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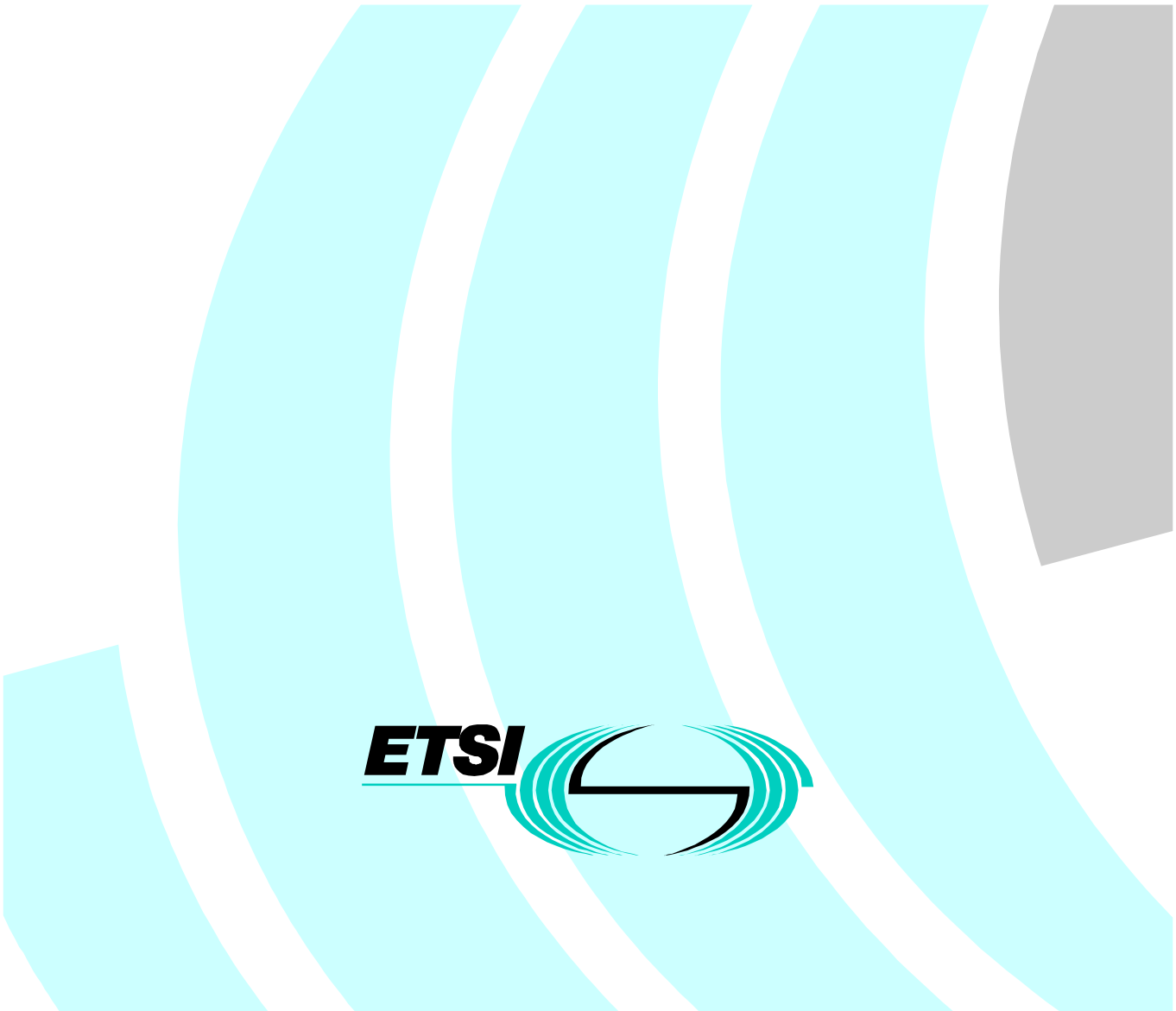
Technical Report

Human Factors (HF);
Symbols to identify telecommunications facilities for deaf and hard of hearing people;
Development and evaluation



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Foreword

This Technical Report (TR) was produced by the ETSI Technical Committee Human Factors (HF).

European Standard (EN) EN 301 462 [1]: *"Human Factors (HF); Symbols to identify telecommunications facilities for the deaf and hard of hearing people"* contains the definitive versions of the symbols that resulted from the work described in the present document.

Introduction

The present document provides a background into the needs of deaf and hard of hearing people in a telecommunications environment and the assistive technologies that are available to them. It also incorporates a brief study of the current use of symbols, especially in the telecommunications environment.

The bulk of the document describes an extensive set of experimental tests designed to determine a set of symbols that are accepTable to the widest population of deaf and hard of hearing people. The studies were carried out in several European countries and followed adapted and extended versions of the procedures described in EG 201 379 [3]: *"Human Factors (HF); Framework for the development, evaluation and selection of graphical symbols"*.

The final parts of the present document describe the decision making process that took into account the experimental testing and other relevant factors in making the final choice of symbols.

1 Scope

The present document reports the background research, symbols development and evaluation undertaken to create a European Standard on symbols to identify telecommunications facilities for the deaf and hard of hearing.

The symbols defined in the final standard will be applicable to all telecommunications equipment that provide the defined facilities and assistive technologies that are intended to support the deaf and hard of hearing".

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.
- A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.

[1] EN 301 462 (V1.0.0): "Human Factors (HF); Symbols to identify telecommunications facilities for the deaf and hard of hearing people".

[2] ETR 070: "Human Factors (HF); The multiple index approach (MIA) for the evaluation of pictograms".

[3] EG 201 379: "Human Factors (HF); Framework for the development, evaluation and selection of graphical symbols".

[4] ETR 113: "Human Factors (HF); Results of an evaluation study of pictograms for point-to-point videotelephony".

[5] ETS 300 375: "Human Factors (HF); Pictograms for point-to-point videotelephony".

[6] ETS 300 381: "Telephony for hearing impaired people; Inductive coupling of telephone earphones to hearing aids".

[7] ETS 300 488: "Terminal Equipment (TE); Telephony for hearing impaired people; Characteristics of telephone sets that provide additional receiving amplification for the benefit of the hearing impaired".

[8] ETS 300 679: "Terminal Equipment (TE); Telephony for the hearing impaired; Electrical coupling of telephone sets to hearing aids".

[9] ES 201 071: "Public Switched Telephone Network (PSTN); Protocol over the local loop for display services; Server Display and Script Services (SDSS)".

[10] ETR 333: "Human Factors (HF); Text telephony; Basic user requirements and recommendations".

[11] ETR 181: "Terminal Equipment (TE); Multimedia portfolio; A compilation of multimedia applications and services provided by ETSI members".

[12] ISO 7001 (1990): "Public information symbols".

[13] ISO 9186 (1989): "Procedures for the development and testing of public information symbols".

[14] ITU-T Recommendation V.8 bis (08/96): "Procedures for the identification and selection of common modes of operation between Data Circuit-terminating Equipments (DCEs) and between Data Terminal Equipments (DTEs) over the public switched telephone network and on leased point-to-point telephone-type circuits".

[15] ITU-T Recommendation V.18 (10/97): "Operational and interworking requirements for DCEs operating in the text telephone mode".

[16] ITU-T Recommendation V.21 (1988): "300 bits per second duplex modem standardized for use in the general switched telephone network".

[17] ITU-T Recommendation V.23 (1988): "600/1200-baud modem standardized for use in the general switched telephone network".

[18] ITU-T Recommendation V.61 (08/96): "A simultaneous voice plus data modem, operating at a voice plus data signalling rate of 4 800 bit/s, with optional automatic switching to data only signalling rates of up to 14 400 bit/s, for use on the general switched telephone network and on leased line point-to point 2-wire telephone-type circuits".

[19] ITU-T Recommendation V.70 (08/96): "Procedures for the simultaneous transmission of data and digitally encoded voice signals over the GSTN, or over 2-wire leased point-to-point telephone type circuits".

[20] ITU-T Recommendation H.324 (03/96): "Terminal for low bit rate multimedia communication".

[21] ITU-T Recommendation H.263 (02/98): "Video coding for low bit rate communication".

[22] IEC 60118-11 (1983): "Hearing aids. Part 11: Symbols and other markings on hearing aids and related equipment. (Implements CENELEC HD 450.11 S) + Amd 6187 (1990)".

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[35] Demographic aspects of hearing impairment: Questions and answers: http://www.gallaudet.edu/~cadsweb/factshee.html.

[36] International Federation of Hard of Hearing People: http://www.ifhoh.org/.

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[38] Kiwi explorer - Deafness: http://www.massey.ac.nz/~rchweb/deaftec.htm.

[39] ITU-T Recommendation T.140 (1998): "Protocol for multimedia application text conversation".

[40] ISO 7000: "Graphical symbols for use on equipment - Index and synopsis".

[41] ISO 3461-1: "General principles for the creation of graphical symbols - Part 1: Graphical symbols for use on equipment".

[42] ISO 3864: "Safety colours and safety signs".

[43] ISO 4196: "Graphical symbols - Use of arrows".

[44] Ross, Mark: "Personal and social identity of hard of hearing people".

[45] Martin, M.C.: "Implications of standardization in telecommunications for hard of hearing people".

[46] Sorkin, Donna L: Developing an identity for people with hearing loss

[47] Lieth, L. von der: A survey of conditions and organizations of hard of hearing people in Europe - a state of the art

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

additional receiving amplification: facility provided in a terminal whereby the gain in the receiving direction from telephone line to ear may be increased (or decreased) relative to that required by the **relevant terminal standard,** for the purpose of enabling the user to select, within certain limits, his/her preferred receiving loudness. (as defined in ETS 300 488 [7]).

coupling: linkage between two systems whereby energy is transferred from one system to another. The energy may be in a form capable of conveying information.

electrical coupling: transmission of information from one device to another through a direct electrical connection. The interconnection from a telephone to a hearing aid is taken from the electrical path to the telephone earphone (as required by ETS 300 679 [8]).

hard of hearing: Implies a hearing impairment with a loss of hearing level between normal and profound (deaf) i.e. in the range 25-65 dB.

hearing aid coupling: facility to enable a hearing aid to detect real-time voice signalling at a telecommunications terminal and present this as an audible sound to the hearing aid user. The technology used to couple the hearing aid to the terminal, may be magnetic induction, direct electrical connection, infra-red or radio signalling.

hearing impairment: reduction of hearing ability (unilateral or bilateral). The reduction may be mild (>25dB hearing loss), moderate (>45dB hearing loss), severe (>65dB hearing loss) or profound (>80dB hearing loss, deafness).

high quality videotelephone: videotelephone with an advanced codec which supports a frame rate >15 frames per second such that the bi-directional video signal is suiTable for lip-reading and/or fluent signing.

inductive coupling: transmission of information from one device to another through the medium of an alternating magnetic field. Typically a magnetic field is provided at the earphone of a telephony terminal so as to be detected by a hearing aid provided with an induction pick up coil. **(**As required by ETS 300 381 [6]).

infra-red coupling: transmission of information from one device to another by means of infra red radiation.

radio coupling: transmission of information from one device to another by means of radio signals.

relevant terminal standard: standard which would apply if the terminal concerned did not provide additional receiving amplification for the benefit of hearing impaired users. (As defined in ETS 300 488 [7]).

symbol: symbols, pictograms, and icons are all graphic devices used to convey information, either as complementary to or as replacement for text. The word symbol is sometimes used specifically to refer to abstract representations, the word pictogram to refer specifically to pictorial representations, and the word icons to screen based graphical devices. In practice these distinctions are often unclear and so the term symbol is used here generically.

telephone amplification: loose term implying the provision of **additional receiving amplification** within a telephone terminal.

text telephone: terminal offering **text telephony** functions, either as a standalone unit or as an addition to a voice telephone, videotelephone or other telecommunications terminal; or as an application in a multifunction computer based terminal.

text telephony: telecommunications facility offering real-time text conversation through telecommunications networks (as described in ETR 333 [10]). Text telephony may be combined with voice or video telephony.

videotelephone: terminal offering **videotelephony** functions, either as a standalone unit, or as an addition to a voice, text or other telecommunications terminal or as an application in a multifunction computer based terminal.

videotelephony: telecommunications service providing an interactive, bi-directional, real-time audio-visual communication, normally intended for a single user at either end.

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

IEC	International Electro-technical Committee
ISO	International Standards Organization

4 Initial Phase

The initial phase consisted of four main activities:

1. An analysis of hard of hearing and deaf people. This looks at exploring who they are and what their needs might be in relation to the use of telecommunications products and services.

2. An analysis of the telecommunications facilities that are available to assist the deaf and hard of hearing, how these should be classified and presented as a Family of symbols. The findings of this study are presented in clause 5.

3. A search through the standards, literature and the Internet for examples and usage of existing symbols relating to the identification of telecommunications facilities and facilities for the disabled in general. This search is discussed in clause 6.

4. The drafting of a design brief for the various groups participating in the exercise. The design brief is contained in Annex A.

5 Hard of hearing and Deaf People: Who are they?

5.1 Introduction

Approximately 10 % of the total population has a mild to profound hearing loss. About 2 % of children under 18 have some level of hearing loss. By age 40, the incidence of hearing loss rises to 10 %. By 65, one third of the population has a hearing loss. From all people with hearing loss, 7-8 % have a profound hearing loss (Sorkin, 1997 [46]).

The group of hearing impaired people is a very heterogeneous group which can be separated meaningfully in at least 5 categories (Von der Lieth, 1997 [47]):

- hard of hearing children;
- adults who have been hard of hearing from childhood;
- deafened adults;
- people who have become hard of hearing in adult life; and
- elderly who have lost their hearing or part of it as they have become old.

To the people in each of these five categories should be added those who have had a cochlear implantation. Von der Lieth [47] further describes these 5 categories. In the following paragraph these categories are summarized.

5.2 Categories of people with hearing impairment

5.2.1 Hard of hearing children

There are approximately 100 deaf children, 100 severely hard of hearing children and 100 mildly hard of hearing children for each million people. In some European countries all deaf and many hard of hearing children will still be in special schools and only a few will be integrated. But for most countries a mainstreaming has appeared so that the school system has three possibilities of services for deaf and hearing impaired children: segregation in special schools, partly segregated/partly integrated in special classes in local schools, individually integrated in local schools.

5.2.2 Adults who have been hard of hearing from childhood

Depending on the hearing loss and the time when it appeared the members of this group will have learned spoken language and be able to participate in education, vocational training and higher education according to their interests, abilities and possibilities. A very important issue will be, if they have access to all technical devices and if necessary to sign language interpreters.

Most hard of hearing young adults from this category seem to have a good possibility to be part of society in a relevant manner which means that they can get training, have jobs and have a social life with families, friends etc.

5.2.3 Deafened adults

This group can be difficult to define, it consists of those people who after they have learned the spoken language, lost their hearing to such a degree, that they can not decipher spoken language by help of their hearing even if they have the best possible hearing aids. Compared to the other groups it is a small number of people, probably only 100-200 per million.

Their hearing loss might come very suddenly or it might develop slowly, so that they for a long time are considered to be hard of hearing. For all of them, the change in hearing status means a radical change in life situation, where until the ultimate situation, where they can no longer hear, they have had a life built on the fact and condition, that they would be able like others to function as hearing (or hard of hearing) persons. They have made their education, their job consideration, their Family life etc. from the viewpoint that they were hearing. Naturally the change in ability to hear will for everyone be a shock and only by going through a traumatic crisis, which often will take years, will they find new ways of living with the loss as part of their life-space. This group has a strong need of supporting systems like counsellors, special education, self help groups and Family training. Naturally it is among these people that the interest for cochlear implants was first developed and many of them have today been helped to a new way of hearing which for some has been exceptionally good and for others only of little help.

5.2.4 People who have become hard of hearing in adult life

In the period of life where most people have a job, raise their children etc. around 10,000 per million will lose their hearing to such a degree that they will need special devices like hearing aids, amplified phones, light signals etc. to continue their existing life situation. For this group many adjustments have to be done, because a technical solution is never enough in itself. To rely on your hearing ability is as natural as relying on your visual perception, your memory etc. so it takes a psychological adjustment to lose part of your hearing. For many a traumatic crisis is involved and this can start long before the hearing loss has been diagnosed and it can go on for years after the necessary technical steps have been taken. But for most hard of hearing people access to modern techniques and special education training in hearing tactics and other topics will over time make the hearing impaired person capable of finding an adjusted life situation. Contact with other people in the same situation will also help make it easier to adjust.

5.2.5 Elderly who have lost their hearing or part of it primarily because they have become old.

For those who start to lose their hearing when they become older this will often happen in connection with other signs of becoming old. Therefore it might be the most reasonable thing to think of this very huge group - at least 1-2 out of ten - as a special handicap and not just as a hearing loss. Its implication on daily life is of a special kind because this age group already is on its way to losing contact with other people partly because of their friends and Family dying, partly because of their own children and grandchildren moving away and partly because they have difficulty moving around and the contact with others that such mobility brings.

5.3 Social identity of the heard of hearing

All together, some 10 % of the population in each European country and the USA have a hearing impairment. What they all have in common is that they can be characterized as having a communication disorder. They have all met problems in their daily life, where they do not have access to the same information as other citizens because they can not hear them or because they have other communication difficulties connected to their impairment like learning new words and concepts, understanding television, reading disabilities, etc.

It has been described that the Deaf communities in the different countries feel even more that they belong to a minority in their own country as well as world-wide. This is understandable, as they have both a special language and a special culture. But this minority is only 1 per thousand, so the minority of hearing impaired people is 100 times as big.

Do the hearing impaired people have their own language/culture in each country? The answer must be no, Von der Lieth [47] says. Nowhere does a specific language/culture for hearing impaired people exist. But special arrangements for hearing impaired people like schools, clubs, cafes, counsellors, etc. do exist. Being impaired is a significant part of the personal and social identity for each person as they can refer themselves to the group of hearing impaired people. Unfortunately many feel that they are confused about their social identity because they neither belong fully to the hearing world or to the deaf world although they feel connected to both communities, and their highest wish is to be allowed to move from one to the other, but on their own conditions.

The stigma associated with hearing loss contributes to the reason many of the hard of hearing avoid discussing the impacts of hearing loss, Donna Sorkin [46] says. She, being executive director of the Self Help organization for Hard of Hearing in the USA, states that many people do not even openly discuss the fact that they are hard of hearing. As a consequence, the vast majority of them still don't seek the technology and other adaptations that can dramatically improve one's ability to communicate.

Having a hearing loss, wearing a hearing aid, is not the same as wearing eye glasses. There is a reticence, almost a shame, about having a hearing loss that often discourages a hard of hearing person from seeking help and taking productive steps.

The stigma of hearing loss manifests itself in many ways. But the outcome is always the same. People neglect taking steps that could help them. Family members, friends, teachers, co-workers and acquaintances make inappropriate judgements. The individuals sense of self-esteem suffers, and he or she is prevented from living their life to full potential.

In strong contrast with the hard of hearing people are those who are profoundly deaf. Many of them feel they belong to the Deaf culture. People who are part of Deaf culture do not view their inability to hear as something that needs to be "fixed". Rather, they believe they are a subculture which has its own language, American Sign Language. In the USA, some 25 % of those with profound hearing loss rely upon sign language. They embrace their deafness with pride and note that they have a cultural identity all their own (Sorkin, 1997 [46]).

For Sorkin, the problem lies in the fact that hard of hearing people have not been so organized about articulating their own needs and rights. The problem from the hard of hearing perspective is that the absence of comparable discussion of hard of hearing needs leads the general public, as well as people who know better, to lump everyone's needs and preferences together. There is a perception that the group of people who use sign language is significantly larger than it really is. And, as a group, the hard of hearing have been relatively ineffective at communicating their message.

A hearing loss is one of the most common two or three impairments that beset human beings. It is also, perhaps, the most misunderstood, in part, probably, because it is so common. After a lifetime of living with one's grandmother or spouse, for example, we simply do not expect, understand, or know how to deal with the kinds of behaviours that occur when a hearing loss develops in later life (Ross, 1997 [44]). It has been termed "An Invisible Condition" (Stone), not because the damage to the auditory system is hidden from our view, which of course it is, but primarily because the effects can be so misunderstood, even by the persons who are themselves afflicted with the condition.

At present the best estimate is that in developed countries only about 20 percent of people who can benefit from hearing aids wear them (Ross, 1997 [44]). These percentages, would be even poorer in developing countries. In some countries, like the Netherlands and Denmark, these percentages are 30 % or higher. It is not just a matter of economics and reimbursement by the insurance companies. If these were the only factors, then most hard of hearing people in the developed countries would be using amplification.

There are two major reasons for the low percentage of persons using hearing aids. The first is that until recently, the situations in which hearing aids are useful are limited because most hearing aids amplify all sounds indiscriminately - background noise and speech. What is required is a more selective amplification of speech. While that feature is becoming more commonly available, many people have stopped using their hearing aids because they do not help hearing in many social situations. The second reason concerns self-acceptance. It's not easy to move hard of hearing people out of their self-constructed closet of isolation and despair.

Then, there are issues like: fear of or unwillingness to learn how to work with this sophisticated technology and the fact that home physicians do not send hard of hearing patients to audiologists (in the Netherlands, insurance companies want to reverse the trend of sending so many patients to specialists).

5.4 Hearing impaired, telecommunications and hearing aids

Today it is difficult to say where telecommunications begins and ends. The reason for this is that the introduction of new technology which includes digital systems, cable and radio services all interface with the basic telephone system. With these new systems and services has come the blurring of the distinctions as to what are telecommunications and what are for instance broadcast entertainment services. Basic voice telephony, which can be thought of as the conventional telephone, can still be given priority as it is the main reason why people with hearing impairment are today often deprived of a means of communication enjoyed by the majority of the population (Martin, 1997 [45]. Today the basic telephone is installed in some 90 % of all homes in the majority of western countries. Our dependence on the telephone grows with the trend for more services being offered through the telephone. Therefore any barrier to the use of the telephone is a barrier to an individual's independence and the effects of these barriers on a person's work and social life as well as their general well being and safety have to be considered.

While it is possible for people with no experience of hearing loss to easily understand that a person with no hearing cannot use the telephone because they do not hear what is being said, it is difficult for them to understand the problems of those with a less than total hearing loss. Furthermore, it is often difficult for the professionals involved in telecommunications to understand the problem because there is a tendency to describe hearing loss in terms of the levels found on an audiogram, i.e. in decibels, rather than in functional terms (Martin, 1997 [45]).

From the point of view of the hard of hearing user the two main important functional factors are - is the sound loud enough to be heard comfortably and can the speech be understood. The number of decibels of hearing loss is not the most important factor and in fact does not always relate well to the ability to hear speech over the telephone.

The other factor which can be of equal importance is that of being able to hear the phone ring. Even with a hearing aid it is often not possible to hear the phone ring when the listener is at a distance from the phone or there is noise in the surrounding area. A further factor which is often overlooked is that of losing visual contact with the person speaking. Consequently while a hearing impaired person may cope very well in a face to face situation, due to the use of lip-reading and facial and body language clues, they may be completely lost in following the conversation over the telephone, particularly if it is with an unknown person and if it involves names and unusual subject matter.

The environment in which the telephone is being used can play an important part in determining if the conversation can be understood or not and the effect of high levels of noise on a person trying to use a hearing aid with the telephone can be disastrous. Therefore, many hard of hearing first take their hearing aid out of the ear before using the telephone. It is often forgotten that the effects of background noise are far greater on a person with a sensorineural hearing loss than a person with normal hearing. A person with normal hearing can subjectively listen and discriminate between what he or she wants to hear and what not. The hearing impaired person needs at least a difference of 6 - 10 dB between background noise and the sound that must be heard.

In hearing aid development one can see two big trends: digital hearing aids and very small "in the ear" hearing aids. Most of the modern "in the ear" aids are so small that a telecoil for inductive coupling is technically not possible anymore. For the next few years, however, there will still be a big market for the cheaper and bigger "in the ear" aids which have these coils for inductive coupling.

There has been a growing interest in radio coupling. However, FM will be limited to specific situations. In fact FM can only be used in a 1 to 1 situation, not for coupling in public places, like railway stations. Yet, hard of hearing associations like the Dutch Hard of Hearing Union stimulate the development of FM-transmission in public places. But, just as car drivers on the highway are warned to listen to certain FM-frequencies, hard of hearing people should know in public spaces whether they can use FM and on which frequencies.

Electrical coupling is not used very much. There are also couplings between infra red and inductive loops. In this case the pendant around the neck is used as inductive loop.

Regarding technological innovations: in general, in contrast to a pair of glasses for full recovery of sharp eyesight, a hearing aid would never be able to fully restore the hearing impairment. The subjective listening to required sound and non-listening to noise can never be imitated by technology. Nevertheless, technological advancements are progressing so fast that hearing aids more and more permit nearly full hearing. Digital hearing aids are still in their infancy. One of the opportunities of digital hearing is that these aids can reinforce in a direction-sensitive way. But also analogous hearing aids are becoming so good that even inductive loops are no longer necessary.

Finally, it must be remembered that the majority of people with hearing loss are over the age of sixty and with increasing age comes an increase in other disabilities particularly declining vision. These additional disabilities, no matter how small, all add to the problems of using the telephone particularly as more and more modern telephones rely on visual displays for a number of services (Martin, 1997 [45]).

5.5 Discussion and conclusions

Approximately 10 % of the total population has a mild to profound hearing loss. This means that hearing loss concerns a large minority of the total population. About 2 % of children under 18 have some level of hearing loss. By 65, one third of the population has a hearing loss. This means that extra attention must be given to elderly people, particularly also, because they might have other diminished physical and mental abilities. For the design of a Family of symbols, this would also imply that many people with hearing impairment might also have poorer performances in both vision and memory.

Hard of hearing people are a heterogeneous group with needs and existential realities different from those manifested by those who are socially or culturally deaf. Hard of hearing is not some lesser manifestation of "deaf", but a disability entity in its own right. It is important to distinguish between the needs of hard of hearing people as people who want to use their residual hearing from those of deaf people for whom sign language is their preferred mode of communication. From all people with hearing loss, 7-8 % have a profound hearing loss. In the USA, some 25 % of those with profound hearing loss rely upon sign language. They embrace their deafness with pride and note that they have a cultural identity all their own.

In general, by not clearly delineating these differences, government, business, the general public, and people with hearing loss themselves are confused. When designing families of symbols these differences must be taken into account.

There is a strong argument in favour of making a Family of symbols which have a subtle appearance, not referring to the stigma of the hearing impairment. This would even mean that the Family of symbols might not have the "ear" drawing, but rather a neutral icon. On the other hand, the ear symbol is so well recognized and accepted that it would raise resistance to abandon this particular symbol. Also, the Family of symbols should be such that not only hard of hearing people are focused on the presence of aids or special equipment, but normal hearing people also remember that they should appreciate the presence of a hard of hearing person. This could even help taking away the hard of hearing stigma.

This is in strong contrast of what profoundly deaf people would like to have: strongly visible, pronounced symbols, which even further enhance their "feeling of pride".

There are no figures about use of public terminals by hard of hearing people. But it seems very clear that the vast majority of the hard of hearing still don't seek the technology and other adaptations that can dramatically improve one's ability to communicate. One of the major reasons is still the inability to discriminate between sound and background noise.

But here, the question also might be raised about any causal relationship that might exist between the fact that hard of hearing people don't use the public terminals and the absence of good symbols. It is difficult to speculate whether hard of hearing people would make more use of special terminals if these were clearly indicated.

In conclusion: multiple factors, amongst others the stigma of hard of hearing, cause the fact that only 1 out of 5 hearing impaired people use hearing aids or special features on telephones, etc.. Technology is rapidly improving and offering new opportunities. But, despite the increasing use of very small "in the ear" hearing aids without coupling possibility, the availability of digital phones without leaking and the increasing use of digital hearing aids, it would still be wise to design a set of symbols, including the sub-symbols for all sorts of coupling. For radio coupling the international FM might be preferred over something like R. The internationally recognized ear symbol and the T sub-symbol should not be abandoned without a great deal of thought. Finally, the new Family of symbols should be designed such that normal hearing people also become aware of the existence and meaning of symbols.

6 Assistive Technologies

6.1 Purpose

In order to assess the range of facilities for deaf and hard of hearing users that might be available now or in the future, a paper study was undertaken. From this list of facilities it was possible to determine which might those most likely to benefit from the provision of special symbols.

This clause describes the range of assistive technologies that are currently available or may soon be available technologically, if not commercially.

6.2 Telephones

6.2.1 General

Originally telephone terminals used carbon transmitters and moving iron receivers. The speech loudness and quality was determined largely by the efficiency of the microphone and of the receiver. Following the advent of the junction transistor it became possible to provide amplification suiTable for users with hearing impairment not severe enough to require the use of a hearing aid [26]. With the coming of integrated circuits, complete telephone circuits were chip based and commonly used electret microphones and moving coil receivers which offered improved sound quality.

As the cost of integrated circuits reduced "Smart" telephones became available with multiple features such as the ability to connect to more than one line and giving single stroke dialling to certain pre-designated addresses. Alpha numeric displays were provided which were able to give calling party identification and other information provided by the network.

6.2.2 Receiving performance

6.2.2.1 General

Modern telephone terminals have a receiving performance with a sensibly flat frequency response ranging from 300 Hz to 3.4 kHz with the loudness set at a level judged to be comforTable for users with normal hearing. This level is surprisingly loud and on the majority of telephone calls in modern networks the speech loudness is some 20 to 25 dB louder than that occurring when two people carry on a conversation when standing 1 metre apart depending on the conditions (reverberant or free field) [27].

This is the reason why many people with impaired hearing find it easier to converse over the telephone than normally face to face.

Some types of telephone are provided with a volume control permitting the receiving loudness to be adjusted both up and down over a small range, generally less than 10 dB.

The upper gain setting is limited by the need to prevent the occurrence of instability and the lower setting by the need for users to be able to hear call progress tones.

6.2.2.2 Amplification of incoming speech (additional receive gain)

When amplification of the incoming speech is intended to be of particular benefit to the hearing impaired, the gain is often so great as to require special measures to prevent instability. An ETSI Standard, ETS 300 488 [[7]], [7] specifies characteristics of telephone sets that provide additional receive amplification for the benefit of the hearing impaired. This standard applies both to telephones that can be connected to the PSTN and the ISDN and there is no reason why similar requirements could not be applied to mobile telephones.

The standard requires the telephone to have normal sending characteristics and, when the receiving gain is set to normal, normal receiving characteristics. The receiving frequency response is permitted to vary outside normal limits when the receiving loudness is set to be outside the normal range allowed by the relevant telephone specification.

Gains of up to 20dB are permitted and the possible use of voice switching for the prevention of instability is acknowledged. Unless provisions are made to prevent instability occurring, it is required that the telephone reverts to normal gain at the end of a call so as to prevent problems when the telephone is used by users with normal hearing.

In the future, in telephony terminals using complex speech circuitry, it is possible that a Smartcard might be used to reconfigure the telephone to meet the user's personal hearing level requirements [25].

6.2.2.3 Provision for an additional earphone

In the past the provision of an additional earphone (sometimes known as a watch receiver) was only common in those countries where poor transmission was prevalent. Nowadays such provision is becoming more common as it has been realized that many hearing impaired users find benefit from the use of such a second earphone additional to that provided in the handset. Where such a second earphone has provision for inductive coupling [6] it provides a useful method of coupling to a body work hearing aid.

