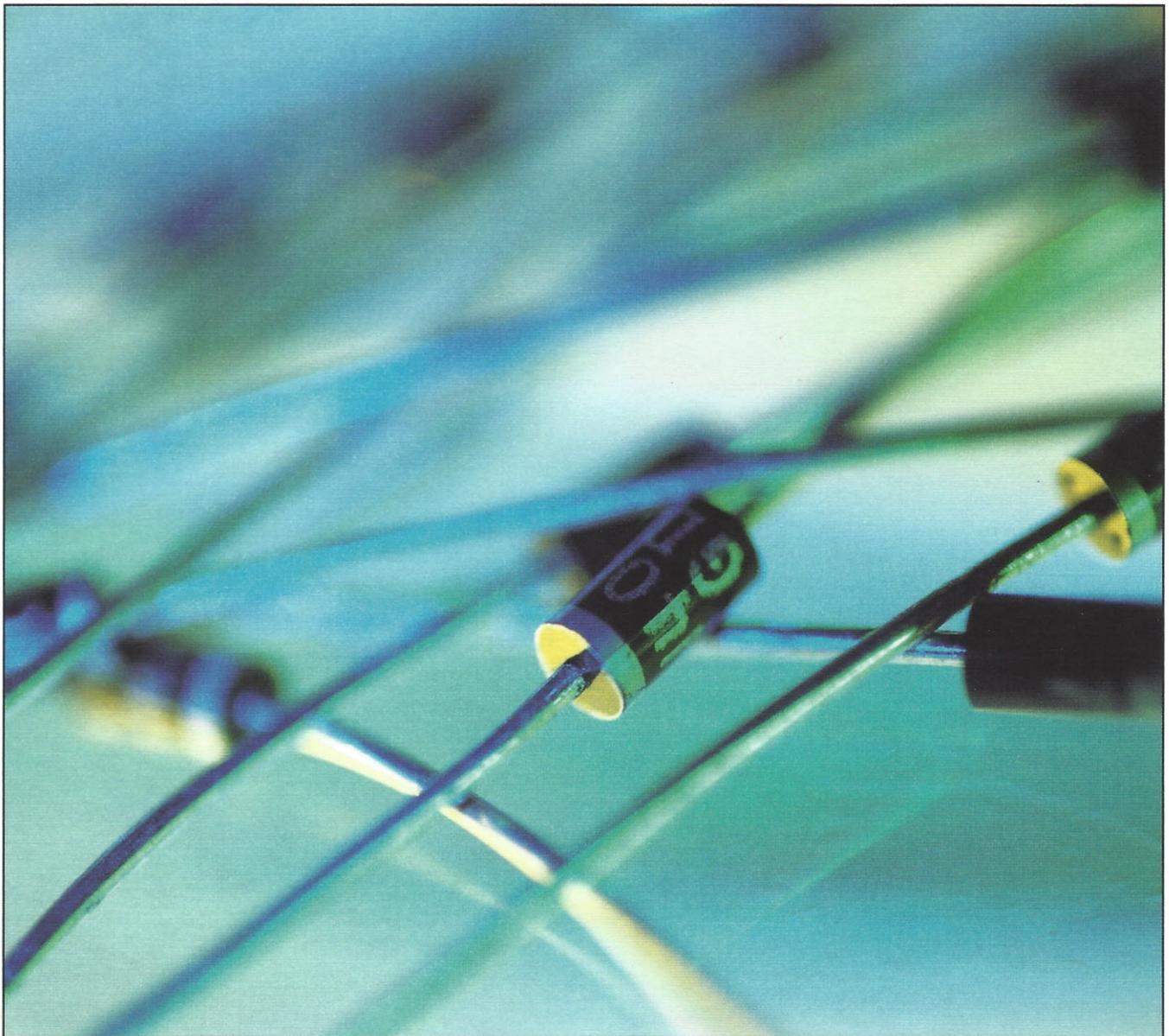


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Antonio Cartelli & Marco Palma

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Interactive Television Accessibility and Usability

Roberto Cuccu

University of Cagliari, Italy

INTRODUCTION

Today, there are more than 70 million people aged 60 and above in the European Union.

