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LONG PAPER

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Five qualitative research methods to make iTV applications universally accessible

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Abstract Television is a powerful media with a strong influence on the lives of the individuals and their behaviour. As new interactive technologies are being developed and marketed with the home as the main market, this creates an effect on domestic activities. This paper is a description of five qualitative research methods applied to the field of interactive television (iTV) application design and evaluation. Overall, the reported work is unique in the young field of iTV, due to the range and variety of the applied methods, some of which are quite novel. The aim of the conducted research was to find techniques to meet TV viewers' future needs and to provide examples of future product concepts. Several techniques were used, including user study based on the "cultural probes" method, interviews, focus groups, design sessions, usability testing, and storytelling. The methods have been applied to average users not concentrating on specific user groups such as the children or the elderly, but these same methods when applied to specific user groups can help finding out about accessibility problems in the quest to achieve universally accessible iTV applications. There are also valuable results from including a group of TV producers in the design sessions to find new concepts of iTV programs. The implications of this paper for the HCI community concern gathering the user data and transforming the results into new product concepts.

Keywords Interactive television · User research · Concept design · Qualitative methods · Usability

1 Introduction

Interactive television (iTV) and the availability of interactive services and applications is part of routine TV viewing today. ITV as a phenomenon is neither new nor untested, as there are experiences and consumer responses to iTV from the 1970s to the 1990s and until the present day [9, 25]. A lot of recent results from studies with TV viewers are available, many of which originate from the UK. For example, there is an extensive TV viewer study for over a 5-year period [23], ethnographic studies of the use of interactive services and home technology products [44, 56], and a personalized TV listings service [57, 67]. There is also an attitude based consumer segmentation to better understand usability and other issues associated with iTV uptake [22], a study on how the television can adapt to groups of TV viewers rather than to individual TV viewers [48], and an experiment to enhance the traditional broadcast television and recent interactive TV shows with collaborative virtual worlds [1].

Outside the UK, there are documented user experiences of iTV, such as a study of television use and TV viewers' attitudes towards new interactive services in Denmark [4, 60], user experiences of interactive video documentaries and other interactive services in Italy [51] and Portugal [13]. There is also a categorization of Japanese TV viewers based on their actual viewing behaviour [29], a Swedish study of multimodal input for iTV [2], and results from usability testing of interactive services in Spain [11] and Iceland [31]. From Finland, there is a set-top box trial to define users' attitudes and experiences with regard to digital television [39], a trial of mobile television prototype broadcasting over wireless networks [70], experiments with streaming mobile video [63], and several usability and user studies on applying qualitative methods in application development for iTV [16–20].

1.1 Accessibility for all iTV users

ITV should provide universally accessible services and applications for all user groups. Accessibility for entertainment technologies and equipment is not only just

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about making sure somebody can operate a service, but also about finding out what services everybody, including the disabled and elderly, might want to use and how these services can improve their quality of life.

New research and design methods can help in the development of usable and acceptable technologies. For example, children and older adults are user groups which will benefit from personalized programs and applications. At the moment, older adults are an increasing user group, as it has been estimated that in Europe the proportion of people aged 60 years or more will increase from 20% in 2000 to 35% in 2050. At the global level, the number of people aged 60 years or more will rise from 606 million in 2000 to 1.9 billion in 2050 [61].

Of all user groups, the elderly are the biggest consumers of television. For example, in the UK, the elderly watch television on average more than 5 h per day. The elderly are active users of the television and therefore it does not appear that age alone is a strong predictor of a person's willingness to interact with the new technology. It has been indicated that the decision to accept or reject a new technology is a complex one, determined by interrelated factors such as perceived need, socio-cultural influences, and the design of the new technology [12]. Efforts to involve the elderly with computer games have revealed that the positive benefits of games include enhanced social interaction with other elders through friendly competition and the feelings of success and achievement. The feelings of accomplishment are important as they have an influence on the self-concept of the participant. In fact, the two main factors affecting the quality of life in an old age are independence and engagement. Independence is based on one's ability to exercise control over one's life—the capacity to care for oneself and to make one's own decisions. Engagement is connectedness to the world and to other people, it is the ability to share experiences and friendship, to communicate and to share resources.

In conclusion, there is a need for universally accessible iTV applications which put emphasis on TV viewers' connectedness to other people. There is an example of a study focusing on how Internet and existing technologies could support online communities for the elderly and children [14] and a study on technologies to support recreational socializing among older adults [62]. The objective is to use the experiences from Internet applications to develop universally accessible iTV applications and technologies which enhance the lives of all user groups.

1.2 Home environment

The home has become a very important and significant site for technological development, including the television. In the 1950s, the concept of home was defined as an activity centre. Most early technologies for the home were targeted towards specific household activities such as cleaning, cooking, laundry, and other duties where labour or time could be saved. With the introduction of television in the late 1950s and early 1960s, the home became an entertainment centre. In the 1980s, with the arrival of PCs at home, it became possible for people to work at home, marking the beginning of the home as a work centre. In the 1990s, new media, and the Internet in particular, began to transform the home even more. Today, the home is viewed as a shopping, learning, communication, and information centre [73].

Human computer interaction research and HCI methods have expanded from research at the workplace to domestic and mobile environments, from research of productivity tools to entertainment and non-utilitarian activities. Design for the domestic environment has shown that the concepts of "productivity" or "efficiency", which may be described and achieved in terms of "plans", "procedures", and "workflows", prove to be too straightforward for the domestic environment. As the domestic environment is a scene for new interactive technologies, the design of new technologies needs to integrate knowledge of the cultural context, the social character of the domestic environment and the user experience of a broad range of users. For example, it is known that entertainment technologies and labour saving devices tend to privatize domestic space and isolate household members from one another. Early studies have shown that PC use at home has resulted in decreased time spent with the hobbies, sleeping, watching TV, outdoor recreation, and the leisure time spent with family and friends [74]. Designers are therefore challenged to produce technologies that will help restore the eroded social connections.

1.3 ITV applications

Over the years, there have been fundamental changes to television technology since the first black and white broadcast in 1936. First, the introduction of colour television was achieved by adding colour information into the existing black and white signal, which resulted in slow upgrade of TV sets during the 1960s. Similarly, teletext information was added into the signal. Lately, the cable, terrestrial, and satellite operators who own television transmission platforms have changed their old analogue technologies with digital systems that make iTV applications and more TV channels possible. Digital transmission in general is less vulnerable to signal interference than the analogue. Yet with digital transmissions, more information can be sent to TV viewers in a given piece of bandwidth due to data compression. Bandwidth efficiency has led to the growth of iTV applications and services on digital television transmission platforms [25]. The world's first DVB-T terrestrial television service was launched in the UK in 1998, followed by Sweden in 1999 and Australia in 2001. In Finland, DVB-T transmissions with MHP were launched in 2001, and MHP set-top boxes were available for

the Finnish TV market in 2002. In August 2004, already 360,000 Finnish households had the digital set-top box (15% of the total of 2.4 million households), and 11% more had intentions to get one during the next 6 months [68].

The first public teletext and videotext systems in the UK and France were introduced to the TV viewers during the 1970s. In the USA, TV viewers were able to participate in votes and surveys. During the 1990s, many trials of different iTV application types were tested on a small number of customers, after which they ended disastrously due to the heavy cost of technology. The first examples of the so-called two-screen iTV appeared in the USA on MTV channel and in the UK on Channel 4. Live computer chat rooms were put on-screen during the TV programs, and TV viewers used a PC at the same time as they were watching TV [25]. In France, Television Par Satellite was the first broadcaster to launch digital interactive services commercially, followed by Canal+. In the UK, Sky Digital launched digital satellite TV in 1998.

Digital television, along with various iTV applications, is changing the traditional consumer experience of television watching. Examples of iTV services and applications include Web browsers, email applications, and games which are located in the set-top box. Online services such as online banking and online games are downloadable applets available from the Internet via a modem in the set-top box. There are also iTV applications broadcasted together with the TV program such as online polls and interactive advertising.

The most popular iTV application is the electronic program guide (EPG). The EPG has two important functions. First, the EPG shows TV program listings with program information; second, the EPG helps the TV viewer to find the favourite TV shows and select any new interesting programs. EPGs aim at reducing the problem of information overload by providing program listings and schedules by program genre, title, or date. If an EPG provides recommendations to the viewer, these are in most cases based on quantitative information gathered from user preferences. In general, personalized EPGs differ from traditional, static EPGs in that the viewer's long-term interests, or information needs, are described in means of updatable user profiles, rather than ad hoc queries posed to the static EPG. Problems related to user profiles concern the means to generate an initial profile for a new viewer, and updating an existing profile over a period of time [40].