Additional earphones are commonly hard wired, the provision of a socket to permit the later addition of such an aid being inhibited by the present lack of standards specifying the sensitivity requirements and the impedance applicable at the interface. Any future standard for an earphone socket should take into account the existence of the ETSI standard for electrical coupling of hearing aids [8].

6.2.2.4 Provision for an external headset

The use of external headsets associated with a telephone is becoming more common, either in addition to or in place of the handset. There are at present no standards for headsets or for the interface to which they are connected. Headsets are commonly used plugged into the socket intended for the handset but unless the headset is specifically designed for use with a particular telephone it is likely that such use will cause the telephone to infringe its approval requirements. Some more complex headsets contain buffer amplifiers with sending and receiving gain controls which attempt to compensate for impedance and level differences between the headset and the handset that it replaces.

Headsets are normally intended to provide a measure of hands free operation to someone with normal hearing who is using the telephone for extended periods but can assist hearing impaired users, particularly when the receiver also provides an inductive coupling facility.

Any future standard for a headset socket should take into account the existence of the ETSI standard for electrical coupling of hearing aids [8].

6.2.2.5 Configurable frequency response

In the future it will be possible to configure on demand the characteristics of a Digital Signal Processor (DSP) used in a complex telephones. Such DSPs are currently only used in mobile telephones, but there is no reason apart from cost why they should not be used on other terminals such as ISDN or even PSTN telephones.

In the future a Smartcard might be used to reconfigure the telephone to meet the user's personal frequency response requirements [25]. It is quite likely that contactless cords could be used to configure a terminal as required at the close approach of a compatibly equipped user.

6.2.3 Ringer

6.2.3.1 General

Some form of ringer is necessary to inform the user of the presence of an incoming call. In the past the acoustic output was normally provided by a bell but nowadays a tone caller is more common. The loudness is normally limited by the availability of power from the line and the common need to connect terminals in parallel.

The general requirement is to provide sufficient loudness to permit a user with normal hearing to hear the ringer in a domestic environment outside of the room in which the telephone terminal is situated. Some designers specify a ringer with a significant energy content below 1 kHz so as to assist users suffering particularly from presbyacusis, but this is difficult to achieve at low cost.

6.2.3.2 Loud ringer

Many tone callers now have volume control provision. The volume control is more often used to reduce the loudness of the ringer. Extra loud ringers are commonly available as separate extension bells or tone callers, intended for general use to gain attention at a distance or in noisy environments and may require the provision of external mains power.

Such loud extension ringers are commonly used to assist the hearing impaired.

6.2.3.3 Frequency adjusTable ringer

Tone callers fitted in terminals commonly have a number of selecTable tones or tunes available that cover a range of frequencies. This can enable hearing impaired users to choose a characteristic that best compensates for their personal hearing defects.

6.2.3.4 Optical indication of ringing

Some terminals are provided with a lamp indication of the incoming ringing, but such indications are seldom bright enough to draw the user's attention. A range of accessories are available which function as extension ringers but which operate either a separate bright flash or a relay which can flash the domestic lighting.

6.2.3.5 Mechanical indication of ringing

Mobile telephones and pagers are commonly fitted with vibrators (often on the battery pack) to give a discreet indication of an incoming call. Such a facility is also useful to a hearing impaired user. There is no reason why similar vibrating package should not be provided, operated by a radio signal controlled by incoming ringing on a telephone line.

6.2.4 Call progress tones

6.2.4.1 General

In order to set up and control the progress of a telephone call it is necessary to monitor the various call progress tones provided by the network which are needed to monitor either call set up or the various supplementary services.

6.2.4.2 Visual indication of tones

Hearing impaired users may have difficulty hearing the call progress tones and it is therefore necessary to provide the required information in visual form. This can be done by the use of a tone detector which either operates a lamp (or lamps) indicating the stage of call progress or which provides a text description on a suiTable display. Such detectors can be difficult to design as there is no common standard for network tones.

When using the ISDN it is possible to provide text messages on call progress directly from the network. This facility could also be provided on the PSTN by using the Server Display and Script Service (SDSS) which is described in ES 201 071 [9] the European equivalent of the American Analogue Display Services Interface (ADSI). Unfortunately, this service also depends on detection of non-standardized call progress tones.

6.2.5 Terminal configurable from Smartcard

In the future it can be expected that it will be possible to configure a terminal to the personal requirements of a user by means of a Smartcard. This is likely to happen in the first place with mobile telephones and later with public terminals of all kinds. As referred to in 6.2.2.2 and 6.2.2.5 above a Smartcard could be used to configure the receiving properties of a terminal although such a facility would require the terminal to be provided with a suiTable card reader.

6.3 Coupling to hearing aids

6.3.1 Inductive coupling

Inductive coupling was first used in the USA where the telephone receiver was relatively inefficient and there was significant fortuitous a.c. field leakage from the receiver. Later, when the use of behind the ear aids became more common, coils wound around the then more efficient receivers and connected in series were used to provide the necessary a.c. coupling field. These in general were constructed to meet a CCITT standard that had been based on the available fortuitous leakage available from American moving iron receivers.

The cheaper receivers that were able to be used with electronic telephones once again provided significant leakage for fortuitous inductive coupling although they often provided a safety hazard due to their propensity to pick up stray pins. Screening of the d.c. field to prevent this hazard often reduced the a.c. field to unusable levels.

Mobile telephony produced a need to reduce component sizes and this led to a growing use of ceramic receivers. These had no available leakage field and were of such high impedance as to provide insufficient current to drive an external coupling coil even if there was room to fit it.

There is an ETSI standard for inductive coupling, ETS 300 381 [[6]] which is compatible with the equivalent ITU-T standard. As a method of coupling it is reasonably secure, the inductive leakage field being undetecTable at a reasonable distance. It is a fairly reliable form of coupling but can suffer from low frequency noise radiated, for example, from fluorescent lighting and other electrical installations. The coupling coil can also act as an aerial which can cause EMC problems, both in the telephone and in the hearing aid.

The pick up coil and the associated "T" switch make it almost impossible to fit an inductive coupler into in-the-canal aids. The growing use of such smaller aids casts doubt on the future use of inductive coupling.

Another form of inductive coupling is used for contactless coupling to Smartcards, where the card can be read simply by placing it on the surface of the reader.

6.3.2 Electrical coupling

Standards exist for the direct electrical coupling between telephones and hearing aids [8] but the use of such coupling is not common except with body worn aids. The need for a coupling lead makes the electrical connection difficult with behind the ear aids and substantially impossible with in-the-ear aids.

Problems of potential vandalism preclude the provision of this type of coupling on public payphones.

6.3.3 Infra red coupling

The use of infrared coupling is growing for coupling to hearing devices in public places such as museums and conference centres, but the provision is generally associated with headsets that are provided at the site. There is no real reason why direct infra-red coupling could not be provided on body worn and behind the ear hearing aids, and in most cases on in-the-ear aids, but there would be difficulties in ensuring reliable coupling to in-the-canal aids.

6.3.4 Radio coupling

Radio coupling is used for control of some hearing aids, and there is no real reason why the speech signal should not be similarly coupled. Security would be a problem, which could be overcome by suiTable encoding.

Radio coupling is not in general use at present except in conjunction with body worn aids in an educational environment where the ability to provide simultaneous coupling to many hearing aid users in a manner substantially free from environmental noise is of great utility.

Radio coupling is also used for contactless coupling to Smartcards where the card can be read simply by placing it in proximity to the reader. This type of usage can be extended to the automatic reading of a badge worn by a user so that a terminal can respond automatically in a pre-programmed manner merely on the approach of a suitably equipped user.

6.4 Text telephony

6.4.1 General

Users who are profoundly deaf cannot benefit from the use of a hearing aid and must resort either to text or sign language for the purpose of communication. Sign language is only possible over some form of videophone, and when the available communication bandwidth precludes the use of such a terminal it is necessary to use either facsimile or a textphone.

In a number of countries, textphone terminals have been developed and later special relay services have been provided which offer a hearing interpreter equipped with a text telephone who can facilitate conversation between a textphone user and a user with an ordinary telephone. Each country has been operating to its own national standard for communications protocol. In the US the original apparatus used Baudot (also known as 5-bit or TDD (Telecommunication Device for the Deaf), and similar equipment was exported to Canada Ireland Iceland and the UK. ASCII was also used in the US and DTMF was used in Holland and Denmark. The EDT (European Deaf Telephone) uses V.21 [16] modulation and is used in Germany Switzerland, Austria, Italy, Spain and Malta. France uses V.23 [17] in a special version of the Minitel called Minitel Dialogue.

This multiplicity of standards has led to the development of the ITU-T Recommendation V.18 [15] , which sets out requirements for a textphone capable of interworking with the installed base of existing textphones. This recommendation also refers to the capability for simultaneous voice and data using ITU-T Recommendation H.324 [20], V.61 [18] or V.70 [19] together with the V.8 bis [14] procedure for selecting the best common mode.

A telephone conversation carried out over a textphone is some 7 times slower than an ordinary voice conversation and, in some countries, special tariffs are provided for deaf users of such terminals. In the UK a text user rebate scheme exists which gives a 60 % rebate on call charges funded voluntarily by BT and managed by a national charity for the deaf. In many countries relay services are provided, sometimes with emergency call facilities.

6.4.2 Provision of textphone

Textphone terminals can be purchased constructed to various standards. As of November 1997 none were available which operate in accordance with ITU Recommendation V.18 [15]. With current trends to deregulation it is not normal for such terminals to be provided as a service by network operators.

In some countries textphones are often provided through charity organizations and sometimes through local authority welfare funds.

6.4.3 Electrical port for text unit

Text telephones can be plugged into any normal PSTN socket and so special provision for a text unit is generally unnecessary. Although it is technically feasible to provide such a socket on a public payphone and there exists a reported demand from users of textphones [28] and porTable modems, there is some resistance from network operators in view of the considerable possibilities for fraud and the fact that such a socket is very liable to vandalism.

6.4.4 Infra red port for text unit

Infra-red coupling of keyboards to computers and personal digital assistants (PDAs) to fixed computers is becoming common but at present there are no agreed standards for such coupling. In a public environment there could be some security problems if the radiation was powerful enough to radiate over any significant distance, but any problems of this nature could be readily solved. In public terminals infra-red coupling could be subject to a simple form of vandalism by obscuring the detector by sticky tape or paint, but such activity could be readily detected and often corrected by a user.

It can be expected that in the face of a growing usage of PDAs there will be a growing demand from users for compatible coupling facilities to be provided at payphones. Such demands can be expected to face initial resistance from public network operators due to the perceived problems of vandalism but in the long run it is probable that such facilities will be provided due to the effects of competition in the provision of service.

6.4.5 Textphone facilities

Textphones are sometimes provided as a facility on a public payphone and there is currently much lobbying from the deaf community to make such provision mandatory, at least on a proportion of such phones. Payphones with such facilities are very costly, the provision having been estimated to cause a 100 % increase in the already high price of a payphone [29] and furthermore they are rather prone to vandalism, so their mandatory provision is strongly resisted by most network operators.

Hearing impaired users have said that privacy is a problem, one user of a text payphone reported finding that "a small group of curious onlookers gathered quickly to see what was happening"[28].

6.5 Messaging

A number of messaging facilities can be provided by current networks. Display phones can provide network messages, Pagers can display short messages as can GSM telephones. It is desirable and possible that in the future all of these facilities could be made compatible with textphone operation to provide a wider range of text services for the profoundly deaf by allowing the exchange of messages between the various services.

A private company has demonstrated a conversion service between mobile terminal access to the GSM and traditional V.21 [16] text telephony using a Nokia 9000 communicator.

6.6 Videotelephony

6.6.1 General

The provision of a video facility on a telephone can provide a communication facility for the profoundly deaf who are unable to benefit from the use of a hearing aid and for whom sign language is their mother tongue. It can also be a powerful aid for hearing impaired users who gain additional clues to speech perception by viewing the face of the speaker for lip reading. The ability to see the talker thus provides the potential both for the use of sign language and lip reading.

Primitive versions of videotelephony have been provided over the PSTN, but the available bandwidth has proved insufficient to provide a markeTable quality. Currently videotelephony is provided on the ISDN normally using both available channels and the terminal is generally a Personal Computer (PC) provided with a camera and a suiTable adaption card.

The quality of picture obtained is not always suiTable due both to the excessive delay and to the low frame rate and within the ITU an appendix is being prepared to Recommendation H.263 [21] outlining optimization and test methods for sign language and lip-reading.

6.6.2 Videophone for sign language

Successful transmission of sign language over a videophone requires a frame rate of about 20 pictures per second with a static resolution (expressed in visible vertical lines) of 160 lines although 25 frames per second is needed for fingerspelling at natural speed. Picture delay should be less than 0.5 seconds. The size of the screen should be 12-30 cm diagonally for single person use in a desktop arrangement. A measure of usability is reported to have been achieved with frame rates as low as 12 per second but such a rate requires modification of the speed of language production.

Current experience with videotelephony to ITU Recommendation H.263 [21] indicates that the goals are hard to meet, that they form a challenge and possibly a need for new technologies.

Users have expressed the desire to have text dialogue available simultaneously with the video communication.

Experiments have been conducted using techniques to transmit just the outlines of the hands and features in a sort of "cartoon" form in an attempt to reduce the required bandwidth for transmission.

6.6.3 Videophone for lip reading

A brief experimental study on the requirements for lip reading indicates that a frame rate of 20 frames per second is needed for full perception of lip-reading at natural speed. For hearing supported lip-reading synchronization of the sound and picture is essential, with time differences of up to 100ms being reported to be acceptable.

It has been reported to Study Group 16 of the ITU that no greater picture resolution is required for lip-reading than that required for sign language.

6.7 Facsimile

Many profoundly deaf people find a facsimile machine provides a useful means of communications. Whilst it provides a more immediate communication than the postal service it does not have the facility to provide a real time conversation.

It is unlikely that there will be any moves to provide for simultaneous two way fax in view of alternative facilities likely to be provided in a multimedia environment.

A recent consultation by BT in the UK on Payphones and disability [28] reported that people in the deaf community tend to use fax a lot, for brief hand written messages, and that fax was particularly important to signers. This would suggest that some form of telewriter would be useful to such users.

6.8 Multimedia

Multimedia applications cover a range of services such as videotelephony, videoconferencing, audiographic conferencing multimedia mail, video on demand, videotex and digital broadcasting. Heterogeneous multimedia platforms such as PC s or workstations are expected to provide a shared workspace [11] with graphics, text, pictures, movies, audio notes etc.) for joint editing or viewing.

Many of these services can provide particular assistance to deaf and the hard of hearing, for example audiographic conferencing can provide a shared whiteboard which would provide the equivalent of the two way fax facility desired by deaf users.

Many new and more complex interactions are being developed. For example, within Study Group 16 of the ITU a draft Recommendation (designated T.140 [39]) is being produced which is intended to provide real time text conversation together with video telephony, text telephony and data conferencing.

Other standards are being developed to provide multimedia facilities on mobile terminals.

6.9 Computer Telephony Integration

Particularly in private networks, telecommunications is moving towards a seamless and powerful connection between computers and telephony hardware known as Computer Telephony Integration (CTI). CTI provides the technology for transmitting telecommunications information around a computing network and has the ability to provide powerful automatic services through its direct access to the network intelligence and to the powerful computing facilities contained therein.

6.10 The Future?

Looking further into the future, the reduction in the cost of bandwidth can be expected to lead to the convergence of telecommunications and broadcasting into one all embracing multimedia system, able to offer either television, videotelephony, text, audio or facsimile communication on demand and the user's terminal will probably be based on an intelligent TV with two way communication, interactivity and computing power [25].

Speech technology is a field of research of growing importance to telecommunications with potential to provide new facilities of particular assistance to hearing impaired users. Ongoing research and the reduction in the cost of computing is providing constant improvement in both speech synthesis and speech recognition leading to more reliable and effective speech to text and text to speech translation.

These improved translation systems can be used to provide automatic relay services for textphone users and also provide subtitles for television and videotelephony.

Speech synthesis is even being associated with the synthesis of talking faces in order to extend the benefits of lip-reading to automatically generated network announcements.

Some work is being carried out on synthesis of sign language, which when combined with automatic speech recognition, could provide the basis for an automatic speech to signing relay service.

Given the will on the part of the network operators, service providers and terminal suppliers to provide the necessary facilities, these trends should lead to a great improvement in the ability of hearing impaired users to communicate in whatever manner is best suited to their capabilities.

6.11 Networks

6.11.1 General

Telecommunications services are offered over a number of different networks, both fixed and mobile, each with its own differing characteristics. Newer networks tend to have access to more intelligence with more facilities often offered over a wider bandwidth. As networks evolve, network capabilities and services are evolving to provide wider bandwidth and more intelligence. These developments can enable the provision of facilities such as personally configured multimedia text, speech and video facilities.

6.11.2 Service over PSTN

The Public Switched Telephone Network (PSTN) is the traditional analogue network providing service delivered over a pair of copper wires. In the face of competition from more powerful networks the PSTN is making available new services such as the provision of calling line identity. A standard (ES 201 071 [9]), being written at the time of this study, for Server Display and Script Services (SDSS), the European version of the American Analogue Display Services Interface (ADSI), a service which gives bi-directional transmission of data between stored programme control systems and customer equipment. In the future, wider bandwidth will be available over the two wire local loop provided by what is known as the Asymmetric digital subscriber loop (ADSL).

6.11.3 Service over ISDN

The Integrated Systems Digital Network (ISDN) provides a digital connection to the subscriber's providing the equivalent of two lines (which can be connected as one when the additional bandwidth is required) together with a control channel which can be used for slow speed data. This extra channel permits new facilities such as the display of call progress messages.

The wider bandwidth of ISDN lines permits the use of multimedia terminals with videotelephony ability and facility sharing which will give both textphone and sign language capability [25]. It is expected that video coding systems will progress to the stage where lip-reading is possible so as to give the additional feedback that is so helpful to those with greater hearing impairments.

6.11.4 Service over mobile telephony

Services provided over radio links generally provide the advantages of mobility, but mostly suffer from a restricted bandwidth. Earlier versions transmitted analogue speech signals but are now generally digital in form. With GSM, the main European service, the radio signal is time division multiplexed, a feature which has the disadvantage of causing a particular problem of interference on hearing aids.

6.11.5 Service over Cable and radio in the local loop

These services are currently most frequently offered in forms that mimic the PSTN – with the limit facilities for advanced services that this frequently implies. However, some may be capable of offering ISDN and broadband services and these offerings should bring the benefits at least as useful as those outlined in 6.11.3.

6.11.6 Service over the Internet

A form of telephony can be provided over the Internet via whatever connection is used (PSTN or ISDN etc.). The speech is in encoded form, sent as packets and subject to delays which can cause unaccepTable reduction in quality. In its simplest form Internet speech requires a precept arrangement between two terminals, but some service providers offer the facility to dial out into a network and so gain access to a subscriber on a public network.

6.12 European projects of relevance

6.12.1 TIDE projects:

6.12.1.1 MORE (Mobile Rescue Phone)

Developing and testing of a GSM mobile telephone with built in Global Positioning System adapTable for elderly, persons with learning disabilities and persons with mobility disabilities.

6.12.1.2 SAFE 21 (Social Alarms for Europe in the 21st Century)

The project aims to use existing communication and information infrastructure to deliver a spectrum of emergency and support services for elderly and disabled people and their carers. Alarm services will use speech, cellphone and global positioning technology with a shared control centre. Domestic services will exploit multimedia techniques and a homebus.

6.12.2 RACE & ACTS projects

6.12.2.1 IPSNI (Integration of People with Special Needs in Broadband Communications)

The IPSNI project aims to define for designers exactly what a future computer terminal should be able to do to accommodate the needs of disabled people. It draws on the expertise of research and telecommunications organizations in seven European countries who are pooling their knowledge on computers and disability.

6.12.2.2 LUSI (Likeable and usable user interfaces)

From the LUSI work came the Human Factors Guidelines for designers of telecommunication services for non-expert users. These are available as both a CD ROM browser and in printed form.

6.12.2.3 UMPTIDUMPTI (Using Mobile Personal Telecommunications Innovation for the Disabled in UMTS Pervasive Integration)

- To develop proposals for meeting user requirements for applications and services, usability requirements, non-conventional uses supporting social integration;
- To specify interfaces, in particular common application programming interfaces, to system services;
- To develop applications and services, taking account of appropriate HCI;
- To demonstrate the applications and services in a networked; environment, eventually evolving towards UMTS type network, using emerging technology and equipment, adapted where necessary.

6.12.3 From other Funding of the EU

6.12.3.1 EQUALITY (Teleservices for all)

The main objective of the project is to demonstrate how the quality of life of the less-favoured European citizen in urban areas, could be improved by providing integrated social, health and local civic teleservices, using generic multi-media telematics value-added delivery systems. During the first stage of the project 6 demonstrators will be implemented and validated during relatively large scaled trials with end-user groups (20 - 50 per site for dedicated applications and 500 - 5000 for generic services), using mature technologies such as TELETEXT and the World Wide Web, to network owners, suppliers and research organizations developing services at the leading edge of technology such as interactive cable TV and ATM service networks. At the end of the project this 6 multi-purpose delivery mechanisms will be enriched by migrated applications from the partner cities.

6.12.3.2 PROMISE (ISPO 20700)

PROMISE: Promoting an Information Society for Everyone: Dissemination and Demonstration of Best Practice in Information Society Applications for Older People and People with Disabilities in Europe.

The project identifies examples of good practice that relate to new opportunities and challenges of Information Society and uses these as a starting point to explore and encourage appropriate actions and policies at European and national level.

6.12.3.3 TCALL (Mobile telecommunication for deaf people)

The project will examine the requirements of people with hearing loss for services that will enable them to communicate, firstly with other deaf people and secondly with the hearing world. The customers for these services will include people with a wide range of degrees of hearing loss, ranging from the hard-of-hearing to profoundly deaf people, whose preferred mode of communication may include sign language. About 10 % of the population will have some degree of hearing loss during their lives.

The research work will examine the use of text and pen-based graphics communication; fax; video transmission of sign-language; and automatic translation (in both directions) between text and speech. Experimental equipment implementing particular services will be made available to deaf people, for evaluation in a series of trials, so that the services may be optimized to meet their requirements. The lessons learned will also be fed into the development of technical standards for future systems, so that appropriate services can be included at the design stage rather than being added on later.

6.12.3.4 Project TFA: Telecommunications for All

This is a three-year project designed to introduce into schools for deaf children new telecommunications technology. Project staff are tailoring off-the-shelf and emerging communications technology for improved access by children in school environments as well as developing systems, materials, and activities that will enable and encourage telephone use based on the developmental level of the child.

6.12.3.5 Study of the interaction of Hearing Aid and Cellular Telephones

The overall purpose of the study of the interaction between hearing aids and cellular phones is to objectively and subjectively evaluate the interference between the two technologies. Phase I objectives are to define the test protocol for physical measurements of the interference, to define a standard methodology for measuring the immunity of hearing aids (including "noise floors"), and to define the test protocol for subjective measurement. The test protocol will produce repeaTable results and include parameters such as the intensity and frequency of the audio interference, the field strength, and the threshold distance of interference. The protocol will include both hearing-impaired and unimpaired subjects.

7 Symbols Research

7.1 Initial research

Whilst there are a large number of symbols referenced in, for example, 'The Symbol Sourcebook' by Henry Dreyfuss, there are but a handful which have any relevance to computers, telecommunications and disabilities. This is mainly due to the advancing age of this of this major reference work. The more recently published 'Icon Book' by William Horton has a more up-to-date collection of symbols and icons relating to computer usage although these are mainly designed for on-screen use.

The main graphical standards referenced included:

- ISO 7000 [40] Graphical symbols for use on equipment;
- ISO 7001 [12] Public information symbols [12];
- ISO 3461-1 [41] General principles for the creation of graphical symbols for use on equipment;
- ISO 3864 [42] Safety colours and safety signs;
- IEC 118-11 [22] Hearing aids. Specification for symbols and other markings on hearing aids and related equipment;
- IEC 416 [23] Guide for general principles for the creation of graphical symbols for use on equipment;
- IEC 417 [24] Graphical symbols for use on equipment;
- ETS 300 375 [5] Pictograms for point to point videotelephony.

More fruitful sources of existing, but not necessarily standardized, symbols were found on the Internet. The Graphic Artists Guild of America had a number of freely available symbols specifically designed to identify facilities for the disabled. Some of these: coupling to hearing aids; telephone amplification; signing facilities and closed captioning, were relevant to the area in which we are working but have there own particular problems. For instance, their symbol for signing facilities might not be generally accepTable in Europe and the symbol for closed captioning is language specific.

At the top level the most commonly found symbol is that of the wheelchair which has now become associated with general facilities for the disabled but which was originally designed to denote wheelchair access.

The next common symbol in the hierarchy is that denoting general facilities for the deaf and hard of hearing. This symbol is frequently associated either with the letter T, to denote inductive coupling for hearing aids, or with more general, language-specific information such as the provision of textphone facilities.

Much valuable information regarding the taxonomy and interrelationship of symbols was gleaned from Fred Brigham at Philips (who took part in the design exercise), particularly the design of symbols using metaphoric rather than literal descriptions of the function or facility.

7.2 Classification of the Symbols

Since one of the aims of the project was to produce a **small** Family of symbols the classification and grouping of them is critical to their successful implementation.

The facilities fall under three main headings: telephone related; textphone related and videotelephone related and for the design teams participating in the project the core set of symbols is defined as:

- A symbol indicating the location of general facilities for the deaf and hard of hearing;
- A symbol indicating the location of a telephone whose handset and/or loudspeaker can have its amplification and/or frequency modified to suit the listener;
- A symbol indicating the location of a telephone with facilities for coupling to hearing aids and the means by which that coupling can be made. This can be either inductive, infra-red, electrical (plug and socket) or radio;
- A symbol indicating the location of a textphone;
- A symbol indicating the location of a videotelephone and whether it is suiTable for use with sign language and/or lip reading.

Any symbols from the designers in addition to these are welcome, especially those dealing with future technologies.

7.3 Current Relevant Symbols

The symbols shown in Tables 1 and 2 were identified as relevant from the preliminary research.

Table 1: Symbols directly related to the deaf and hard of hearing

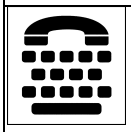
	General Facilities for Hearing Impaired (World Federation of the Deaf approved)
	Coupling: Inductive (ETSI proposal)
	Coupling: Electric (ETSI proposal)
	Assistive Listening Systems, non specific (US Graphic Artists Guild proposal)
	Amplification (US Graphic Artists Guild proposal)
	Textphone (World Federation of the Deaf approved)
	Signing Facilities: • General (US Graphic Artists Guild proposal)
	• General (UK Sign Language Interpreter)
	• Videotelephone Signing possible (Anon proposal)

Table 2: Symbols indirectly related to the deaf and hard of hearing

	Related symbols
	Closed Captioning, i.e. sub-titling (US Graphic Artists Guild proposal)
	General Facilities for Disabled
	Information

8 Test Procedures

8.1 General

Symbols can help facilitate the identification of available services for the hearing impaired. Such symbols could be of use in a variety of scenarios including large signs on public access terminals and small labels on the packaging of telecommunications equipment. Well designed symbols should allow the user to intuitively understand the service described. In addition such symbols should be language independent allowing use internationally and for those with reading difficulties. However before international standardization, it is essential that proposed symbols are tested in different countries to ensure that they carry the same intuitive meaning and are truly culture and language independent.

8.2 Methodological Considerations

8.2.1 General

The method of evaluating symbols pictograms and icons has been specified in detail with the Multiple Index Approach described in ETR 070 [2] and EG 201 379 [3]. The method is prescriptive but allows some choice of assessment criteria dependent on the final application of the symbol. A set of symbols for the hearing impaired is defined as a "good" set if:

- each symbol in a Family is associated with the corresponding referent (i.e. the service to be represented);
- no symbol in a Family is associated with any referent other than the correct one;
- users feel subjectively certain about their selection of a symbol for the service they seek.

Therefore the test method has to consider errors as well as correct associations. In addition the most effective evaluation will come from scenario based studies where the subjects are asked to imagine a realistic situation before making their selections. This has to be balanced by the limited budget and time available for carrying out the study.

There are four ways of assessing the associativeness of symbols.

	Display	Task
1)	One symbol at a time	Name referent;
2)	Families of symbols	Pick symbol for referent;
3)	One symbol and all referents	Pick referent for symbol;
4)	Families of symbols and all referents	Map all symbols to referents.

The most likely way for the proposed symbols to be used is as follows. The user will have a service in mind and be looking for a symbol which indicates that service is available. This effectively eliminates the option of presenting more than one referent at a time to subjects and suggest option 2 as the required methodology.

The Multiple Index Approach as described in ETR 070 [2] was developed on the basis of these considerations. The approach used in the ETR takes the form of a questionnaire with three parts.

Part 1 Symbol Associativeness

One service (referent) is described and presented with all the symbols of one Family and the respondent is asked to choose which symbol best represents the service. They are also asked to score subjective certainty and suitability.

Part 2 Symbol Preference

The respondent is presented with the symbol from each Family that represents the service and asked to choose the one that is most suitable.

Part 3 Family Preference

The respondent is presented with all the families of symbols and asked to give their preferred set.

The results from Part 1 are the main indicator for the usability of the sets to be tested. Parts 2 & 3 are to be used mainly to ensure that the symbol set fulfils not only the associativeness criteria but also meets aesthetic considerations. They can be used as additional information where associativeness results are similar.

8.2.2 Respondent selection

It is accepted that the hearing impaired community cannot be easily split into convenient groups. Indeed, hearing impairment should really be considered as a continuous spectrum of parameters defining hearing loss. Selection of respondents to accurately represent the patterns of hearing loss would not be practical, however, and would result, for instance, in such a small number of prelingually deaf as to make their input insignificant. In addition it is difficult to gain access to some hearing impaired people (such as those who will not admit to hearing impairment). For practical reasons therefore it was decided to split the respondent group to reflect usage of the services for which symbols were being developed. These were as follows:

- Deaf signers 10
- Deaf non-signers 10
- Hearing impaired (using amplification) 20

It was also decided to included another set of users who were not hearing impaired such as carers, social workers etc. This was left to local organizers as it might be difficult to gain access to this group. (In the UK pilot this Group was found through signing classes). The minimum requirement was for 10 people.

8.2.3 Size of Trial

The problems of running a trial utilizing signing translators and lip-speakers meant that the number of variables had to be limited. the intention was to keep the time required for the trial down to one hour or less. Experience suggests that data starts to become unreliable if trialists work for much more than 60 minutes. Given the defined experimental method, with 3 questions for each referent in Part 1, 1 question for each referent in Part 2 and a single question in Part 3, then the number of tasks (questions) given to the trialists (T) is given by:

$$T = 3 \times (F \times S) + S + 1$$

(where F is the number of symbol families and S is the number of symbols per family)

Therefore four families of nine symbols gives 118 tasks. Estimating one task per minute gives a trial length of approximately 2 hours which is well in excess of the one hour limit. Even if the three tasks for each referent in Part 1 are counted as a two rather than three tasks, the total still comes to 82 minutes. This estimate was one of the factors to be tested in the pilot trial.