According to Eurostat, over the next 15 years, the population aged 65 and over will increase by 22%. Many of these citizens will experience dexterity, cognitive, hearing, and sight problems in later life. This means that more than one in seven adults in Europe will have hearing problems. Some 7.4 million people already suffering uncorrectable sight loss will add to the number of European citizens experiencing some form of sensory impairment (Stallard, 2003).

Interactive digital television (iTV) is evolving into an enhanced entertainment and information service. There are various degrees of interactivity in digital television: pressing a simple remote control button, sending information back and forth, or servicing providers by means of a return path. If they are to be adopted, interactive facilities need to be usable by viewers, even because, as Jacob Nielsen points out, "increased accessibility for users with disabilities almost invariably leads directly to improved usability for all users" (Slatin & Rush, 2003). Unfortunately, interactive digital television design appears to have been based on the conceptual models of keyboard-based systems, but their users, skills, goals and attitude of interaction differ. The TV audience is more diverse, some having no prior computer experience. It must be realised that iTV is not a PC and therefore cannot be treated as such.

As far as usability for interactive television, a literature review shows that the approach followed by the majority of scientific publications is also mainly PC-centric and in the majority of cases implicitly focused on the work environment. Differences between the two environments and strategies for resolution of the issues involved have been noted by academics and practitioners (Chorianopoulos, 2003). Unfortunately, traditional usability engineering techniques focus on and have been

developed to measure work-related goals like successful task completion, efficiency and error rate, parameters usually positively correlated with user satisfaction. In a usability test of three video interfaces, users preferred the interface that required more time, clicks, and had the highest error rate. According to Drucker, Glatzer, De Mar, and Wong (2002), 'While the performance based on time to task completion and number of clicks was the worst in the novel interface, the user satisfaction was significantly better with this interface.' Users made their choice on the basis of how amusing and relaxing an interface was.

The emergence of interactive television requires a fresh view of current paradigms. New usability evaluation techniques for interactive television must be designed and experimented with. This brings new challenges for television programme producers who have no strong tradition of minutely analysing viewer interaction with television, preferring instead to rely on survey methods such as diaries, questionnaires, focus groups, or automated monitoring to discover viewers' attitudes (Gauntlett & Hill, 1999). Several evaluation techniques may be applicable to digital television, including analytical approaches such as heuristic evaluation (Nielsen, 1993), consisting of having a small set of evaluators examine the interface and judge its compliance with recognised usability principles («heuristics»). Building on growing evidence from studies reported in the literature, it is becoming possible to derive TV-specific heuristics. Nonetheless, nothing has yet been definitively established. Here we concentrate on empirical evaluation, based on observation and interview sessions with viewers.

According to Pemberton and Griffiths (n.d.), there are a number of areas that distinguish the use of personal computers from the use of iTV. These differences suggest that evaluating digital television might require an approach differing from that for desktop applications. They also suggest that results reliable for desktop applications may need handling with more

caution in an interactive television context. According to Gauntlett and Hill (1999) and Masthoff (2002), the major differences are:

- **Physical characteristics of interaction:** Viewers watch television at some distance from the screen, typically in an environment oriented toward relaxation and comfort. Resolution is much lower than computer display screens, and color behaves differently. Detailed information is presented via audio. All interactions are carried out via a handset (combined in some cases with a keyboard).
- **Multiple information channels are mediated via the same device:** There is conflict between watching the broadcast stream and manipulation of any interactive components; viewers must divide their cognitive resources between watching and interacting, and this may be reflected in design through allocation of screen 'real-estate.'
- **The optional status of television viewing:** Television tends to mean leisure and entertainment rather than work or other serious pursuits. Thus, the task-oriented approach most often adopted by usability evaluators may be inappropriate.
- **Social characteristics of interaction:** The domestic setting in which TV is utilised is complex, and its numerous facets make evaluation difficult.

BACKGROUND

Abilities may vary from person to person, and, in the course of time, in different people with the same type of disability. People may have combinations of different disabilities and combinations of varying severity levels. The number and severity of limitations tend to increase as people age and may include changes in vision, hearing, memory, or motor function. Many accessibility solutions described in this document contribute to "universal design" (also called "design for all") by benefiting nondisabled users as well as people with disabilities. In this article, three different disabilities will be focused on: sight, visual impairment, and dyslexia.