Figure 1 shows a screenshot of an EPG. The area on the left is a scrollable list of available TV programs. As the TV viewer moves the cursor on the left, the program information of the selected program is updated on the right. The live TV program is part of the user interface.

Some personalized EPGs recommend programs based on TV viewer's past behaviour with the system [43], while others take into account the past viewing history of the whole household [7]. Family filtering in this case is a result of the TV watching being a family

Fig. 1 Electronic program guide

event, and thus requiring the recommendation system to represent and adapt the individual preferences of the family members, and this without the need for user identification [26]. For this specific recommender system, TV viewers first graded all the program categories and told what is the probability for them to be in front of the TV in any given 2-h slot. The TV viewer stereotypes were then classified according to age and occupation groups.

Personalized news applications like news on demand (NOD) are an example of video on demand (VOD) applications. NOD applications are designed to address two problems: First, how to find news and other related information that is of importance to the viewer; second, how to provide this information when it best suits the viewer. For example, viewer's information queries can result in the construction of individually tailored "personalcasts" or video stories which combine information from multiple broadcast news sources, personalizing the content to viewer's information needs [49]. There are also media spaces which combine content from TV and the Web, such as sports scores, traffic news, local events, and financial news. The TV news stories are processed, stored, and prioritized on the basis of both topics of interest listed in the user profile and on cues TV broadcasters use to indicate the importance of a story [77].

A step beyond iTV applications providing personalized media spaces are personal video recorders (PVRs) which store the video content in the set-top box on the consumer side. PVRs are set-top boxes with hard drives capable of storing several hours of video. They make viewers able to collect and create their own personal video archives. Some PVRs, or rather DVRs (digital video recorders), include iTV applications presented here earlier like an EPG. Examples of DVRs are BSkyB's Sky$^+$, DIRECTV's DVR, Nokia's Mediaterminal, ReplayTV's DVR, and TiVo Inc.'s DVR. From the point of view of the TV viewer, the usefulness of such

a multimedia database is measured by the retrieval facilities it supports. The viewer must be able to quickly navigate in a non-linear manner through video programs at a much higher speed than fast forward and reverse features allow on current VCRs.

Many television service providers are also Internet service providers (ISPs). They provide Internet access through the TV, instead of through a PC. TV viewers access Web pages with a built-in Web browser in the digital set-top box like Nokia's Mediaterminal. It is also possible to get Internet on TV with a separate set-top box or a receiver like Microsoft's MSN TV which includes Web on TV, email, chat, and shopping applications. The drawback of accessing Web pages through the TV is that many Web sites don't look good when viewed on TV, as they have been designed for viewing on a PC. In general, Web graphics and layouts look small when viewed from 2 m away on the living room sofa. Also the remote control is not well suited for user navigation compared to a mouse. Therefore, the Web sites should provide a version of their Web content designed separately for TV viewers.

Applications presented so far have mainly concentrated on gathering and presenting information to the TV viewer. In addition to information related applications, there are also applications related to entertainment, edutainment (entertainment that is intended to be educational), and competition. Examples of such applications are online applications and TV quizzes appearing on the screen while the program is running or shortly afterwards. These applications attempt to make programs more interesting to watch. The graphical and text overlays which appear on top of programs give viewers at home an opportunity to try to answer questions from a range of answers that pop up on-screen before the TV quiz contestants answer these same questions in the TV studio. In the case of quiz shows, the TV viewers' scores can be recorded so that they see how they are doing in comparison to the studio contestants.

TV games have traditionally been played by purchasing a TV game console like Sony's PlayStation, Microsoft's Xbox, or Nintendo's GameCube. TV games can range from fast-action arcade-style zapping to strategy and word games. Games have universal appeal and therefore have always been one of the most popular forms of iTV content. Games' interactivity allows a continuous stream of challenging and competitive situations that have to be resolved by the players. Competition is therefore regarded as a key element of the explanation of players' entertainment experience [75]. Also other characteristics as curiosity and players' use of fantasy in video game play are of importance. There are evaluation and usability testing methods for games [58].

2 Usability

Usability relates to the effectiveness and efficiency of interaction among users, their tasks and the task environment. Usability has been defined as the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use [33]. Usability has multiple components to be systematically approached, improved, and evaluated. Usability is traditionally associated with and can be measured in terms of a number of attributes, including learnability, efficiency, memorability, frequency and severity of errors, and subjective satisfaction [52].

The ISO 13407 standard specifies an iterative cycle of four activities for designing usability [34]. These four steps are:

1. Specify the context of use
2. Specify the user and organizational requirements
3. Produce design solutions
4. Evaluate designs against requirements.

Ongoing standardization work aims to further the usability concept established in ISO 9241 and to tackle usability issues of everyday products, or consumer products and equipment used by the general public [35]. The aim of this proposed standard is to provide guidance on how to design products that can be used intuitively and to specify the usability information to be provided with a consumer product so that the purchaser can judge the ease of use of a product at the time of purchase.

2.1 Television usability

The use of entertainment equipment differs from the use of equipment meant for productive purposes, such as the PC in the working environment. Mainly, watching the television as a leisure time activity is not composed of tasks to be accomplished or distinct goals to be achieved as is the case of products for working. Good usability is important, as TV viewers are not interested in problem solving during their leisure time. Television usability can be seen as a step further from the traditional PC usability and the more recent Web usability. For example, the TV set is located far away from its viewers as the distance between viewers' eyes and the screen is typically 2–3.5 m. There are special constraints on screen resolution and the user interface layouts, as the TV screen is not good at displaying detailed images. Activities in the rest of the room will easily distract viewers and the on-screen content will have to be more attractive to get attention compared to content on a PC screen. Both the amount of information in sight at a given moment and the number of user selections must be decreased.

ITV applications have resulted in a need for intuitive user navigation and simple remote control devices. In the past, channel surfing was performed by "thumb navigation" in which TV viewers hold the remote control in one hand and pressed the buttons with a thumb, with 69% of the remote control button presses used for

channel surfing [45, 46]. For iTV applications, there is now a cursor on the screen which the viewer moves around by pressing the arrow keys, completing the selection with the "OK" key. User navigation can also be implemented with the four colour keys (Red/Green/Yellow/Blue). If navigation is not intuitive, the viewer is forced to look away from the screen to check the remote to be able to navigate—which can be time consuming and annoying. In general, pointing at and selecting items with a remote consists of a sequence of actions that have to be planned and monitored with a much larger degree of cognitive load compared to pointing and clicking with a mouse.

Most of the living room TV watching happens in a group, and thus iTV applications intended for use during group-viewing times should take this into account. Television related social behaviour causes TV viewers to want to get what they need from the applications quickly and easily, during advertising breaks and boring bits, or when waiting for the next program to start. Enabling quick access means that interactivity is less likely to annoy the rest of the people watching. Unobtrusive user interaction can be achieved, for example, by using inserts rather than taking up the whole screen. It is also important to let the viewers preserve the context of use which is watching the TV show. The context can be preserved by using inserts or by overlaying information on top of the screen using semi-transparent graphics rather than solid graphics.

Usability testing of iTV applications provides valuable feedback to application developers. Usability testing is carried out not only to measure the usability attributes to find out the system's overall usability, but also to gather information about the different types of viewers that are likely to use the services, what they want, how they live their lives, and what will be easy for them to understand on-screen. As an example of such a usability test, there is an early study of testing a group of EPG, weather channel, and telebanking applications [11]. The study consisted of a set of tasks for the study participants to perform, a structured interview, and a questionnaire about difficulty, speed of the system response, help for navigation in sight, and aesthetic appearance of the applications. Usability testing has also been applied to a set of VOD, NOD, and Web browsing applications [31]. TV viewers have also been involved in usability testing of animated characters and dynamic advertising while watching music videos [10]. There also exist guidelines for usability testing [59].

2.2 Qualitative methods for iTV design

User research is an attempt to find answers to questions such as who the users are, which products and services they are using, how do they use them, and which attitudes do they have towards the future. Qualitative user research aims to reveal the underlying ideas, descriptions, and understandings of the events not evident on the basis of, for example, quantitative research. Quantitative surveys and questionnaires do not try to explain why events happen or what something means. During qualitative research, the researcher herself acts as a research instrument in the process of selecting the research method, gathering the data, analysing the data, and evaluating the results. The researcher is an essential tool, as the gathering of the data is often intertwined with the analysis of results.

Qualitative research can complement quantitative research in a variety of ways. By providing a meaningful context, qualitative data can inform the content and language of more structured questions, therefore making the quantitative data from user surveys better applicable. Without any qualitative research to provide context, the validity of a user survey can be seriously flawed. Researchers may find out after sending out hundreds of surveys that they have been asking the wrong questions or using terminology the respondents do not understand [5].