8.3 Pilot Trial

The difficult and unique problems associated with running an international trial of this kind necessitated a full size pilot trial. Firstly, it was necessary to get a site where the different groups could participate together with the necessary support.

Secondly, it was necessary to produce a standard set of instructions and questionnaire booklet for each of the four groups of subjects; profoundly deaf signers, profoundly deaf non-signers, hearing aid users, and normal hearers.

8.3.1 Trial site and procedures

The pilot trial was run in the UK at the Suffolk Deaf Association. The head of the unit was able to provide not only access to the required respondents but professional signing translators and "lip-speakers". The trial was run exactly as proposed for the main trials. The local organizer was briefed and given the instruction leaflets and questionnaire booklets. The experimenters then took no further part except to observe the process and record problems.

For each trial, the trial organizer read, and if required signed or lip spoke, the standard set of instructions to the group of respondents. The respondents then worked at their own pace until they had completed the questionnaire booklet. The exception was the profoundly deaf signing group. In the case each question was signed separately and the signer waited until all respondents had answered the question, before signing the next question. A copy of the instructions and of sample pages from the questionnaire are included in Annex B.

8.3.2 Symbol Referents used in Pilot trial

These were chosen as:

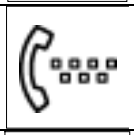
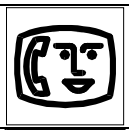
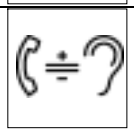
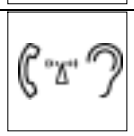
- General facilities for deaf and hard of hearing people;
- Textphone;
- Videotelephone suiTable for signing;
- Videotelephone suiTable for lip-reading;
- Amplification;
- Inductive Coupling;
- Electrical Coupling;
- Infra-red Coupling;
- Radio Coupling.

All nine referents were tested by the hearing aid users and the normal hearing groups, the amplification and coupling referents were not tested by the profoundly deaf groups.

8.3.3 Symbol families used in pilot trial

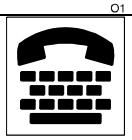
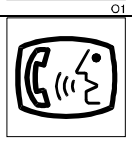
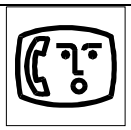
Four families of nine symbols were sourced and used within the Associativeness questions. These symbols are shown in Table 3.

Table 3: Original symbols used in the Pilot Trial

Referent	F1	F2	F3	F4
General facilities				
Textphone				
Videotelephone suiTable for signing				
Videotelephone suiTable for lip-reading				
Amplification				
Inductive Coupling				
Electrical Coupling				
Infra-red Coupling				
Radio Coupling				

A number of additional symbols were provided by the design teams in order to include a range of possible symbol elements for the coupling technologies. As this was the pilot trial it was deemed to be appropriate to include such additional symbols in the user preference questions in order to judge potential user reactions to the various designs. The symbols that were used are shown in Table 4.

Table 4: Additional symbols used in the Pilot Trial

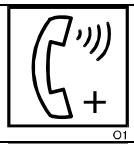
Referent	Other 1	Other 2	Other 3	Other 4	Other 5	Other 6	Other 7	Other 8
General facilities	 O1	 O2						
Textphone	 O1							
Video-telephone suiTable for signing	 O1							
Video-telephone suiTable for lip-reading	 O1	 O2	 O3					
Amplifi-cation	 O1	 O2						
Inductive Coupling	 O1	 O2	 O3	 O4	 O5			
Electrical Coupling	 O1	 O2	 O3	 O4	 O5	 O6	 O7	 O8
Infra-red Coupling	 O1	 O2	 O3	 O4	 O5	 O6	 O7	
Radio Coupling	 O1	 O2	 O3	 O4				

8.3.4 Pilot trial results

The main purpose of the pilot trial was to test the trial methodology, so formal analysis of the data was only undertaken to test the data analysis techniques and to consider opportunities for simplifying the proposed large scale data collation.

Some basic rank order analysis was undertaken on the user preference data in order to look at the possible trends and to try to give guidance to the symbol designers, especially with respect to the creation of suiTable symbols for the coupling technologies. Where the number of times that a symbols was chosen was less than 10 % of the total number of choices it was not included in the Table of results. The Table of rank order of symbol preference is shown in Table 5.

Table 5: Rank order of user preference for symbols used in the Pilot Trial

Referent	1st	2nd	3rd	4th (>10 % response)
General facilities	 O2			
Textphone			 O1	None over 10 %
Video-telephone suiTable for signing			None over 10 %	None over 10 %
Video-telephone suiTable for lip-reading	 O1			
Amplifi-cation	 O2		 O1	
Inductive Coupling		 O2	 O3	None over 10 %
Electrical Coupling	 O5			 O2
Infra-red Coupling	 O4		 O3	
Radio Coupling	 O2			 O1

Within the coupling technologies there seemed to be a preference for the coupling to be reflected by the earpiece in the outline ear and for the technology to be labelled by its initial letter or "T" in the case of induction. However although the use of initial letters reflects the recommendations defined in BSI 6083 Part 11 [22], this solution is Latin alphabet and largely English language dependent.

Results for the certainty and suitability ("How well does the symbol you selected represent a …") questions appeared to be of very little value. For the vast majority of the respondents their response to the certainty question was identical to their response to the suitability question. For example, they were either "very certain" that the symbol was the correct choice and that it represented the referent "very well" or they were "very uncertain" that the symbol was the correct choice and they felt that the symbol represented the referent "very badly". Most of the answers were at the two extremes of the scale with a few answers at the next most extreme points. This bimodal distribution makes meaningful comparative analysis of the results of the answers to these questions hard to interpret. In addition a significant number of the respondents were very unfamiliar with the underlying referents (e.g. Videotelephones) and thus they were in a poor position to judge whether the symbol correctly represented that referent or not and hence could not be certain of their choice.

The analysis of a certainty and suitability question would significantly exceed the analysis of the actual choices made as they would require the counting of multiple categories for each question and a subsequent analysis across all these categories to get any value from these questions. In contrast, the choice question only required the keeping of a simple tally for each symbol or Family chosen with a range of informative analyses being possible from these raw scores.

A final justification for a reduced emphasis on these questions is that a previous study on videotelephony pictograms [4] conducted an extensive analysis of these questions but never once cited them in describing the decision process that resulted in the choice of the final symbol set. This was probably because the other measures used in this trial discriminated more sharply between different symbols and the results from the certainty and suitability questions appeared to show much weaker discrimination. This might be expected if the answers formed a similar bimodal distribution to the one observed in this trial.

8.3.5 Changes recommended from the pilot trial

Comments on the trial from the participants were formalized and stimulated by a short questionnaire given immediately after the pilot trial. These comments were taken into account when the main trial was being designed.

Observations of the pilot trial by the trial designer led to several significant changes for the main trial.

- The issue of coupling technology is very confusing. Trial participants were unfamiliar with the range of possible coupling technologies and were thus confused by the large number of subtle variants of the symbols. A simplified symbol set was proposed.
- An example page showing how the questions should be answered was provided in each trial booklet.
- Signing translators were no longer to read out the service definition on each question.
- A suggestion was made that early finishers move to a different location.
- An effort was made to reduce the overall task time.
- A consultant to the project identified an important new aspect of assessing a Family of symbols. He noted that it would be of considerable interest to discover if respondents, when presented with a group of symbols that does not include the correct symbol for the referent service, will pick an incorrect symbol or conclude that the correct symbol is absent. It was agreed that symbol choice questions where the correct service symbol is missing should be included in the trial.
- The case for keeping a separate certainty and suitability question was very weak and could not justify the extra analysis time that they would require.
- The separate certainty and suitability questions should be replaced by a single certainty question.

8.4 Main Trials

8.4.1 Trial location and organization

A brochure (Annex C) describing the purpose of the project was produced in order to publicize the work of the project. One of the purposes of this brochure was to encourage bodies around Europe to participate in the running of the trials. The main trials were carried out in:

- Portugal - The trials were organized by Prof. Leonor Moniz Pereira and Mrs Celeste Simões of the Department of Special Education and Rehabilitation, Faculty of Human Kinetics at the University of Lisbon. The questionnaire respondents were contacted through Associação Portuguesa de Surdos (Portuguese Deaf Association) and Associação Cultural de Surdos do Barreiro (Barreiro Cultural Association of the Deaf).

- Holland - The trials were organized by Dr. Geraldus van Berlo, Glaukopis b.v., Knegsel, with support from the Institute of Perception, Eindhoven. The respondents were contacted through Verzorgingshuis De Gelderhorst (Home for deaf adults), Nederlandse Vereniging Voor Slechthorenden (Netherlands Association for the Hard of Hearing), Instituut voor Perceptie-Onderzoek (Institute for Perception).

- Belgium - The trials were organized and respondents contacted by Mme Erna Kruger and Mme Katalin Farkas, of the Federation Francophone des Sourds de Belgique, Brussels.

- Finland - The trials were organized and respondents contacted by Mrs Sirpa Lauren of the Finnish Association for the Hard of Hearing, Helsinki and Mrs Irja Lähteenmäki of the Finnish Deaf Association, Helsinki.

A text copy of the English language questionnaire was provided to the participating country for translation and returned to the project leader. Subsequently the symbols were added and master copies produced in the appropriate language. Different variants of the questionnaire were provided for use with the different categories of respondent:

- prelingual deaf people (using signing translator during trial);

- profoundly deaf people (using lip-speaker during trial);

- hearing aid users;

- carers/social workers/normal hearing.

Each variant of the master questionnaire was produced on different coloured paper and the organizers of the trial were asked to produce the questionnaires they produced from the master documents on the correct coloured paper.

The number of questions on the questionnaires varied according to the type of respondent. The questionnaires for the prelingual and profoundly deaf respondents had fewer questions as facilities that were of no relevance to these people, such as hearing aid coupling facilities, were omitted from the questionnaires.

These were sent to the participating countries together with detailed instructions on the procedures necessary for running the trials. An example of the (English language) questionnaire and the instructions to the trial organizers is shown in Annex D.

All completed questionnaires were sent to the UK for analysis. This consisted firstly of a summarization process where the data from each individual questionnaire was manually transferred to a summary sheet. After this process the summarized data could be entered onto spreadsheets for individual countries, and subsequently incorporated into one large summary spreadsheet.

8.4.2 Referents used in the main trials

Seven referents were used throughout the main trials. These were:

- General facilities for deaf and hard of hearing people (General Facilities);
- Textphone;
- Videophone - General;
- Videophone - suiTable for fluent signing and lip-reading;
- Amplification;
- Inductive Coupling;
- Electrical Coupling.

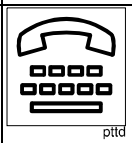
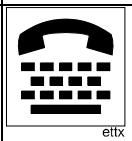
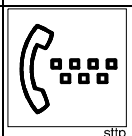
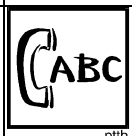
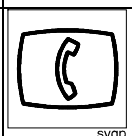
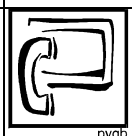
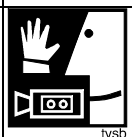
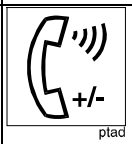
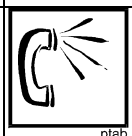
The decision was taken to exclude two of the coupling referents that were used in the Pilot Trial for the following reasons:

- testing six families meant the questionnaire needed to reduce the number of referents to keep it to a reasonable size;
- coupling was the most confusing issue; inductive coupling to hearing aids was understood by those who used it, as was directly plugging something in (electrical coupling). It is probable that the relative lack of any experience of infra-red and radio coupling of hearing aids accounted for the difficulties the respondents seem to have in distinguishing between the variants when these were added to the set of couplings, even though respondents were aware of TV remote controls and Mobile telephones.

8.4.3 Symbol families used in the main trials

Seven families of seven symbols were sourced from designers in the UK, Philips and Telefonica; and used within the main trials, these were:

Table 6: Symbol Families used in the Main Trial

Referent	F1	F2	F3	F4	F5	F6	F7
General facilities	 pgdd	 tgda	 egdx		 sgdp	 tgdb	 pgdb
Textphone	 pttd	 ttta	 ettx		 sttp	 tttb	 pttb
Videotelephone - General	 pvgd	 tvga	 evgx		 svgp	 tvgb	 pvgb
Videotelephone suiTable for signing and lip-reading	 pvsd	 tvsa	 evsx		 svsp	 tvsb	 pvsb
Amplification	 ptad	 ttaa	 etax		 stap	 ttab	 ptab
Inductive Coupling	 pcid	 tcia	 ecix		 scip	tcib	pcib
Electrical Coupling	pced	tcea	ecex		scep	tceb	pceb

For the first three countries to run the main trials, six symbol families were used. The symbol families used were as follows:

- **Trial Site** **Families used**
- Portugal: 1, 2, 3, 4, 5, 6
- Netherlands 1, 2, 3, 4, 5, 7
- Belgium: 1, 2, 3, 4, 5, 7

The reason that one of the families was changed after the Portugese trial was:

- six families of seven symbols design was the maximum size that could be tested before respondent fatigue becomes severe;
- the design of Family seven was too late for inclusion in the Portguese trial;
- Family six was in all respects the worst performing Family of the original six used (see 8.4.8).

The results of the data from the first three trials showed that neither Family five, six nor seven would be the Family upon which the final set of symbols would be based (see 8.4.10). This allowed the experiment to concentrate safely on families one to four for the final Finish trial. This enabled a full factorial design that asked respondents to identify the symbol for a referent both when an appropriate symbol was present and when it was absent to be run (see 8.4.4).

- **Trial Site** **Families used**
- Finland: 1, 2, 3, 4

8.4.4 Task modification

As outlined in clauses 8.3.4 and 8.3.5 only a single "certainty" question was used to replace the separate "certainty" and "suitability" questions used in the Pilot Trial. In the first three main trials, six of the seven symbol families were used.

In the Pilot Trial each referent was tested for each Family and in each case the target symbol was present. After the Pilot Trial there was a concern that a trial where the correct symbol for the referent was always present was not representative of the full range of real world experience. For example, where a respondent may be looking for a facility by scanning a symbol set for a particular referent which may or may not be present.

Theoretically, given the two cases of a referent being present or absent we can conceive of five possible outcomes:

Table 7: Possible outcomes of searching for a symbol

	Correct referent found	Erroneous referent selected	No referent selected
Referent present	OK	Not OK	Not OK
Referent absent	Impossible	Not OK	OK

As a result of this new insight, the format of the Associative Question set was changed for the main trials. It was decided that a target referent not present condition should be included. In order to avoid an excessively large questionnaire and to keep the overall task time to one hour or less it was necessary to run an incomplete design.

With six families of seven referents a full factorial design (all symbols presented to all subjects) with all referents both present and absent would equate to:

6 x 7 x 2 = 84 pages for the association question set

This being too many to expect respondents to handle it was decided to run a full factorial design for the referent symbol present condition and to sample the referent absent condition to verify if it was a significant effect. It was decided to test the absent condition on twelve referents, two from each family.

6 x 7 = 42 + 12 = 54 pages for the association question set

To make the Table of conditions in the symbol not present condition balance, so that each referent was tested on two families, one referent needed to be excluded from each family. The General Facilities referent was omitted as most of the symbol sets used a variant of the ear with diagonal line and most respondents would be expecting such a symbol. As a result it was not expected that testing the missing "general facilities for the deaf" condition would produce very meaningful results for most of the symbol families.

Table 8 shows how the symbol absent condition was assigned to different symbols in each Family to balance the number of times each symbol was presented.

Table 8: Distribution of the symbol present and symbol absent conditions (excluding Finnish trial)

	General facilities	Textphone	Video-phone - general	Video-phone - signing and lip-reading	Amplifi-cation	Inductive Coupling	Electrical Coupling
Family 1	P	P & A	P	P	P	P & A	P
Family 2	P	P	P & A	P	P & A	P	P
Family 3	P	P	P & A	P	P	P	P & A
Family 4	P	P	P	P & A	P	P & A	P
Family 5	P	P & A	P	P & A	P	P	P
Family 6	P	P	P	P	P & A	P	P & A
NOTE: Where P = Present Condition and A = Absent condition.							

Given that the 3 symbols related to amplification and hearing aid coupling were omitted for deaf respondent, the total number of questions for the experimental groups were:

	Hearing/Hard of Hearing	Profoundly Deaf
Associative Set =	54 = (6x7) + (2x6)	30 = (6x4) + (2x3)
Preference Set =	8 = (7 +1)	5 = (4+1)
Total =	62	35

The order of presentation of the referents and the source Family of the target symbol were randomized for the Association Set of questions in the Main Trial. The Preference question set followed the association set and their order of presentation for the services was separately randomized. The preferred Family question was always last. The same presentation order for all questions was used for each experimental group in each of the Portuguese, Dutch and Belgian trials.

For the last trial in Finland it was decided to try to get useful information from having a full factorial design on both the "symbol present" and "symbol not present" questions. This was achieved by removing the two least popular families of symbols so that only four families were involved. This resulted in the full factorial design shown in Table 9.

Table 9: Distribution of the symbol present and symbol absent conditions (Finnish trial)

	General facilities	Textphone	Video-phone - general	Video-phone - signing and lip-reading	Amplifi-cation	Inductive Coupling	Electrical Coupling
Family 1	P & A	P & A	P & A	P & A	P & A	P & A	P & A
Family 2	P & A	P & A	P & A	P & A	P & A	P & A	P & A
Family 3	P & A	P & A	P & A	P & A	P & A	P & A	P & A
Family 4	P & A	P & A	P & A	P & A	P & A	P & A	P & A
NOTE: Where P = Present Condition and A = Absent condition.							

The result was a slightly enlarged questionnaire:

(4 x 7 x 2) + 7 + 1 = 64 Questions, of which;

the Associative Set = 56 and the Preference Set = 8 (7 referents and 1 Family choice).

8.4.5 Respondents

The instructions to trial organizers (Annex D) stated that the required numbers of respondents should be:

- prelingual deaf people (using signing translator during trial);
- profoundly deaf people (using lip-speaker during trial);
- hearing aid users;
- carers/social workers/normal hearing.

The trial organizers were asked to book extra people to improve the chance that the required numbers were obtained. Given that the trials were being run because of the goodwill of the organizations involved, the organizers were not pressured to guarantee that the full number of respondents in each category were obtained. It was thus possible that fewer than the recommended number of respondents would be found for every category. Similarly, it is possible that greater than the recommended number of respondents would be found for other categories. It was considered that these small imbalances in the design were a small price to pay for the enthusiastic co-operation of the trial organizers.

The resulting breakdown of respondents is shown in Table 10.

Table 10: Breakdown of respondents by hearing impairment, sex and age

Country	Hearing Impairment	Male	Female	Average Age	Age Range
Portugal					
	Pre-lingual deaf	5	4	30	18 – 65
	Post-lingual deaf	6	5	36	18 – 61
	Hard of hearing	7	12	24	17 – 48
	Normal hearers	5	13	27	14 – 50
Netherlands					
	Pre-lingual deaf	6	2	54	27 – 85
	Post-lingual deaf	8	6	76	55 – 84
	Hard of hearing	8	14	64	42 – 82
	Normal hearers	9	14	41	19 – 60
Belgium					
	Pre-lingual deaf	5	3		
	Post-lingual deaf	6	4		
	Hard of hearing	4	4		
	Normal hearers	4	4		
Finland					
	Pre-lingual deaf	5	5	39,9	28 - 60
	Post-lingual deaf	4	6	55,5	30 - 70
	Hard of hearing	8	11	46	25 - 63
	Normal hearers	7	12	45	30 - 60

8.4.6 The format of trial results

The purpose of the MIA process has never been to provide a statistically significant result. Its power lies in providing a "rich picture" from which informed design decisions can be made. But because of the large amount of data the spreadsheets can to be hard to interpret. The tables of results for each country appear in Annexes E to H. In this clause each type of Table within these Annexes is described in some detail.

The tables relating to symbol associativeness consist of matrices of "function" (i.e. the referent) against "symbol selected", with the order of symbols being the same as the order of functions. The figures in the boxes are the percentage of respondents that selected the particular symbol to represent the given referent. The actual numbers of respondents from which those percentages are derived are listed before each group of tables.

Tables 1 to 6 in each Annex (tables 1 to 4 for Finland) summarize the associativeness results where the desired symbol IS present for each of the symbol families. In these tables a good symbol set will have high percentages on the diagonal where the symbol was the symbol designed to represent the given referent.

Tables 7 to 12 (Tables 5 to 8 in Finland) summarize where the desired symbol IS NOT present. In these tables a good symbol set will be evident by a high numbers in the bottom row as this is the condition where no symbol was selected.

Table 13 in each Annex (Table 9 for Finland) relates to symbol preference and consists of a matrix of referent against preferred family. Comparison between families has been facilitated by presenting mean percentages for a Family across all symbols. The same preference data was presented in Table 14 (Table 10 for Finland) for all respondents except those with normal hearing.

Table 15 (Table 11 for Finland) relates to Family preference and is the simplest to interpret consisting merely of a Family number and a percentage "vote". Again, results are presented without people who have normal hearing in Table 16 (Table 12 for Finland).

The results for individual countries were combined where appropriate and the large number of resulting tables are presented in Annex I.

No analysis of the certainty question that was retained in the associativeness section of the questionnaire was undertaken due to the very large amount of other analyses needed and the relative ineffectiveness of this measure in the previous videotelephone pictogram study [4]. The analysis of the "Misses" condition and the "n Missing values" condition described in [4] were not attempted as they were judged to be misleading measures that reflect a complex interrelationship between the qualities of the symbol being evaluated and the other symbols in the symbol Family.

Additional questions related to accuracy of representation of the referent and how accepTable the symbol is to the deaf and hard of hearing people were added to the Symbol Preference questions. These questions were visually inspected during the collection of the questionnaire data to look for signs of symbols that might prove very unsuitable. In particular there was concern to ascertain whether the conventional General Deaf symbol, with the ear and diagonal line, was considered suiTable by the deaf and hard of hearing communities. As well as the visual inspection of the answers to these questions the project obtained a clear message from the 1998 Convention of the International Federation of Hard of Hearing People that there were strong feelings that a symbol recognizably the same as the conventional General Deaf symbol should be retained.

8.4.7 Portugal results

8.4.7.1 Task 1: Symbol selection

All the detailed tables of results for the Portugal trial are shown in Annex E. Tables E.1 to E.6 show the results of the Associativeness test for the symbol present condition. The correct hit data derived from these tables, where the intended symbol was chosen for the given referent, is presented in Table 11.

Table 11: Percentage of correct hits when symbol present

	Families						Mean
	Family 1	**Family 2**	**Family 3**	**Family 4**	**Family 5**	**Family 6**	
General Deaf	11	7	21	24	11	3	13
Amplified Telephone	70	51	51	46	43	38	50
Text telephone	79	64	67	74	58	73	69
Inductive Coupling	24	24	5	16	16	11	16
Electrical Coupling	14	78	13	43	36	54	40
General Videophone	32	26	19	36	21	51	31
Signing Videophone	84	61	77	74	91	53	74
Mean	45	44	36	45	39	40	42

NOTE: A high score in Table 11 represents a good result.

For each referent a rank ordering was derived from Tables E.1 to E.6, with the Family having the highest number of correctly chosen symbols being placed in first position. Table 12 shows these rank orderings for each of the referents.

Table 12: Rank order of families across the seven referents for Portugal

	Position			
	1	2	3	4
General Deaf	Family 4	Family 3	Families 1,5	Families 1,5
Amplified Telephone	Family 1	Families 2,3	Families 2,3	Family 4
Text Telephone	Family 1	Family 4	Family 6	Family 3
Inductive Coupling	Families 1,2	Families 1,2	Families 4,5	Families 4,5
Electrical Coupling	Family 2	Family 6	Family 4	Family 5
General Videophone	Family 6	Family 4	Family 1	Family 2
Signing Videophone	Family 5	Family 1	Family 3	Family 4

Tables E.7 to E.12 show the results of the Associativeness test for the symbol absent condition. In the trial plan each Family had two conditions where the required symbol was absent. Errors in preparing the trial materials meant that for Family 1 the "General Videophone" referent was tested in addition to the planned two referents. This error has no negative effect on the results obtained. The percentage of respondents who correctly identified that the symbol was missing was derived from these tables. This data is presented in Table 13.

Table 13: Percentage of correctly identified that a symbol was missing

	Families						Mean
	1	2	3	4	5	6	
General Deaf	-	-	-	-	-	-	
Amplified Telephone	-	57	-	-	-	46	52
Text telephone	42	-	-	-	53	-	48
Inductive Coupling	43	-	-	26	-	-	35
Electrical Coupling	-	-	62	-	-	43	53
General Videophone	22	37	21	-	-	-	27
Signing Videophone	-	-	-	29	47	-	38
Mean	36	47	42	28	50	45	42

The rank orders of families with highest number of correct identification that the target symbol was missing are shown in Table 14.

Table 14: Rank order of families across the seven referents for Portugal

	Position	
	1	2
Amplified Telephone	Family 2	Family 6
Text Telephone	Family 5	Family 1
Inductive Coupling	Family 1	Family 4
Electrical Coupling	Family 3	Family 6
General Videophone	Family 2	Family 1
Signing Videophone	Family 5	Family 4

False Alarms

Table 15 presents, for each symbol, the number of false alarms for the symbol present condition. A false alarm is where a symbol has been chosen as the symbol for an inappropriate referent. This data is derived from the figures underlying the percentages given in Tables E.1 to E.6 (using the respondent numbers rather than the percentages that Tables E.1 to E.6 contain).

Table 15: False alarms (correct symbol present)

	Families						Mean
	1	**2**	**3**	**4**	**5**	**6**	
General Deaf	1	5	10	10	2	10	6
Amplified Telephone	7	21	6	3	4	9	8
Text telephone	10	14	18	16	15	25	16
Inductive Coupling	6	3	3	5	10	1	5
Electrical Coupling	0	18	2	7	8	17	9
General Videophone	14	14	20	15	6	11	13
Signing Videophone	68	54	80	66	68	52	65
Mean	17	18	20	17	16	18	18

Table 16 presents, for each symbol, the number of false alarms for the symbol missing condition. This data is derived from the figures underlying the percentages given in Tables E.7 to E.12 (using the respondent numbers rather than the percentages that Tables E.7 to E.12 contain).

Table 16: False alarms (correct symbol missing)

	Families						Mean
	1	**2**	**3**	**4**	**5**	**6**	
General Deaf	1	6	1	15	1	9	6
Amplified Telephone	5	3	2	2	1	0	2
Text telephone	6	8	7	2	11	8	7
Inductive Coupling	3	4	4	0	0	8	3
Electrical Coupling	12	0	0	10	0	3	4
General Videophone	5	1	1	32	22	4	11
Signing Videophone	36	30	44	9	22	10	25
Mean	10	7	8	10	8	6	8

Selectivity

The selectivity parameter is the ratio of correct selections to false alarms for each symbol. This measure is a very good parameter for comparison at the symbol level. This is not a meaningful measure for the symbol absent condition.

In the original MIA method means of the ratios are presented in the table. The infinite value of the ratio in Table 17 shows the unsuitability of means as a method of indicating the central tendency of a group of ratios. The median value of the sets of ratios have been used instead.

Table 17 shows the selectivity ratios for the symbol present condition.

Table 17: Selectivity (the ratio of correct selections to false alarms) for the symbol present condition

	Families						Median
	Family 1	Family 2	Family 3	Family 4	Family 5	Family 6	
General Deaf	6,0	0,8	1,2	1,4	3,0	0,2	1,2
Amplified Telephone	3,7	0,9	3,1	5,7	4,0	2,3	3,4
Text telephone	4,5	2,7	2,0	0,4	2,2	1,1	2,1
Inductive Coupling	1,5	3,0	1,5	1,2	0,6	4,0	1,5
Electrical Coupling	∞	1,6	0,4	2,3	1,6	1,2	1,6
General Videophone	1,3	1,1	0,8	1,1	2,0	2,6	1,2
Signing Videophone	0,7	0,6	0,6	0,6	0,8	0,6	0,6
Median	3,7	1,1	1,2	1,2	2,0	1,2	-

8.4.7.2 Task 2: Test of symbol preference

In this task each respondent was given all the candidate symbols for a particular referent and asked to choose the one that best represented it. The columns of Table 18 give the percentages of all the respondents that chose each Family for a referent. Table 19 presents the same data but excluding those respondents who were normal hearers.

Table 18: Test of Symbol preference (all subjects) in %

	Function							
Pictogram selected	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone	mean
Family 1	8	65	20	23	29	25	9	24
Family 2	12	21	30	31	26	23	14	22
Family 3	25	9	24	9	3	27	11	17
Family 4	25	0	17	20	20	2	9	14
Family 5	16	3	0	9	9	8	50	14
Family 6	14	3	9	9	14	15	7	10

Table 19: Test of Symbol preference (without normal hearers) in %

	Function							
Pictogram selected	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone	mean
Family 1	9	47	19	22	42	31	10	23
Family 2	6	29	35	28	11	25	13	21
Family 3	35	12	19	11	0	25	13	19
Family 4	32	0	19	28	26	0	6	16
Family 5	6	6	0	6	5	0	52	11
Family 6	12	6	8	6	16	19	6	11

8.4.7.3 Task 3: Overall Family preference

Table 20 gives the results for the task where respondents had to name the Family which they personally preferred. Table 21 shows the same information but it excludes respondents who were normal hearers.

Table 20: Overall Family preference

Family	Frequency	%	Valid %
Family 1	4	7.	7
Family 2	7	12	13
Family 3	20	35	37
Family 4	13	23	24
Family 5	5	9	9
Family 6	5	9	9
Missing	3	5	Missing

Table 21: Overall Family preference (without normal hearers)

Family	Frequency	%	Valid %
Family 1	0	0	0
Family 2	2	5	6
Family 3	17	44	47
Family 4	9	23	25
Family 5	3	8	8
Family 6	5	13	14
Missing	3	8	Missing

8.4.8 Discussion of the Portugal results

|In this discussion the scope will be mainly limited to a discussion of symbol families. Individual symbols will be considered in greater depth in the discussion of the results from all the trials. Table 22 and 23 present a summary of the information from other parts of subclause 7.4. The two best figures in each column are highlighted in bold and the two worst figures in italic.

Table 22: Results summary for the symbol present condition for Portugal

Symbol Family	Parameter						
	Mean % symbols correctly identified	Mean *n* False Alarms	Median Selectivity	Mean Symbol Preference %	Family Preference %	Mean Symbol Preference (excluding hearers) %	Family Preference (excluding hearers) %
Family 1	**45**	**17**	**3,7**	**24**	*7*	**23**	*0*
Family 2	44	18	*1,1*	**22**	13	**21**	*6*
Family 3	*36*	*20*	1,2	17	**37**	19	**47**
Family 4	**45**	**17**	1,2	*14*	**24**	16	**25**
Family 5	*39*	**16**	**2,0**	*14*	*9*	*11*	8
Family 6	40	18	1,2	*10*	*9*	*11*	14
Mean	42	18	1,7	17	17	17	17

Table 23: Results summary for the symbol absent condition for Portugal

Symbol Family	Parameter						
	Mean % symbols correctly identified	Mean *n* False Alarms	Median Selectivity	Mean Symbol Preference %	Family Preference %	Mean Symbol Preference (excluding hearers) %	Family Preference (excluding hearers) %
Family 1	*36*	*10*	**-**	**24**	*7*	**23**	*0*
Family 2	**47**	**7**	**-**	**22**	13	**21**	*6*
Family 3	42	8	**-**	17	**37**	19	**47**
Family 4	*28*	*10*	**-**	*14*	**24**	16	**25**
Family 5	**50**	8	**-**	*14*	*9*	*11*	8
Family 6	45	**6**	**-**	*10*	*9*	*11*	14
Mean	42	18	**-**	17	17	17	17

From the first column in Table 22 it can be seen that all the families produced quite poor overall average percentage correct recognition rates ranging from 36 % to 45 %. These figures masks some overall quite good results for individual symbols in a single family, with a highest score of 91 % recognition rate for one of the Signing Videophone symbols shown in Table 11. There were also some reasonable average recognition rates for some types of symbol with 69 % of people across all families recognizing the Text Telephone symbol. Overall, Families 1, 2 and 4 appear to be the ones with the highest overall correct recognition rates.