What a person with specific impairment experiences is often an impediment due to overloading input on different abilities at the same time. A typical case is a prelingual deaf person. Although one might think

the only problem might be one of hearing, possibly to be overcome with captions or a cochlear implant, the handicap is much more severe than expected. Having acquired reading and speaking skills as a deaf person, he can generally recognise words that have been taught to him during speech training. All other terms will have to be inferred from context. In other words, in some forms of disability, the main problem lies in integrating different inputs into a comprehensible piece of information without being overwhelmed by the task.

Dyslexia

Approximately 4% of the population is severely dyslexic

A further 6% have mild to moderate problems connected with dyslexia

(Tiresias Organization, <http://www.tiresias.org/guidelines/dyslexia.htm>)

Developmental dyslexia is a condition or learning disability causing difficulty in reading and writing and present despite normal intellectual, cognitive, and sensory development. People are often identified as dyslexic when their reading or writing problems cannot be explained by a lack of intellectual ability, inadequate instruction, or sensory problems such as poor eyesight.

Dyslexia is not limited to reversing the order of letters in reading or writing. Nor is it a visual perception deficit involving reading letters or words backwards or upside down, as often implied in popular culture.

The most frequent symptoms of dyslexia are:

- Difficulty in learning through language alone
- Difficulty in processing information sequentially

Dyslexics are visual thinkers and use all their senses. As they tend to think in images, they find it difficult at times to understand letters, symbols, or written words.

A dyslexic person has difficulty reading the words in a line and starting again on the next line and frequently skips whole words or whole lines. She might also add extra syllables to words due to difficulty in reading

from left to right. Dyslexics tend to favour inferring processes rather than decoding ones. Although this is a valid instrument in itself, it might be a source of error. They tend to start decoding the first part of the word and then “make up” the rest of it (Shaywitz & Shaywitz, 2001).

Deafness

There are more than 80 million Europeans with hearing loss

(Hear It Organization, <http://www.hear-it.org/page.dsp?page=2569>)

There are several types of deafness, some of them overlapping:

- **Unilateral:** The inability to perceive sounds with one ear.
- **Prelingual:** Deafness acquired before normal speech developed, not usually allowing normal development of speaking skills.
- **Perilingual:** Deafness acquired while the first language was still being learned, often causing incomplete development of speaking skills.
- **Postlingual:** Deafness acquired after speaking skills had completely developed
- **Partial:** A decrease in one’s ability to perceive sounds without causing total hearing loss.
- **Profound:** A severe decrease in one’s ability to perceive sounds, rendering him completely unable to hear sounds of normal (or any) intensity.

An individual’s hearing loss is assessed using audiometry, which measures loss in decibels (dB) at different frequencies. The different levels of hearing loss are classified as:

- **MILD 16–35 dB.** May have difficulty hearing faint or distant speech, losing up to 10% of the speech signal when the speaker is at a distance greater than three feet or if the environment is noisy.
- **Moderate 36–50 dB.** Understands conversational speech at a distance of 3–5 feet. Amplification may enable the listener to hear and discriminate all sounds. Without amplification, 50% to 100% of the speech signal may be lost. Speech may be

affected unless optimally amplified.

- **Moderate/Severe 51–70 dB.** Conversation must be very loud to be heard without amplification. A 55dB loss can mean 100% of the speech signal is lost.
- **Severe 71–90 dB.** If loss is prelingual, spoken language and speech may not develop spontaneously or be severely delayed in absence of modification or intervention.
- **Profound 91 dB or greater.** Aware of vibrations more than tonal pattern. Many rely on vision rather than hearing as the primary avenue for communication and learning.

The above degrees of deafness affect speaking and reading skills in different ways. In mild hearing loss, there are no comprehension problems, but omission or alteration of certain phonemes; for example, /b/, can be confused with /p/. In moderate hearing loss, damage involves both significant (the letters in words) and their meaning. In severe or profound loss, there is no perception of the spoken word.