The two most important qualitative user research methods applied are interviews and observations. Observations are carried out in the users' environment to gather information about users' tasks and the context of use. This information leads to understanding the users' goals during task analysis [28]. Other qualitative methods include ethnomethodological studies, action research, focus group studies, diaries, photographs, and storytelling [21, 72]. Also life histories and biographies, cultural reviews, self-evaluations, and simulations have been applied as research methods [66]. It is evident that there is no universal methodology that would suit every given situation. Usually, qualitative researchers utilize a combination of methods. For example, researchers visit users at their working environment or leisure and observe them as they carry out their tasks. However, observation alone does not explain why people behave the way they do, and it is recommended to make interviews to let people themselves give an interpretation of their behaviour. Researchers can then consider these interpretations and observed behaviours as they analyse the findings.

Interviews help to obtain rich data for building theories that describe a setting or explain a phenomenon. It takes a lot of time, flexibility, and effort to succeed in the interview process. Interviewers must find and recruit interviewees, coordinate schedules, secure equipment, generate quality questions, arrange the interviews, inspect and analyse the data, and produce a concrete outcome. The interview method is an example of an interaction encountered in everyday life, an encounter with strangers and therefore the interview results depend on how this interaction takes place. The interviewee might give false interpretations of her own behaviour, and the interviewer might have biased preconceptions of the content and quality of events emerged or of potential problems. It has been recommended to share the research results with the interviewees in order to get feedback and to make research projects more visible

[14]. There are different interviewing techniques available, such as contextual interviews, critical incident interviews, focus groups, and usability roundtables [3, 8, 28].

A focus group is a group discussion organized to explore a specific set of issues. A focus group study is a short-term research method which often brings out users' spontaneous reactions and ideas. Focus group sessions produce a lot of information quickly, including users' vocabulary, and they enable the study participants to discuss several alternatives simultaneously. Focus groups also reveal thoughts and preferences of "power users", as advanced users sometimes face needs that will later be general in the marketplace [54]. Focus groups originate from market research, but they draw stimulus from sociology and focused interviews. Focus group sessions provide information about group dynamics and organizational issues. Holding separate sessions with several but contrasting homogenous groups is believed to produce information of greater depth than with several heterogeneous groups. The planning and design of focus groups consists of making decisions on the development of the group agenda, the balance of openness and pre-structuring, the role of the group moderator, recruitment methods, and the group composition. The collective activity in the focus group takes place in tasks such as viewing a film, evaluating a set of statements, or simply debating a particular set of questions. Focus groups can be applied for gathering feedback on product concepts [65] or user requirements [41]. The preferred focus group size is from four to eight participants [21].

Ethnographic studies are a qualitative research method which aims to develop a thorough understanding of users' current work practices or leisure time habits. Ethnographic research is based on field trips, and the traditional field methods consist of observations, contextual interviewing, note taking, and video recording. The research takes place in natural settings and it develops a descriptive understanding as opposed to a prescriptive one. Ethnographers describe how people actually behave, not how they ought to behave [6]. Ethnographic research is a time consuming approach, consisting of arranging the field trips, collecting the data and analysing the material. Given limited time in the field, the researchers can constraint the research focus and scope, use key informants, use multiple observers or interactive observation techniques, and apply collaborative data analysis [50].

Storytelling is an approach to describe and understand user activities in context [32]. Ethnography, interviews, and focus group studies often result in stories. They are the first artefacts to describe user interactions, user's intentions and motives, and contextual information. User stories are specific, concrete examples of what the results of the user interaction should be. Texts of personal experience disclose the scene and plot, the dimensions of place and time. Plot, meaning, and interpretation are far from straightforward, as a story can have many viewpoints and a complex structure [64]. Stories often communicate important themes that explain a topical or cultural arena, or they arise from the individual's need to give an explanation to a personally significant event. Stories can also act as a design communication tool, and storytelling made by designers can help to model and design HCI systems [15, 27].

3 EPG usability study

A usability study of two EPGs was conducted to find which user interaction features contribute to usability in iTV environment [20]. The study concentrated on information searching on EPGs and navigation. The aim of the study was to test which of the two user interface approaches, prototype A or B, was more applicable in iTV environment. Both user interfaces were implemented for the purposes of the study. The prototypes were implemented with the aid of the Macromedia Director multimedia authoring program. The prototypes included an 8-day television program information database of 12 TV channels. Short videoclips simulated the 12 live TV shows. The output from a PC was shown on a TV screen with the aid of SCART connector to a graphics card. The estimated workload for the prototype implementations and the usability study was 12 man months. The three-member team included a usability engineer, a graphical designer, and a multimedia programmer.

A screenshot of prototype A can be seen in Fig. 2. Program types are a scrollable program list which provides information about selected TV program types. As the user moves the cursor on the program types on the left with the remote control buttons, a list of related programs is updated on the right. There is a live TV show on the upper left corner of the screen. The three navigation buttons "Back", "Down", and "Up" are

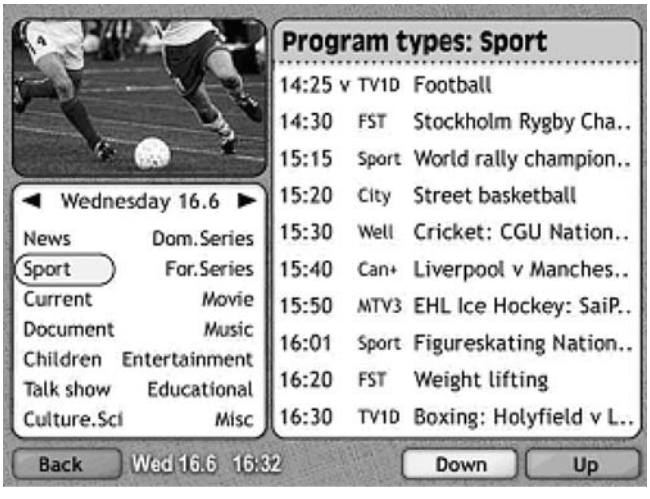

Fig. 2 Prototype A: program types

activated with the colour keys on the remote control (Red/Yellow/Blue).

The prototypes were usability tested in six test sessions. The number of sessions was kept small, as it is known that five or six test sessions allow finding the majority of user interface problems [53]. The usability test setup included a TV set, a remote control, a PC, an infrared signal receiver, a video camera, and microphone. Video recordings and notes were made during each session for later inspection. During the sessions, the thinking aloud evaluation protocol was applied to provide insight into study participants' intentions. Every study participant completed four short tasks with both prototypes. User preferences and development ideas were collected in a brief discussion afterwards.

3.1 Results

The usability study of two EPGs revealed information about navigation in the television environment and information searching in EPGs. Study participants completed four short tasks with both prototypes A and B:

1. "What's on 'WSOY' channel at the moment?"
2. "What's on 'City TV' channel tomorrow at 21.15?"
3. "In your opinion, what is the most interesting sports program the day after tomorrow?"
4. "You want to see a film called 'Chain Reaction' that starts on the 'Movie' channel tomorrow at 00.00. Almost at the same time, at 23.20, a movie called 'Weekly Western' on TV2 channel starts. Please take a look at the program information of both movies. In your opinion, which of the movies is more interesting? Why?"

The first two tasks cover information searching, the third task concerns information evaluation, and fourth task concerns information comparison. These types of information needs are likely to occur in everyday life. Additional short questions gave more insight into study participants' intentions and thoughts: *"Please explain how you got to this page"*, *"Please explain what you are watching right now"*, and *"Please explain how the system works as a whole"*. At the end of a test session, user preferences and development ideas were collected in a discussion.

The usability study revealed that, in general, the study participants were not interested in finding some specific TV program information. Instead, they wanted to browse through all the channel information to get a general picture and find out whether there will be something interesting on TV tonight. One study participant wanted to have his "favourite four channels" option on EPG that would provide him with four TV channels in parallel for a comparison. This study participant also wanted to modify the TV listing by erasing information of the pay TV channels he was not subscribing to. User navigation was implemented with arrow keys and colour keys on the remote control. In general, study participants did not like to switch the navigation from arrow keys to colour keys and back. They examined the arrow keys before considering the colour keys.

On the average, it took 22 min for the study participants to complete the four tasks with both prototypes A and B. It is therefore concluded that the prototypes were equally fast to use. It must be noted that the thinking aloud evaluation protocol does effect measuring the time in completing each task. The time estimates are therefore only indicative as to show if there were serious usability problems.