As another view on this data, in Table 12 Family 4 appears seven times, Family 1 appears six times, Families 2, 3 and 5 appear four times and Family 6 appears 3 times.

Because of the incomplete allocation of referents to families in the missing symbol part of the trial design, interpretation of Table 23 has to be done with extreme caution. For example, a low average score for a Family may be because two "difficult" referents were allocated to that family. Similarly a low average score for a particular type of symbol may be due to two poor families being allocated that referent.

Most of the scores in the Table are quite low. Ideally each cell in the underlying table, Table 13, would contain a figure of 100 %, more realistically one would hope for a high figure. Figures such as 21 % indicate that respondents were sufficiently unsure of the meaning of the symbols to choose one of the wrong symbols 79 % of the time. One conclusion that can be drawn from this is that either the symbol sets were poor at clearly indicating the required referent or that the referents were poorly understood by many of the respondents. Evidence from the Pilot Trial would indicate that this latter factor may well explain a lot of the low scores.

Table 14 needs to be examined when assessing the figures in the first column of Table23. Most families occupy both first and second (or third) positions in Table 14. However Family 2 is always first in Table 14 which confirms its high score in Table 23 and Family 4 is always second in Table 14 which confirms its low score in Table 23. The results for Family 6 are much more ambiguous as there is a slightly above average score in Table 23 but it is always second in Table 14. All the other families have a mixture of first and second (or third) scores in Table 14 which gives no greater or lesser weight to the results in the first column of Table 23. This would tend to indicate that Family 2 might be better at minimizing the number of incorrectly identified symbols whilst Family 4 might be worse, with Family 6 giving a somewhat ambiguous picture.

The false alarm data in Tables 22 and 23 shows little overall discrimination between the symbol sets. Tables 15 and 16 from which the figures originate does, however, show very clearly that across all of the symbol sets a symbol for a Signing Videophone is frequently incorrectly identified as representing some other referent. Further examination of the Tables E.1 to E.6 shows that it is most frequently incorrectly selected for the General Videophone and General Deaf referents. It is almost equally incorrectly selected for these two referents for Families 1, 2 and 4 and it is particularly frequently incorrectly selected for the General Deaf referent in Family 6 and the General Videophone referent in Families 3 and 5.

Table 22 clearly shows that Family 1 has a better set of selectivity measures overall, with Family 5 also showing better than average abilities. The underlying table, Table 17, also shows that the Amplified Telephone symbols as a group also seem to perform well and the Signing Videophone symbols perform badly with regards to the selectivity ratio. Selectivity scores are used more extensively in the selection process for individual symbols.

The symbol preference data and Family preference data in Tables 22 and 23 are identical. Both the results for all respondents and those for the group of respondents that excludes normal hearers consistently give the highest symbol preference scores to Families 1 and 2 and the lowest scores to Families 6 and 5. In the Family Preference results, Families 3 and 4 are consistently the two most popular families across the two groups of respondents. Family 1 was consistently the least popular Family with Families 2, 5 and 6 all scoring poorly. There are distinctly different best performing families in the Symbol Preference and Family Preference tasks but Families 5 and 6 were not the best performers in either category.

The wide range of different measures makes it extremely difficult to assess the overall best and worst families. A crude summary of all the above results can be seen by looking at the ranks of the performance in all the different tests for the more reliable and complete symbol present data. This data is presented in Table 24.

Table 24: Ranked test data across all tests

Symbol Family	Parameter								
	Symbols correct	False Alarms	Select.	Symbol Pref.	Family Pref.	Symbol Pref. (exc. hearers)	Family Pref. (exc. hearers)	Mean rank	Rank order
Family 1	1.5	2.5	1	1	6	1	6	2,7	1
Family 2	3	4.5	6	2	3	2	5	3,6	4
Family 3	6	6	4	3	1	3	1	3,4	3
Family 4	1.5	2.5	4	4.5	2	4	2	2,9	2
Family 5	5	1	2	4.5	4.5	5.5	4	3,8	5
Family 6	4	4.5	4	6	4.5	5.5	3	4,5	6

This overall summary identifies Families 1 and 4 as the most promising overall and Family 6 as the least promising overall. As it was necessary to eliminate one Family to enable a new set of symbols for the remaining trials, it was decided to eliminate the lowest overall rated symbol family, Family 6. Although there were individual symbols in this Family that performed well its design did not make it rate highly in the Family Preference scores. With this rating this symbol set would never become the basis upon which the final symbol Family would be based. As Family 6 was so radically different in design from the other symbol families it was also difficult to identify successful design characteristics of individual symbols that could be incorporated into the design of symbols based on a more conventional design model. Nevertheless, in the selection of the design characteristics of the final symbols it would still be possible to look at adopting or adapting features from successful symbols in Family 6.

8.4.9 Netherlands and Belgium results

8.4.9.1 Task 1: Symbol selection

All the detailed tables of results for the Netherlands trial and the Belgian trials are shown in Annex F and Annex G respectively. Tables of results for the combined data from the Netherlands and Belgian trial appear in Annex I. Tables F.1 to F.6 and G.1 to G.6 show the results of the Associativeness test for the symbol present condition. The correct hit data derived from the Netherlands tables, where the correct symbol was chosen for the given referent, is presented in Table 25.

Table 25: Percentage of correct hits when symbol present (Netherlands)

	Families						Mean
	Family 1	**Family 2**	**Family 3**	**Family 4**	**Family 5**	**Family 7**	
General Deaf	21	26	42	38	24	16	28
Amplified Telephone	86	73	84	84	55	38	70
Text telephone	84	76	70	85	80	58	76
Inductive Coupling	64	33	56	51	17	33	42
Electrical Coupling	22	82	56	49	60	96	61
General Videophone	54	31	45	41	37	65	46
Signing Videophone	82	50	76	75	88	54	71
Mean	59	53	61	60	52	51	56

The correct hit data derived from the Belgian tables, where the correct symbol was chosen for the given referent, is presented in Table 26.

Table 26: Percentage of correct hits when symbol present (Belgian)

	Families						Mean
	Family 1	**Family 2**	**Family 3**	**Family 4**	**Family 5**	**Family 7**	
General Deaf	12	41	65	56	9	15	33
Amplified Telephone	93	25	44	69	6	25	44
Text telephone	97	29	94	100	50	15	64
Inductive Coupling	50	13	13	13	6	6	17
Electrical Coupling	6	63	13	19	25	50	29
General Videophone	41	9	24	41	14	9	23
Signing Videophone	65	9	47	44	73	0	40
Mean	52	27	43	49	26	17	36

From the tables F.1 to F.6 the rank ordering of families across the referents was derived and is presented in Table 27.

Table 27: Rank order of families across the seven referents for Netherlands

	Position			
	1	2	3	4
General Deaf	Family 3	Family 4	Family 2	Family 5
Amplified Telephone	Family 1	Families 3,4	Families 3,4	Family 2
Text Telephone	Family 4	Family 1	Family 5	Family 2
Inductive Coupling	Family 1	Family 3	Family 4	Families 2,7
Electrical Coupling	Family 7	Family 2	Family 5	Family 3
General Videophone	Family 7	Family 1	Family 3	Family 4
Signing Videophone	Family 5	Family 1	Family 3	Family 4

From the tables G.1 to G.6 the rank ordering of families across the referents was derived and is presented in Table 28.

Table 28: Rank order of families across the seven referents for Belgium

	Position			
	1	2	3	4
General Deaf	Family 3	Family 4	Family 2	Family 5
Amplified Telephone	Family 1	Family 4	Family 3	Families 2,7
Text Telephone	Family 4	Family 1	Family 3	Family 5
Inductive Coupling	Family 1	Families 2,3,4	Families 2,3,4	Families 2,3,4
Electrical Coupling	Family 2	Family 7	Family 5	Family 4
General Videophone	Families 1,4	Family 1,4	Family 3	Family 5
Signing Videophone	Family 5	Family 1	Family 3	Family 4

Tables F.7 to F.12 and G.7 to G.12 show the results of the Associativeness test for the symbol absent condition. In the trial plan each Family had two conditions where the required symbol was absent. Errors in preparing the trial materials meant that for Family 2 the "General Videophone" referent was tested in addition to the planned two referents. This error has no negative effect on the results obtained. The percentage of respondents who correctly identified that the symbol was missing was derived from these tables. This data is presented in Tables 29 and 30.

Table 29: Percentage of correctly identified symbol missing conditions (Netherlands)

	Families						Mean
	1	2	3	4	5	7	
General Deaf	-	-	-	-	-	-	
Amplified Telephone	-	28	-	-	-	9	19
Text telephone	23	25	-	-	35	-	28
Inductive Coupling	24	-	-	14	-	-	19
Electrical Coupling	-	-	39	-	-	11	25
General Videophone	-	23	21	-	-	-	22
Signing Videophone	-	-	-	18	27	-	23
Mean	24	25	30	16	31	10	23

Table 30: Percentage of correctly identified symbol missing conditions (Belgium)

	Families						Mean
	1	2	3	4	5	7	
General Deaf	-	-	-	-	-	-	
Amplified Telephone	-	94	-	-	-	78	86
Text telephone	85	-	-	-	88	-	87
Inductive Coupling	44	-	-	44	-	-	44
Electrical Coupling	-	-	87	-	-	69	78
General Videophone	-	100	41	-	-	-	71
Signing Videophone	-	-	-	55	94	89	79
Mean	65	97	64	50	91	79	74

The rank orders of correct identification that the target symbol was missing are shown in Tables 31 and 32.

Table 31: Rank order of families across the seven referents for Netherlands

	Position		
	1	2	3
Amplified Telephone	Family 2	Family 7	-
Text Telephone	Family 5	Family 2	Family 1
Inductive Coupling	Family 1	Family 4	-
Electrical Coupling	Family 3	Family 7	-
General Videophone	Family 2	Family 3	-
Signing Videophone	Family 5	Family 4	-

Table 32: Rank order of families across the seven referents for Belgium

	Position		
	1	2	3
Amplified Telephone	Family 2	Family 7	-
Text Telephone	Family 5	Family 1	-
Inductive Coupling	Families 1,4	Families 1,4	-
Electrical Coupling	Family 3	Family 7	-
General Videophone	Family 2	Family 3	-
Signing Videophone	Family 5	Family 7	Family 4

False Alarms

Tables 33 and 34 present, for each symbol, the number of false alarms for the symbol present condition in the Netherlands and the Belgian trials respectively. A false alarm is where a symbol has been chosen as the symbol for an inappropriate referent. This data is derived from the figures underlying the percentages given in Tables F.1 to F.6 and Tables G.1 to G.6 (using the respondent numbers rather than the percentages that these tables contain).

Table 33: False alarms (correct symbol present) Netherlands

	Families						Mean
	1	2	3	4	5	7	
General Deaf	2	13	7	8	5	12	12
Amplified Telephone	29	5	8	7	22	1	12
Text telephone	12	18	9	14	12	14	13
Inductive Coupling	31	10	21	33	39	26	27
Electrical Coupling	1	53	16	21	14	52	26
General Videophone	9	16	22	23	8	33	19
Signing Videophone	34	31	41	25	42	22	33
Mean	17	21	18	19	20	23	20

Table 34: False alarms (correct symbol present) Belgium

	Families						Mean
	1	2	3	4	5	7	
General Deaf	1	0	1	0	1	4	1
Amplified Telephone	4	2	1	0	5	0	2
Text telephone	0	2	2	4	2	3	2
Inductive Coupling	4	2	2	7	2	1	3
Electrical Coupling	0	5	3	3	2	4	3
General Videophone	1	4	7	12	6	6	6
Signing Videophone	12	5	23	7	15	7	12
Mean	3	3	6	5	5	4	4

Tables 35 and 36 present, for each symbol, the number of false alarms for the symbol missing condition for the Netherlands trial and the Belgian trial respectively. This data is derived from the figures underlying the percentages given in Tables F.7 to F.12 and G.7 to G.12 (using the respondent numbers rather than the percentages that these tables contain).

Table 35: False alarms (correct symbol missing) Netherlands

	Families						Mean
	1	2	3	4	5	7	
General Deaf	5	14	5	5	1	36	11
Amplified Telephone	11	4	6	2	2	4	5
Text telephone	0	13	8	4	3	7	6
Inductive Coupling	3	11	20	3	7	36	13
Electrical Coupling	21	12	2	30	1	5	12
General Videophone	5	17	1	45	45	8	20
Signing Videophone	6	26	38	3	15	2	15
Mean	7	14	11	13	11	14	12

Table 36: False alarms (correct symbol missing) Belgium

	Families						Mean
	1	2	3	4	5	7	
General Deaf	1	0	0	5	0	3	2
Amplified Telephone	3	0	0	2	0	0	1
Text telephone	0	0	0	0	0	0	0
Inductive Coupling	2	1	3	0	0	4	2
Electrical Coupling	6	0	0	3	0	0	2
General Videophone	1	0	0	13	4	2	3
Signing Videophone	1	0	19	1	1	0	4
Mean	2	0	3	3	1	1	2

Selectivity

The selectivity parameter is the ratio of correct selections to false alarms for each symbol. This measure is a very good parameter for comparison at the symbol level. This is not a meaningful measure for the symbol absent condition.

In the original MIA method means of the ratios are presented in the table. The infinite value of the ratio in Table 16 shows the unsuitability of means as a method of indicating the central tendency of a group of ratios. The median value of the sets of ratios have been used instead.

Table 37 shows the selectivity ratios for the symbol present condition in the Netherlands.

Table 37: Selectivity for the symbol present condition in Netherlands

	Families						Median
	Family 1	Family 2	Family 3	Family 4	Family 5	Family 7	
General Deaf	10,5	2,0	6,0	4,8	4,8	1,3	4,8
Amplified Telephone	3,0	14,6	10,5	12,0	2,5	38,0	11,3
Text telephone	7,0	4,8	7,8	6,1	6,7	4,1	6,4
Inductive Coupling	2,1	3,3	2,7	1,5	0,4	1,3	1,8
Electrical Coupling	22,0	1,5	3,5	2,3	4,3	1,8	2,9
General Videophone	6,0	1,9	2,0	1,8	4,6	2,0	2,0
Signing Videophone	2,4	1,6	1,9	3,0	2,1	2,4	2,3
Median	6,0	2,0	3,5	3,0	4,3	2,0	-

Table 38: Selectivity for the symbol present condition in Belgium

	Families						Median
	Family 1	Family 2	Family 3	Family 4	Family 5	Family 7	
General Deaf	6,0	3,1	9,3	7,0	1,8	1,3	4,6
Amplified Telephone	3,2	5,0	5,5	9,9	0,3	25,0	5,3
Text telephone	8,1	1,6	10,4	7,1	4,2	1,1	5,7
Inductive Coupling	1,6	1,3	0,6	0,4	0,2	0,2	0,5
Electrical Coupling	6,0	1,2	0,8	0,9	1,8	1,0	1,1
General Videophone	4,6	0,6	1,1	1,8	1,8	0,3	1,5
Signing Videophone	1,9	0,3	1,1	1,8	1,7	0,0	1,4
Median	4,6	1,3	1,1	1,8	1,8	1,0	-

8.4.9.2 Task 2: Test of symbol preference

In this task each respondent was given all the candidate symbols for a particular referent and asked to choose the one that best represented it. The columns of Tables 39 and Table 40 give the percentages of all the respondents that chose each Family for a referent. Tables 41 and 42 present the same data but excluding those respondents who were normal hearers.

Table 39: Test of Symbol preference (all subjects) in % Netherlands

	Function							
Pictogram selected	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone	mean
Family 1	15	64	34	20	2	8	27	24
Family 2	23	4	27	23	16	11	6	16
Family 3	16	9	22	16	13	44	26	22
Family 4	29	11	5	20	9	13	12	14
Family 5	5	7	6	2	4	7	27	9
Family 7	13	4	6	18	56	16	2	15

Table 40: Test of Symbol preference (all subjects) in % Belgium

	Function							
Pictogram selected	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone	mean
Family 1	6	81	29	38	13	24	24	25
Family 2	6	0	6	25	25	6	0	8
Family 3	24	13	50	13	19	48	21	28
Family 4	59	0	15	19	13	6	0	18
Family 5	0	6	0	6	0	6	56	14
Family 7	6	0	0	0	31	9	0	8

Table 41: Test of Symbol preference (without normal hearers) in % Netherlands

	Function							
Pictogram selected	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone	mean
Family 1	12	59	39	23	0	13	21	23
Family 2	17	9	20	18	9	18	9	15
Family 3	20	14	22	23	9	38	30	24
Family 4	37	0	5	18	9	15	12	15
Family 5	5	14	7	5	0	3	26	9
Family 7	10	5	7	14	73	13	2	14

Table 42: Test of Symbol preference (without normal hearers) in % Belgium

	Function							
Pictogram selected	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone	mean
Family 1	4	100	24	43	29	20	16	23
Family 2	8	0	8	29	29	4	0	7
Family 3	20	0	56	0	14	60	28	35
Family 4	60	0	12	29	0	4	0	17
Family 5	0	0	0	0	0	0	56	12
Family 7	8	0	0	0	29	12	0	6

8.4.9.3 Task 3: Overall Family preference

Tables 43 and 44 give the results for the task where respondents had to name the Family which they personally preferred. Tables 45 and 46 show the same information but it excludes respondents who were normal hearers.

Table 43: Overall Family preference Netherlands

Family	Frequency	%	Valid %
Family 1	14	21	22
Family 2	6	9	9
Family 3	12	18	18
Family 4	21	31	32
Family 5	5	7	8
Family 7	7	10	11
Missing	2	3	Missing

Table 44: Overall Family preference Belgium

Family	Frequency	%	Valid %
Family 1	4	12	12
Family 2	0	0	0
Family 3	17	50	50
Family 4	12	35	35
Family 5	1	3	3
Family 7	0	0	0
Missing	0	0	Missing

Table 45: Overall Family preference (without normal hearers) Netherlands

Family	Frequency	%	Valid %
Family 1	7	16	16
Family 2	2	5	5
Family 3	10	23	23
Family 4	16	36	37
Family 5	3	7	7
Family 7	5	11	12
Missing	1	2	Missing

Table 46: Overall Family preference (without normal hearers) Belgium

Family	Frequency	%	Valid %
Family 1	2	8	8
Family 2	0	0	0
Family 3	15	60	60
Family 4	8	32	32
Family 5	0	0	0
Family 7	0	0	0
Missing	0	0	Missing

8.4.10 Discussion of the Netherlands and Belgium results

In this discussion the scope will be mainly limited to a discussion of symbol families. Individual symbols will be considered in greater depth in the discussion of the results from all the trials. Tables 47 to 50 present a summary of the information from other parts of subclause 7.4. The two best figures in each column are highlighted in bold and the two worst figures in italic.

Table 47: Results summary for the symbol present condition for Netherlands

Symbol Family	Parameter						
	Mean % symbols correctly identified	Mean *n* False Alarms	Median Selectivity	Mean Symbol Preference %	Family Preference %	Mean Symbol Preference (excluding hearers) %	Family Preference (excluding hearers) %
Family 1	59	**17**	**6,0**	**24**	**22**	**23**	16
Family 2	53	*21*	*2,0*	16	*9*	15	*5*
Family 3	**61**	**18**	3,5	**22**	18	**24**	**23**
Family 4	**60**	19	3,0	*14*	**32**	15	**37**
Family 5	*52*	20	**4,3**	*9*	*8*	*9*	*7*
Family 7	*51*	*23*	*2,0*	15	11	*14*	12
Mean	56	20	3,0	14	14	14	14

Table 48: Results summary for the symbol present condition for Belgium

Symbol Family	Parameter						
	Mean % symbols correctly identified	Mean *n* False Alarms	Median Selectivity	Mean Symbol Preference %	Family Preference %	Mean Symbol Preference (excluding hearers) %	Family Preference (excluding hearers) %
Family 1	**52**	**3**	**4,6**	**25**	12	**23**	8
Family 2	27	**3**	1,3	*8*	*0*	*7*	*0*
Family 3	43	*6*	*1,1*	**28**	**50**	**35**	**60**
Family 4	**49**	*5*	**1,8**	18	**35**	17	**32**
Family 5	*26*	*5*	**1,8**	14	3	12	*0*
Family 7	*17*	4	*1,0*	*8*	*0*	*6*	*0*
Mean	36	4	1,7	14	14	14	14

Table 49: Results summary for the symbol absent condition for the Netherlands

Symbol Family	Parameter						
	Mean % symbols correctly identified	Mean *n* False Alarms	Median Selectivity	Mean Symbol Preference %	Family Preference %	Mean Symbol Preference (excluding hearers) %	Family Preference (excluding hearers) %
Family 1	24	**7**	-	**24**	**22**	**23**	16
Family 2	25	*14*	-	16	*9*	15	*5*
Family 3	**30**	**11**	-	**22**	18	**24**	**23**
Family 4	*16*	13	-	*14*	**32**	15	**37**
Family 5	**31**	**11**	-	*9*	*8*	*9*	*7*
Family 7	*10*	*14*	-	15	11	*14*	12
Mean	23	12	-	14	14	14	14

Table 50: Results summary for the symbol absent condition for Belgium

Symbol Family	Parameter						
	Mean % symbols correctly identified	Mean *n* False Alarms	Median Selectivity	Mean Symbol Preference %	Family Preference %	Mean Symbol Preference (excluding hearers) %	Family Preference (excluding hearers) %
Family 1	65	2	-	**25**	12	**23**	8
Family 2	**97**	**0**	-	*8*	*0*	*7*	*0*
Family 3	*64*	*3*	-	**28**	**50**	**35**	**60**
Family 4	*50*	*3*	-	18	**35**	17	**32**
Family 5	**91**	**1**	-	14	3	12	*0*
Family 7	79	**1**	-	*8*	*0*	*6*	*0*
Mean	74	2	-	14	14	14	14

One comparison that is very important in this section is to determine whether the results from the Netherlands trial are similar in character to those from the Belgian trial. If this were case it would be possible to perform final symbol Family and individual symbol selection on the combined results from these two countries.

In the Belgian trial symbol Family 7 was the lowest performing Family in six out of the seven measures in Table 48. The only measure Family 7 was not worst on was the number of false alarms little weight should be placed on the small differences within the set of results with a range between three to six. In Table 50 a similar picture emerges of Family 7 being the lowest performing Family on four of the six measures. Family 7 managed an average score in the overall percentage correctly recognized score, but again its top-ranking score in the False Alarms measure must be viewed with some caution because of the very low numbers involved.

Even though Family 7 fared better in the Netherlands trial, it was still rated amongst the lowest two families in at least half of the measures in Tables 47 and 49. It was also never rated as one of the top two families on any of the measures in either table. As a result Family 7 was judged to be one of the families that would not be tested in the final Finnish trial.

The wide range of different measures makes it extremely difficult to assess the overall best and worst families. A crude summary of all the above results, which further illustrates the above issue, can be seen by looking at the ranks of the performance in all the different tests for the more reliable and complete symbol present data. This data is presented in Tables 51 and 52.

Table 51: Ranked test data across all tests for the Netherlands

Symbol Family	Parameter								
	Symbols correct	False Alarms	Select.	Symbol Pref.	Family Pref.	Symbol Pref. (exc. hearers)	Family Pref. (exc. hearers)	Mean rank	Rank order
Family 1	3	1	1	1	2	2	3	1,9	1
Family 2	4	5	5,5	3	5	3,5	6	4,6	4
Family 3	1	2	3	2	3	1	2	2,0	2
Family 4	2	3	4	5	1	3,5	1	2,8	3
Family 5	5	4	2	6	6	6	5	4,9	5,5
Family 7	6	6	5,5	4	4	5	4	4,9	5,5

Table 52: Ranked test data across all tests for Belgium

Symbol Family	Parameter								
	Symbols correct	False Alarms	Select.	Symbol Pref.	Family Pref.	Symbol Pref. (exc. hearers)	Family Pref. (exc. hearers)	Mean rank	Rank order
Family 1	1	1,5	1	2	3	2	3	1,9	1
Family 2	4	1,5	4	5,5	5,5	5	5	4,4	5
Family 3	3	6	5	1	1	1	1	2,6	2
Family 4	2	4,5	2,5	3	2	3	2	2,7	3
Family 5	5	4,5	2,5	4	4	4	5	4,1	4
Family 7	6	3	6	5,5	5,5	6	5	5,3	6

Examination of the pattern of results in Tables 51 and 52 shows a remarkable degree similarity. Families 1, 3 and 4 performed well in both trials. Family 7 was the worst overall in both countries, despite fairing better in the Netherlands. Families 2 and 5 were both quite poor but overall Family 5 was the poorest of the two when the two countries were considered together. It is of note that the results in Table 52 are very similar to the summary results of the Belgian trial that are shown in Table 24. Table 24 further confirms that the other Family to be dropped for the Finnish trial is Family 5.

As was stated with the Portugal trial, Families 5 and 7 can still be taken into consideration when individual symbols are being selected and redesigned. Eliminating them from the Finnish trial merely recognizes that they would not be appropriate candidates upon which the Family design of the final symbol Family would be based.

Further consideration of the symbols in the Netherlands and Portugal trials will be undertaken in the final symbol evaluation.

8.4.11 Finland results

8.4.11.1 Task 1: Symbol selection

The Finland trial was the first opportunity to use a full factorial design to evaluate the symbol present and the symbol absent conditions. The four most promising symbol families that emerged from the Portugal, Netherlands and Belgium trials were used in this trial.

All the detailed tables of results for the Finland trial are shown in Annex H. Tables H.1 to H.4 show the results of the Associativeness test for the symbol present condition. The correct hit data derived from these tables, where the correct symbol was chosen for the given referent, is presented in Table 53.

Table 53: Percentage of correct hits when symbol present

	Families				Mean
	Family 1	Family 2	Family 3	Family 4	
General Deaf	38	11	34	30	28
Amplified Telephone	95	27	42	47	53
Text telephone	90	50	90	91	80
Inductive Coupling	76	6	76	11	42
Electrical Coupling	11	32	50	40	33
General Videophone	59	23	50	60	48
Signing Videophone	57	40	46	55	50
Mean	61	27	55	48	48

From the tables H.1 to H.4 the rank ordering of families across the referents was derived and is presented in Table 12.

Table 54: Rank order of families across the seven referents for Finland

	Position			
	1	2	3	4
General Deaf	Family 1	Family 3	Family 4	Family 2
Amplified Telephone	Family 1	Family 4	Family 3	Family 2
Text Telephone	Family 4	Families 1,3	Families 1,3	Family 2
Inductive Coupling	Families 1,3	Families 1,3	Family 4	Family 2
Electrical Coupling	Family 3	Family 4	Family 2	Family 1
General Videophone	Family 4	Family 1	Family 3	Family 2
Signing Videophone	Family 1	Family 4	Family 3	Family 2

Tables H.5 to H.6 show the results of the Associativeness test for the symbol absent condition. The percentage of respondents who correctly identified that the symbol was missing was derived from these tables. This data is presented in Table 55.

Table 55: Percentage of correctly identified symbol missing conditions

	Families				Mean
	Family 1	Family 2	Family 3	Family 4	
General Deaf	42	65	53	49	52
Amplified Telephone	89	86	95	95	91
Text telephone	82	89	86	91	87
Inductive Coupling	63	47	58	61	57
Electrical Coupling	39	76	54	67	59
General Videophone	50	74	62	60	62
Signing Videophone	51	79	42	26	50
Mean	60	74	64	64	65

The rank orders of correct identification that the target symbol was missing are shown in Table 56.

Table 56: Rank order of families across the seven referents, symbol missing conditions

	Position			
	1	2	3	4
General Deaf	Family 2	Family 3	Family 4	Family 1
Amplified Telephone	Families 3,4	Families 3,4	Family 1	Family 2
Text Telephone	Family 4	Family 2	Family 3	Family 1
Inductive Coupling	Family 1	Family 4	Family 3	Family 2
Electrical Coupling	Family 2	Family 4	Family 3	Family 1
General Videophone	Family 2	Family 3	Family 4	Family 1
Signing Videophone	Family 2	Family 1	Family 3	Family 4

False Alarms

Table 57 presents, for each symbol, the number of false alarms for the symbol present condition. A false alarm is where a symbol has been chosen as the symbol for an inappropriate referent. This data is derived from the figures underlying the percentages given in Tables H.1 to H.4 (using the respondent numbers rather than the percentages that Tables H.1 to H.4 contain).

Table 57: False alarms (correct symbol present)

	Families				Mean
	Family 1	Family 2	Family 3	Family 4	
General Deaf	0	5	1	5	3
Amplified Telephone	4	3	2	3	3
Text telephone	8	13	7	7	9
Inductive Coupling	22	1	13	8	11
Electrical Coupling	2	17	1	7	7
General Videophone	4	10	22	27	16
Signing Videophone	26	21	23	26	24
Mean	9	10	10	12	10

Table 58 presents, for each symbol, the number of false alarms for the symbol missing condition. This data is derived from the figures underlying the percentages given in Tables H.5 to H.8 (using the respondent numbers rather than the percentages that Tables H.5 to H.8 contain).

Table 58: False alarms (correct symbol missing)

	Families				Mean
	Family 1	Family 2	Family 3	Family 4	
General Deaf	1	6	10	6	6
Amplified Telephone	8	3	6	2	5
Text telephone	11	12	6	8	9
Inductive Coupling	28	4	33	13	20
Electrical Coupling	12	23	4	15	14
General Videophone	31	15	37	49	33
Signing Videophone	49	23	29	34	34
Mean	20	12	18	18	17

Selectivity

The selectivity parameter is the ratio of correct selections to false alarms for each symbol. This measure is a very good parameter for comparison at the symbol level. This measure is not meaningful for the symbol absent condition.

In the original MIA method means of the ratios are presented in the table. The infinite value of the ratio in Table 16 shows the unsuitability of means as a method of indicating the central tendency of a group of ratios. The median value of the sets of ratios have been used instead.

Table 59 shows the selectivity ratios for the symbol present condition.