Visual Disabilities

In Europe there are 2.7 million totally blind people, 12.8 million with low vision and 15.5 million with visual impairment.

(World Health Organization, <http://www.who.int/mediacentre/factsheets/fs282/en/index.html>)

There are many types of low vision, for instance poor acuity (vision that is not sharp), tunnel vision (seeing only the middle of the visual field), central field loss (seeing only the edges of the visual field) and clouded vision. Visual limitations tend to increase as people age. An ever-increasing number of people are at risk of visual impairment as populations grow and older age groups predominate.

Important Differences between Television and the Web

When working for iTV, there are some areas that designers accustomed to creating normal Web sites should take into account (Johansson, 2005):

1. **Screen size:** Television screens are often larger than computer screens, but their resolution is lower.
2. **Color and contrast:** Limited to a smaller range of colors on a TV. Fully saturated colors and some color combinations tend to bleed. The picture is generally much fuzzier than the one on a computer screen.
3. **Fonts and readability:** Because of greater viewing distance, the designer needs to use larger text on TV than on a computer screen. You will also want to increase line height a bit and add a little letter spacing to avoid individual letters bleeding into each other.
4. **Viewing distance:** The normal viewing distance is much greater for television than for computers, which makes the image reaching the eye smaller. Designers need to make text and important graphics larger than if the application were viewed on a computer screen.
5. **Navigation:** The main navigation tool for iTV is the remote control.
6. **Sound:** Web sites rarely use sound, while television uses it continuously. Speech therefore needs to be made available to people who cannot hear.

MAIN FOCUS OF THE ARTICLE

This document is based on an iTV usability test carried out on the following small group of disabled people:

1. A dyslexic child
2. A severe hearing-impaired teenager with bilateral neurosensory hypoacusia having a cochlear implant.
3. A moderately-severe teenager with bilateral neurosensory hypoacusia having a cochlear implant.
4. A low-vision teenager

The number of subjects was reduced to the minimum, as suggested by Nielsen (2000) when he states:

as you add more and more users, you learn less and less because you will keep seeing the same things again and again. There is no real need to keep observing the same

thing multiple times, and you will be very motivated to go back to the drawing board and redesign the site to eliminate the usability problems. ...After the fifth user, you are wasting your time by observing the same findings repeatedly but not learning much new.

The usability test was organised as follows:

Step 1: Planning the usability test

It was decided to have one subject (the visually impaired one) add her comments while performing each task ('think aloud') and the other three after finishing all tasks (retrospectively). The first subject was also asked to complete the questionnaire retrospectively. When using the 'think aloud' method, participants report on incidents as soon as they happen. When using the retrospective approach, participants perform all tasks uninterrupted, and then report any observations (critical incidents). Studies have reported no significant difference between the 'think aloud' vs. retrospective approaches in terms of the number of useful incident reports given by participants. The test was set to be a task-oriented activity, where users had to follow precise instructions and interact with the additional services of interactive television.

Step 2: Defining the audience and goals of usability testing

The goals of usability testing should be focused on determining whether the interface is usable and whether the intended audience, and anyone else who might come into contact with it, can use it. The study set reasonable goals to be achieved with a limited amount of time and subjects.

Step 3: Choosing subjects and evaluators

The subjects chosen for this usability test were volunteers in contact with a local support center for young people with impairments. They were:

- 1 visually impaired
- 2 hearing impaired
- 1 reading impaired (dyslexic)

The evaluators were a psychologist working in a public center for disabled people and a multimedia consultant. The psychologist acted as the facilitator, giving feedback and helping subjects carry out their

tasks. According to Spool (2005), a good facilitator knows how to draw out exactly the right information from the participant without giving away the store. He knows how to use the very limited test time to focus on those elements that are most important for the team. The other member of the team stood apart, taking notes without interfering with the experiment. Both evaluators took notes on verbal and nonverbal messages conveyed by subjects.

Step 4: Providing a pretest questionnaire

An initial questionnaire was administered to subjects in order to gather useful information about them before the test. In particular, the pretest questionnaire collected additional background information about their familiarity with digital television, computers, and video games. This additional information proved valuable in analysing and interpreting data.

