman, S., Scott, P., & Trow, M. (1994). *The new production of knowledge: The dynamics of science and research in contemporary societies*. Sage.

Grates, M. Heming, A.-C., Vukoman, M., Schabsky, P, & Sorgalla, J. (2018). New perspectives on user participation in technology design processes: an interdisciplinary approach. *The Gerontologist*, 59(1), 45-57.

Greenhalgh, T., Shaw, S., Wherton, J., Hughes, G., Lynch, J., A'Court, C., . . . Stones, R. (2016). Scals: A fourth-generation study of assisted living technologies in their organisational, social, political and policy context. *BMJ Open*, 6(2), e010208. https://doi.org/10.1136/bmjopen-2015-010208

Hagen, H., Nitschke, M., Schlindwein, D., & Goll, S. (2018). Akzeptanz als Problem, Partizipation als Lösung? Zu Prämissen und Bias in der partizipativen Forschung. In *Technische Unterstützungssysteme, die die Menschen wirklich wollen: Dritte transdisziplinäre* (p. 127-137). Konferenz: Hamburg 2018.

Karlsson, F., Holgersson, J., Söderström, E., & Hedström, K. (2012). Exploring user participation approaches in public e-service development. *Government Information Quarterly*, 29(2), 158-168. https://doi.org/10.1016/j.giq.2011.07.009

Künemund, H. (2018). Problem centered design: shifting debates from the user to problems. *Gerontechnology*, 17(1), 34s. https://doi.org/10.4017/gt.2018.17.s.037.00

Künemund, H., & Fachinger, U. (eds.) (2018). *Alter und Technik*. Springer Fachmedien Wiesbaden. https://doi.org/10.1007/978-3-658-21054-0

Künemund, H., & Tanschus, N. (2013). Gero-Technology: Old Age in the Electronic Jungle. In K. Komp & M. Aartsen (eds.), *Old Age In Europe* (p. 97-112). Springer. https://doi.org/10.1007/978-94-007-6134-6_7

Künemund, H., & Tanschus, N. M. (2014). The technology acceptance puzzle. Results of a representative survey in Lower Saxony. *Zeitschrift Fur Gerontologie Und Geriatrie*, 47(8), 641-647. https://doi.org/10.1007/s00391-014-0830-7

Lassen, A. J., Bønnelycke, J., & Otto, L. (2015). Innovating for 'active ageing' in a public–private innovation partnership: Creating doable problems and alignment. *Technological Forecasting and Social Change*, 93, 10-18. https://doi.org/10.1016/j.techfore.2014.01.006

Mackay, H., Carne, C., Beynon-Davies, P., & Tudhope, D. (2000). Reconfiguring the User. *Social Studies of Science*, 30(5), 737-757. https://doi.org/10.1177/030631200030005004

Marcus, A., (Ed.) (2015). *Design, user experience, and usability: Design discourse.* Conference proceedings of the 4th international conference, DUXU 2015, held as a part of HCI International 2015, Los Angeles, CA, USA, August 2-7. Springer.

Merkel, S., & Kucharski, A. (2019). Participatory Design in Gerontechnology: A Systematic Literature Review. *The Gerontologist*, 59(1), e16-e25. https://doi.org/10.1093/geront/gny034

Nedopil, C., Schauber, C., & Gleinde, S. (2013a). *Knowledge Base: AAL Stakeholders and their requirements*. Ambient and Assisted Living (AAL) European Programme. http://www.aal-europe.eu/wp-content/uploads/2015/02/AALA_Knowledge-Base_YOUSE_online.pdf

Nedopil, C., Schauber, C., & Glende, S. (2013b). *Guideline: The Art and Joy of User Integration in AAL Projects*. Active and Assisted Living (AAL) European Programme. http://www.aal-europe.eu//wp-content/uploads/2015/02/AALA_Guideline_YOUSE_online.pdf

Neven, L. (2010). 'But obviously not for me': Robots, laboratories and the defiant identity of elder test users. *Sociology of Health & Illness*, 32(2), 335-347. https://doi.org/10.1111/j.1467-9566.2009.01218.x

Neven, L. (2015). By any means? Questioning the link between gerontechnological innovation and older people's wish to live at home. *Technological Forecasting and Social Change*, 93, 32-43. https://doi.org/10.1016/j.techfore.2014.04.016

Norman, D. A. (1988). *The psychology of everyday things*. Basic Books.