The presence of live TV show was however a reason for some study participants to say that *"prototype A is more like a TV and prototype B is more like a PC"*. Some study participants preferred prototype A over prototype B as it included the live TV show. According to a study participant, *"You don't want to lose what you were watching at (when accessing the TV program information)"*. It is also noted that the study participants read the textual information on the program listings carefully and when in doubt, the study participants first examined the textual information on the TV screen with the arrow keys and only after that they turned to colour keys. Furthermore, the study participants had an erroneous assumption that the colours seen on the TV screen were in connection with the colour keys on the remote control. This was not always true, but the finding proves that both textual information and the mapping of user interface colours to colour keys on the remote control could help implement easier user navigation.

4 Focus group study

The focus group study aimed at creating an understanding of TV viewers on the basis of both quantitative and qualitative user research [19]. The study had two goals. First, to reveal specific data on selected TV viewers' expectations and preferences for forthcoming digital TV services, and second, to formulate initial user grouping for digital TV by adding new qualitative user data into the existing user group data.

A user grouping exists that had been formulated in questionnaire studies by Suomen Trenditieto Oy, a company providing research and counselling services in the new economy. Between 1997 and 2000, the neural network oriented study gave eight user groups as a result [69].

Three of these eight user groups which were thought to be most interested in interactive services and new media were selected for the study. The aim of the focus group study was therefore to reveal specific data on these three groups' expectations and preferences. The study was conducted in cooperation with the above mentioned research company.

Within each focus group session, a structured conversation was held focusing on study participants' current TV use and their expectations of new iTV applications to come. Altogether, 21 study participants took part in the sessions. This was half the amount of people recruited for sessions beforehand by phone. Each session included three to six study participants and two interviewers. Sessions were recorded for later inspection. Focus group sessions were held in 2000, when the percentage of TV owners among the total Finnish population was 95% and the average daily TV viewing time was 2 h and 48 min [42]. At the same time, percentage of digital TV and digital set-top box owners was 0% as the equipment was not yet available on the Finnish market.

To provoke conversation with study participants, colour printed screenshots of EPG prototypes were presented as examples of the new applications. An example of such a screenshot can be seen in Fig. 3. This screenshot shows a remote control scrollable EPG. As the user moves the cursor on the TV program list on the left, the information about the selected TV programs is updated on the right. There is also a live TV show on the upper right corner on the TV screen, and the three navigation buttons "browse", "day", and "return" are activated with the colour keys on the remote control (Green/Yellow/Blue).

4.1 Results

Focus group study results consist of qualitative user data, namely, the three updated user profiles and the focus group session recordings. The specific data on study participants' expectations and preferences on forthcoming digital TV services shows some common opinions. For example, all study participants were interested in the introduction of new technology, but they wanted to wait and see what the new interactive services can offer for them. In study participants' opinion, the purchase decision of digital TV was based on the new interactive services, not the new TV channels. Furthermore, study participants wanted to access email on TV but they did not want to read their emails in the living room in the presence of other family members.

Fig. 3 EPG screenshot shown to study participants

The focus group study results were combined with existing quantitative user data. The resulting user profiles are a valuable source of information for application developers in the concept development phase. The strength of combined user profiles is that while the unchanging data from the questionnaire study took 4 years to gather, the dynamic data from the focus group study was gathered in a few weeks. Combined user profiles are fast and easy to update when needed. This refers to, for example, easier allocation in marketing efforts. Combined user profiles can also help in tailoring a product for different customers.

An example from the "Pioneers" user profile shows that Pioneers are young people who appreciate prosperity, travelling, adventure, games, shopping, listening to music, and search for excitement. Their mean age is 21 years. Nearly half of them are students who want to get the latest entertainment electronics. Not surprisingly, going to work has no special value for them and it is only a means to make a living. Pioneers go with the new technology and they have a broad interest in chatting and playing online games on the Internet. This also highlights them among the eight user groups. Quantitative user data show that:

- 55% of the Pioneers are men
- 27% of the Pioneers live in the Helsinki capital area. Many are still living at home with their parents
- 88% of the Pioneers have access to the Internet
- 67% of the Pioneers have a home PC
- 50% of the Pioneers have a TV game console
- 42% of the Pioneers consider entertainment as their main reason for using the Internet.
- Qualitative user data show that, in general, Pioneers were well informed about the forthcoming digital TV:
- In one Pioneer's opinion, "It would be nice to get background information on sports events while watching the game. One wouldn't be at the mercy of the announcer."
- As an opinion to PPV movies, a Pioneer did not like the idea of *"Planning the TV watching in advance. It wouldn't be relaxing anymore, but (it would feel more like) work."* There was a comment that PPV is considered a good idea as video rental is difficult to use: *"It is not hard to rent a movie, but it is hard to find the time to hand the movie back to the videostore."*
- In one Pioneer's opinion, "The connection to the Internet, if it is fast and an easier way to connect to the Net, could make me do the purchase decision (of set-top box). Today, you have to turn on the PC and it is slow." "What you need the PC for if everything (applications) is on television?"
- "It would work out for me to use online banking via television for personal finance, I have no doubts about

that. There should be several televisions as not to run out of television screens when someone wants to pay the bills and the other wants to watch TV.''
- Some Pioneers said they *''Don't even have time to watch the existing channels''* (and therefore they felt they had no use for the iTV applications).
- There was also an opinion for not using home shopping as ''I rather go out for shopping (and to see other people) than to choose on the screen.'' ''You got to have the flavor of the product, (to get) some more feeling about it.''

Colour printed screenshots of EPG prototypes were presented to study participants to provoke conversation. These screenshots were examples of possible future iTV applications. The study revealed that the study participants were not able to comment on the screenshots, as some of them tried to discover how the system works while others' attention was drawn to the appearance of the application. The same need for hands-on demonstrations was identified in a series of evaluations of digital TV services [47]. In this study, the users were first accepting of visual aspects in the user interface but they then found these same features of interaction quite complex as they tried to use them in a user trial. It can be concluded that users' acceptance of an iTV application cannot be evaluated without a working prototype.

5 TV use and home environment study

The user study at the home environment was concentrated on the subject of how to bring the future users into the early stages of new product development [16]. The study had three goals. First, to gather data about users and their home environment, second, to find new user requirements, and third, to enable users to design innovations of future iTV applications for themselves.

In the early stages of new application development, designers have to find user requirements for a product the user has not seen before. Designers need to predict which tasks the user wants to accomplish with such future applications and how user preferences will change over time. The approach applied in this study was to conduct research on the use of existing, similar equipment (the analogue television) and then try to find innovations with study participants. The resulting study was a continuation of the focus group study reported in the previous section.

The study approach was adapted from a study called cultural probes, in which the focus of research was not on commercial products but on offering new understandings of technology and new opportunities through design [24]. Cultural probes as a research approach arose from the traditions of artist-designers rather than the more typical science and engineering based approaches. The primary concern was to find new ways by which the new technology could enter and affect everyday culture. Lately, cultural probes have been applied to bringing information technology to the elderly [55] and informing the design of children's technology [36]. There is also a comparative study on using cultural probes and observation in concept design [38] and a study on using cultural probes in mobile contexts [30].

The cultural probes method enables users to more directly inspire and shape new technologies. Instead of showing well established design concepts which merely create feedback on the details of the user interface, researchers apply a design oriented approach with technology probes, instruments which are deployed to find about the unknown—to hopefully return with useful or interesting data.

These probes combine the social science goal of collecting information about the use and the users of the technology in a real-world setting, the engineering goal of field-testing the technology, and the design goal of inspiring users and researchers to think of new kinds of technology to support users' needs and desires.

Ten study participants, five women and five men whose ages ranged between 16 and 78 years, gathered data on themselves and their home environment with the help of material sent to their home addresses in advance. The material consisted of an envelope with questionnaires, two diaries, several structured questions, and a disposable camera.

Figure 4 shows an example of a photograph taken by a study participant. The picture presents the study participant watching the evening news with his son. There are four children in the family and also four TV sets: *''The evening news is one of the programs by which we come together in the living room to watch the program together. The children play football, and often, if there is a football match on TV, we change the arrangements for the weekend. TV series or movies don't make such changes to our schedules.''*

Examples of structured questions are:

1. TV at home: ''In which rooms are your TV sets, VCRs, set-top boxes, and TV game consoles located?''

Fig. 4 Watching the evening news with children

2. TV program information: "In your opinion, what is the most interesting program today? How did you learn about it? When do you usually access TV program information?"
3. PC and Internet use: "What is your favourite PC application? What is your favourite Web site? Is it possible to transfer these applications to TV and would they become more interesting to use? In which ways would they be different?"
4. Family members: "In which rooms do you spend time together with the family? What activities do you do?"
5. The favourite TV program: "Select your favourite TV program. It is now your task to make the program interactive and more interesting to watch. Your innovation can be an interactive service, a game, a quiz, etc. How does it work? Do you play it alone or do you make a team with other players?"
6. TV in the future: "Your task is to tell what the TV will look like in the year 2006. How do you use it? Which tasks are performed automatically by the TV that are not automated today?"