Step 5: Providing brief instructions (the test script)

During the test, participants had to follow a printed task sheet. The copy for the visually impaired was printed with larger fonts. The task was designed to be:

- **Short.** Time is precious during usability testing.
- **Specific.** The wording of the scenario should be unambiguous and have a specific goal.
- **Realistic.** The scenario should be typical of the activities that an average user would do on his own.
- **In the user's language and related to her context.** The scenario should explain the task the same way users would.

Step 6: Set the test

In order to facilitate the test, it is important for evaluators to:

- Keep participants focused on the task. People will tend to wander off, but it is important to keep them focused.
- Take shorthand notes or (even better) get someone else to take notes, focusing on really important/interesting behaviour.

- Let the participant make mistakes. This will reveal aspects of the interface that may need improvement.
- Answer questions with questions, forcing the user to give more feedback.
- Do not tell the participant what to do, but you can suggest and discuss design solutions that might solve a usability issue.
- Do not explain the interface. Doing so prevents you from getting their unbiased perception of the site.

Step 7: Post-test questionnaire

At the end of the test, participants had to fill in a questionnaire about their experience. The purpose of the post-test questionnaire is to record the participant's perception of test difficulty and to gather relevant comments where applicable. The questionnaire should reflect the participant's overall perception of the system's usability and specific perception related to usability concerns.

Step 8: Process the results

After the session was over and the participant had left, evaluators completed their notes, writing down all the interesting and important behaviour the participant exhibited during the session.

Individual Pathologies and Test Responses

The following are the observation sheets for each subject and a description of their disability.

Observation sheet #1

C.P. 16 years old

Diagnosis: severe bilateral neurosensorial hypoacusia, with language impairment, use of cochlear implantation and oral comprehension through lip reading.

User's first experience with ITV

Test Time: 18 minutes

Tasks 1-9

First Part

Task sheet for testing the accessibility of digital television

Tasks to carry out

First Part

1. Press button #2 on the remote in order to select channel #2
2. Press the red button on the remote to load interactive elements
3. Once they are loaded, choose the "NEWS" menu
4. Choose the second piece of news among those listed using the arrows
5. Press on OK to read the news
6. Read the news aloud in all its parts (it will take more than one page)
7. Go back to the initial menu, pressing EXIT
8. Now choose the option SURVEY
9. Cast your vote on one of the options presented

Second Part

10. Press button #5
11. Load the interactive options by pressing the red button
12. Choose the menu item GAMES
13. Choose the first game on the list
14. Read the game instructions
15. Play the game
16. When you finish, press the EXIT button

Third Part

17. Press button #7
18. Load the interactive options by pressing the red button
19. Choose NEWS from the menu
20. Scroll down the list and choose one that you find interesting
21. Read the news aloud
22. When you finish, press the EXIT button
23. Turn off the television and the decoder

Observations

Good dexterity with the remote and good knowledge of how to use remote buttons and functions.

In order to read the text on the screen, he has to get closer to the TV, less than a meter away.

He experiences some difficulty in reading due to scarce visibility and sharpness, due to low color or brightness contrast in relation to the background (for example, white or yellow text on a green background), text on a decorated background or the use of too narrow a font, with too little space between letters.

Difficulty in understanding the news text, written in narrative form, without having the most important parts highlighted and the structure clearly marked. Subject not familiar with some terms used in the news.

Tasks 10-16

Second Part

Observations

Game instructions unintelligible to the subject. The way they are described forces the hearing-impaired viewer to try to summarise complex content in order to discover the relevant steps to follow. The task of interpreting the instructions too difficult without the help of the facilitator.

Third Part

Tasks 17–23

Observations

Reading is difficult due to low contrast with the background and to the length of narrative texts.

Difficulty in finding information on the screen was due to:

- a. Too much input
- b. Inattention to visual stimuli at the edges of the central area

Drop-down menus not easy to navigate.

Notes

Many problems are due to the subject's limited acquired vocabulary, to having her read some texts aloud and to decoding long and complex texts. Problems in handling too many pieces of information at once.

