Context-Integrating, Practice-Centered Analysis of Needs

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Abstract The development of supporting technology often neglects real challenges for a self-determined lifestyle, especially in age. The objective of the contribution is to explain the KPB-methodology, which was developed in a project founded by the German Ministry of Education and Research (BMBF). This methodology allows capturing needs and problem situations of elderly people in their domestic environment. Implications for product development will be explained. With the project, we answered the question, which problems elderly people have to deal with for a self-determined life. We investigated the life situation based on socio-scientific methods and translated it into technical requirements.

1 Introduction

Nowadays, it is undisputed that technical systems can help human beings to overcome naturally given performance limits. Just think of the capability of flying. Irrespective of whether the performance limits are caused by biological factors, illness or age, technical systems in their various forms can help to strengthen own resources and expand the options for action. Activities in both the professional and private environment can be carried out in a time- and energy-optimized manner, which in turn creates space for personal self-realization. However, this requires that the technical systems are perceived and accepted by the user regarding to these possibilities.

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2 Responsibility of the Engineer in Designing Technical Support Systems

The basis for supporting people in their everyday life is that the developer understands the user's needs and wishes as well as his or her individual living environment. To this end, it must be borne in mind that human beings can play two different roles in the evaluation and interpretation of products:

- In his role of a user, the human being takes a product and interprets its functionality through design and product-characteristics. By placing the functionality defined for himself in his life context, which is shaped by his individual life and action situation, the user decides on the usability of the product for himself. Accordingly, decisions for a product are not only characterized by its functionality but also by affective, emotional, and social aspects.
- In his role as an engineer, the human being takes up technological possibilities to implement these functions within a product in order to support the user and to expand his potential. This technology-driven mind-set is naturally oriented towards the needs of the user, but often reduces them to considerations of performance. Decisions related to the engineering point of view are characterized by physical connections on the one hand and, on the other hand, by rational aspects such as DFX criteria, technical and production feasibility.

Sarodnik describes these different views as "*mutual symmetric ignorance*" between user and engineer [Sar06]. Ultimately, it leads to the creation of functional and high-quality products, but these are not accepted by the user because they are not perceived by the user in the sense of problem solving.

The needs assessment for the planning and the conceptual design of products that are really intended to help people must not only take into account the life and action situation of people. A social responsibility of the engineer arises from the fact that products also have an assistance function [Gra17]. While performing everyday activities, people have to overcome multifaceted resistances. If the human being uses products to overcome his own shortcomings, this also works as training effect that is associated with a strengthening of competence and preservation. Otherwise, if products just focus on avoiding resistance in tackling the tasks, this can result in a loss of competence of the user [Gra17]. This results in the necessity to place the training effect in the product functionality above the purely compensatory functionality.

3 State of the Art

Three main approaches are common to describe users in product development: the methods of user participation, user experience (UX) and acceptance research.

User participation as an interdisciplinary concept encompasses a number of methods and approaches [Sar06]. Based on the definition of the development goals and

the clarification of reasons for the integration of users in the development process (finding of ideas, product evaluation, and validation), the manner of integrating the user—from being a passive observation object up to being an independent innovator—has to be concretized. In addition, the target group must be defined. Decisions on the type of user integration that take into account the objectives lead to indications in which development stage the user's expertise is necessary. Summarized representations can be found in [Rei04, Fic05] for example. User participation sets the framework for integrating knowledge and expectations of users into the development process, thus supporting the transformation process. Difficulties arise from the used product models. The user can only partially access its functions, usually he receives explanations from the developer, because the models or prototypes are not intuitively interpretable. In addition, the test situation does not correspond to the real usage in everyday life. In total, this can lead to a falsification of results.

The methods of the UX research support the transformation process between user and developer. The aim here is to determine the usability of a product [DIN11], in particular affective, emotional, and psychological effects of its use. Hassenzahl refers to this as the "adventure of the user" [Has15]. UX research is not clearly delimited. Similar to user participation, UX comprises a set of methods for recording subjective aspects of product usage. Difficulties result from the absence of a human model on which the results can be evaluated. Ultimately, it is not clear which aspects or functions contribute to a positive perception of the product.