The study participants completed the questionnaires, filled the diaries with reports of a 3-day television-watching period and took photographs of objects and events at home. They also designed innovations of future iTV applications for themselves. A subsequent 1-h interview with the researcher revealed more of the study participants' needs for specific types of information and their thoughts of the television in the future. The interviews were recorded for later inspection.

5.1 Results

The study of TV use and the home environment aimed at bringing the future users into the early stages of new product development. As a result, a large amount of ethnographic data was collected. This includes questionnaire results, diaries, photographs, users' innovations of future iTV applications, and notes from the interviews. However, the research method was not ethnographic research in the sense that the study participants, not researchers, collected the data at the home environment. The user centred research approach enabled the TV viewers themselves to gather the results, explain them, and give their interpretations as why events happened. The study participants were not mere subjects of research, but equal research partners during the study, and the results of the study present the authentic voice of the users. The study revealed information about TV viewers and their home environment, user preferences, and innovations of future iTV applications. The results were organized in four categories:

1. User profiles
2. Proposals to enhance TV programs
3. Preferences for future applications
4. Innovations of future applications.

The category 2 "Proposals to enhance TV programs" consists of innovations for enhancing existing TV programs. As it is known, a TV series can attract TV viewers to watch the same series for years. In this case, an enhancement to a program is understood as an interactive feature which will make an interesting TV program even more interesting to watch. Here are some examples of the proposals:

1. Info boxes on the ongoing TV show: "I'm interested in all references to popular culture and entertainment. It was quite interesting on MusicTV channel (a while ago) to see the info boxes running during the music videos. I would like to watch this type of information about the actors or the scriptwriter, and if there is any other productions of this type."
2. Quiz on the ongoing TV show: "I want to get an online quiz while watching the TV show. It is like a simple question (popping up on the screen), 'How many Oscars has the actress won?', or 'The winner is the one who writes SHOSTAKOVITCH fastest'. I want that type of quick interaction, so that it doesn't require you to sit down (for a long time)."
3. EPG of favourite TV shows: "It would be great to get a list of the programs I'm interested in. I often read the TV listings on the newspapers and there is nothing but the titles of the programs. I miss out (interesting programs) if they have no description."
4. Background information about talk shows: "There could be a menu of links on the screen providing the information collected when the talk show (or a documentary) was edited. The information could explicate the arguments presented during the show. For example, if they talk about the depreciation of the value of money, the graphs barely flash on the screen. Now you could click on the remote button and get them in sight again."
5. Holiday reservations on TV: "It is such a tough job (to get reasonably priced tickets for the whole family). Somebody always says he got the tickets cheaper. At present, I can make a holiday reservation on the Internet. For example, I have been to Greece and I know what it is like there so I can make the next holiday reservation on the Internet (or on TV). Internet is awfully usable for all my domestic and foreign travels."
6. Information and video on travel destinations: "You could show information about travel destinations on TV. Travel brochures include a small picture that presents the destination maybe a lot better than you find it in reality. On TV you could show extensive travel information and video."
7. Racing quiz for Formula 1 fanatics: "I would like to make guesses on who will do the next pit stop (during the race), who will stop altogether, or which car will beat another. I would get points for right guesses on the

tactics chosen and I could see the race statistics. I could also see camera shots from the pit during the race.''

Despite study participants' broad range of interests, the enhancement proposals show that TV viewers would like to get more background information about their favourite TV programs. When editing a TV show, a lot of material must be left out. This material would be of interest to TV viewers and fans who otherwise access this information in Internet chat rooms, actors' and actresses' Web pages and fan clubs, or newspapers. An iTV application could provide the TV viewer with this additional material during or after watching the TV show. The following are some examples from the category 4 ''Innovations of future applications'':

1. Start page: Study participants were asked to invent a Start page for TV with self-chosen links to information and functionality. Their preferences included: links to shops and comparison of prices, Yellow pages, TV games, voice control over TV, home banking, email and Web on TV, links to civil service departments, bus and train timetables, ticket reservations for a theater, and news on selected areas like F1 racing. The study participants also wanted to be able to read today's newspapers on TV screen, load books and magazines on TV, view family photo album on TV, get an EPG of favourite programs, DVD and video storage capabilities, and an electronic wallet that can be reloaded from the bank's Web pages.
2. HomeShop with live video: ''There is a HomeShop application with a product catalog. I first select the products from a catalog on the screen. If I need more information, I make questions to the salesperson in the shop over a video connection.'' Suitable HomeShop products are spare parts for the car, furniture, cars, books, or music.
3. SMS with a snapshot: ''I could send a snapshot to friends (taken with a digital camera or a video camera). I also want to add a Post-It type short message to the snapshot. It would work the same way as when someone wants to leave me a message on my answering machine today.''
4. TV alerts the TV viewer for favourite programs: ''The TV could turn itself on at prescheduled times and choose the TV program type according to the time. It is a certain timer! I want to preset all the programs I've watched, and which programs are available and when the programs are on.''
5. TV recommends TV viewer's favourite programs: ''As I turn on the TV, it tells me (on which channels and) when my favourite TV programs are on. This is according to my personal user profile.'' ''The TV recommends me the same type of TV shows I've watched before.''
6. Fan clubs and bulletin boards for a sports club: ''I could have a bulletin board on TV for my badminton club. I could also sign in for events there.'' ''You could share experiences with other parents whose children play football, like information about children's football camps. Coaches and organizers (around the country) could find something in common there. There are big football camps for children during the summer.'' ''Ice hockey fan clubs could offer their members chat rooms on TV.''
7. Theater tickets online: ''I want to make ticket reservations for a theater on TV. I want the service to tell me which theater offers which plays and when.'' ''The local theater has its program on the local paper weeks in advance but if I want to go there tonight or tomorrow, I need to know if there are any tickets left. Otherwise I need to make a reservation months in advance.''
8. Chat room for friends: ''I would like to have a chat room on TV with my friends. We have our pictures on the screen and a sign to expose we have turned on the TV. It is not so sure in the Web whom you are talking to. You could participate either with the keyboard or your mobile phone, with an SMS. The service turns itself on when someone has something to say. You could watch the TV while you are on the chat. This is faster than turning on the PC and waiting for 5 min before logging into the Internet chat, or sending an SMS.''
9. Video on demand cookbook: ''I want to see a cooking program on TV with new recipes in a chosen breadth with pictures, video, and text. It is an on-demand cookbook for both children and adults. A TV program is easy to follow as there you see the results. I feel I have more time to cook according to a recipe now as the children are older.''
10. Video on demand English language course: ''I want to have a private study English language course on TV that I can start at a chosen moment.''
11. Trivial Pursuit on TV: ''We play board games like Trivial Pursuit for pleasure with the family. If the game remained in the set-top box memory it would be easier to start a new game, and you wouldn't have to reopen a certain board or cards.''

In conclusion, study participants had a broad range of interests and their proposals and innovations were based on personal preferences. Altogether, 75 proposals and innovations for present and future TV use were made. In general, the most popular user preference for the future TV use was email on TV. Other favourite concepts were SMS on TV, TV games, personal video connection on TV, EPGs, information about travel destinations, and quiz on the ongoing TV show.

The study also revealed that the tasks of self-evaluation or the short TV watching diaries should be fairly easy and quick to fill in as not to interrupt the other tasks at home. The 1-h interviews revealed that the study participants were capable of discussing their own life and their TV watching, but they were not as capable of discussing the new ideas about the future introduced by the researcher. It is therefore more profitable to

concentrate on TV viewers' present TV use and their own experiences.

6 Concept design study

The concept design study aimed at elaborating new concepts of iTV programs and services with designers [17]. More precisely, a set of user study results presented in the previous section was brought to the public service broadcasting company YLE (Finnish Broadcasting Company). There, a preselected set of user profiles was applied by designers while proposing innovations for iTV applications. YLE was selected as a research partner as they were already designing new concepts of future interactive programs. They were also interested in obtaining feedback from TV viewers about some of the concepts they had designed beforehand. YLE is an important broadcasting company in Finland, as its non-commercial channels TV1 and TV2 are two of the four nationwide analogue TV channels. During 2002, YLE's channels accounted for 45% of the total television viewing time. It broadcasted on average 208 h of TV programs each week, 55% of the total 376 h [37].