Observation Sheet #2:

N.P. 15 years old

Diagnosis: Bilateral neurosensorial hypoacusia, with language impairment, use of cochlear implantation, good oral skills, myopia and astigmatism.

User expert in the use of iTV programs

Test Time: 13 minutes

Tasks 1-9

First Part

Observations

Good dexterity with the remote, good knowledge of buttons and functions.

Some minor problems in reading due to scarce visibility and brightness caused by low contrast.

Tasks 10-16

Second Part

Observations

Some problems in reading due to terms the viewer is not familiar with.

Third Part

Tasks 17–23

Observations

Reading sometimes difficult due to low contrast.

Notes

Previous experience with digital television and Personal Computer allows the subject to be more autonomous in using the device.

Some problems are due to the subject's limited vocabulary and to his difficulty in summing up long, complex texts. Problems in distinguishing visual elements on the screen.

Observation Sheet #3: P. P. - 8½ years old

Diagnosis: dyslexia, disorthography, discalculia

User's first experience with iTV, but expert in using computer and play station.

Test Time: 35 minuti

Tasks 1-9

First Part

Observations

In order to be able to read, he must be at least 1.5 meters from the TV.

Good dexterity with the remote and good knowledge of its functions

Difficulty in finding the News. Too many visual stimuli and too much to read at the same time.

Difficulty in reading the News due to:

- a. The text being too long and complex
- b. Taking too long to decode the meaning of the text, with a consequent loss of motivation.

Trying to avoid mistakes, he anticipates some operations, based on his previous experience with play station and computer.

Tasks 10-16

Second Part

Observations

Difficulty in finding information on the screen, due to:

- a. Input overload
- b. Inattention to stimuli at the edges of the screen.

Difficulty in reading text in capital letters

No problem in playing the game, as similar to some others he's already played.

As he becomes familiar with the functions, to overcome his slow reading, he proceeds by trial and error and tends not to follow the instructions. As a result, he doesn't always reach his goal.

Tasks 17 -23

Third Part

Observations

The subject acts quickly once he understands what to do, but he is very slow in reading instructions.

When the pointer moves over them, hyperlinks not contrasting with the background do not allow the viewer to read the whole text before clicking on the right part.

Tries to compensate for his difficulty in reading by using other perceptions and trial-and- error procedures.

He experiences some difficulty in reading due to scarce visibility and sharpness caused by low colour or brightness contrast with the background or the use of too narrow a font, with little space between letters.

The presence of images does not seem to either help or hinder.

Observation Sheet M.C. #4: 19 years old

Diagnosis: severe bilateral amblyopia due to congenital nystagmus

PC user, little familiarity with ITV

Test Time: 20 minutes

Tasks 1-9

Observations

The subject finds it a bit difficult to read small-sized texts and in general texts that are too bright and flickering.

Yellow text on green background is clearer than white on green background.

In general, she also finds black text on a white background readable, provided that fonts are not too small or letters too crowded.

Tasks 10-16

Second Part

Observations

The subject has no problem in reading text on any part of the screen.

Good readability of dark blue texts on yellow background.

Tasks 17 -23

Third Part

Observations

In this channel, texts are readable enough. News in black against a pale blue background is particularly clear for the subject, thanks even to the large space between lines.

Minor problems in understanding how to use arrows and exit buttons.

Notes

The subject uses the device well and autonomously. Difficulties arise only due to text readability: spacing, font, size, kerning, contrast with background.

SYNTHETIC TABLE OF OBSERVATIONS ACCORDING TO IMPAIRMENT

See Tables 1-3.

FUTURE TRENDS

Industry is aiming for a well-designed, engaging, enhanced television environment with a high return on investment. Many elderly people and visually-impaired people want a minimum amount of confusion within a practical system. This appears to create a conflict of needs between industry and some viewers. Television is traditionally a social, relaxing diversion, so even the general public does not want to work at it. By adopting a user-centered approach and finding out what people want from this media form, the industry's mission can be accomplished.

When it is well-known that a very large percentage of the television audience, especially during the daytime and nonpeak viewing hours,

Table 1.