Table 59: Selectivity (the ratio of correct selections to false alarms)

	Families				Median
	Family 1	Family 2	Family 3	Family 4	
General Deaf	∞	1,2	20,0	3,4	11,7
Amplified Telephone	8,8	3,3	8,0	6,0	7,0
Text telephone	7,0	2,4	7,4	7,6	7,2
Inductive Coupling	1,3	2,0	2,2	0,5	1,7
Electrical Coupling	2,0	0,7	19,0	2,4	2,2
General Videophone	8,5	1,3	1,3	1,3	1,3
Signing Videophone	1,3	1,1	1,1	1,2	1,2
Median	7,0	1,3	7,4	2,4	-

8.4.11.2 Task 2: Test of symbol preference

In this task each respondent was given all the candidate symbols for a particular referent and asked to choose the one that best represented it. The columns of Table 60 give the percentage of all the respondents that chose each Family for a referent. Tables 61 presents the same data but excluding those respondents who were normal hearers.

Table 60: Test of Symbol preference (all subjects) in %

	Function							
Pictogram selected	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone	mean
Family 1	25	95	32	46	11	19	35	35
Family 2	27	3	5	3	28	21	18	15
Family 3	31	3	50	49	50	42	18	35
Family 4	17	0	13	3	11	19	29	15

Table 61: Test of Symbol preference (without normal hearers) in %

	Function							
Pictogram selected	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone	mean
Family 1	27	89	30	44	18	26	33	35
Family 2	21	6	5	6	35	24	28	18
Family 3	24	6	51	50	35	32	17	31
Family 4	27	0	14	0	12	18	22	16

8.4.11.3 Task 3: Overall Family preference

Table 62 gives the results for the task where respondents had to name the Family which they personally preferred. Table 63 shows the same information but it excludes respondents who were normal hearers.

Table 62: Overall Family preference

Family	Frequency	%	Valid %
Family 1	21	36	40
Family 2	0	0	0
Family 3	20	34	38
Family 4	11	19	21
Missing	6	10	Missing

Table 63: Overall Family preference (without normal hearers)

Family	Frequency	%	Valid %
Family 1	12	31	35
Family 2	0	0	0
Family 3	14	36	41
Family 4	8	21	24
Missing	5	13	Missing

8.4.12 Discussion of the Finland results

|In this discussion the scope will be mainly limited to a discussion of symbol families. Individual symbols will be considered in greater depth in the discussion of the results from all the trials. Tables 64 and 65 present a summary of the information from other parts of subclause 7.4. The two best figures in each column are highlighted in bold and the two worst figures in italic.

Table 64: Results summary for the symbol present condition

Symbol Family	Parameter						
	Mean % symbols correctly identified	Mean *n* False Alarms	Median Selectivity	Mean Symbol Preference %	Family Preference %	Mean Symbol Preference (excluding hearers) %	Family Preference (excluding hearers) %
Family 1	**61**	**9**	**7,0**	**35**	**40**	**35**	**35**
Family 2	*27*	10	*1,3*	*15*	*0*	*18*	*0*
Family 3	**55**	10	**7,4**	**35**	**38**	**31**	**41**
Family 4	*48*	*12*	*2,4*	*15*	*21*	*16*	*24*
Mean	48	10	4,5	25	25	25	25

Table 65: Results summary for the symbol absent condition

Symbol Family	Parameter						
	Mean % symbols correctly identified	Mean *n* False Alarms	Median Selectivity	Mean Symbol Preference %	Family Preference %	Mean Symbol Preference (excluding hearers) %	Family Preference (excluding hearers) %
Family 1	*59*	**20**	-	**35**	**40**	**35**	**35**
Family 2	**74**	*12*	-	*15*	*0*	*18*	*0*
Family 3	64	18	-	**35**	**38**	**31**	**41**
Family 4	64	18	-	*15*	*21*	*16*	*24*
Mean	65	17	-	25	25	25	25

The wide range of different measures makes it extremely difficult to assess the overall best and worst families. A crude summary of all the above results, which further illustrates the above issue, can be seen by looking at the ranks of the performance in all the different tests for the more reliable and complete symbol present data. This data is presented in Table 66.

Table 66: Ranked test data across all tests

Symbol Family	Parameter								
	Symbols correct	False Alarms	Select.	Symbol Pref.	Family Pref.	Symbol Pref. (exc. hearers)	Family Pref. (exc. hearers)	Mean rank	Rank order
Family 1	1	1	2	1,5	1	1	2	1,4	1
Family 2	4	2,5	4	3,5	4	3	4	3,6	4
Family 3	2	2,5	1	1,5	2	2	1	1,7	2
Family 4	3	4	3	3,5	3	4	3	3,4	3

In the Tables 66 Families 1 and 3 gave the best scores on at least six out of the seven measures. Similarly Families 2 and 4 were the worst on at least six out of the seven measures. One comparison that is very important in this section is to determine whether the results from the Finland trial are similar in character to those from the other trials. If this is the case it is legitimate to perform final symbol Family and individual symbol selection on the combined results (for Families 1 to 4) on the combined results from all the countries. A simple measure is to look at the overall rank order data from the rightmost column of Tables 24, 51, 52 and 66. These results are presented together in Table 67.

Table 67: Comparison of rank orders of Families 1 to 4 across countries

Family	Rank Order			
	Portugal	Netherlands	Belgium	Finland
Family 1	1	1	1	1
Family 2	4	4	4	4
Family 3	3	2	2	2
Family 4	2	3	3	3

From Table 67 it is very clear that there is a very strong consistency on the overall reaction to these four families across all the countries tested.

8.4.13 Overall results

8.4.13.1 Task 1: Symbol selection

Given the general consistency of response to the symbols across the different countries identified in subclauses 8.4.10 and 8.4.12 the results of all the trials were combined in the most appropriate way. All the basic results tables for these combined results are shown in Annex I.

Extracting the relevant figures from Tables I.1, I.3, I.5, I.7, I.9, I.11 and I.13 Table 68 can be constructed to show the percentage of correct hits for the symbol present condition across all trials. Similarly Tables I.2, I.4, I.6, I.8, I.10, I.12 and I.14 can be used to construct a Table of percentage of correctly identified missing symbol conditions for the symbol absent condition as shown in Table 70.

Table 68: Percentage of correct hits when symbol present

	Families							Mean
	Family 1	Family 2	Family 3	Family 4	Family 5	Family 6	Family 7	
General Deaf	23	19	38	35	16	3	16	21
Amplified Telephone	85	49	59	62	42	38	34	53
Text telephone	86	59	78	86	66	73	44	70
Inductive Coupling	55	21	43	26	15	11	26	28
Electrical Coupling	15	65	37	41	45	54	84	49
General Videophone	47	24	36	43	26	51	45	39
Signing Videophone	73	44	64	64	86	53	36	60
Mean	55	40	51	51	42	40	41	46

As has been found throughout the analysis of trial results, Table 68 illustrates that Families 1, 4 and 3 show the best mean scores for the percentage of correct hits. From Table 68 the rank ordering of families across the referents was derived and is presented in Table 69.

Table 69: Rank order of families across the seven referents

	Position			
	1	2	3	4
General Deaf	Family 3	Family 4	Family 1	Family 2
Amplified Telephone	Family 1	Family 4	Family 3	Family 2
Text Telephone	Families 1,4	Families 1,4	Family 3	Family 6
Inductive Coupling	Family 1	Family 3	Families 4,7	Families 4,7
Electrical Coupling	Family 7	Family 2	Family 6	Family 5
General Videophone	Family 6	Family 1	Family 7	Family 4
Signing Videophone	Family 5	Family 1	Family 3	Family 4

Table 69 illustrates that, despite the overall superiority of families 1, 4 and 3 in the number of correct hits, for individual referents the best symbols can also be found from some of the families with the worst overall performance. Examination of these results will be expanded when analysis at the single symbol level is undertaken.

Table 70: Percentage of correctly identified symbol missing conditions

	Families							Mean
	Family 1	Family 2	Family 3	Family 4	Family 5	Family 6	Family 7	
General Deaf	42	65	53	49	-	-	-	52
Amplified Telephone	89	60	95	95	-	46	20	68
Text telephone	62	61	86	91	53	-	-	71
Inductive Coupling	43	47	58	34	-	-	-	43
Electrical Coupling	39	76	55	67	-	43	26	51
General Videophone	43	56	35	60	-	-	-	49
Signing Videophone	51	79	42	29	46	-	54	52
Mean	53	63	61	61	50	45	33	-

A rank ordering for the symbol missing condition must be treated with a degree of caution because of the incomplete sampling of the range of possible conditions. Nevertheless the data is presented as Table 71.

Table 71: Rank order of families across the seven referents for the symbol missing condition

	Position			
	1	2	3	4
General Deaf	Family 2	Family 3	Family 4	Family 1
Amplified Telephone	Families 3,4	Families 3,4	Family 1	Family 2
Text Telephone	Family 4	Family 3	Family 1	Family 2
Inductive Coupling	Family 3	Family 2	Family 1	Family 4
Electrical Coupling	Family 2	Family 4	Family 3	Family 6
General Videophone	Family 4	Family 2	Family 1	Family 3
Signing Videophone	Family 2	Family 7	Family 1	Family 5

The apparently good performance of Family 2 for not selecting an incorrect symbol in the symbol missing condition shown in Tables 70 and 71 and is also present in the Finnish results in Tables 56 and 65 needs some explanation. On the surface it looks as if Family 2 symbols have some special quality that makes them unlikely to be selected for the wrong referent. The reason for a large part of this phenomenon in fact points to a more complex explanation. Tables throughout Annexes E to I show that a confusion between the Inductive Coupling and Electrical Coupling symbols and between the General Videophone and the Signing Videophone symbols is prevalent in all the symbol sets to some degree or another. In the symbol present condition, the respondents usually pick the correct symbol. However, in the symbol missing condition this confusion results in a large number of instances of people picking the symbol from the pair that is shown to them when asked for the other referent rather than say that the symbol is absent. As a result, in most instances, the number of correct identifications of a missing symbol is very low for Inductive Coupling, Electrical Coupling, General Videophone and Signing Videophone, as can be seen in Table 55.

The exception to the above rule is Family 2 where the correct identification of a missing symbol is very high for the Electrical Coupling, General Videophone and Signing Videophone referents. This is directly related to the fact that the other symbol of the confusable pair is sufficiently obscure that it is not recognized as anything remotely relevant. This is most graphically illustrated in the case of the Electrical Coupling referent where the symbol that would normally be picked instead of this one, the Inductive Coupling symbol, had a lamentably low rate of recognition as can be seen by the 6 % correct recognition rate shown on Table 53. Similarly the 23 % recognition rate for the General Videophone symbol in Table 55 is a significant contributory factor to the high 79 % of people in Table 70 who picked no symbol when the referent for which the symbol was missing was the Signing Videophone. It is thus clear that, the apparent special characteristic of Family 2 is in fact an artefact of the very poor recognition rate of some of its symbols.

False Alarms

Table 72 presents, for each symbol, the number of false alarms for the symbol present condition. A false alarm is where a symbol has been chosen as the symbol for an inappropriate referent Tables I.1, I.3, I.5, I.7, I.9, I.11 and I.13 (using the respondent numbers rather than the percentages that these tables contain). As the sample sizes differ for the different families the means for all families are not comparable. The means for Families 1 to 4 alone have been computed. However, all the data in this Table is an essential factor in computing the Selectivity parameter that is shown in Table 74.

A Selectivity parameter for the missing symbol case would be misleading because of the varying sample sizes and the incomplete sampling used in the experimental design. For this reason, no overall false alarm calculations have been computed for the symbol missing case as they are not needed for a Selectivity calculation and they are of little value in their own right because of the varying sample sizes between families. Any need to refer to Selectivity for the missing symbol case can be accommodated by referring to the analysis of this parameter in the sections on individual countries.

Table 72: False alarms (correct symbol present)

	Families						
	1	**2**	**3**	**4**	**5**	**6**	**7**
General Deaf	4	23	19	23	8	10	16
Amplified Telephone	44	31	17	13	31	9	1
Text telephone	30	47	36	41	29	25	17
Inductive Coupling	63	16	39	53	51	1	27
Electrical Coupling	3	93	22	38	24	17	56
General Videophone	28	44	71	77	20	11	39
Signing Videophone	140	111	167	124	125	52	22
Mean	45	52	53	53	-	-	-

Selectivity

The selectivity parameter is the ratio of correct selections to false alarms for each symbol. This measure is a very good parameter for comparison at the symbol level. This is not a meaningful measure for the symbol absent condition.

In the original MIA method means of the ratios are presented in the table. The infinite value of the ratio in Table 17 shows the unsuitability of means as a method of indicating the central tendency of a group of ratios. The median value of the sets of ratios have been used instead.

Table 73 shows the selectivity ratios for the symbol present condition.

Table 73: Selectivity (the ratio of correct selections to false alarms) for the symbol present condition

	Families							
	Family 1	**Family 2**	**Family 3**	**Family 4**	**Family 5**	**Family 6**	**Family 7**	**Median**
General Deaf	13,5	1,7	4,3	3,2	3,1	0,2	1,0	3,1
Amplified Telephone	2,6	2,1	4,7	6,5	1,3	2,3	21,0	2,6
Text telephone	6,3	2,8	4,7	4,5	3,6	1,1	2,6	3,6
Inductive Coupling	1,2	1,8	1,5	0,7	0,3	4,0	0,6	1,2
Electrical Coupling	6,7	0,9	2,3	1,5	1,8	1,2	0,9	1,5
General Videophone	3,6	1,2	1,1	1,2	2,1	2,6	1,1	1,2
Signing Videophone	1,1	0,9	0,8	1,1	1,1	0,6	1,6	1,1
Median	3,6	1,7	2,3	1,5	1,8	1,2	1,1	-

8.4.13.2 Task 2: Test of symbol preference

In this task each respondent was given all the candidate symbols for a particular referent and asked to choose the one that best represented it. Because in the different countries different families were tested there are a number of ways of summarizing these results. The eight alternative presentations for all respondents and for all respondents except normal hearers are presented in Tables I.15 to I.22 in Annex I. The columns of the tables give the percentages of all the respondents that chose each Family for a referent.

A summary of the data contained in these tables is given in Table 74 for all respondents and Table 75 excluding normal hearers.

Table 74: Symbol preference, preferred Family (all respondents)

Subset of data	Best Family						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
Families 1 - 6	3,4	1	2	2	1	3	5
Families 1 - 7	4	1	1	1	7	3	5
Families 1 - 5	4	1	3	2	2	3	5
Families 1 - 4	4	1	3	1	2	3	1

Table 75: Symbol preference, preferred Family (minus normal hearers)

Subset of data	Best Family						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
Families 1 - 6	3	1	2	2,4	1	1	5
Families 1 - 7	4	1	3	1	7	3	5
Families 1 - 5	4	1	3	1	1	3	5
Families 1 - 4	4	1	3	1	1	3	3

8.4.13.3 Task 3: Overall Family preference

In this task respondents had to name the Family which they personally preferred. Tables I.23 to I.30 In Annex I present different subsets of this overall picture according to which families were present in the different trials. The same information is shown for all respondents and also excluding respondents who were normal hearers. Table 76 gives the rank order of Family preference for the different groupings of families for all respondents and Table 77 gives the same view with normal hearers excluded.

Table 76: Family preference (all respondents)

	Rank Order				
	Families 1-6	Families 1-7	Families 1-5	Families 1-4	Mean rank
Family 1	6	3	3	3	3,8
Family 2	3	5,5	4	4	4,1
Family 3	1	2	1	1	1,3
Family 4	2	1	2	2	1,8
Family 5	4,5	5,5	5	-	5
Family 6	4,5	-	-	-	4,5
Family 7	-	4	-	-	4

Table 77: Family preference (excluding normal hearers)

	Rank Order				
	Families 1-6	Families 1-7	Families 1-5	Families 1-4	Mean rank
Family 1	6	3	3	3	3,7
Family 2	5	6	5	4	5
Family 3	1	1	1	1	1
Family 4	2	2	2	2	2
Family 5	4	5	4	-	4,3
Family 6	3	-	-	-	3
Family 7	-	4	-	-	4

8.4.14 Discussion of the results

8.4.14.1 Symbol Family level results

The tables in subclauses 8.4.8, 8.4.10 and 8.4.12 give a very strong overall message that across all measures Families 1, 2, 3 and 4. Combined with the Finnish results in subclause 8.4.12 the overall order for the families would appear to be Family 1, Family 3, Family 4 and Family 2. Table 78 gives a broad view of the results at the symbol Family level across all countries for Families 1 to 4.

Table 78: Results summary for the symbol present condition

Symbol Family	Parameter						
	Mean % symbols correctly identified	Mean *n* False Alarms	Median Selectivity	Mean Symbol Preference %	Family Preference %	Mean Symbol Preference (excluding hearers) %	Family Preference (excluding hearers) %
Family 1	**55**	**45**	**3,6**	**33**	*17*	*24*	*17*
Family 2	*40*	*52*	*1,7*	*19*	*3*	*7*	*3*
Family 3	51	53	**2,3**	**30**	**46**	**38**	**46**
Family 4	51	53	*1,5*	*18*	**34**	**31**	**34**
Mean	48	51	2,3	25	25	25	25

Table 79: Results summary for the symbol absent condition

Symbol Family	Parameter						
	Mean % symbols correctly identified as missing	Mean *n* False Alarms	Median Selectivity	Mean Symbol Preference %	Family Preference %	Mean Symbol Preference (excluding hearers) %	Family Preference (excluding hearers) %
Family 1	*53*	-	-	**33**	*17*	*24*	*17*
Family 2	**63**	-	-	*19*	*3*	*7*	*3*
Family 3	61	-	-	**30**	**46**	**38**	**46**
Family 4	61	-	-	*18*	**34**	**31**	**34**
Mean	48	-	-	25	25	25	25

Tables 78 and 79 present a mixed picture on which Family is the best. Across all the different parameters it appears that Family 1 shows the best performance on correct symbol recognition and the sensitive Selectivity parameter. The second best Family on performance is Family 3. On the preferences of the respondents Family 3 scores very well with Family 4 being the next best. Table 80 shows ranked data across all the parameters to help determine the big picture.

Table 80: Ranked test data across all countries for the symbol present condition

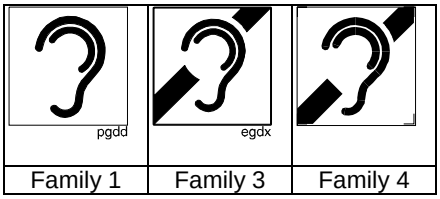
Symbol Family	Parameter								
	Symbols correct	False Alarms	Select.	Symbol Pref.	Family Pref.	Symbol Pref. (exc. hearers)	Family Pref. (exc. hearers)	Mean rank	Rank order
Family 1	1	1	1	1	3	3	3	1,9	1,5
Family 2	4	2	3	3	4	4	4	3,4	4
Family 3	2,5	3,5	2	2	1	1	1	1,9	1,5
Family 4	2,5	3,5	4	4	2	2	2	2,9	3

Table 80 shows Families 1 and 3 as the best performers with Family 4 being the third best family. Looking at Table 79, Family 3 appears superior to Family 1 in the symbol absent condition. Given that the symbol absent condition represents a realistic symbol usage option, the choice of Family on which the final symbols should be based was Family 3. In the choice of individual symbols the good performance of Families 1 and 4 would be taken into account when looking at the final symbol design.

8.4.14.2 Symbol level results

In the following analysis, the more successful candidates are compared to judge their results.

Symbol 1: General Deaf



Three symbols appeared as potentially the most successful candidates – Family 3, Family 4 and Family 1. The different parameters are shown in Table 81.

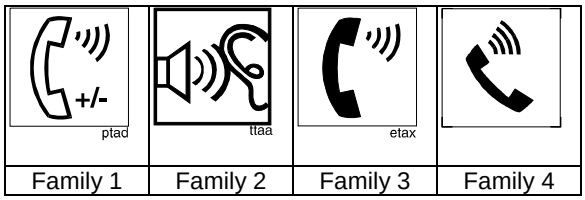
Table 81: Results summary for the symbol present condition

Symbol Family	Parameter					
	% symbols correctly identified	% correctly identified symbol missing	*n* False Alarms	Selectivity	Symbol Preference %	Symbol Preference (excluding hearers) %
Family 1	23	42	4	13,5	16	15
Family 3	38	53	23	4,3	27	28
Family 4	35	49	19	3,2	35	42

Overall the Family 3 symbol has the best selection scores, closely followed by Family 4 whereas the order of this pair was reversed for the preference scores. The Family 1 symbol was the least good of the three symbols on both these measures. The Family 1 symbol did have superior scores for the False Alarm and Selectivity measures but good scores in these measures are not as important for a symbol that is supposed to represent a very broad general concept.

The Family 3 symbol was the one finally selected as it was very similar to the slightly better scoring Family 4 symbol and was judged to be both a better visually balanced design and it gave greater room in the lower right corner of the symbol for additional elements needed to construct variants of the general symbol. As Family 3 was the preferred family, no redesign of the symbol was deemed necessary.

Symbol 2: Amplified Telephone



Three symbols appeared as potentially the most successful candidates –Family 1, Family 2, Family 3 and Family 4. The different parameters are shown in Table 82.

Table 82: Results summary for Amplified Telephone

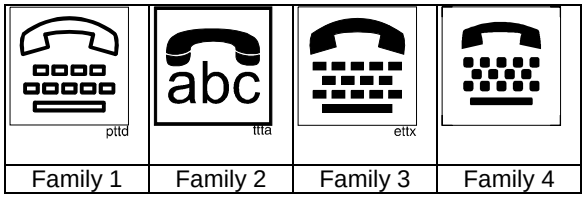
Symbol Family	Parameter					
	% symbols correctly identified	% correctly identified symbol missing	*n* False Alarms	Selectivity	Symbol Preference %	Symbol Preference (excluding hearers) %
Family 1	85	89	44	2,6	80	76
Family 2	49	60	31	2,1	8	14
Family 3	59	95	17	4,7	8	10
Family 4	62	95	13	6,5	4	0

The Family 1 symbol has clearly the best correctly recognized and preference scores. In the symbol missing case, the Family 3 and 4 symbols were slightly superior to Family 1 but not by a significant margin.

The inferior performance of the Family 1 symbol on the False Alarm measure is a little difficult to explain as the very similar Family 3 and 4 symbols scored very well on these measures. This tends to indicate that the poorer performance of this symbol relates more to its similarity to other symbols in Family 1 than in any design characteristic of the symbol itself.

The final choice of symbol design was to take the design of the Family 1 symbol and translate it into the style of Family 3.

Symbol 3: Text Telephone



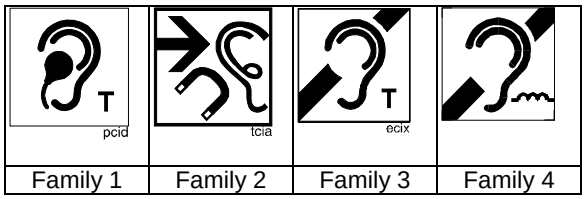
Three symbols appeared as potentially the most successful candidates –Family 1, Family 2, Family 3 and Family 4. The different parameters are shown in Table 83.

Table 83: Results summary for Text Telephone

Symbol Family	Parameter					
	% symbols correctly identified	% correctly identified symbol missing	*n* False Alarms	Selectivity	Symbol Preference %	Symbol Preference (excluding hearers) %
Family 1	86	62	30	6,3	31	31
Family 2	59	61	47	2,8	19	19
Family 3	78	86	36	4,7	37	37
Family 4	86	91	41	4,5	12	13

The Family 2, although superior to some of the other symbols, is clearly the weakest of these four symbols scoring the lowest or second lowest score in each category. There is little to separate the other three symbols, but the overall highest preference ratings and the fact that it is a member of the chosen Family makes the final choice the Family 3 symbol.

Symbol 4: Inductive Coupling



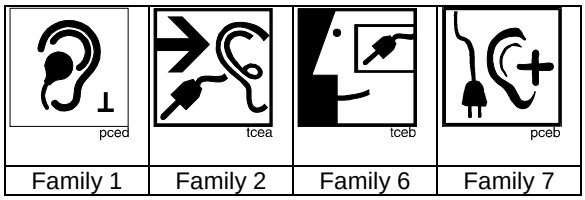
Three symbols appeared as potentially the most successful candidates –Family 1, Family 2, Family 3 and Family 4. The different parameters are shown in Table 84.

Table 84: Results summary for Inductive Coupling

Symbol Family	Parameter					
	% symbols correctly identified	% correctly identified symbol missing	*n* False Alarms	Selectivity	Symbol Preference %	Symbol Preference (excluding hearers) %
Family 1	55	43	63	1,2	34	33
Family 2	21	47	16	1,8	23	21
Family 3	43	58	39	1,5	25	26
Family 4	26	34	53	0,7	18	19

The symbols from Families 1 and 3 performed best on the correct identification and respondent preference measures. The Family 3 symbol also did well on the missing symbol test and was average on the False Alarm and Selectivity tests. The symbol of Family 2 only excelled in the false Alarms score whereas the Family 4 symbol was not outstanding in any area. This led to the clear conclusion that the Family 3 symbol was the preferred choice.

Symbol 5: Electrical Coupling



Three symbols appeared as potentially the most successful candidates –Family 1, Family 2, Family 6 and Family 7. The different parameters are shown in Table 85.

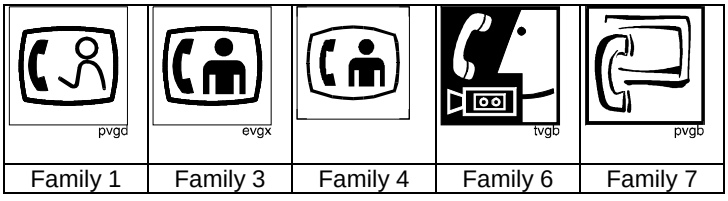
Table 85: Results summary for Electrical Coupling

Symbol Family	Parameter					
	% symbols correctly identified	% correctly identified symbol missing	*n* False Alarms	Selectivity	Symbol Preference %	Symbol Preference (excluding hearers) %
Family 1	15	39	3	6,7	18	30
Family 2	65	76	93	0,9	33	28
Family 6	54	43	17	1,2	14	16
Family 7	84	26	56	0,9	49	62

Although not the highest scoring symbol in most categories, the Family 1 symbol was popular with the group of respondents that excluded hearers and it offered a high Selectivity rating. however it was excluded from further consideration as it was very clearly depicting the coupling of hearing aids and a style was needed that allowed for the creation of a symbols that could be illustrate coupling of other devices for deaf or hard of hearing people.

The common factor in all of the remaining better performing symbols is the clear depiction of a plug on a lead. This would appear to be an important element and it was decided to use this as an element added to the Family 3 General Deaf symbol.

Symbol 6: General Videophone



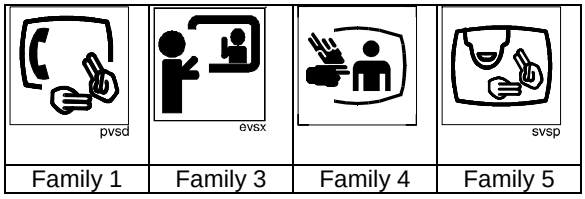
Three symbols appeared as potentially the most successful candidates –Family 1, Family 2, Family 4, Family 6 and Family 7. The different parameters are shown in Table 86.

Table 86: Results summary General Videophone

Symbol Family	Parameter					
	% symbols correctly identified	% correctly identified symbol missing	*n* False Alarms	Selectivity	Symbol Preference %	Symbol Preference (excluding hearers) %
Family 1	47	43	28	3,6	21	25
Family 3	36	35	71	1,1	47	43
Family 4	43	60	77	1,2	13	11
Family 6	51	-	11	2,6	15	19
Family 7	45	-	39	1,1	14	13

There was very little variation in the correct identification scores, but the Family 3 symbol was marginally the worst. However the Family 3 symbol was the best in the missing symbol condition. In terms of preference the Family 3 symbol was clearly ahead of the alternatives and so, as it was part of the chosen symbol Family, it was selected as the chosen symbol.

Symbol 7: Signing Videophone



Three symbols appeared as potentially the most successful candidates –Family 1, Family 3, Family 4 and Family 5. The different parameters are shown in Table 87.

Table 87: Results summary Signing Videophone

Symbol Family	Parameter					
	% symbols correctly identified	% correctly identified symbol missing	*n* False Alarms	Selectivity	Symbol Preference %	Symbol Preference (excluding hearers) %
Family 1	73	51	140	1,1	21	17
Family 3	64	42	167	0,8	21	25
Family 4	64	29	124	1,1	9	7
Family 5	86	46	125	1,1	42	43

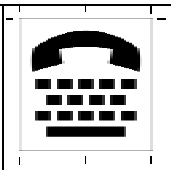
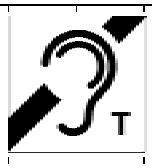
The symbol from Family 5 scored comfortably highest on the correct identification and preference scores, was equal best on the Selectivity score and was the second best on the missing symbol and False Alarm scores. To translate this symbol into the chosen Family 3 style would have meant that the hands would have to be drawn as solid figures rather than as outlines as in Family 5. The designer on the team suggested that the hands would not appear convincing if drawn as a solid figure and the hands in Family 4 would tend to bear that out as it was a very unpopular choice.

In order to fit into the style of the chosen Family 3, it was necessary to opt for a modified version of the actual Family 3 symbol which increased the emphasis on arms rather than hands by showing both arms in what is hoped would be a signing gesture.

8.4.15 Final symbol choice

Subclause 8.4.14 explains the rationale for the choice of symbol Family and individual symbols. The resultant symbols that were designed to meet those criteria are shown in Table 88.

Table 88: Symbols initially selected as the "final" set

						
GD	TT	CI	VG	VS	CE	TA

After initial circulation of documents containing the above choice of symbols, strong concerns were expressed by symbols standards committees and their members. In particular, specific concerns were expressed by IEC SC3 Committee:

1. A concern that symbol elements that overlapped with similar symbols and symbol elements in existing symbols standards should be redrawn in line with the design of these symbols and following the correct symbol drafting rules;

2. The "±" element that was used in the chosen "Amplified Telephone" symbol was seen to conflict with the "variability" symbol contained in IEC 60416 [23], ISO 3461-1 [41] and ISO 4196 [43].

The Human Factors Technical Committee (TC-HF) considered these concerns very carefully and agreed with the first issue and resolved that the symbols should be updated to address these concerns. TC-HF were less convinced by the second request because of evidence from the Pilot Study that symbols containing the "±" symbol element were better understood by deaf and hard of hearing users than symbols containing the variability element described by IEC SC3 Committee.

It was decided that TC-HF would still use the "±" symbol becaause it felt accuracy of symbol recognition was the most important criteria. However it was also decided to put this view to IEC SC3 Committee to understand the strength of their concerns. IEC SC3 Committee asked its members for comments and they consistently expressed a strong feeling that the "±" symbol element was the big reason to be dissatisfied with the suggested symbols and gave a concern about proliferation of different symbol elements having the same meaning was something to be avoided wherever possible.

It seems likely that symbols standards bodies would have a strong influence on the outcome of a vote by their member countries when voting on a standard that proposed a set of symbols. It was therefore felt that in order to get approved as a standard, the "variability" symbol element would have to be used.

The final set that was adopted for incorporation into EN 301 462 [1] were as shown in Table 89.