The aim of the research was to present the user profiles to designers and help them concentrate specifically on one TV viewer at a time instead of groups of TV viewers familiar from the audience research. The intention was that the detailed personal information the TV viewers had collected about themselves would inspire the designers to make new concepts of interactive programs. The adopted approach differs from the traditional audience research in which research results usually consist of poll statistics on TV viewers' opinions, numbers of TV viewers watching given TV programs, demographic information about TV viewer groups, or focus group session results after a group of TV viewers has seen a TV show pilot. None of these contain the rich qualitative data that can be found in the user profiles.

At present, the design practice in broadcasting companies starts with script writing. If the script obtains approval, the process of making a TV program or a TV series starts. Members of the production team refine and edit the script. The production team consists of directors, composers, producers, graphic designers, set designers, actors, film editors, etc. However, the design practice here cannot be compared to the prevailing design practice of, for example, consumer products. During the concept design of consumer products, the designer can determine quite accurately what the end product will look like, whereas in broadcasting companies the scriptwriter cannot determine with such accuracy what the future TV program will be. The outcome is shaped by the whole production team throughout the TV production. Only after the post-production and the completion of the TV program, it can be seen what the finished TV program is exactly like.

There was a series of five design sessions in YLE. Each of the 60–90 min sessions included a researcher and two session participants. Altogether, ten concept designers, producers, television editors, and audience researchers took part in the sessions which were recorded for later inspection. First, the session participants read through a user profile, consisting of a shortened transcription of the interview with the user, and the photographs. Figure 5 shows two session participants reading the user profile. After the session, a conversation followed during which the session participants focused on what the TV viewer had said about herself, her current TV use, her favourite TV programs, leisure time activities, and other preferences. This lively discussion provoked the session participants to imitate existing program hosts, television announcers, and the studio audience. The resulting concepts of interactive programs and services were written down by the researcher so as not to disturb the designers who focused on the discussion, storytelling, and role-playing.

At the end of the session, the innovations that the user had designed for herself were presented to the session participants as a feedback. The designers could now compare their new concepts to the user's innovations. This was a way to provide an instant feedback to designers about their concepts as they could now see if there were any similarities between the user's and the designers' new concepts and the designers' views of what would best suit this particular user.

6.1 Results

The five design sessions in YLE resulted in 29 new concepts of iTV programs and services. The study revealed four types of user interaction which are listed below in the order of designers' preference:

1. SMS sent to the TV studio during the program
2. User access to additional information about the ongoing program

Fig. 5 Design session participants

3. Postcard sent to the TV studio before or after the program
4. Phone call or email sent to the TV studio during the program.

Figure 5 shows two session participants who were working in YLE as television editors making programs on subjects such as culture, literature, adult education, and the information society. It was found during the sessions that sometimes the designers found it difficult to design new concepts for a given TV viewer as they perceived him or her to be older or younger than the group of people referred to as 'our audience'. Interestingly, it was also found that in the designers' opinion, notes from the interviews and the user's innovations they had designed for themselves were considered more important than photographs taken at the home environment. Photographs, however, provided *''Information about the TV viewer's lifestyle and they give some more feeling (to it)''*. In the designers' opinion, reading the user profile should not take more than 10 min, as the idea is to use the material to provoke a lively discussion and not to study the material in great detail. Maybe it would help if the session participants could read the user profiles in advance and choose the one that is closest to their taste.

It was a new idea for designers to concentrate specifically on one TV viewer at a time as a basis for new concept design. Instead of user profiles, designers in YLE use the results from the audience research for their creative work. These data include demographic information about TV viewer groups, numbers of TV viewers watching given TV programs, and focus group session results after a group of TV viewers had watched a TV show pilot. According to the designers, they make concepts on topics they are interested in and they were concerned about losing the creative aspect of their work if they concentrate too specifically on a given target group. It is recommended that user profiles are applied to providing the designers with new ideas rather than setting limitations on them. At present, the script writing and new concept design consists of individual work and discussions in groups with colleagues. For example, there is no systematic method to collect new program concepts for later analysis. Also, there is no routine documentation on the creative process itself as to tell how the new ideas were created or which events prompted the designers for new concepts. It is known that the creative process is an intuitive one and it is also hard to express in words even when part of that process takes place while having a discussion with colleagues. This might explain the lack of documentation.

Some of the 29 new concepts can be found below. The basic idea of a new television program is presented in the form of a shortened dialogue between the two designers. There was a discussion about the topic and also role-playing as designers imitated known actors, program hosts, and television announcers, and how the user interaction would take place between the TV viewer and the TV studio or the set-top box application providing additional information. Variations, for example, of new topics for a historical series were designed. The dialog also shows the reasons why a concept would suit this particular TV viewer:

'Sing along' music program (SMS sent to the TV studio during the program) ''If we think about a positive, Finnish program that creates unifying feelings on the national level, we could have an interactive music program. The TV viewers send their requests for songs to the TV studio in advance, like which artist they want to see playing which song, and you are able to sing along with the artists at least during some of the songs. There is a ticker application on the TV screen with the lyrics.'' ''Interestingly, many TV viewers do sing karaoke at home.'' ''Last summer they had a live concert like this from Helsinki city center and you could send requests for songs and artists in advance. Then they mixed the artists according to voting and the concert was highly popular.'' ''I wonder why they haven't done that on TV? Here you have a cross-generation program and it makes it challenging to have the generations meet together, to set out the young artists to sing the golden oldies and vice versa.''

Cooking program for home chefs (providing additional information about the ongoing program) ''What I was thinking about is a cooking program that shows how to make the traditional, time-consuming but healthy Finnish food 'the easy way'.'' ''What if we went to the various provinces with the camera to see how the dish was made during 1950s the traditional way, and then we show how to do it in the urban kitchen, the easy way?'' ''And if we show how they make the dish in province A and we then shift to province B, God forbid, they make the same dish in entirely different way.'' ''TV viewers can send us recipes and tips from their childhood. The recipes are collected in the set-top box memory or into a book. The recipe collection is searchable.'' ''In my opinion, it is essential that we don't intimidate the TV viewers to user interaction. But you do encourage them by sharing where to look for recipes: 'Just press the 'OK' key when you are ready for that'.''

Memories of recent history (postcard sent to the TV studio before or after the program) ''People of her age are extremely worried about their memory and which are the things they can still remember, properly and accurately.'' ''Our program could give them some material for recall. The TV show would address issues of recent history from politics to pop music, from fashion to daily life. The idea of the program is to mix a documentary with an entertainment program. This is an entertaining program on cultural history.'' ''We could play with the idea of 'How much do you still remember of....' For example, the show presents black-and-white video from the archives, something that was quite popular at the time and therefore easy to recall. The program proceeds 1 year at a time, starting from the year 1950.'' ''We can ask the TV viewers to write or call us

and tell, for example, 'Which event do you remember from that year particularly?', or 'What was important to you at that time?'. Then we make an interview with someone who sent us an interesting recollection by mail or phone. This is also a TV program that tells the young generation how people lived before them. It is a way to transfer the cultural heritage, to maintain the memory of a generation.'' ''It is important for TV viewers of her age to be able to sit back and relax. We cannot force the features of iTV on these people, we rather tell them what to do if they have an interest to participate in the TV show.''

Our family life (postcard sent to the TV studio before or after the program) ''They live in a one-family house. He said he had built the house himself. Could you have a program on what it is like to live in a one-family house as a type of living? You take every aspect there is: the maintenance of the house, the kitchen work and cooking, gardening, heating the sauna, etc.'' ''But it is the Finnish dream, to live in a one-family house with a small garden, isn't it? ''Yes, then you get privacy. If the name of the program is 'Our family life', we have current affairs, human relations skills, and parenting.'' ''You can make this a series for one hundred years! If the house is on the lakeside, you show how to build a pier, or how to fix it, or how to make a pool. You also have examples of 'How to Get Along with Your Neighbour'. There you see dramatized scenes of conflicts and situations where TV viewers find it too difficult to participate and come to the TV show in person.'' ''As it is an interactive program we ask TV viewers to send us their questions and tips on a postcard. We also have a 24-h phone line for TV viewers to make a call and dictate their own stories. The next week you see your story dramatized on TV and other TV viewers can now give their suggestions as how to best solve the situation.'' ''That's a good idea. In general, people love to talk about their opinions when someone asks them to do so.''