General Disability Category	Main Difficulties	Suggestions
Hearing impairment	<p>In reading due to:</p> <ul style="list-style-type: none"> a) low contrast with background b) little space between letters, words and lines c) texts overly long <p>In finding the required information on the screen due to:</p> <ul style="list-style-type: none"> a) input overload b) inattention to visuals at the edges of the main central area c) drop-down menus not user friendly <p>In comprehension of information, due to:</p> <ul style="list-style-type: none"> a) texts being written in an elaborate style b) not having a clearly understandable structure c) not highlighting the most relevant pieces of information 	<ul style="list-style-type: none"> • Increase contrast between text and background • Increase space between letters, words, and lines • Use short texts with a clear structure and highlighted keywords. • Increase contrast and visibility of all elements on the screen (arrows, etc.) • Input reduction • Move all useful information inside the central area of the screen • Introduce arrows to show the sequence of events to be followed • Introduce an interactive glossary for all words not frequently used • Create a demo showing the use of specific functions

Table 2.

General Disability Category	Main difficulties	Suggestions
Dyslexia	<ol style="list-style-type: none"> 1. In order to read, subject needs to be close to the screen (1.5 m) 2. Too many visual and reading stimuli at the same time 3. Difficulty in reading a long, complex text 4. Long time required to decode texts, with consequent reduction in motivation 5. Inattention to stimuli at edges of the screen 6. Links that fade into the background are not entirely visible 7. Low contrast between text and background and little space between letters 8. Images do not specifically contribute to the task 	<ul style="list-style-type: none"> • Introduce the option of automatic text reading • Improve contrast with background and increase spacing and kerning • Use short texts, with a clearly understandable structure and highlighted keywords • Reduce visual input • Move all items to the central part of the screen • Introduce sequential arrows to show order of steps

Table 3.

General Disability Category	Main difficulties	Suggestions
Low vision	<ol style="list-style-type: none"> 1. Some texts are too small in size or too bright and flickering 2. White texts on green background are not as clear as yellow texts on green background 3. Texts with limited spacing are less readable 	<ul style="list-style-type: none"> • Use the following color combinations: yellow on green; black on pale blue; white on black • Use larger font sizes, wider spacing, and more distance between letters • Use interactive devices to magnify particular texts • Use interactive devices for speech synthesis

is made up of disabled and elderly people, it seems surprising that broadcasters and equipment manufacturers have not given more thought to providing access for this group of people. There is no question, however, that even the healthiest of older people suffers from some impairments, both physical and mental, and it makes good sense for those designing television-based equipment to take them into account if they want to maximise the potential market for digital services such as home shopping.

As stated by the Tiresias Organization, people over 50 years of age naturally have worse vision than when they were younger. Bifocals are common, more light is needed to see fine details, and reflective glare is often more problematic than for younger people. These visual disadvantages apply to the vast majority of 'ordinary' people who would not consider themselves as being blind or partially sighted, but it is worth noting that in addition to all these people, there are some 11 million people throughout Europe classified as having 'low vision,' defined as an ability to utilise some aspects of visual perception, but with greater dependency on information received from other sources. If the controls and displays on digital TV systems could be designed to suit people who have difficulty in seeing clearly, the market for interactive-type TV services would be greatly expanded at little cost.

Customisation is the opportunity for the user to specify the configuration. An option displaying a system specifically suited to any user's needs would

be useful for everyone. Smart cards could provide a viable method of customising iTV and other systems. Users' preferences are stored on the smart card, so when it is inserted into the system, it will reconfigure the display appropriately according to the code on the card. Smart cards have advantages over other methods of adapting systems because they can be transferable between systems and require less time and input. In the future, one card may suffice for use on many devices: a multi-service prepayment card (Gill, 1994).

On interactive digital television, smart cards could be used to control text size, content layout, speech output, color combinations, subtitles, audio description, signing, timeouts, reminders and alerts, mode-changing capabilities according to level of expertise, and so forth (Gill, 2002). If people are able to alter the presentation of information, it will render it more accessible. Visual impairment does not lead to a homogeneous population where one solution will benefit everyone, as is evident even from such a small subject sample. Customisation of settings could enable increased accessibility and usability. Further detailed work is thought to be necessary into navigation, the use of column colors and their combination, and content density. At what point does the screen become too crowded?