Last but not least, acceptance research provides numerous models that explain or predict the acceptance of products. A summary can be found, e.g., in [Bir14]. Based on the "Theory of Planned Behavior" many acceptance models were developed. According to Venkatesh [Ven00], the most important ones were integrated into the "Unified Theory of Acceptance and Use of Technology" (UTAUT). Acceptance is referred to as the behavior of the user when actually using the product. Common for acceptance models is that all relevant direct and indirect factors influencing the acceptance are known and considered. Nevertheless, it is not possible to make conclusions for the product resp. the functionality of the product. Thus, it is not possible to deduce how the product has to be changed in order to increase its acceptance, but predictions and assessments can be made with regard to its acceptance.

4 A Method for Describing the Everyday Practice of Human Beings

With the methodological approaches mentioned above, the significance of the product functionality for the user can be described, whereby the user is more or less taken into account as an individual only. However, these methods focus on product use. Here, a method for describing everyday practices is presented: The object of investigation is first of all routines of action in everyday life, and patterns in the conduct of life are to be recorded. Based on this, it is important to determine to what extent and

where technical support is accepted and can be integrated in these daily routines. From this, it is necessary to derive functionalities, specifications for functionalities in the product as well as completely new ideas for technical assistance in everyday life.

Within the scope of a research project the everyday practices of elderly people in the home environment was investigated. A method for context-integrated, practice-oriented needs analysis (KPB methodology) has been developed, which consists of a set of qualitative survey methods and is based on sociological approaches to lifestyle and practice theory. This method is adaptable to a lot of other situations in daily life.

The everyday way of life is understood as an active achievement of a person, who is characterized by a high degree of habits and the spatial-material context. Everyday life does not take place "automatically", but is actively designed, whereby the process usually does not take place in a highly reflexive manner, but rather routinely and, as a rule, evades consciousness.

Another foundation is the theory of practice [Pon16]. From this perspective, the practical way of life is the central point for technological development, as it is the concrete "place" where support needs to be manifested. It is assumed that the use of technology should not "disturb" the familiar routines of everyday life. Something new is often encountered with a defensive attitude when it interrupts long practiced daily routines. From our point of view, this defensiveness should therefore be seen as a quasi "natural" reaction and not as a lack of willingness to innovate by the users. If one takes the practice theoretical argument seriously, then the direction of product development is given: systems should be developed which can be integrated into the existing lifestyle as easily as possible and which possess a high degree of practicality (see also [Bir16]). Then, there is a good chance that they will be accepted. In order to achieve this goal, day-to-day practices must first be identified and described.

For data collection, a set of qualitative survey methods has been composed. The first study focused on supporting the lifestyle of older people, since aspects of everyday routines are very pronounced here. 23 elderly, physically handicapped persons were interviewed twice. They are designated as research partners in the sense of a participatory research approach. The basic idea was to establish a triangular relationship between researchers, research partners, and the research topic "life management" in order to reflexively develop and analyze the latter in a joint dialogue.

The data collection was carried out in the domesticity of the research partners, which allowed the systematic inclusion of the material context. Verbal survey methods such as interview, think-aloud method and reflexive dialogue methods were extended by elements of field research in the form of practical demonstrations. The first visit served to provide a comprehensive overall picture of the respective life situation. Essential parameters of living conditions such as material equipment, living environment, health situation, social integration, and education were asked for in a guideline-supported interview. At the same time, the initial interviews served to create a sustainable relationship of trust.

After the introduction, the focus was on the practices for dealing with everyday life. Since lifestyle is largely made up of routines, the main task was to make this to the object of conscious reflection; these should be evaluated by the research partners

in terms of their difficulty in solving problems. Contrary to expectations, it was not easy to identify areas that seemed problematic from the subjective point of view of the elderly. As a rule, they had developed individual, sometimes highly creative handling strategies in order to cope with their limitations. Their competent "answers" sometimes concealed the underlying problems, which led us to systematically collect the handling strategies as well.

During the second visit, the focus was on handling strategies. Based on the trusting, equal work alliance, the elderly showed great willingness to demonstrate in practice how they deal with their everyday problems. This allowed us to understand problematic items in more detail, which formed the basis for finding ideas for technical solutions. Also, from the point of view of the research partners, the practices were not necessarily good solutions, since implementation was often associated with additional efforts and sometimes entailed considerable risks. In this respect, it can be expected that technical support aimed at these practices will have a great chance of being accepted. A detailed description of the methodology can be found in [Bir16].