Human relations skills at workplace (phone call or email sent to the TV studio during the program) ''I'm entirely convinced that today, there is a need for a TV series that covers issues related to human relations skills at workplace.'' ''Maybe this TV viewer has a small

work community and when a new employee arrives there he leaves immediately as the old employees eat him alive.'' ''The workplace is a difficult subject as people are awfully reluctant to step forward, they'll come to the program only when they have positive examples to tell, like how some unit solved a problem. TV viewers could write about their experiences and actors would then dramatize the situations. This would make a delicious TV series.'' ''They could also dictate their stories on a 24-h phone line or send us an email. TV viewers watching the program call to the TV studio and give their suggestions as how to best solve the situation.''

In general, creating new concepts that depend on TV viewer's active participation was not easy, due to three main reasons. First, the TV viewers will not watch a program just because it provides them with a new user interaction style, unless they are techies. Instead, TV viewers watch a program if it has something to say about the present day or history, the path of life in general, or if it provides them with background for some current issue. Second, YLE is not allowed to compete with the commercial TV channels. Therefore, all gambling and 'Wheel of Fortune' program types had to be left out as the TV viewer has a potential for winning money in the program. Third, programs and TV series are unique and it is hard to say which new TV series will appeal to the audience, be it made interactive or not. Designers said from their past experience that *''The feedback from the audience is always a surprise''* (as which TV series will be a success) and *''You can't say for sure beforehand if the TV viewer will be pleased with the program or not''*. Experienced concept designers and television editors have knowledge of what has worked out before, but as the same TV series will be watched for various reasons depending on the TV viewers' subjective likes and dislikes, and it will remain difficult to know for sure if a TV series will become a success or not. It can be concluded that there are at least four possible groups of new interactive programs:

1. Opinion polls and voting
2. Requests for personal contribution
3. Quizzes and competitions
4. Provision of information.

The types of programs that will most likely become popular are the ones with instant user interaction during the TV show. An SMS sent quickly from a mobile phone is considered a relatively easy user activity that doesn't interfere with watching the program. Sending a postcard or an email from a modem in the set-top box before or after the show will need quite a lot more concentrated brainwork and user motivation. These will serve better those TV viewers who have more interest in the program and who wish to send an interesting recollection to the TV studio.

7 Storytelling study

Storytelling and TV viewers' possible futures was a qualitative user study including future users into product design [18]. The aim of the research was to collect users' stories about their present TV use, user's innovations of future applications and possible future user needs and preferences. Four study participants between the ages of 29 and 37 took part in the study. Two women and two men had a 80–110 min semi-structured interview with the researcher. The interviews were recorded for later inspection.

In general, it is difficult to have an interview with a study participant about non-existing future devices or applications that would meet the interviewee's future user needs. To tackle this problem, three ''Artist's view

of the future'' drawings presenting possible future setup and equipment at home were shown to study participants. These three drawings present different locations at home: the living room, the work room, and the kitchen. Each location is a separate entity in which family members carry out different tasks. It is also common to have a separate TV set in each of these rooms. The reason for using drawings instead of photographs or pictures of present services is that it was thought that drawings would give more freedom to study participants in relating to their future needs and preferences. Photographs or specific images of services already available could have limited study participants' creativity.

Figure 6 shows one of the drawings, namely, the artist's view of the living room in the future. The drawing shows a family in which every family member is using his own entertainment electronics: the children play TV games, the mother is talking on the video phone while reading, and the father is watching a hockey game on TV. During an interview, the study participant was asked to comment on each of the drawings. For example, the following questions were posed regarding the drawing of the future living room:

1. ''Here is a drawing of the living room in the future. In your opinion, is this picture realistic?''
2. ''What was the first thing to come in to your mind when you saw the picture?''
3. ''What type of TV programs can one watch in the future, especially in the living room?'' (As a distinction from the TV sets in other rooms.)
4. ''Will children get new TV program types?''
5. ''Nowadays families must try to find a TV program that suits every family member. Can you think of such a program in the future that suits everyone and brings the family together to watch the program?''

These open-ended questions were part of the semi-structured interview. In a semi-structured interview, various types of questions are to be used in an opportunistic manner, depending on the demands of the situation [76]. Open-ended questions allow the study participant to answer in her own words in a variety of ways, thus providing greater freedom and less restrictions. The study participant is able to introduce relevant information, ideas, and concepts the researcher may not have thought about. The researcher on the other hand tries to enter the world of the study participant, to understand and get a sense of the interviewee's decision making. At best, the researcher will learn what it is like to view the world through the heart and mind of another. The use of the ''Artist's view of the future'' drawings was a step further from the semi-structured interview in order to enable the study participant to introduce new ideas and innovations of future applications.

7.1 Results

The storytelling study resulted in TV viewers' stories of their present and future TV use and their innovations of future applications. Four study participants between the ages of 29 and 37 years participated in the 80–110 min semi-structured interviews during which the study participant was shown drawings of possible future setup and equipment at home. The three ''Artist's view of the future'' drawings inspired the study participant to tell stories of present and future TV use. Figure 6 presents the artist's view of the living room in the future and Fig. 7 presents the kitchen in the future. There is a TV set in both rooms and the family members can be seen accessing iTV programs and applications.

In general, users' stories are an important result of interviews and focus group studies. Users' stories are able to inform the development of new products by

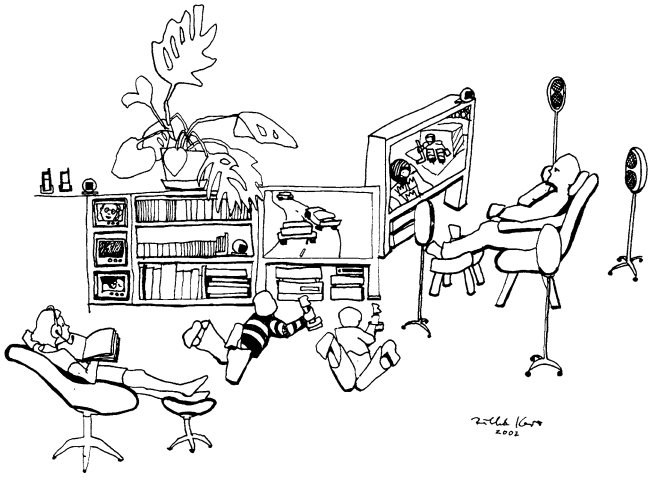

Fig. 6 Artist's view of the living room in the future

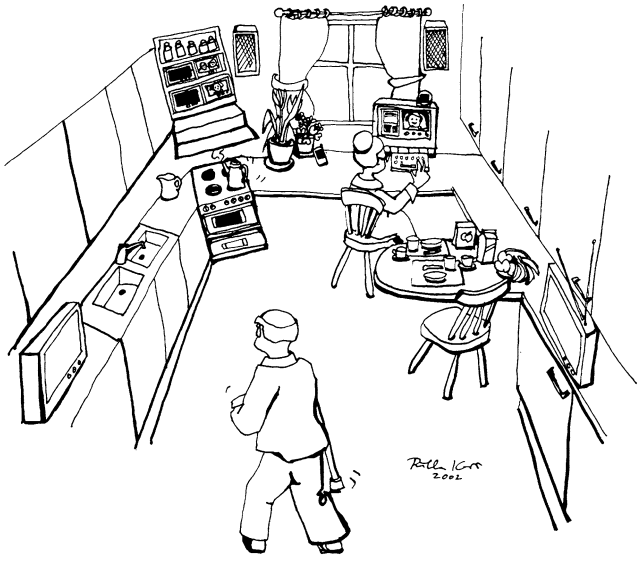

Fig. 7 Artist's view of the kitchen in the future

providing users' own design ideas and their views of the future [71]. The stories describe users' intentions and motives, their interactions, and contextual information [64]. Stories may have many viewpoints and a complex structure, as the changing of viewpoint may imply some future consequences of early actions. Some examples of TV viewers' stories of their present and future TV use are discussed below.

Susan, a 30-year-old physiotherapist, had an opinion of having a TV set in the kitchen and the types of TV programs one could watch in the kitchen: *"As for today, we watch the living room TV while we are at the kitchen table. The only reason for me to buy a separate TV set for the kitchen would be the two 'Morning TV' shows which we surf intensively. We watch the two shows according to a topic and surf between the two channels. I can't think of any other program we would watch in the kitchen."* If the TV set is located in the kitchen, the TV viewer will be sitting closer to the TV screen than in the living room and is thus able to read more textual information. The disadvantage of having a TV set in the kitchen is that usually the kitchen is a place for preparing meals and having a meal with the family, so it can be questioned if the TV set in the kitchen has an effect on learning social skills.