Norman, D. A., & Draper, S. W. (eds.) (1986). User centered system design: New perspectives on human-computer interaction. Lawrence Erlbaum.

Peine, A., Faulkner, A., Jæger, B., & Moors, E. (2015). Science, technology and the 'grand challenge' of ageing – Understanding the socio-material constitution of later life. *Technological Forecasting and Social Change*, 93, 1-9. https://doi.org/10.1016/j.techfore.2014.11.010

Peine, A., & Neven, L. (2019). From Intervention to Co-constitution: New Directions in Theorizing about Aging and Technology. *The Gerontologist*, 59(1), 15-21. https://doi.org/10.1093/geront/gny050

Peine, A., Rollwagen, I., & Neven, L. (2014). The rise of the "innosumer" – Rethinking older technology users. *Technological Forecasting and Social Change*, 82, 199-214. https://doi.org/10.1016/j.techfore.2013.06.013

Peine, A., van Cooten, V., & Neven, L. (2017). Rejuvenating Design. *Science, Technology, & Human Values*, 42(3), 429-459. https://doi.org/10.1177/0162243916664589

Pelizäus-Hoffmeister, H. (2013). *Zur Bedeutung von Technik im Alltag.* Springer VS.

Vestergaard, S., & Andersen-Ranberg, K. (2013). Hearing impairment and adverse outcomes among Europeans. In A. Börsch-Supan, M. Brandt, H. Litwin, & G. Weber (Eds.), *Active ageing and solidarity between generations in Europe: First results from SHARE after the economic crisis*. (p. 225-232) De Gruyter. https://doi.org/10.1515/9783110295467.fm

Vines, J., Pritchard, G., Wright, P., Olivier, P., & Brittain, K. (2015). An Age-Old Problem: Examining the Discourses of Ageing in HCI and Strategies for Future Research. *ACM Transactions on Computer-Human Interaction*, 22(1), 1-27. https://dl.acm.org/doi/10.1145/2414536.2414633

Walker, A. (2007). Why involve older people in research? *Age and Ageing*, 36(5), 481-483. https://doi.org/10.1093/ageing/afm100

Wanka, A., & Gallistl, V. (2018). Doing Age in a Digitized World—A Material Praxeology of Aging With Technology. *Frontiers in Sociology*, 3, 6. https://doi.org/10.3389/fsoc.2018.00006

Wanka, A., & Gallistl, V. (2021). Socio-Gerontechnology – ein Forschungsprogramm zu Technik und Alter(n) an der Schnittstelle von Gerontologie und Science-and-Technology Studies [Socio-gerontechnology-a research program on technology and age(ing) at the interface of gerontology and science and technology studies]. *Zeitschrift fur Gerontologie und Geriatrie*. Advance online publication. https://doi.org/10.1007/s00391-021-01862-2

Waycott, J., Pedell, S., Vetere, F., Ozanne, E., Kulik, L., Gruner, A., & Downs, J. (2012). Actively engaging older adults in the development and evaluation of tablet technology. In: *OzCHI '12: Proceedings of the 24th Australian Computer-Human Interaction Conference* (p. 643-652). ACM Press.

Youse GmbH (2013). *Toolbox: Methods of User Integration for AAL Innovations*. Active and Assisted Living (AAL) European Programme. http://www.aal-europe.eu//wp-content/uploads/2015/02/AALA_ToolboxA5_online.pdf