5 Results and Implications for Product Development

5.1 Socio-scientific Results

A central finding was that we did not identify any problems, but always identified already "worked on"problem situations. The older people had cleverly and imaginatively developed strategies and practices to cope with the age-related limitations of everyday life. These practices were sometimes very simple and often not even visible at first glance. Nevertheless, they formed suitable "answers"to individual limitations often realised by using the simplest domestic inventories. Analytically, it is possible to differentiate between five different practices.

So-called *body techniques* are often used. Older people develop and establish, partly intentionally and partly unconsciously, physical handling routines in dealing with their challenges. One of the respondents had consciously developed a special body technique for climbing stairs. She entered the stairs diagonally and with both hands on the railing to slowly push her way up and down the stairs. If the potential of one's own body was not sufficient for the execution of everyday actions, its *enhancement* as a form of "technical upgrading" took place. This could be the walker, which allowed a person with limited mobility to cover distances, or the walker used as a means of transport. Another common technique was *empowerment*. Many older people consciously trained their existing skills to keep them stable. This could be the gymnastics in front of the TV set, but also climbing stairs or memory training on the computer.

And when the problems could no longer be overcome on their own, *social support* was actively organized, partly by their own children, but also by formal service providers who left their social environment untouched. We found changes in the

material environment to be particularly important, especially because we often did not notice them at first glance. It was only gradually that many small, spatial adaptations were discernible, which the older people had to face in handling with their everyday life. An example: An elderly woman had "crammed" her hallway with furniture to hold onto them while walking. This "Furniture Walk" does not correspond to current considerations on accessibility, but can be an effective strategy to move forward.

5.2 Conclusions for the Engineering Perspective

Our quintessence from the qualitative survey: not problems, but the ways of dealing with them should form the basis for technical developments. What this means in concrete terms can be shown on the basis of the discussions on routines for action and a support hierarchy.

5.2.1 Importance of Action Routines

The focus of investigations lays on elderly people who live in their home environment and manage their everyday life largely independently. One of the most important findings was that their everyday life is determined by routines of action. Routines of action are defined as activities of everyday life that remain stable for a certain period of time and provide people with a framework for action [according to Has15]. They have generally grown over a long period of time. The fact that they are highly valued by the elderly can be attributed to the fact that they give structure to life and thus relieve the strain on action.

Strategies that older people use to deal with their everyday challenges and problems have also proved to be forms of action routines. These handling strategies can be tedious and involve considerable difficulties. Nevertheless, they are still capable of solving the respective problems, which means that they are no longer interpreted as problems by the elderly themselves. The development of routines is usually carried out creepingly, adapting to the restrictions that increase over time. In view of growing restrictions on mobility, an elderly person increasingly limits the amount of living space he or she uses by staying only in certain places, so-called "residential islands", which are easily accessible to them and which have been adapted to their needs.

In order to implement supporting technology systems in the everyday life of older people, it is necessary to adapt them to prevailing routines to make them being accepted. On the one hand, their ignorance casts doubt on the still existing competences of the elderly, what is usually seen as stigmatising. On the other hand, it does not correspond to the subjective problem definition of older people: if they perceive a problem as being overcome, their willingness to use technology to solve the problem will be small.

However, there is one exception: crises or incisive events such as a stay in a hospital, a move-out etc. lead to a break with routines that have been used up to then, with the consequence that in these situations new things—such as the use of technology—are more readily accepted.

5.2.2 Considerations for the Design of Technical Support Systems

The three-level support hierarchy outlined above [Pae12] has been confirmed and implies the following conclusions for technical systems.