Table 89: Symbols selected for inclusion in EN 301 462 [1]

						
GD	TT	CI	VG	VS	CE	TA

9 Videotelephone symbol - Comprehension test

9.1 Test proposal

The appropriateness test had been conducted in accordance with ISO 9186 [13] as far as possible. It therefore seemed proper to perform the comprehension test according to the same standard. The comprehension test of ISO 9186 [13] is commonly performed on a number of symbols with different variants of each referent being allocated to different test sets. The task for the videotelephone symbol was a little easier, there being only one referent, a videotelephone, and four symbol variants to be tested. Four test booklets were therefore prepared as called for in the ISO standard each with a title sheet, an instruction sheet an, example sheet and and a test variant whose meaning was to be interpreted.

The ISO standard calls for the comprehension test to be conducted in at least four countries with at least 100 respondents for each symbol set. This would call for 400 subjects in each country, a task that was considered to be well beyond the available effort of the members of TC-HF or of the STF. The target was therefore set for 50 subjects for each of the four tests giving a total of 200 subjects.

The analysis of the answers in accordance with the standard also called for significant effort. The ISO standard requires each of the responses to be recorded and submitted to three judges, each of whom is required to assign one of seven categories to each of the responses.

The seven categories are listed below:

1. Correct understanding of the symbol is certain.
2. Correct understanding of the symbol is likely.
3. Correct understanding of the symbol is marginally likely.
4. The meaning which is stated is the opposite to that which is intended.
5. The reponse is wrong.
6. The response given is "Don't know".
7. No response is given.

The numbers of responses in each of the seven categories are then converted to percentages of the total number of responses.

9.2 Test conduct

This target set for the number of tests was found to be somewhat over-optimistic. The size of the sample required and the analysis of the responses (which had to be done in the language of the respondents) meant that the test required too much effort for most TC-HF members to be able to do the work on a voluntary basis. The requirement to construct a test booklet for each subject was not a trivial exercise as it required the provision of 200 four page booklets.

In spite of many requests it only proved possible to find one volunteer to conduct a test in Norway. A member of the STF conducted a test in the UK. In neither case was it feasible to find the targeted complement of 200 subjects. In the eventuality it only proved possible to test 41 subjects in Norway and 160 in the UK.

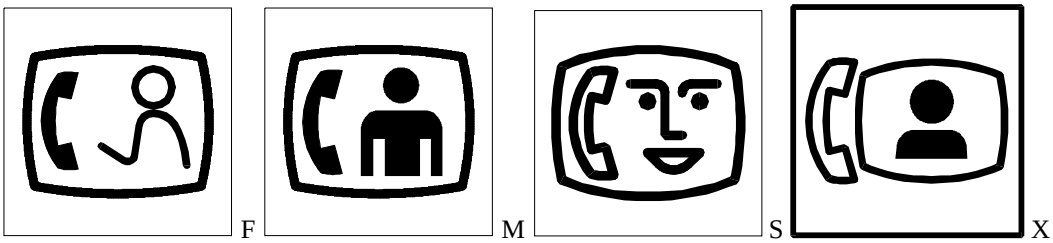
During the conduct of the tests it became clear that the ISO test was not very appropriate for the videophone symbol being tested:

- the standard notes that "Although the composition of the sample of respondents is usually not critical, the validity of the test results will be increased if the sampleresmbles the eventual user population. The sample should therefore consist preferably of respondents who are familiar with a given referent".

It proved impossible to find a source of sufficient subjects who were likely to be familiar with videotelephony. The responses of the random members of the public who were actually used in the UK made it evident that the concept of videotelephony was known to a relatively small proportion of them. In Norway tthere seemed a little greater knowledge of the facility. *Nevertheless, the answers that were obtained showed that one of the four symbols was identified more correctly than the other three.*

9.3 Test results

The four symbols tested were:



Detailed results of the tests are given in Annex Y. Of the total respondents tested, 62 % were male and 38 % female. 25 % fell into the 15 – 30 year old category. 44 % were aged 31 – 50 and 31 % were over 50 years old.

In the UK tests there were a total of 160 subject, 40 for each symbol. In the Norwegian tests there were a total of 41 subjects, 11 for symbol F, 12 for symbol M, 11 for symbol S and only 7 for symbol X.

The results are summarized in the following tables:

Table 89: UK Results

Response Category	F	M	S	X
1	10 %	17.5 %	30 %	50 %
2	5 %	2.5 %	7.5 %	5 %
3	-	2.5 %	-	2.5 %
5	70 %	65 %	45 %	37.5 %
6	15 %	12.5 %	17.5 %	5 %

Table 90: Norwegian Results

Response Category	F	M	S	X
1	18 %	33 %	45 %	43 %
2	9 %	-	-	-
3	-	-	9 %	-
5	55 %	58 %	36 %	43 %
6	18 %	8 %	9 %	14 %

Table 91: Combined Results

Response Category	F	M	S	X
1	12 %	21 %	33 %	49 %
2	6 %	2 %	6 %	4 %
3	-	2 %	2 %	2 %
5	67 %	63 %	43 %	38 %
6	16 %	11 %	16 %	6 %

Considering the combined data from the two countries and adding the percentage of responses in category 1 to those in category 2 gives the comprehension scores.

For Symbol F the score was 18 %, for Symbol M the score was 23 %, for symbol S the score was 39 % and for Symbol X the score was 53 %.

Symbol X is therefore the most comprehensible variant.

Adding the responses in category 3 raises the comprehension score of Symbol X to 55 %.

9.4 Conclusion of the videotelephone symbol comprehension test

Of the symbols tested, it is reasonable to consider that Symbol X is most likely to be comprehended as the symbol for a videotelepone. Even so, the symbol did not meet the ISO 9186 [13] requirements (66 %) for the required degree of comprehensibility. The most probable reason for the result was that few of the respondents in the UK were familiar with the existence or features of a videotelephone. It is very possible that a higher score would have been achieved with a more knowledgeable set of test subjects.

In view of the relatively small number of tests that it was possible to carry out (compared to the requirements of the test of ISO 9186 [13]) and of the results obtained, the result cannot be said to be in any way conclusive. As far as can be seen from the figures derived in the two countries tested there was some difference between them for the responses obtained. In Norway there was little difference between the results for symbols S and X whereas in the UK symbol X scored significantly better than symbol S. It is likely that the respondents in Norway were more familiar with the concept of the videotelephone.

Nevertheless, based on the total score and in view of the probability that the final score was depressed by the lack of knowledge of the facility being described, TC-HF might think it accepTable to recommend the use of Symbol X even though a comprehensibility of 66 % was not achieved.

It may be noted that Symbol X was the only symbol of the four to be surrounded by a heavy border. It may be significant that 6 % of the responses for this symbol referred to a booth and another 8 % to a "public" facility, the border possibly being interpreted as a telephone box. The symbol might be improved by the removal of this border.

Annex A (informative): Design brief

Design Objectives

To design a Family of related, language-independent symbols which will enable deaf and hard of hearing users, as well as their friends and partners, to readily identify available assistive telecommunications facilities.

Important features of the design brief are that:

- we are trying to develop a compact set of symbols to achieve the design objectives;
- the symbols should have a readily identifiable Family image;
- the symbols themselves should not necessarily be trying to identify a specific technical feature but a benefit to the user. There may be more than one technology available for instance which will solve the user's particular communications problem, e.g. the transmission and reception of text, but the specifics of it do not have to be spelt out in words or symbolic form;
- the application of the symbols will range from printed matter such as telephone directories and user guides, to on-product and on-screen graphics, room and concourse signage, etc.

The symbols themselves will be tested on a range of deaf and hard of hearing user in order to evaluate their effectiveness. (see page 7).

User Scenarios

The symbols could help identify facilities with suiTable features in, for example, the following situations:

- which telephone numbers in a directory identify connections to textphones or a textphone relay service;
- which telephone numbers identify connections to videotelephones capable of supporting signing and/or lip-reading;
- which public areas have inductive, electrical, infra-red or radio coupling for hearing aids;
- where to find a public textphone or telephone with an infra-red coupling for another messaging terminal, e.g. Apple or Psion;
- which of a set of telephones in a public place provide amplification and/or frequency configuration;
- which telephones have inductive, electrical, infra-red or radio coupling for hearing aids, or sockets for additional headsets;
- which telephones show the telecoms network tones, like busy or call-waiting, as visible indicators, etc., etc.

Assistive Technologies

The core assistive technologies that have been identified by the specialist task force are those related to the telephone, the textphone and the videophone. The symbology should indicate to the way in which the user relates to these technologies through auditory, visual or tactile means and the ways in which these relationships can be modified and enhanced by the technology.

Telephone Related:

- Couplings for hearing aids.
  - Inductive, electrical (sockets), infra-red, radio;
- Sockets for headsets and additional earphones;
- Modifying the received speech
  - Amplification and frequency shifting;
- Modifying telecoms network tones
  - Amplification, frequency shifting, visual indications, tactile indications;
- Smart card configurable facilities.

Textphone Related:

- Identification of public textphones;
- Identification of textphone relay services;
- Ports and couplings for textphone units or other text-based terminals e.g. PDA's
  - Electrical, infra-red, radio;
- Other interactive messaging services.

Videotelephone Related:

- Identification of a videotelephone facility;
  - SuiTable for signing
  - SuiTable for lip-reading

Future Technologies:

- Automated recognition, translation and/or presentation systems
  - Speech to text to signing (any combination);
- Multimedia
  - Shared whiteboards, video mail boxes, etc., etc.

The Core Set of Symbols

In order that the testing of the symbols can be kept within reasonable limits it has been determined that a core set of symbols, representing the most commonly available facilities, should be developed. This should not however inhibit the designers from developing other symbols that form logical extensions to the set.

The Core Symbols c.f. 'Existing Symbols'

1) A symbol indicating the location of general facilities for the deaf and hard of hearing.
2) A symbol indicating the location of a telephone whose handset and/or loudspeaker can have its amplification and/or frequency modified to suit the listener.
3) Symbols indicating the location of a telephone with facilities for coupling to hearing aids and the means by which that coupling can be made. This can be either inductive, infra-red, electrical (plug and socket), or radio.
4) A symbol indicating the location of a textphone.
5) A symbol indicating the location of a videophone and whether it is suiTable for use with sign language and/or lip reading.

Possible Subsidiary Symbols c.f. 'Existing Symbols'

1) A symbol identifying public spaces, auditoriums, concourses, etc., equipped with facilities for coupling to hearing aids. Inductive, infra-red, electrical, radio.

2) Symbols identifying the location of facilities for connecting devices, such as PDA's, laptop computers, etc., to the telecommunications network, and the type of connection available.

3) Etc., etc.

Presentation of Symbols

In order that designs from various sources can efficiently be collated and integrated into the questionnaires it is desirable that they should be available on disk as well as on paper. The collation and integration of the symbols and text will be PC-based using MS Word and CorelDraw.

Existing Symbols

The symbols portrayed on the following two pages in both positive and negative form are the result of a preliminary research into some published but not necessarily standardized graphics. This is not an exhaustive set of symbols and we would welcome your input to extend this list, for example with symbols from your own country.

The attributions for the symbols are as follows:

General Facilities for the Hearing Impaired

WFD approved (unconfirmed)

Electrical Coupling to Hearing Aid

ETSI Proposal

Inductive Coupling to Hearing Aid

ETSI Proposal

Textphone

WFD approved (unconfirmed)

Coupling/Amplification (non-specific)

Graphic Artists Guild Proposal (U.S.)

Amplification

Graphic Artists Guild Proposal (U.S.)

Signing Facilities 1

Graphic Artists Guild Proposal (U.S.)

Signing Facilities 2

BSL, BDA

Videotelephone Signing Possible

Anonymous Proposal

General Facilities for the Disabled

Standardized

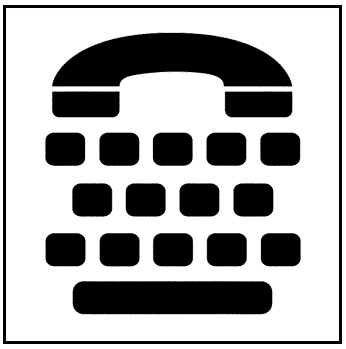
Query/Help/Information

In general usage

General facilities for the hearing-impaired.

Electrical coupling to hearing-aid

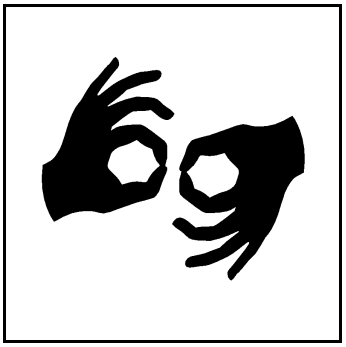
Inductive coupling to hearing-aid.



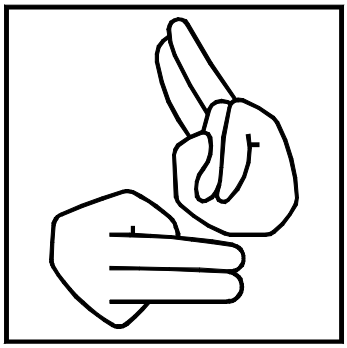
Textphone.

Coupling/amplification non-specific

Amplification.



Signing facilities. 1

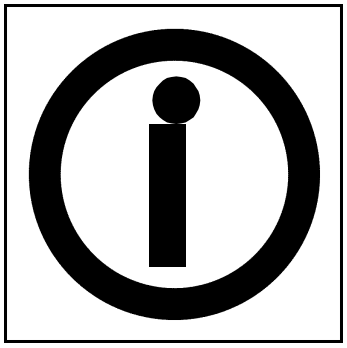


Signing facilities. 2

Videotelephone signing possible.

General facilities for the disabled.

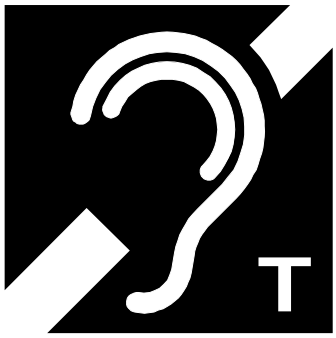
Query/help.



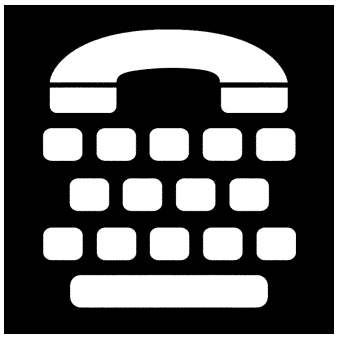
Information/help.

General facilities for the hearing-impaired.

Electrical coupling to hearing-aid



Inductive coupling to hearing-aid.

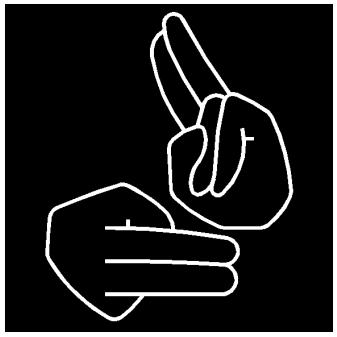


Textphone.

Coupling/amplification non-specific

Amplification.

Signing facilities. 1

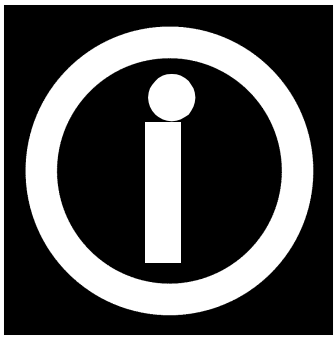


Signing facilities. 2

Videotelephone signing possible.

General facilities for the disabled.

Query/help.



Information/help.

Symbols Testing

The families of symbols from the design teams will be collated into a standardized questionnaire according to the ETSI approved test procedure. The questionnaire and symbols will be tested in a pilot trial with deaf and hard of hearing users, as well as carers and other concerned members of the public. Following the pilot trial the test methodology, questionnaire and symbols may then be modified for the main trials. These will take place in a minimum of three European countries in April/May 1998. After the analysis of the results from the main trials the most effective symbols or Family of symbols will then be specified in a new European Standard.

Time Schedules

Distribution of symbol descriptions and final design brief to design groups.	Wk 50/97
Draft symbol concepts prepared for pilot trial.	Wk 03/98
Pilot trials of symbols.	Wk 07/98
Revision of symbol designs for main trials.	Wk 11/98
Main trials	Wk 19/98

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Annex B (normative): Pilot Trial Materials

B.1 Instructions to respondents

Instructions to trial organiser

The tasks involved in this questionnaire are not difficult ones but difficulties could arise when using the services of signing translators and lip speakers. Because of this it is recommended that the group size is limited to 10

1) Give out the questionnaires.
2) Read out instructions with signing/lip speaking translation where necessary
3) Ask if anybody has any queries or problems
4) When everybody is happy ask them to begin and work their way through the booklet until they reach the end. Reinforce at this stage that they should only circle ONE symbol even if several seem accepTable and that they can ask questions at any stage.
5) When individuals finish it is obviously important that they do not influence those still working on the questionnaire.
6) When everybody has finished collect in the questionnaires and thank the respondents again.

Instructions to be read out by the organiser and translator

Thank you for volunteering to take part in this trial.

Having symbols to indicate to deaf and hard of hearing people what services are available at a particular location or with a particular product is obviously helpful. But unless these symbols are the same everywhere this could easily lead to confusion.

The European Commission has sponsored this study to help standardise a set of symbols for these services and that is why we are asking you to help.

Several sets of symbols have been produced by different designers across Europe. We want to see which is best.

On each page of this booklet we will ask you to pretend that you are looking for a particular service and then ask you to choose (by circling with a pencil) the most appropriate symbol. You will then be asked how confident you were in that choice and how well you thought the symbols represented the service.

There are no right or wrong answers. Remember, you are helping us test the symbols, we are not testing you.

As you work through the pages, please ask if you have any queries or problems.

B.2 Sample questionnaire pages

B.2.1 Association questions

A question is asked for each referent in each family. The order of presentation of the symbols for each referent within a family is randomised, as is the order of questions within the assocaition set.

With four families and nine referents, there were 36 pages of association questions for the hearing aid and hearing groups, and 16 pages for the profoundly deaf groups. Each of these pages had a title and question number for the referent, a definition of the referent “What is it?", the task question “Which symbol?", and “Certainty" and “Representativeness" ratings. At the bottom of the page was a code which identified the Symbol Family, the Symbol Referent and the Respondent group DS, DL, HH or HE. A two digit code to identify the respondent was not used. At the same time, beneath each symbol a single consonant code was used to identify a symbol to a referent.

Videophone Q.3

What is it?
This provides a full colour, motion picture of the person you are calling as well as sound. Most videophones allow some measure of signing but some higher quality videophones will allow lip-reading as well.

Which symbol?
Identify one symbol which indicates that a videophone service is available of sufficient quality to allow signing. (Please circle)

How certain are you of your choice? (Please tick)

Very uncertain ☐ ☐ ☐ ☐ ☐ Very certain

How well does the symbol you selected represent a videophone for signing?

Very badly ☐ ☐ ☐ ☐ ☐ Very well

 F4:S8:DE01

B.2.2 Symbol preference questions

For this section there is one question page per referent. Which for the profoundly deaf groups meant a total of 4 pages (general facilities, textphone, videophone for signing, videophone for lip-reading), and for the hearing aid and hearing groups meant 9 pages (as before plus amplification and 4 coupling pages).). The order of presentation of the referents is randomised.

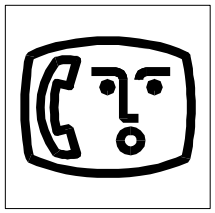
The page format is basically the same, with a title and question number, followed by the definition “What is it?" (using the same wording as before) and the task question “Which symbol?" (which used different to clarify the change in task). This followed be the simple rating question asking how well the symbol represents the referent.

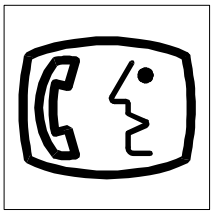
Again, codes are used benetah each symbol to define its source, and at the bottom of the page to reflect the task, target symbol and the respondent group.

Videophone – lip reading Q.17

What is it?
This provides a full colour, motion picture of the person you are calling as well as sound. Most videophones allow some measure of signing but some higher quality videophones will allow lip-reading as well.

Which symbol?
On this page you will see all the possible symbols indicating that lip-reading via a videophone is available. Please draw a circle around the symbol which best represents this service


O3


O2

How well does the symbol you selected represent a videophone for lip reading?

Very badly ☐ ☐ ☐ ☐ ☐ Very well

 S9:DE01

B.2.3 Family preference question

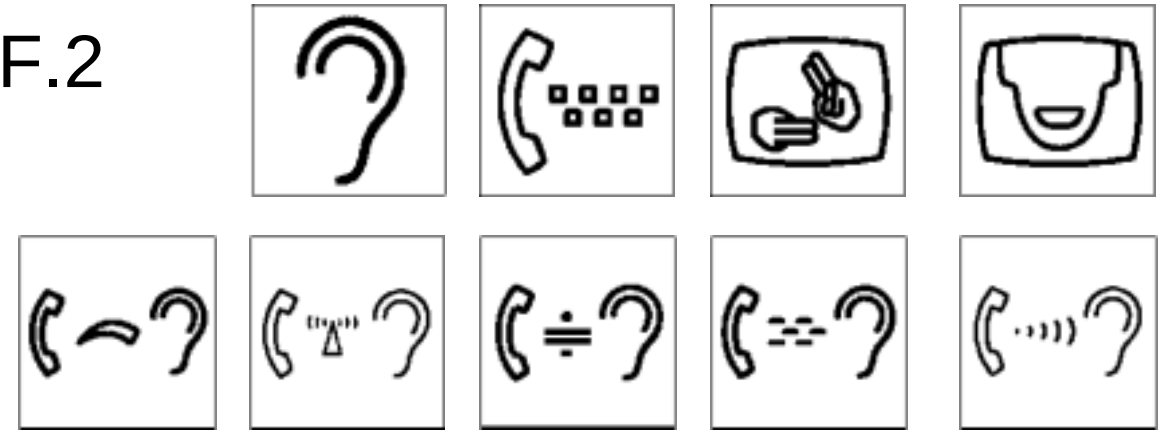
For this section there is one question spread over two pages. The respondents task is simply to restudy the families and declare a preference.

Which Family Q.21

On these next pages you will see all the families of symbols. Please look at them all again and give your preference in the space provided after the last family.

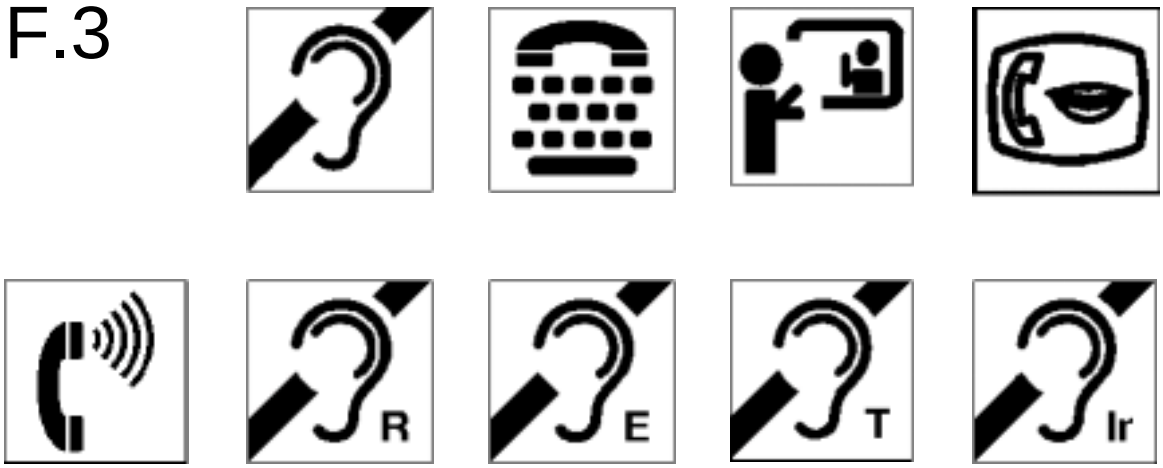
F.1

F.2



Which family, continued Q.21

F.3



F.4

Which symbol family do you prefer? I prefer family no: F ☐

 DE01

Annex C (normative): Brochure

To help publicize the work of STF 106 and to aid COST 219 bis delegates and others to seek assistance for the trials we have prepared an A4 brochure. The text is reproduced below and the whole document is also available from the ETSI Web Site: WWW.ETSI.FR - within the TCHF area.

STF 106

Symbols to identify telecommunications facilities for the deaf and hard of hearing

Aims

To create, test and publish, in a European Standard, a family of symbols that will help deaf and hard of hearing users, as well as their friends and partners, to easily recognise one or more key assistive telecommunication technologies.

How would they help?

These symbols will be available to help identify, for example:

- which telephone numbers in a directory connect to textphones or a textphone relay service;
- which telephone numbers connect to videotelephones capable of supporting signing or lip reading;
- which public terminals have inductive or perhaps infra-red coupling for hearing aids;
- where to find a public textphone or public telephone with an infra-red coupling for another messaging terminal, e.g. Apple or Psion Personal Digital Assistant;
- which of a set of telephones in a shop provide amplification circuits and/or frequency configuration (c.f. a type of graphic equaliser);
- which telephones have inductive or electrical coupling for hearing aids, or sockets for additional headsets
- which telephones show the telecomms network tones like busy or call waiting as visible indicators;
- Etc...

STF 106 is a Specialist Task Force set up by the European Telecommunications Standards Institute (ETSI) and responsible to the Technical Committee for Human Factors. The STF is jointly funded by the European Commission and ETSI.

For more information on ETSI, see their web site at: WWW.ETSI.FR

Assistive Technologies

These are the assistive technologies we have identified so far, some or all of these may need a symbol.

Telephone related:

- Couplings for hearing aids
    - inductive, electrical, infra-red, radio
- Sockets for headsets, and additional earphones
- Changing the received speech
    - amplification, frequency configuration
- Changing telecomms ring signals and tones
    - amplify, configure frequency, visual indications, mechanical
- Smart Card Configurable

Textphone related:

- Public Textphones
    - private textphone numbers
- Textphone Relay services
- Ports and couplings for textphone units or other text-based terminals e.g. PDAs
    - electrical, infra-red, radio
- Other interactive messaging services

Videotelephone related

- SuiTable for signing
- SuiTable for lip-reading

Future possibilities

- Automated recognition, translation and/or presentation systems
    - speech to text to signing
      (any combination)
- Multimedia
    - shared white boards
    - video mail boxes

If you know any more, please tell us...

Symbols

These are the symbols we have found so far, but if you know any others, please tell us...

Note: These are the same as those reproduced in Clause 5

How can you help?

There are three ways you may be able to help:

1. Tell us about the things we may have missed;
2. Tell us about situations where a symbol or clear label may have been able to help;
3. Tell us if you think you could help run a test.

What have we missed?

- Can you tell us about telecomms services and facilities in your own country that may help the deaf and hard of hearing and that we have not listed?
- Have you seen any symbols or pictograms that identify telecomms services or facilities intended to help the deaf and hard of hearing, and that we have not listed?

Can you tell us stories of everyday situations that have happened to you or a friend where a clear symbol could have helped?
For example:

- using a public payphone - did it have an inductive loop or other hearing aid support systems?
- callers to your textphone - did they expect a spoken conversation?
- sending something back to a mail order company - did they have a videotelephone connection and is anybody trained in signing?

Could you or your local organisation help with the testing of the symbols?

We will be testing how easy it is to recognise what the new symbols are identifying, in several European Countries. At present these include: the UK, Finland, Netherlands and probably Portugal; but other countries are very welcome to join in.

To talk to us or to know more about any of these points, please contact the people shown on the back panel of this brochure.

Testing! What is involved?

We shall be able to give you the basic questionnaire and the rules for running the test. You may need to think about:

- finding a sample of deaf and hard of hearing people, (We would like it to be a minimum of 40 per country, 20 hearing aid users and 20 profoundly deaf. We also expect the sample to match the normal deaf and hard of hearing population in age and gender);
- getting the questionnaire translated into your local language;
- getting the people together in groups, where there may need to be facilities for hearing aid users and translators for signing and lip speaking;
- and finally, running the test in April, May or June 1998, and sending us the completed questionnaires.

We are not asking much, are we!

Contacts

If you would like to help, please contact either:

ETSI STF 106 Team Leader

Alan Ferris, C.Psychol., MErgS, EurErg.

c/o Ferris Associates,

131 Heathrow, BISHOP'S STORTFORD,
Herts., CM23 5DN, England

Tel: +44 1 279 503 298 Fax: +44 1 279 466 281

email: alan@ferris.dungeon.com

ETSI Technical Committee for Human Factors

Knut Nordby, Chairman

c/o Telenor R&D,

P.O. Box 83, N-2007 KJELLER, Norway.

Tel: +47 63 84 86 30 Fax: + 47 63 81 00 76

email: knut.nordby@fou.telenor.no

Annex D (normative): Main Trial Materials

D.1 Main - Instructions

D.1.1 Main - Trial organisation

STF 106: Symbols to identify telecommunications facilities for deaf and hard of hearing people

Instructions to Trial Organisers

Pre-trial organisation

You will have received several master copies of the questionnaire and instructions. These should be colour coded for ease of use and analysis. Please ensure that all copies are in the same colours as the masters. You require the following numbers of trialists, each of whom will use a questionnaire of the appropriate colour.

Ivory/cream	10	prelingual deaf people (using signing translator during trial)
Yellow	10	profoundly deaf people (using lip-speaker during trial)
Green	20	hearing aid users
White	20	carers/social workers/normal hearing

Although the instructions are almost the same for each group, we found it helpful to colour code the instructions the same as the questionnaires. If possible we would like you to print the final question (Identifying a preferred family of symbols) on a single A3 page fold-out. It is also helpful to arrange for one or two extra people to attend for each session, and to print some extra copies of each booklet to cover these extra people as well as the organiser and translator. For example: if session 1 needs 10 people, make arrangements for 12 to attend and print 14 Ivory booklets. However, if some of the trialists you have booked fail to take part do not worry, exact numbers are not required.

The tasks involved in this questionnaire are not difficult ones but care needs to be taken when using the services of signing translators and lip speakers. Because of this it is recommended that each group size is limited to 10, (i.e. you may want to plan for two groups of hard hearing subjects).

As we are asking them to circle or tick their answers, do not forget to have sufficient pencils available!

We also found in the pilot trial that having a second room where early finishers can go is a good idea, as this minimises boredom for those finishing early and distraction for those yet to finish. You may wish to consider offering some small refreshments at this point, and also use this time to present any reward or payments for expenses. NB. The prelingually deaf people will all finish at the same time, as they work through the questionnaire page by page with their signing translator.

Running the trial

When you are ready:

1. Give out the appropriate colour questionnaires and make sure everybody has a pencil.
2. Read out appropriate colour instructions with translation where necessary and making sure to show them the example on the first page.
3. Ask if anybody has any queries or problems. (NB: It may be helpful to those conducting future trials if a note is made of any difficulties).
4. When everybody is happy with what they have to do, ask them to begin and work their way through the booklet until they reach the end. Reinforce at this stage that they should only circle ONE symbol even if several seem accepTable and that they can ask questions at any stage. Also, reinforce that there may not be a symbol representing that service. (NB: Those using the signing translator should be asked to do their questionnaires one page at a time. During the pilot study, the signing translator noted that continued repetition of the definitions for each question was unnecessary, we recommend you use your discretion).
5. When individuals finish it is obviously important that they do not influence those still working on the questionnaire. If a second room is available you may ask then to wait there.
6. When everybody has finished collect in the questionnaires and thank the trialists again.
7. Finally, if anybody wants to make any comments or observations about the symbols or the way the trial was conducted, please take a note of these and return it to the STF 106 organisers along with the questionnaires.