CONCLUSION

Guidelines need to be determined, based on scientific principles and specifically for television, enabling designers to meet the needs of people utilising the systems. The results of this usability test have shown weaknesses in interface television design and have permitted the formulation of a series of recommendations for designers of interactive services. These include:

- Items in drop-down menus should also be activated by buttons on the remote, as some users lack the required dexterity to follow prompts on the screen
- Graphic interface displays have to be adjustable to support users' personal preferences, with the option of changing default settings, accessed through a menu subset on the graphic user interface (GUI).
- Display layouts should be simple and in a consistent linear format, in order to avoid input overload in some users
- Strong visual contrast with the background
- Sufficient screen space, enough space between letters, distinguishable breaks between words, the use of double-spacing
- Simple, concise language without abbreviations
- Use of interactive devices to magnify particular texts
- Use of interactive devices for speech synthesis
- Use of short texts, with a clearly-organised structure and highlighted keywords
- Reduction of visual input
- Moving all items to the central part of the screen
- Introduction of arrows to show the sequence of events to be followed.
- Creation of a demo to show the use of specific functions

Disabled people are not a homogeneous population where one solution will benefit all. Customisation of settings could enable increased accessibility and usability.

One final consideration in regard to usability in iTV is that, as a general rule, in the case of digital television, it is required to use a combination of remote controls and on screen displays to provide user interaction.

However, users may have difficulties understanding how to scroll and navigate, recognising when an item is highlighted and knowing that it is necessary to press 'OK' to access one's highlighted chosen item. As suggested by Klein, Karger, and Sinclair (2003), due to the fact that the grammar of this type of interaction is based on that of personal computers and is similar to that of mobile phones, people who have never used these products are at a disadvantage in being able to understand how to interact. The result is that some users without experience of personal computers are confused by, or even unable to use, almost every aspect of digital TV.

A solution might be to have a universal design, that is, a design of product and environments to be usable by all people to the greatest extent possible. Unfortunately, in the real world, this ideal is not easily achievable. As a consequence, "universal," in universal design, should not imply one optimal solution for everyone, but rather it should stress the need for inherent flexible, customisable content.

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KEY TERMS

Cochlear Implant: A cochlear implant is an electronic prosthetic device surgically implanted in the inner ear under the skin behind the ear to provide useful sound perception via electrical stimulation of the auditory nerve. Cochlear implants are intended to provide prelingually or postlingually deaf children who obtain limited functional benefit from conventional amplification with improved sound and speech detection and improved auditory perception and speech.

Customization of the Interface: Customization is the ability of the user to specify the configuration. An option displaying a system specifically suited to any user's needs would be universally useful.

Dyslexia: Dyslexia is a neurologically based disorder interfering with the acquisition and processing of language. Varying in severity, it is manifested by difficulties in receptive and expressive language, including phonological processing, reading, writing, spelling, handwriting, and sometimes arithmetic.

Facilitator in a Usability Test: In a usability test, a facilitator is one who encourages the subject's full participation, promoting understanding of the tasks. A good facilitator knows how to draw out exactly the right information from the participant without giving away the store. He knows how to use the very limited test time to focus on those elements that will be most important to the team of evaluators.

Heuristic Evaluation of Usability: Heuristic evaluation involves having a small set of evaluators examine the interface and judge its compliance with recognized usability principles ("heuristics"). Experience has shown that different people encounter different usability problems. Therefore, it is possible to significantly improve the effectiveness of the method by involving multiple evaluators.

Prelingual Deafness: This kind of deafness already exists before the person can speak (before the age of three). Profound deafness in childhood affects the development of auditory speech perception, speech production, and language skills.

Retrospective Approach to Test Usability: When using the retrospective approach, participants uninter-ruptedly perform all tasks and then report any observations (critical incidents).

Usability Test Script: During a usability test, participants follow a printed task sheet. Tasks should be designed to be short, specific, realistic, in the user's language, and related to the user's context.

Think Aloud Method to Test Usability: When using the "think aloud" method in a usability test, participants report on incidents as soon as they happen.