Technical Systems for Training

At the first stage, technical systems can contribute to the independence of older people by motivating them to train their existing physical and cognitive abilities resp. to help practice these abilities. This level precedes practical everyday actions. This form of technical application corresponds to the empowerment (Sect. 4), which older people often choose as a conscious strategy to manage their everyday life even in the future. They want to maintain or strengthen the forces and abilities necessary for their routines of action. At this point, the engineer's knowledge of everyday routines is of secondary importance. The design of technical systems with regard to functionality can be relatively free, but the development of systems requires knowledge of competences and capabilities, their limits, and knowledge of the mechanisms by which these competences are formed. This appears to be possible only in close cooperation with somatically-centered departments such as medicine, gerontology, and sports methodology. Training support equipment should also take up aspects of the "Joy of Use" in order to generate positive success experiences.

Technical Systems to Support Everyday Actions

Technical systems can be used in a supportive manner on the second stage by assisting the implementation of problematic everyday practices and coping strategies. They can take over parts of everyday routines, make them easier or reduce the challenges of the material context. It is essential here to orientate oneself strictly to the daily routines, so that the technical system can be integrated without any significant effort and without the disruption of the routines. Only then an acceptance by the user can be expected. The functions of the technical system must always represent the action routines or parts of them. There are three forms of assistive technology.

Enhancement describes supporting systems worn directly on the body, such as hearing aids. These are connected to the body before performing the action. The user is supported during the action, but does not have to worry about the system. The product is only removed after the end of the action. According to the intensive interrelationship between technology and human, the product must be able to react to variations in the action routine resulting from the operating conditions—ideally without the user noticing this.

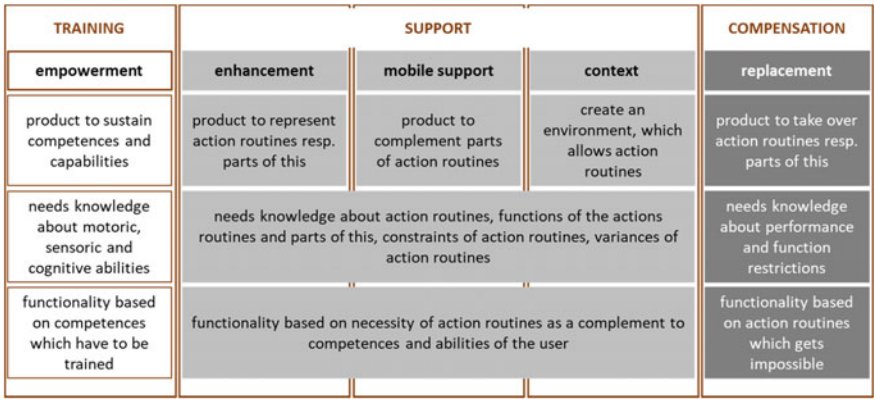

Fig. 1 Specification of the support hierarchy [Pae14]

Mobile devices describe systems that are not permanently connected to the user or the environment. One example is the rollator. Mobile supporting systems allow the user to gain more freedom, since they are only activated when required. This gives the user more freedom to use his or her own competences. The device is only used if the action is particularly strenuous. This can be associated with limited spatial or temporal availability.

Changes in context describe support systems that are firmly attached to the environment, such as handles in the bathroom. This means that the systems are also available for other users, but are less flexible and can only be used at the specific installation location. Such approaches appear to be effective in the home environment, but they also require an analysis of the routines of action.

Technical Systems to Compensate Lost Abilities

The use of compensatory technology on the third stage only becomes necessary when a requirement of everyday life can no longer be met even with support. But here too, the use of technology can contribute to enabling an independent life within one's own four walls. In this situation, the way of life has to be adapted accordingly, which means a deep cut in the user's lifestyle. The decision for compensatory technology is usually triggered by a crisis situation such as hospitalization or (further) illness. It is to be expected that technical systems that are considered in such situations will be accepted the better they can be integrated into remaining routines of action. Nevertheless, this form of technical support can be conceived relatively free from the routines of action. The decisive factor is the function to be fulfilled, which the user can no longer execute independently. These findings are illustrated in Fig. 1.

6 Conclusion

Technical systems can provide an important contribution to support people in their individual lifestyles and thus maintain their quality of life. However, the developer has a great responsibility in the development of technical systems to assist the user. It is not a matter of replacing skills, but of providing targeted support for actions in everyday life by means of technical systems. In this sense, the developer must understand the life and action situation and take this into account in the description of the target system and the requirements. The above contribution is intended to provide suggestions for this.

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