Post-trial organisation

Please parcel up all the completed questionnaires and send, together with any written comments from the preparation or running of the trial, to:

Mr D Pollard, Tel: +44 1 473 311 384

ETSI STF 106,

c/o 19 The Street, Fax: +44 1 473 312 175

Capel,

Ipswich, Email: derek.pollard@bt-sys.bt.co.uk

IP9 2EE,

United Kingdom

As this is our only data source it is very valuable to us, therefore may we ask you to use an international carrier capable of guaranteeing delivery in less than a week.

In conclusion, please accept the grateful thanks of ETSI STF 106 and all members of ETSI TCHF. This project could not work without your help, and we promise to keep you informed of the results later this year.

Alan Ferris (Team leader)

D.1.2 Main - Respondents

D.1.2.1 Profoundly deaf people using signing

STF 106: Symbols to identify telecommunications facilities for deaf and hard of hearing people

Instructions to be read out by organiser and signed by translator

Ivory

Thank you for volunteering to take part in this trial.

Having symbols to indicate to deaf and hard of hearing people what telecommunications services are available at a particular location or with a particular product is obviously helpful. But unless these symbols are the same everywhere this could easily lead to confusion. The European Commission has sponsored this study to help standardise a set of symbols for these services for deaf and hard of hearing people and that is why we are asking you to help. Several sets of symbols have been produced by different designers across Europe. We want to see which is best.

On each page in this booklet we will ask you to pretend that you are looking for a particular service and then ask you to choose (by circling with a pencil) the most appropriate symbol. Many of these symbols will be new to you, so do not expect them to be familiar.

Please turn to the first page now and we will go through an example. *(Hold up first page in front of you).* First, we have a definition of what a videophone service suiTable for deaf and hard of hearing people is. Then, you are asked to indicate a symbol showing that a videophone suiTable for deaf and hard of hearing people is available. It you think it is this one *(Pointing)* then draw a circle around it in pencil. Sometimes, you may think there is NO appropriate symbol, in this case circle the blank square. *(Pointing to blank square)* You will then be asked how confident you were in that choice. Please tick the box that most closely matches your feeling of confidence; e.g. Very uncertain - Uncertain - Don't Know - Certain - Very Certain

Each question on each page will be read and signed in full, so please only do one page at a time. As we work through the pages, please ask if you have any queries or problems. There are no right or wrong answers. ***Remember, you are helping us test the symbols, we are not testing you.***

Before we start then, has anybody got any questions?

D.1.2.2 Profoundly deaf people using lip reading, Hard of hearing and Hearing groups

STF 106: Symbols to identify telecommunications facilities for deaf and hard of hearing people

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Instructions to be read out by organiser

Green

Thank you for volunteering to take part in this trial.

Having symbols to indicate to deaf and hard of hearing people what telecommunications services are available at a particular location or with a particular product is obviously helpful. But unless these symbols are the same everywhere this could easily lead to confusion. The European Commission has sponsored this study to help standardise a set of symbols for these services for deaf and hard of hearing people and that is why we are asking you to help. Several sets of symbols have been produced by different designers across Europe. We want to see which is best.

On each page in this booklet we will ask you to pretend that you are looking for a particular service and then ask you to choose (by circling with a pencil) the most appropriate symbol. Many of these symbols will be new to you, so do not expect them to be familiar.

Please turn to the first page now and we will go through an example. *(Hold up first page in front of you).* First, we have a definition of what a videophone service suiTable for deaf and hard of hearing people is. Then, you are asked to indicate a symbol showing that a videophone suiTable for deaf and hard of hearing people is available. It you think it is this one *(Pointing)* then draw a circle around it in pencil. Sometimes, you may think there is NO appropriate symbol, in this case circle the blank square. *(Pointing to blank square)* You will then be asked how confident you were in that choice. Please tick the box that most closely matches your feeling of confidence; e.g. Very uncertain - Uncertain - Don't Know - Certain - Very Certain

There are no right or wrong answers. ***Remember, you are helping us test the symbols, we are not testing you.***

As you work through the pages, please ask if you have any queries or problems. When you have finished, please do not talk to those still working on the questionnaire.

Before we start then, has anybody got any questions?

D.2 Main - Sample questionnaire pages

D.2.1 Main - Association questions

D.2.1.1 Target symbol present

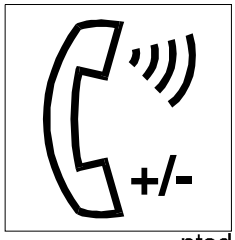
Amplification Q.1

What is it?

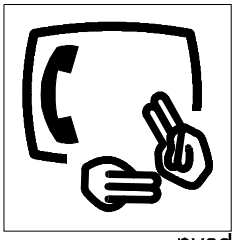
The loudness of the speech coming out of the handset is adjusTable on some telephones.

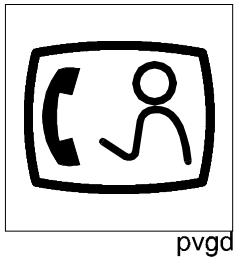
Which symbol?

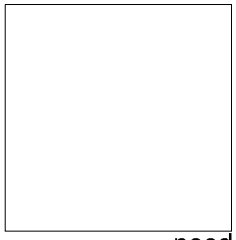
Can you identify one symbol which indicates that the speech output from a public telephone can be increased by the user? (Please circle)

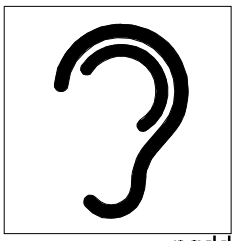


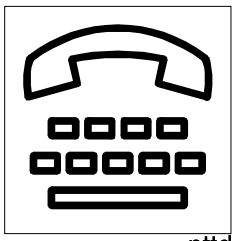
ptad

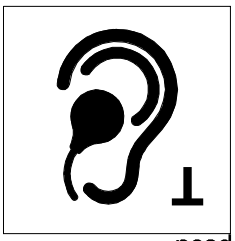

pvsd


pvgd


pood


pgdd


pttd


pced

How certain are you of your choice? (Please tick, e.g. ☑)

Very uncertain ☐ ☐ ☐ ☐ ☐ Very certain

D.2.1.2 Target symbol absent

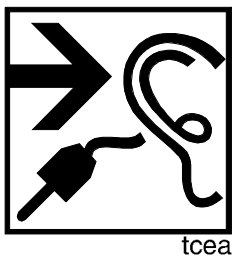
Amplification Q.14

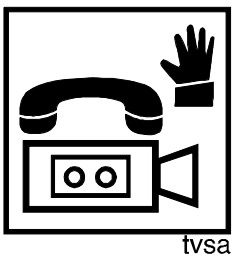
What is it?

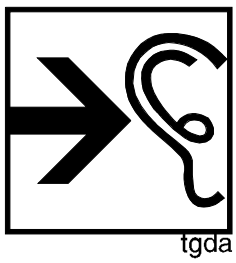
The loudness of the speech coming out of the handset is adjusTable on some telephones.

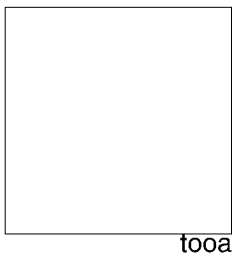
Which symbol?

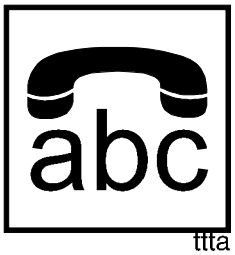
Can you identify one symbol which indicates that the speech output from a public telephone can be increased by the user? (Please circle)


tcea

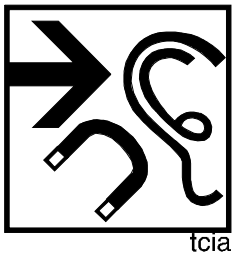

tvsa

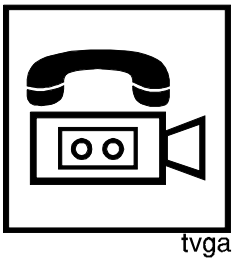

tgda


tooa



ttta


tcia


tvga

How certain are you of your choice? (Please tick, e.g. ☑)

Very uncertain ☐ ☐ ☐ ☐ ☐ Very certain

 F2:S3n:ENGLISH MASTER HE/HH

D.2.2 Main - Symbol preference questions

Amplification Q.58(NL+)

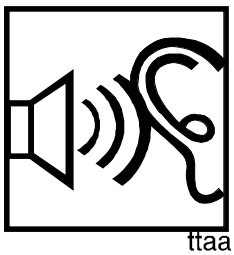
What is it?

The loudness of the speech coming out of the handset is adjusTable on some telephones.

Which symbol?

On this page you will see all the possible symbols indicating that amplification is available. Please draw a circle around the symbol which best represents this service.

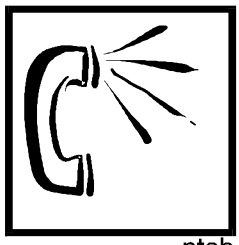
ptad


ttaa


etax


ptas


stap


ptab

How well does the symbol you selected represent a telephone with amplification?

Very badly ☐ ☐ ☐ ☐ ☐ Very well

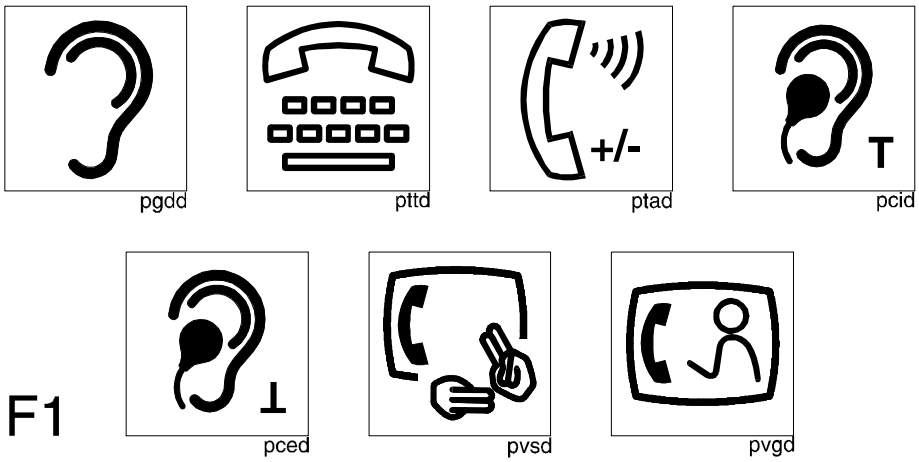
How accepTable is the symbol you selected to deaf and hard of hearing people?

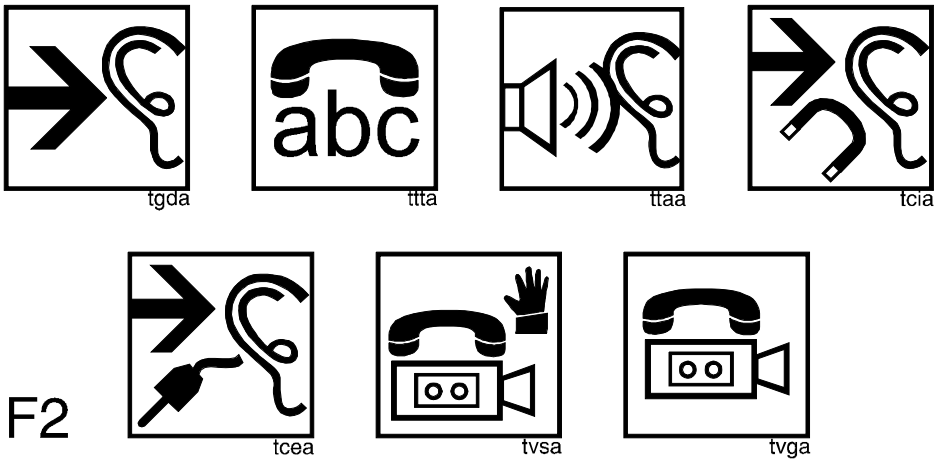
Very unacceptable ☐ ☐ ☐ ☐ ☐ Very acceptable

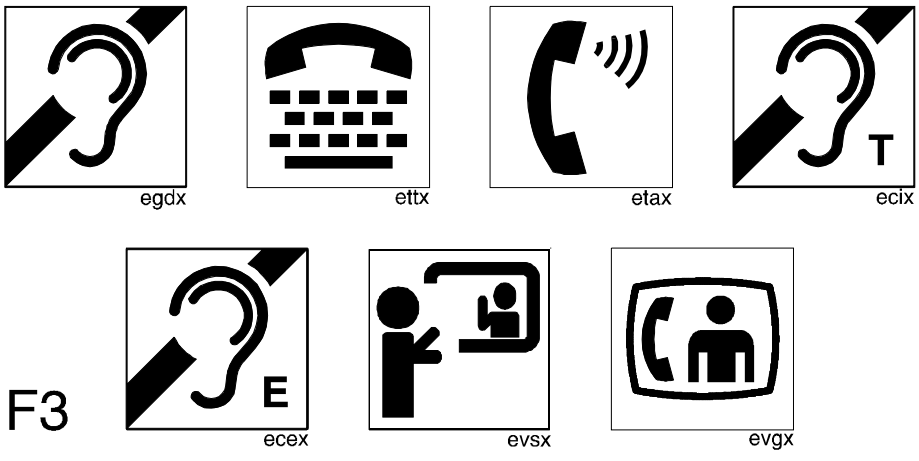
D.2.3 Main - Family preference question

Which Family? Q.62

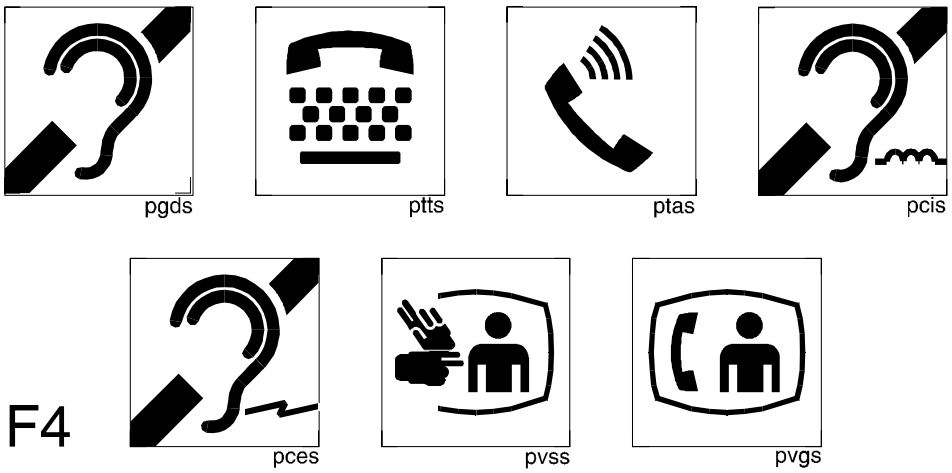
On these next pages you will see all the families of symbols. Please look at them all again and give your preference in the space provided after the last family.

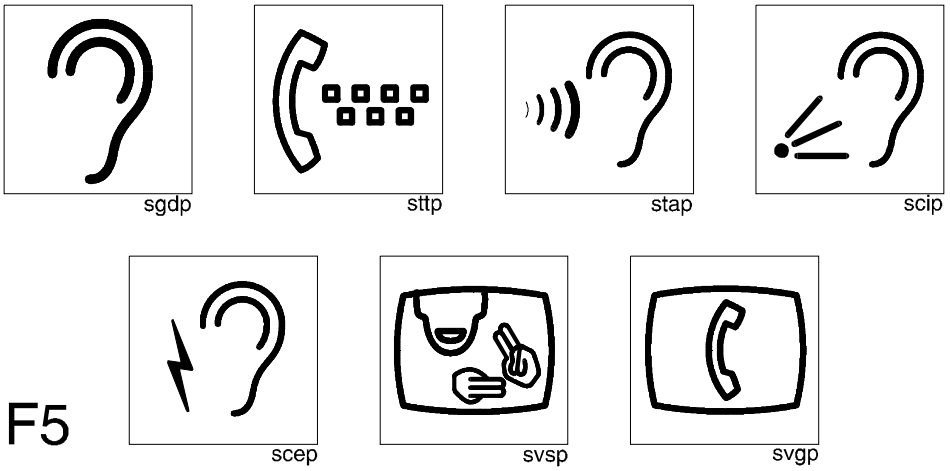


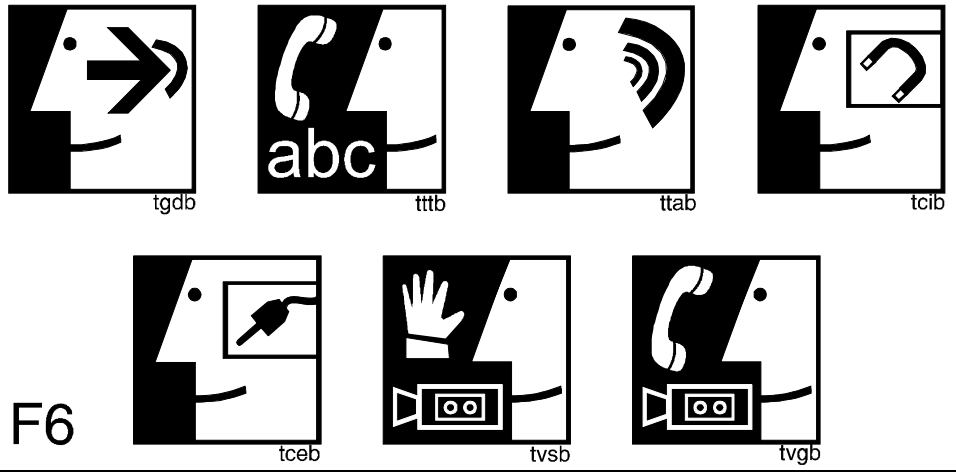




Which Family?... continued Q.62(PT)



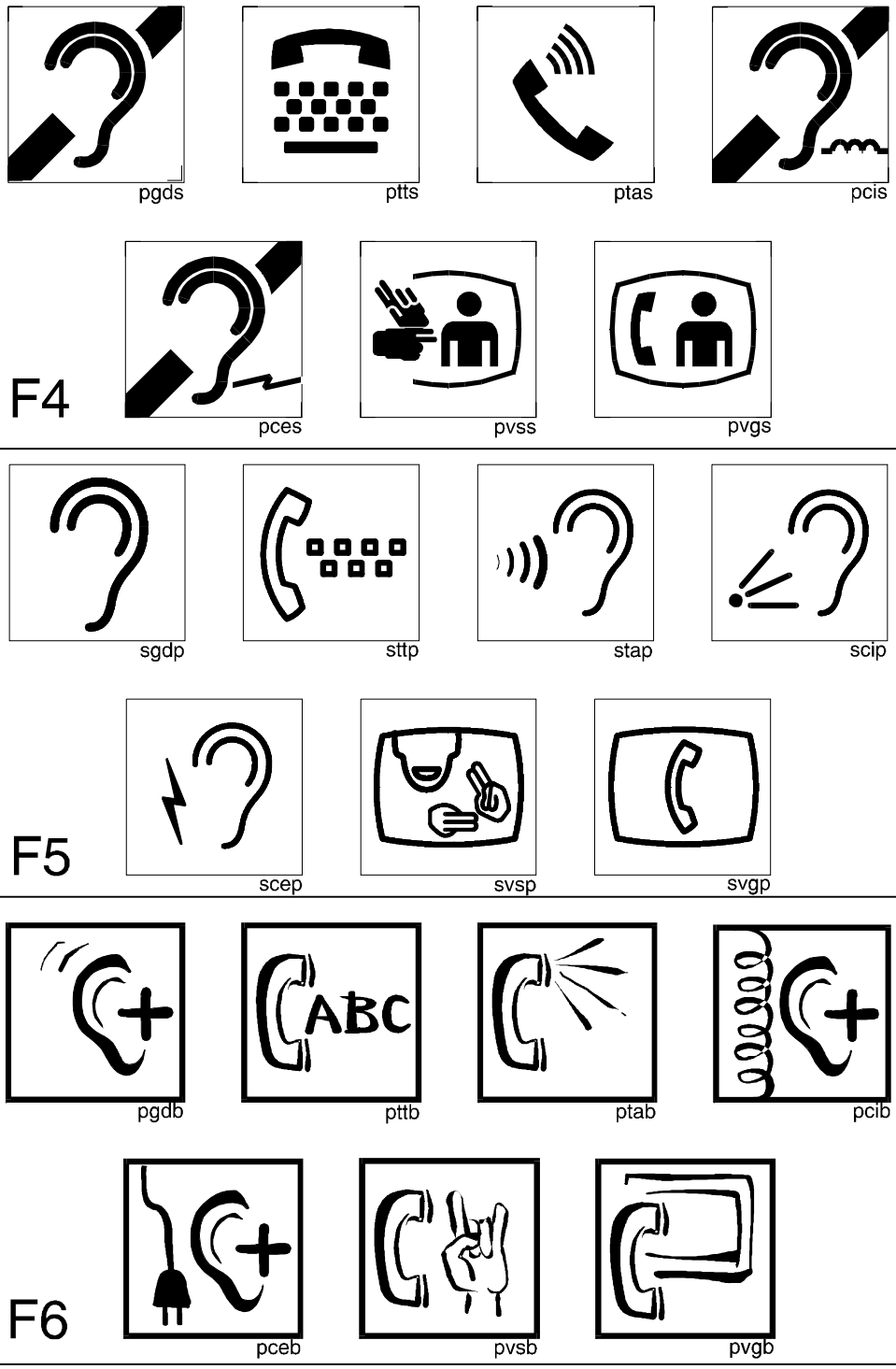




Which symbol family do you prefer? I prefer symbol family no: F ☐

Thank you again for your help.

Which Family?... continued Q.62(NL+)



Which symbol family do you prefer? I prefer symbol family no: F ☐

Thank you again for your help.

Annex E (informative): Tables with the results of the Portugal Trial

The sample sizes for the following tables are:

- 57 for the General Deaf, Text Telephone, General Videophone and Signing Videophone;
- 37 for the Amplified Telephone, Inductive Coupling and the Electrical Coupling.

The smaller sample size excludes subjects who are deaf, as the symbols in this group have no relevance for people who are deaf.

Table E.1: Selection Matrix Family 1: Target symbol present in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	11	3	0	0	0	0	0
Amplified Telephone	4	70	0	0	5	4	2
Text Telephone	0	0	79	8	8	4	4
Inductive Coupling	2	0	0	24	11	0	2
Electrical Coupling	0	0	0	0	14	0	0
General Videophone	9	5	4	5	8	32	0
Signing Videophone	37	16	16	16	0	46	84
Symbol not on page	39	5	2	46	54	16	9

Table E.2: Selection Matrix Family 2: Target symbol present in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	7	3	0	8	0	2	0
Amplified Telephone	12	51	3	8	11	5	4
Text Telephone	16	0	64	5	0	0	5
Inductive Coupling	2	0	0	24	6	0	0
Electrical Coupling	9	0	0	35	78	0	0
General Videophone	2	0	8	3	0	26	12
Signing Videophone	38	8	12	0	0	39	61
Symbol not on page	16	38	12	16	6	28	18

Table E.3: Selection Matrix Family 3: Target symbol present in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	21	3	7	11	0	2	0
Amplified Telephone	2	51	2	5	3	0	2
Text Telephone	11	8	67	8	11	4	0
Inductive Coupling	0	0	0	5	5	2	0
Electrical Coupling	2	0	0	3	13	0	0
General Videophone	7	11	2	0	3	19	18
Signing Videophone	34	0	16	22	18	65	77
Symbol not on page	23	27	7	46	47	9	4

Table E.4: Selection Matrix Family 4: Target symbol present in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	24	0	9	0	0	5	4
Amplified Telephone	2	46	0	3	0	2	0
Text Telephone	7	8	74	3	0	9	5
Inductive Coupling	0	3	0	16	11	0	0
Electrical Coupling	0	3	0	16	43	0	0
General Videophone	5	0	9	0	0	30	12
Signing Videophone	40	11	3	22	19	39	74
Symbol not on page	22	30	5	41	27	16	5

Table E.5: Selection Matrix Family 5: Target symbol present in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	11	0	0	3	0	0	2
Amplified Telephone	4	43	2	0	0	2	0
Text Telephone	19	3	58	0	8	0	0
Inductive Coupling	5	5	0	16	11	2	0
Electrical Coupling	4	5	0	11	36	0	0
General Videophone	5	3	0	3	0	21	2
Signing Videophone	0	16	26	24	14	58	91
Symbol not on page	53	24	14	43	31	18	5

Table E.6: Selection Matrix Family 6: Target symbol present in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	3	2	0	16	5	0	2
Amplified Telephone	14	38	0	0	0	2	0
Text Telephone	21	0	73	5	3	11	7
Inductive Coupling	0	2	0	11	0	0	0
Electrical Coupling	2	2	3	38	54	0	0
General Videophone	0	5	0	3	3	51	11
Signing Videophone	45	21	16	11	11	0	53
Symbol not on page	16	30	8	16	24	37	28

Table E.7: Selection Matrix Family 1: Target symbol absent in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	-	-	2	0	-	0	-
Amplified Telephone	-	-	4	8	-	0	-
Text Telephone	-	-	0	5	-	22	-
Inductive Coupling	-	-	5	0	-	0	-
Electrical Coupling	-	-	0	32	-	0	-
General Videophone	-	-	9	0	-	0	-
Signing Videophone	-	-	39	11	-	56	-
Symbol not on page	-	-	42	43	-	22	-

Table E.8: Selection Matrix Family 2: Target symbol absent in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	-	16	-	-	-	0	-
Amplified Telephone	-	0	-	-	-	5	-
Text Telephone	-	0	-	-	-	14	-
Inductive Coupling	-	11	-	-	-	0	-
Electrical Coupling	-	0	-	-	-	0	-
General Videophone	-	3	-	-	-	0	-
Signing Videophone	-	14	-	-	-	44	-
Symbol not on page	-	57	-	-	-	37	-

Table E.9: Selection Matrix Family 3: Target symbol absent in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	-	-	-	-	3	0	-
Amplified Telephone	-	-	-	-	5	0	-
Text Telephone	-	-	-	-	5	9	-
Inductive Coupling	-	-	-	-	5	4	-
Electrical Coupling	-	-	-	-	0	0	-
General Videophone	-	-	-	-	3	0	-
Signing Videophone	-	-	-	-	16	67	-
Symbol not on page	-	-	-	-	62	21	-

Table E.10: Selection Matrix Family 4: Target symbol absent in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	-	-	-	21	-	-	12
Amplified Telephone	-	-	-	5	-	-	0
Text Telephone	-	-	-	0	-	-	3
Inductive Coupling	-	-	-	0	-	-	0
Electrical Coupling	-	-	-	21	-	-	3
General Videophone	-	-	-	5	-	-	52
Signing Videophone	-	-	-	23	-	-	0
Symbol not on page	-	-	-	26	-	-	29

Table E.11: Selection Matrix Family 5: Target symbol absent in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	-	-	0	-	-	-	2
Amplified Telephone	-	-	2	-	-	-	0
Text Telephone	-	-	0	-	-	-	19
Inductive Coupling	-	-	0	-	-	-	0
Electrical Coupling	-	-	0	-	-	-	0
General Videophone	-	-	7	-	-	-	32
Signing Videophone	-	-	39	-	-	-	0
Symbol not on page	-	-	53	-	-	-	47

Table E.12: Selection Matrix Family 6: Target symbol absent in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	-	10	-	-	14	-	-
Amplified Telephone	-	0	-	-	0	-	-
Text Telephone	-	10	-	-	11	-	-
Inductive Coupling	-	5	-	-	16	-	-
Electrical Coupling	-	8	-	-	0	-	-
General Videophone	-	5	-	-	5	-	-
Signing Videophone	-	15	-	-	11	-	-
Symbol not on page	-	46	-	-	43	-	-

Table E.13: Test of Symbol preference (all subjects) in %

Pictogram selected	Function							
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone	mean
Family 1	8	65	20	23	29	25	9	24
Family 2	12	21	30	31	26	23	14	22
Family 3	25	9	24	9	3	27	11	17
Family 4	25	0	17	20	20	2	9	14
Family 5	16	3	0	9	9	8	50	14
Family 6	14	3	9	9	14	15	7	10

Table E.14: Test of Symbol preference (without normal hearers) in %

Pictogram selected	Function							
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone	mean
Family 1	9	47	19	22	42	31	10	23
Family 2	6	29	35	28	11	25	13	21
Family 3	35	12	19	11	0	25	13	19
Family 4	32	0	19	28	26	0	6	16
Family 5	6	6	0	6	5	0	52	11
Family 6	12	6	8	6	16	19	6	11

Table E.15: Overall Family preference

Family	Frequency	%	Valid %
Family 1	4	7.	7
Family 2	7	12	13
Family 3	20	35	37
Family 4	13	23	24
Family 5	5	9	9
Family 6	5	9	9
Missing	3	5	Missing

Table E.16: Overall Family preference (without normal hearers)

Family	Frequency	%	Valid %
Family 1	0	0	0
Family 2	2	5	6
Family 3	17	44	47
Family 4	9	23	25
Family 5	3	8	8
Family 6	5	13	14
Missing	3	8	Missing

Annex F (informative): Tables with the results of the Netherlands Trial

The sample sizes for the following tables are:

- 67 for the General Deaf, Text Telephone, General Videophone and Signing Videophone;
- 45 for the Amplified Telephone, Inductive Coupling and the Electrical Coupling.

The smaller sample size excludes subjects who are deaf, as the symbols in this group have no relevance for people who are deaf.