Andrew, a 29-year-old elementary school teacher, considered future entertainment equipment use at home as he was shown the 'living room in the future' drawing: *"I doubt about the father's pleasure to watch the movie, or the sports event, next to these children playing TV games. I play PlayStation2 games myself and as I know the resulting side tones, well.... Maybe you wouldn't enjoy watching the TV show as close to children as this. And furthermore, I can't afford to as much equipment as you see in the picture."*

Susan was asked which TV programs types, in her opinion, could bring the family together to watch the television: "As a family, we could watch Nature series together. Children get interested in them as well. And as funny as it might sound, I am myself interested in sports. Something I couldn't think of watching together with the children are the soap operas." Andrew had an opinion about the present and future TV shows: "I believe that in principle, people want to watch the same type of TV shows as they do today. They want to see News and Sports, maybe some series, some of which are more entertaining and some of which are more into culture.... The children are a large market niche, they will certainly get new types of TV programs. You already have the 'product family' TV programs. You must buy children's toys and clothes according to a TV series. Probably you'll get more of these."

Some examples of proposed innovations of future applications are:

1. Kitchen TV: "Let's assume these people are a retired couple. There is a schedule for the day on the TV screen, a list of things or some work you must do after the morning routine. If you have to pay the bills, the program gives you a reminder on the screen: 'Remember to pay such and such a bill', 'Water the plants', or 'Order something online'. ...I use the scheduling function in my mobile phone a lot. I could use it as well on my TV. If we move into a very automatic style of life, the program could tell you what to have for a dinner and then it reminds you to buy certain ingredients. ...I could think of an interactive program that helps you with practical matters and you can write down something for yourself in some free space. Or you could do scheduling for the coffee machine or the oven, if everything is connected to the set-top box."
2. Fitness program: "I work at a health club and I would like to see an interesting Fitness program on TV. The topics discussed in the program would cover fitness and health issues, taking exercise and where to go to exercise a certain new form of physical activity. I'm also interested to hear what is happening in health clubs in other parts of the world as this is part of my job description. I could think of watching a TV show made in famous health clubs in the USA and taking notes of what they have there and what we don't yet have here. It is fine for me to watch the program only once a week or twice a month, not every day."
3. Morning TV program: "I predict that the 'Morning TV' shows will survive. For many, watching the program has become a certain kind of a ritual in the morning. At least you watch the Morning News. In the future the program could take only a portion of your TV screen. There are different 'boxes' on the screen and one of them contains the Morning News. You don't have to open the box completely, the screen looks like a computer screen with various windows. You could see stock rates running along and there could be TV program listings for the day, just to see there is nothing unusual."
4. Program on nature tourism: "I'll take a hiking trip to the north of Finland next month. If there existed a program on nature tourism and if it had a connection to something I'll be doing myself, I could go to their Web pages after watching the TV show. I haven't followed programs on traveling much but if I had it in my plan to travel somewhere, I could go to their Web pages to see if they are close to what I have in mind."

With iTV applications, it is possible to make the TV viewer an active participant watching the program. For example, the "Fitness Program" is a TV show where it is easy to visit the Web pages of the program after the show. The Web pages can include photographs and links to health clubs and fitness centres presented earlier in the TV show. "Program on Nature Tourism" Web pages can also be accessed after the show.

During the study, the TV viewers found it easy to talk about their life and their own experiences, whereas storytelling about possible futures based on the artist's

drawings was more difficult. The TV viewers more or less commented on what they saw in the artist's drawings or what they thought they saw in the pictures. The TV viewers also made more innovations based on their own experiences and daily life than on the artist's drawings.

8 Discussion

This section discusses the research methods, gives some more insight into the research results, and provides some future directions for HCI research of interactive services and applications.

The EPG usability study aimed at designing and implementing new iTV applications. Two EPG prototypes were implemented and tested with real users and the test results were discussed. The area of research was restricted to information searching and navigation in EPGs. It was concluded that in user interfaces, navigation is considered as a part of the functionality and content and it can not be designed independently from the two. To achieve universally accessible iTV applications, a future study could find out how the information content should be organized, which information layouts and colours contribute to intuitive navigation, and which navigation type is fastest and easiest to use and to learn to use on the TV screen.

The focus group study resulted in three updated user profiles. It was stated that updating a user profile with new focus group session results is quite easy, and this refers to easier allocation in marketing efforts. User profiles can then help in creating new product versions or in tailoring a specific product to a selected group of customers. An example of a future application is an interactive TV game that is modified based on a weekly TV show. The game must relate to the plot of the show but it must also live up to the expectations of various TV viewer groups. An interactive TV game or a quiz is likely to draw the attention of all family members some of which are more competent in a specific topic, but even so all family members want to be able to take part in the quiz. In such a case each family member has a user profile which the application developers then update with qualitative user data. Each profile contains information of the TV viewer's expectations and preferences on the interactive game. The profiles can collect information about accessibility problems related to earlier programs and games, and thus help achieve universally accessible iTV applications.

The user study at the home environment resulted in ten user profiles. As is the case with qualitative research in general, the study resulted in a large amount of user data. As the study is a time-consuming exercise consisting of planning the research, collecting the data and analysing the results, it is recommended to start in the early phases of new product design. It is also recommended to reduce the number of study participants from ten to four or five. It was found that at their leisure at home with plenty of time, TV viewers were able to give thorough answers to questions. During a focus group session, there was not enough time for such brainwork, but the focus groups rather revealed the TV viewers' opinions and their first reactions to new concepts. To achieve universally accessible iTV applications, the tasks of self-evaluation and the short TV watching diaries are promising ways to collect data on specific audiences and their lives, domestic tasks, and their TV watching. The study also revealed a need to form a set of family profiles in addition to the individual user profiles, as the TV set is a purchase for the whole family. There is a need of some characteristics or a method to define values, relationships, and interdependencies among the family members which have an effect on the television related social behaviour and the way families watch the TV together. To visualize such family profiles is of course more difficult than to visualize individual user profiles.

The concept design study in YLE resulted in new concepts of iTV programs and services. During the study, designers considered TV viewers' stories of their daily life and innovations they designed for themselves especially useful and many times a piece of data inspired the designers to new ideas and concepts. It is understood that this material provided designers with some "artistic freedom" as they expressed a concern about losing the creative aspect of their work if they concentrated too specifically on a given target group. They also said that they were more used to thinking of their audiences in terms of groups of people familiar from the audience research, and applying any qualitative data was a new approach to them. In the future, designers can reuse the material as a tool they can refer to whenever they need to remind themselves about who the users are or what aspects they look forward to in iTV applications. It is clearly a subject of further research to try to include the disabled into the audience research as a TV viewer group. This new TV viewer group and the collected statistical data can then be made livelier and more understandable by the qualitative data from the user profiles.

The storytelling study resulted in users' stories of their television use and their proposed innovations of iTV applications for the future. Many of the innovations were quite close to written scenarios. It is therefore possible to combine users' stories and edit them further to make longer scenarios. For example, a set of stories could exemplify 'An afternoon at the Jones's' in which every family member has a story to tell. New user requirements can also be extracted from users' stories. The drawback of using users' stories is the transcription of the interviews which takes a lot of time. The rewards in stories are that they are the 'authentic voice of the users'. For example, during participatory future-scenario workshops the future users are given new ideas by the designers which then mold their opinions about the possible futures. Social pressure might make it uncomfortable for the user to express dissenting opinions, whereas during an interview, the user has more freedom to talk about personal experiences that are felt as

important. This is very important for the disabled, as many times it is other people who decide on their behalf as what to do, and they do not have opportunities to express their opinions.

9 Conclusion

This paper has presented how five qualitative research methods have been applied to the field of iTV application design and evaluation. More details on the work documented in this paper and the results can be found online [19]. The purpose of this paper has been to show methods which help find out what would benefit the TV viewers in a situation where the technologies under discussion are not yet available. This paper shows how the methods can be applied, and what kind of results they can provide. Most importantly, the new methods show how to shift the point of interest from usability testing in the late phases of new product design to the early phases of application design.

In conclusion, some of the techniques, particularly the user study at the home environment and the storytelling study, are good ways of making TV producers aware of the concerns of audiences they may not be close to, e.g., the elderly and the disabled. As the concept design study revealed, the TV producers were used to thinking of their audiences in terms of groups of people familiar from the audience research, and the disabled are not yet included into the audience research as a TV viewer group.

In general, iTV applications could help the disabled to group together the same way that the Internet and the online communities today link individuals with others sharing common interests. It is known that for those with less real-life social contacts, virtual communities provide peer support and collaboration. The objective is to use the experiences from the Internet applications to develop universally accessible online iTV communities which could enrich the functioning of the disabled people.

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