Table F.1: Selection Matrix Family 1: Target symbol present in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	21	2	0	0	2	0	0
Amplified Telephone	31	86	0	7	9	0	0
Text Telephone	0	2	84	0	0	15	1
Inductive Coupling	14	0	1	64	33	4	3
Electrical Coupling	1	0	0	0	22	0	0
General Videophone	4	2	6	0	2	54	0
Signing Videophone	18	2	6	5	2	19	82
Symbol not on page	10	5	3	25	30	7	13

Table F.2: Selection Matrix Family 2: Target symbol present in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	26	11	0	2	2	9	0
Amplified Telephone	0	73	0	2	4	2	1
Text Telephone	9	0	76	0	0	0	18
Inductive Coupling	12	0	0	33	2	2	0
Electrical Coupling	25	0	4	51	82	8	9
General Videophone	3	11	9	4	0	31	1
Signing Videophone	11	0	7	0	4	26	50
Symbol not on page	14	4	3	7	4	23	21

Table F.3: Selection Matrix Family 3: Target symbol present in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	42	4	2	2	0	4	0
Amplified Telephone	5	84	0	4	4	0	1
Text Telephone	8	0	70	0	0	6	0
Inductive Coupling	0	7	6	56	18	6	3
Electrical Coupling	15	0	0	13	56	0	0
General Videophone	9	0	8	0	4	45	13
Signing Videophone	14	0	14	2	4	30	76
Symbol not on page	8	4	2	22	13	9	6

Table F.4: Selection Matrix Family 4: Target symbol present in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	38	4	2	0	7	3	0
Amplified Telephone	2	84	2	4	0	5	0
Text Telephone	6	0	85	0	0	11	5
Inductive Coupling	25	4	2	51	31	0	0
Electrical Coupling	0	2	2	33	49	5	2
General Videophone	9	0	8	0	2	41	17
Signing Videophone	11	0	0	0	0	27	75
Symbol not on page	9	4	2	11	11	9	2

Table F.5: Selection Matrix Family 5: Target symbol present in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	24	0	2	2	0	4	0
Amplified Telephone	18	55	0	12	0	6	1
Text Telephone	10	0	80	0	0	6	1
Inductive Coupling	19	39	3	17	13	1	0
Electrical Coupling	1	2	0	29	60	0	0
General Videophone	6	2	0	0	0	37	4
Signing Videophone	10	0	9	5	4	37	88
Symbol not on page	12	2	6	36	22	9	4

Table F.6: Selection Matrix Family 7: Target symbol present in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	16	22	0	2	0	2	0
Amplified Telephone	0	38	0	0	0	0	1
Text Telephone	3	0	58	0	0	16	3
Inductive Coupling	21	18	0	33	0	6	0
Electrical Coupling	30	13	1	51	96	3	0
General Videophone	0	0	18	4	2	65	27
Signing Videophone	18	0	15	0	0	0	54
Symbol not on page	12	9	7	9	2	8	15

Table F.7: Selection Matrix Family 1: Target symbol absent in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	-	-	18	2	-	-	-
Amplified Telephone	-	-	5	22	-	-	-
Text Telephone	-	-	0	0	-	-	-
Inductive Coupling	-	-	14	0	-	-	-
Electrical Coupling	-	-	0	47	-	-	-
General Videophone	-	-	18	2	-	-	-
Signing Videophone	-	-	23	2	-	-	-
Symbol not on page	-	-	23	24	-	-	-

Table F.8: Selection Matrix Family 2: Target symbol absent in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	-	26	5	-	-	2	-
Amplified Telephone	-	0	5	-	-	5	-
Text Telephone	-	2	0	-	-	28	-
Inductive Coupling	-	2	23	-	-	0	-
Electrical Coupling	-	21	2	-	-	5	-
General Videophone	-	21	18	-	-	0	-
Signing Videophone	-	0	23	-	-	37	-
Symbol not on page	-	28	25	-	-	23	-

Table F.9: Selection Matrix Family 3: Target symbol absent in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	-	-	-	-	7	3	-
Amplified Telephone	-	-	-	-	11	1	-
Text Telephone	-	-	-	-	0	12	-
Inductive Coupling	-	-	-	-	41	3	-
Electrical Coupling	-	-	-	-	0	3	-
General Videophone	-	-	-	-	2	0	-
Signing Videophone	-	-	-	-	0	57	-
Symbol not on page	-	-	-	-	39	21	-

Table F.10: Selection Matrix Family 4: Target symbol absent in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	-	-	-	9	-	-	2
Amplified Telephone	-	-	-	2	-	-	2
Text Telephone	-	-	-	0	-	-	6
Inductive Coupling	-	-	-	0	-	-	5
Electrical Coupling	-	-	-	64	-	-	3
General Videophone	-	-	-	5	-	-	65
Signing Videophone	-	-	-	7	-	-	0
Symbol not on page	-	-	-	14	-	-	18

Table F.11: Selection Matrix Family 5: Target symbol absent in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	-	-	2	-	-	-	0
Amplified Telephone	-	-	2	-	-	-	2
Text Telephone	-	-	0	-	-	-	7
Inductive Coupling	-	-	6	-	-	-	7
Electrical Coupling	-	-	2	-	-	-	0
General Videophone	-	-	31	-	-	-	57
Signing Videophone	-	-	23	-	-	-	0
Symbol not on page	-	-	35	-	-	-	27

Table F.12: Selection Matrix Family 7: Target symbol absent in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	-	64	-	-	15	-	0
Amplified Telephone	-	0	-	-	7	-	5
Text Telephone	-	0	-	-	0	-	33
Inductive Coupling	-	13	-	-	63	-	5
Electrical Coupling	-	9	-	-	0	-	5
General Videophone	-	2	-	-	2	-	29
Signing Videophone	-	2	-	-	2	-	0
Symbol not on page	-	9	-	-	11	-	24

Table F.13: Test of Symbol preference (all subjects)

Pictogram selected	Function							
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone	mean
Family 1	15	64	34	20	2	8	27	24
Family 2	23	4	27	23	16	11	6	16
Family 3	16	9	22	16	13	44	26	22
Family 4	29	11	5	20	9	13	12	14
Family 5	5	7	6	2	4	7	27	9
Family 7	13	4	6	18	56	16	2	15

Table F.14: Test of Symbol preference (without normal hearers)

Pictogram selected	Function							
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone	mean
Family 1	12	59	39	23	0	13	21	23
Family 2	17	9	20	18	9	18	9	15
Family 3	20	14	22	23	9	38	30	24
Family 4	37	0	5	18	9	15	12	15
Family 5	5	14	7	5	0	3	26	9
Family 7	10	5	7	14	73	13	2	14

Table F.15: Overall Family preference

Family	Frequency	%	Valid %
Family 1	14	21	22
Family 2	6	9	9
Family 3	12	18	18
Family 4	21	31	32
Family 5	5	7	8
Family 7	7	10	11
Missing	2	3	Missing

Table F.16: Overall Family preference (without normal hearers)

Family	Frequency	%	Valid %
Family 1	7	16	16
Family 2	2	5	5
Family 3	10	23	23
Family 4	16	36	37
Family 5	3	7	7
Family 6	5	11	12
Missing	1	2	Missing

Annex G (informative): Tables with the results of the Belgium Trial

The sample sizes for the following tables are:

- 34 for the General Deaf, Text Telephone, General Videophone and Signing Videophone;
- 16 for the Amplified Telephone, Inductive Coupling and the Electrical Coupling.

The smaller sample size excludes subjects who are deaf, as the symbols in this group have no relevance for people who are deaf.

Table G.1: Selection Matrix Family 1: Target symbol present in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	12	7	0	0	0	0	0
Amplified Telephone	6	93	0	13	0	0	0
Text Telephone	0	0	97	0	0	0	0
Inductive Coupling	0	0	0	50	25	0	0
Electrical Coupling	0	0	0	0	6	0	0
General Videophone	3	0	0	0	0	41	0
Signing Videophone	15	0	0	0	0	21	65
Symbol not on page	64	0	3	38	69	38	35

Table G.2: Selection Matrix Family 2: Target symbol present in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	41	0	0	0	0	0	0
Amplified Telephone	0	25	0	6	6	0	0
Text Telephone	6	0	29	0	0	0	0
Inductive Coupling	0	0	0	13	13	0	0
Electrical Coupling	3	0	0	25	63	0	0
General Videophone	0	0	3	0	0	9	9
Signing Videophone	3	0	3	0	0	9	9
Symbol not on page	47	75	65	56	19	82	82

Table G.3: Selection Matrix Family 3: Target symbol present in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	65	0	0	0	0	3	0
Amplified Telephone	3	44	0	0	0	0	0
Text Telephone	3	0	94	0	0	3	0
Inductive Coupling	0	6	0	13	0	3	0
Electrical Coupling	3	0	0	13	13	0	0
General Videophone	3	0	3	0	0	24	15
Signing Videophone	15	0	0	0	0	53	47
Symbol not on page	9	50	3	75	88	15	38

Table G.4: Selection Matrix Family 4: Target symbol present in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	56	0	0	0	0	0	0
Amplified Telephone	0	69	0	0	0	0	0
Text Telephone	0	0	100	0	0	9	3
Inductive Coupling	12	0	0	13	19	0	0
Electrical Coupling	0	0	0	19	19	0	0
General Videophone	3	0	0	0	0	41	32
Signing Videophone	9	0	0	0	0	12	44
Symbol not on page	21	31	0	69	63	38	21

Table G.5: Selection Matrix Family 5: Target symbol present in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	9	0	3	0	0	0	0
Amplified Telephone	12	6	0	6	0	0	0
Text Telephone	6	0	50	0	0	0	0
Inductive Coupling	0	13	0	6	0	0	0
Electrical Coupling	0	0	0	13	25	0	0
General Videophone	6	0	0	0	0	14	12
Signing Videophone	0	0	0	0	0	43	73
Symbol not on page	68	81	47	75	75	43	15

Table G.6: Selection Matrix Family 7: Target symbol present in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	15	13	0	6	6	0	0
Amplified Telephone	0	25	0	0	0	0	0
Text Telephone	3	0	15	0	0	3	3
Inductive Coupling	3	0	0	6	0	0	0
Electrical Coupling	3	6	0	13	50	0	0
General Videophone	0	0	12	0	0	9	6
Signing Videophone	0	0	0	0	0	0	0
Symbol not on page	76	56	73	75	44	88	91

Table G.7: Selection Matrix Family 1: Target symbol absent in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	-	-	3	0	-	-	-
Amplified Telephone	-	-	0	19	-	-	-
Text Telephone	-	-	0	0	-	-	-
Inductive Coupling	-	-	6	0	-	-	-
Electrical Coupling	-	-	0	37	-	-	-
General Videophone	-	-	3	0	-	-	-
Signing Videophone	-	-	3	0	-	-	-
Symbol not on page	-	-	85	44	-	-	-

Table G.8: Selection Matrix Family 2: Target symbol absent in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	-	0	-	-	-	0	-
Amplified Telephone	-	0	-	-	-	0	-
Text Telephone	-	0	-	-	-	0	-
Inductive Coupling	-	6	-	-	-	0	-
Electrical Coupling	-	0	-	-	-	0	-
General Videophone	-	0	-	-	-	0	-
Signing Videophone	-	0	-	-	-	0	-
Symbol not on page	-	94	-	-	-	100	-

Table G.9: Selection Matrix Family 3: Target symbol absent in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	-	-	-	-	0	0	-
Amplified Telephone	-	-	-	-	0	0	-
Text Telephone	-	-	-	-	0	0	-
Inductive Coupling	-	-	-	-	12	3	-
Electrical Coupling	-	-	-	-	0	0	-
General Videophone	-	-	-	-	0	0	-
Signing Videophone	-	-	-	-	0	56	-
Symbol not on page	-	-	-	-	87	41	-

Table G.10: Selection Matrix Family 4: Target symbol absent in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	-	-	-	19	-	-	6
Amplified Telephone	-	-	-	12	-	-	0
Text Telephone	-	-	-	0	-	-	0
Inductive Coupling	-	-	-	0	-	-	0
Electrical Coupling	-	-	-	19	-	-	0
General Videophone	-	-	-	0	-	-	39
Signing Videophone	-	-	-	6	-	-	0
Symbol not on page	-	-	-	44	-	-	55

Table G.11: Selection Matrix Family 5: Target symbol absent in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	-	-	0	-	-	-	0
Amplified Telephone	-	-	0	-	-	-	0
Text Telephone	-	-	0	-	-	-	0
Inductive Coupling	-	-	0	-	-	-	0
Electrical Coupling	-	-	0	-	-	-	0
General Videophone	-	-	9	-	-	-	6
Signing Videophone	-	-	3	-	-	-	0
Symbol not on page	-	-	88	-	-	-	94

Table G.12: Selection Matrix Family 7: Target symbol absent in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	-	22	-	-	6	-	0
Amplified Telephone	-	0	-	-	0	-	0
Text Telephone	-	0	-	-	0	-	0
Inductive Coupling	-	0	-	-	25	-	0
Electrical Coupling	-	0	-	-	0	-	0
General Videophone	-	0	-	-	0	-	11
Signing Videophone	-	0	-	-	0	-	0
Symbol not on page	-	78	-	-	69	-	89

Table G.13: Test of Symbol preference (all subjects)

Pictogram selected	Function							
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone	mean
Family 1	6	81	29	38	13	24	24	25
Family 2	6	0	6	25	25	6	0	8
Family 3	24	13	50	13	19	48	21	28
Family 4	59	0	15	19	13	6	0	18
Family 5	0	6	0	6	0	6	56	14
Family 7	6	0	0	0	31	9	0	8

Table G.14: Test of Symbol preference (without normal hearers)

Pictogram selected	Function							
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone	mean
Family 1	4	100	24	43	29	20	16	23
Family 2	8	0	8	29	29	4	0	7
Family 3	20	0	56	0	14	60	28	35
Family 4	60	0	12	29	0	4	0	17
Family 5	0	0	0	0	0	0	56	12
Family 7	8	0	0	0	29	12	0	6

Table G.15: Overall Family preference

Family	Frequency	%	Valid %
Family 1	4	12	12
Family 2	0	0	0
Family 3	17	50	50
Family 4	12	35	35
Family 5	1	3	3
Family 7	0	0	0
Missing	0	0	Missing

Table G.16: Overall Family preference (without normal hearers)

Family	Frequency	%	Valid %
Family 1	2	8	8
Family 2	0	0	0
Family 3	15	60	60
Family 4	8	32	32
Family 5	0	0	0
Family 6	0	0	0
Missing	0	0	Missing

Annex H (informative): Tables with the results of the Finland Trial

The sample sizes for the following tables are:

- 58 for the General Deaf, Text Telephone, General Videophone and Signing Videophone;
- 38 for the Amplified Telephone, Inductive Coupling and the Electrical Coupling.

The smaller sample size excludes subjects who are deaf, as the symbols in this group have no relevance for people who are deaf.

Table H.1: Selection Matrix Family 1: Target symbol present in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	38	0	0	0	0	0	0
Amplified Telephone	1	95	0	5	3	0	0
Text Telephone	0	0	90	0	17	2	2
Inductive Coupling	9	0	0	76	36	2	2
Electrical Coupling	1	3	0	0	11	0	0
General Videophone	3	0	3	0	0	59	0
Signing Videophone	16	0	5	0	0	19	57
Symbol not on page	32	3	2	18	33	19	40

Table H.2: Selection Matrix Family 2: Target symbol present in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	11	0	0	8	5	0	0
Amplified Telephone	0	27	0	6	0	2	0
Text Telephone	9	11	50	0	3	0	5
Inductive Coupling	0	0	0	6	3	0	0
Electrical Coupling	9	0	0	31	32	2	0
General Videophone	2	0	6	0	0	23	8
Signing Videophone	16	0	5	0	0	16	40
Symbol not on page	54	62	39	50	57	58	47

Table H.3: Selection Matrix Family 3: Target symbol present in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	34	0	0	3	0	0	0
Amplified Telephone	2	42	0	0	0	2	0
Text Telephone	9	0	90	0	0	3	0
Inductive Coupling	0	8	2	76	21	0	2
Electrical Coupling	0	0	0	3	50	0	0
General Videophone	7	0	3	0	3	50	27
Signing Videophone	16	0	3	0	0	21	46
Symbol not on page	33	50	2	18	26	24	25

Table H.4: Selection Matrix Family 4: Target symbol present in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	30	0	2	0	10	0	0
Amplified Telephone	0	47	2	3	2	0	0
Text Telephone	7	0	91	0	0	2	3
Inductive Coupling	0	3	0	11	17	0	0
Electrical Coupling	0	0	0	19	40	0	0
General Videophone	9	0	0	11	0	60	31
Signing Videophone	23	0	0	0	7	18	55
Symbol not on page	32	50	5	57	24	21	10

Table H.5: Selection Matrix Family 1: Target symbol absent in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	0	0	0	0	0	2	0
Amplified Telephone	2	0	0	8	8	2	0
Text Telephone	2	0	0	0	22	2	2
Inductive Coupling	14	11	4	0	31	3	2
Electrical Coupling	4	0	0	26	0	0	0
General Videophone	5	0	2	3	0	0	46
Signing Videophone	32	0	12	0	0	41	0
Symbol not on page	42	89	82	63	39	50	51

Table H.6: Selection Matrix Family 2: Target symbol absent in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	0	5	0	3	5	2	0
Amplified Telephone	4	0	2	0	0	0	0
Text Telephone	12	5	0	0	5	0	2
Inductive Coupling	0	3	0	0	8	0	0
Electrical Coupling	11	0	0	47	0	0	0
General Videophone	0	0	4	0	5	0	19
Signing Videophone	9	0	5	3	0	25	0
Symbol not on page	65	86	89	47	76	74	79

Table H.7: Selection Matrix Family 3: Target symbol absent in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	0	0	0	22	5	0	0
Amplified Telephone	3	0	0	6	5	0	0
Text Telephone	5	0	0	0	0	3	2
Inductive Coupling	21	0	7	0	37	2	2
Electrical Coupling	0	0	0	11	0	0	0
General Videophone	5	3	4	3	0	0	55
Signing Videophone	12	3	4	0	0	33	0
Symbol not on page	53	95	86	58	54	62	42

Table H.8: Selection Matrix Family 4: Target symbol absent in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	0	3	2	8	0	2	0
Amplified Telephone	0	0	0	3	3	0	0
Text Telephone	7	0	0	0	0	4	4
Inductive Coupling	5	0	0	0	27	0	2
Electrical Coupling	9	3	0	24	0	0	0
General Videophone	11	0	4	5	0	0	68
Signing Videophone	19	0	4	0	3	35	0
Symbol not on page	49	95	91	61	67	60	26

Table H.9: Test of Symbol preference (all subjects)

Pictogram selected	Function							
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone	mean
Family 1	25	95	32	46	11	19	35	35
Family 2	27	3	5	3	28	21	18	15
Family 3	31	3	50	49	50	42	18	35
Family 4	17	0	13	3	11	19	29	15

Table H.10: Test of Symbol preference (without normal hearers)

Pictogram selected	Function							
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone	mean
Family 1	27	89	30	44	18	26	33	35
Family 2	21	6	5	6	35	24	28	18
Family 3	24	6	51	50	35	32	17	31
Family 4	27	0	14	0	12	18	22	16

Table H.11: Overall Family preference

Family	Frequency	%	Valid %
Family 1	21	36	40
Family 2	0	0	0
Family 3	20	34	38
Family 4	11	19	21
Missing	6	10	Missing

Table H.12: Overall Family preference (without normal hearers)

Family	Frequency	%	Valid %
Family 1	12	31	35
Family 2	0	0	0
Family 3	14	36	41
Family 4	8	21	24
Missing	5	13	Missing

Annex I (informative): Tables with the cumulative results of all the Trials

The sample sizes for the following tables are:

- 216 for the General Deaf, Text Telephone, General Videophone and Signing Videophone;
- 136 for the Amplified Telephone, Inductive Coupling and the Electrical Coupling.

The smaller sample size excludes subjects who are deaf, as the symbols in this group have no relevance for people who are deaf.

Table I.1: Selection Matrix Family 1: Target symbol present in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	23	2	0	0	1	0	0
Amplified Telephone	11	85	0	5	5	1	0
Text Telephone	0	1	86	2	7	6	2
Inductive Coupling	8	0	0	55	27	2	2
Electrical Coupling	1	1	0	0	15	0	0
General Videophone	5	2	4	1	3	47	0
Signing Videophone	22	5	7	6	1	26	73
Symbol not on page	31	4	2	30	42	18	23

Table I.2: Selection Matrix Family 1: Target symbol absent in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	0	0	4	1	0	1	0
Amplified Telephone	2	0	2	14	8	1	0
Text Telephone	2	0	0	1	22	7	2
Inductive Coupling	14	11	6	0	31	3	2
Electrical Coupling	4	0	0	36	0	0	0
General Videophone	5	0	7	1	0	0	46
Signing Videophone	32	0	21	4	0	45	0
Symbol not on page	42	89	62	43	39	43	51

Table I.3: Selection Matrix Family 2: Target symbol present in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	19	4	0	5	2	3	0
Amplified Telephone	3	49	1	5	5	2	1
Text Telephone	10	3	59	1	1	0	8
Inductive Coupling	4	0	0	21	4	0	0
Electrical Coupling	13	0	1	38	65	3	3
General Videophone	2	4	7	2	0	24	7
Signing Videophone	18	2	7	0	1	24	44
Symbol not on page	30	38	25	27	21	43	37

Table I.4: Selection Matrix Family 2: Target symbol absent in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	0	14	2	3	5	1	0
Amplified Telephone	4	0	3	0	0	3	0
Text Telephone	12	2	0	0	5	10	2
Inductive Coupling	0	5	10	0	8	0	0
Electrical Coupling	11	7	1	47	0	1	0
General Videophone	0	8	10	0	5	0	19
Signing Videophone	9	4	13	3	0	29	0
Symbol not on page	65	60	61	47	76	56	79

Table I.5: Selection Matrix Family 3: Target symbol present in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	38	2	2	4	0	2	0
Amplified Telephone	3	59	0	3	2	0	1
Text Telephone	8	2	78	2	3	4	0
Inductive Coupling	0	5	2	43	13	3	1
Electrical Coupling	6	0	0	7	37	0	0
General Videophone	7	3	4	0	3	36	18
Signing Videophone	20	0	9	7	7	40	64
Symbol not on page	19	29	3	34	35	14	15

Table I.6: Selection Matrix Family 3: Target symbol absent in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	0	0	0	22	4	1	0
Amplified Telephone	3	0	0	6	7	0	0
Text Telephone	5	0	0	0	1	7	2
Inductive Coupling	21	0	7	0	27	3	2
Electrical Coupling	0	0	0	11	0	1	0
General Videophone	5	3	4	3	1	0	55
Signing Videophone	12	3	4	0	4	53	0
Symbol not on page	53	95	86	58	55	35	42

Table I.7: Selection Matrix Family 4: Target symbol present in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	35	1	3	0	5	2	1
Amplified Telephone	1	62	1	3	1	2	0
Text Telephone	6	2	86	1	0	7	4
Inductive Coupling	9	3	0	26	20	0	0
Electrical Coupling	0	1	0	23	41	1	0
General Videophone	7	0	5	3	1	43	22
Signing Videophone	22	3	1	6	7	25	64
Symbol not on page	21	27	3	39	25	19	8

Table I.8: Selection Matrix Family 4: Target symbol absent in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	0	3	2	13	0	2	5
Amplified Telephone	0	0	0	4	3	0	0
Text Telephone	7	0	0	0	0	4	4
Inductive Coupling	5	0	0	0	27	0	2
Electrical Coupling	9	3	0	35	0	0	2
General Videophone	11	0	4	4	0	0	58
Signing Videophone	19	0	4	9	3	35	0
Symbol not on page	49	95	91	34	67	60	29

The sample sizes for the following tables are:

- 158 for the General Deaf, Text Telephone, General Videophone and Signing Videophone;
- 98 for the Amplified Telephone, Inductive Coupling and the Electrical Coupling;

representing subjects from all countries except Finland.

The smaller sample size excludes subjects who are deaf, as the symbols in this group have no relevance for people who are deaf.

Table I.9: Selection Matrix Family 5: Target symbol present in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	16	0	1	2	0	2	1
Amplified Telephone	11	42	1	6	0	3	1
Text Telephone	13	1	66	0	3	3	1
Inductive Coupling	10	22	1	15	10	1	0
Electrical Coupling	2	3	0	19	45	0	0
General Videophone	6	2	0	1	0	26	5
Signing Videophone	4	6	13	12	7	46	86
Symbol not on page	38	24	18	45	34	19	7

Table I.10: Selection Matrix Family 5: Target symbol absent in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	-	-	1	-	-	-	1
Amplified Telephone	-	-	1	-	-	-	1
Text Telephone	-	-	0	-	-	-	12
Inductive Coupling	-	-	3	-	-	-	3
Electrical Coupling	-	-	1	-	-	-	0
General Videophone	-	-	17	-	-	-	38
Signing Videophone	-	-	24	-	-	-	0
Symbol not on page	-	-	53	-	-	-	46

The sample sizes for the following tables are:

- 57 for the General Deaf, Text Telephone, General Videophone and Signing Videophone;
- 37 for the Amplified Telephone, Inductive Coupling and the Electrical Coupling;

representing subjects from Portugal only.

The smaller sample size excludes subjects who are deaf, as the symbols in this group have no relevance for people who are deaf.

Table I.11: Selection Matrix Family 6: Target symbol present in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	3	2	0	16	5	0	2
Amplified Telephone	14	38	0	0	0	2	0
Text Telephone	21	0	73	5	3	11	7
Inductive Coupling	0	2	0	11	0	0	0
Electrical Coupling	2	2	3	38	54	0	0
General Videophone	0	5	0	3	3	51	11
Signing Videophone	45	21	16	11	11	0	53
Symbol not on page	16	30	8	16	24	37	28

Table I.12: Selection Matrix Family 6: Target symbol absent in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	0	10	0	0	14	0	0
Amplified Telephone	0	0	0	0	0	0	0
Text Telephone	0	10	0	0	11	0	0
Inductive Coupling	0	5	0	0	16	0	0
Electrical Coupling	0	8	0	0	0	0	0
General Videophone	0	5	0	0	5	0	0
Signing Videophone	0	15	0	0	11	0	0
Symbol not on page	0	46	0	0	43	0	0

The sample sizes for the following tables are:

- 101 for the General Deaf, Text Telephone, General Videophone and Signing Videophone;
- 61 for the Amplified Telephone, Inductive Coupling and the Electrical Coupling;

representing subjects from Belgium and the Netherlands.

The smaller sample size excludes subjects who are deaf, as the symbols in this group have no relevance for people who are deaf.

Table I.13: Selection Matrix Family 7: Target symbol present in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	16	20	0	3	2	1	0
Amplified Telephone	0	34	0	0	0	0	1
Text Telephone	3	0	44	0	0	11	3
Inductive Coupling	15	13	0	26	0	4	0
Electrical Coupling	21	11	1	41	84	2	0
General Videophone	0	0	16	3	2	45	20
Signing Videophone	12	0	10	0	0	0	36
Symbol not on page	34	21	29	26	13	36	41

Table I.14: Selection Matrix Family 7: Target symbol absent in %

Symbol selected	Function						
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone
General Deaf	0	57	0	0	13	0	0
Amplified Telephone	0	0	0	0	5	0	3
Text Telephone	0	0	0	0	0	0	18
Inductive Coupling	0	11	0	0	53	0	3
Electrical Coupling	0	7	0	0	0	0	3
General Videophone	0	2	0	0	2	0	21
Signing Videophone	0	2	0	0	2	0	0
Symbol not on page	0	20	0	0	26	0	54

Table I.15: Test of Symbol preference (Portugal all subjects) in %

Pictogram selected	Function							
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone	mean
Family 1	8	65	20	23	29	25	9	24
Family 2	12	21	30	31	26	23	14	22
Family 3	25	9	24	9	3	27	11	17
Family 4	25	0	17	20	20	2	9	14
Family 5	16	3	0	9	9	8	50	14
Family 6	14	3	9	9	14	15	7	10
Best Family	**3,4**	**1**	**2**	**2**	**1**	**3**	**5**	**1**

Table I.16: Test of Symbol preference (Portugal without normal hearers) in %

	Function							
Pictogram selected	**General Deaf**	**Amplified Telephone**	**Text Telephone**	**Inductive Coupling**	**Electrical Coupling**	**General Videophone**	**Signing Videophone**	**mean**
Family 1	9	47	19	22	42	31	10	23
Family 2	6	29	35	28	11	25	13	21
Family 3	35	12	19	11	0	25	13	19
Family 4	32	0	19	28	26	0	6	16
Family 5	6	6	0	6	5	0	52	11
Family 6	12	6	8	6	16	19	6	11
Best Family	**3**	**1**	**2**	**2,4**	**1**	**1**	**5**	**1**

Table I.17: Test of Symbol preference (Netherlands and Belgium all subjects) in %

	Function							
Pictogram selected	**General Deaf**	**Amplified Telephone**	**Text Telephone**	**Inductive Coupling**	**Electrical Coupling**	**General Videophone**	**Signing Videophone**	**mean**
Family 1	11	69	33	25	5	14	26	24
Family 2	17	3	19	23	18	10	4	13
Family 3	19	10	32	15	15	46	24	24
Family 4	40	8	8	20	10	11	8	15
Family 5	3	7	4	3	3	6	37	11
Family 7	10	3	4	13	49	14	1	13
Best Family	**4**	**1**	**1**	**1**	**7**	**3**	**5**	**1,3**

Table I.18: Test of Symbol preference (Netherlands and Belgium without normal hearers) in %

	Function							
Pictogram selected	**General Deaf**	**Amplified Telephone**	**Text Telephone**	**Inductive Coupling**	**Electrical Coupling**	**General Videophone**	**Signing Videophone**	**mean**
Family 1	9	69	33	28	7	16	19	23
Family 2	14	7	15	21	14	13	6	12
Family 3	20	10	35	17	10	47	29	28
Family 4	45	0	8	21	7	11	7	16
Family 5	3	10	5	3	0	2	37	10
Family 7	9	3	5	10	62	13	1	11
Best Family	**4**	**1**	**3**	**1**	**7**	**3**	**5**	**3**

Table I.19: Test of Symbol preference (All countries except Finland all subjects) in %

	Function							
Pictogram selected	**General Deaf**	**Amplified Telephone**	**Text Telephone**	**Inductive Coupling**	**Electrical Coupling**	**General Videophone**	**Signing Videophone**	**mean**
Family 1	12	70	30	27	21	20	21	28
Family 2	17	10	24	30	33	16	7	18
Family 3	24	10	31	14	16	46	21	25
Family 4	39	5	12	23	21	9	9	17
Family 5	8	5	3	6	8	8	42	13
Best Family	**4**	**1**	**3**	**2**	**2**	**3**	**5**	**1**

Table I.20: Test of Symbol preference (All countries except Finland without normal hearers) in %

Pictogram selected	Function							mean
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone	
Family 1	10	64	30	28	37	24	17	26
Family 2	12	16	24	26	22	20	8	17
Family 3	28	11	31	16	11	46	25	28
Family 4	46	0	12	26	26	9	7	18
Family 5	4	9	3	5	4	1	43	12
Best Family	**4**	**1**	**3**	**1**	**1**	**3**	**5**	**3**

Table I.21: Test of Symbol preference (all subjects) in %

Pictogram selected	Function							mean
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone	
Family 1	16	80	31	34	18	21	36	33
Family 2	21	8	19	23	33	19	15	19
Family 3	27	8	37	25	30	47	29	30
Family 4	35	4	12	18	18	13	21	18
Best Family	**4**	**1**	**3**	**1**	**2**	**3**	**1**	**1**

Table I.22: Test of Symbol preference (without normal hearers) in %

Pictogram selected	Function							mean
	General Deaf	Amplified Telephone	Text Telephone	Inductive Coupling	Electrical Coupling	General Videophone	Signing Videophone	
Family 1	15	76	31	33	30	25	31	31
Family 2	15	14	19	21	28	21	20	19
Family 3	28	10	37	26	21	43	33	31
Family 4	42	0	13	19	21	11	16	19
Best Family	**4**	**1**	**3**	**1**	**1**	**3**	**3**	**1,3**

Table I.23: Overall Family preference (Portugal)

Family	Frequency	%	Valid %
Family 1	4	7.	7
Family 2	7	12	13
Family 3	20	35	37
Family 4	13	23	24
Family 5	5	9	9
Family 6	5	9	9
Missing	3	5	Missing

Table I.24: Overall Family preference (Portugal without normal hearers)

Family	Frequency	%	Valid %
Family 1	0	0	0
Family 2	2	5	6
Family 3	17	44	47
Family 4	9	23	25
Family 5	3	8	8
Family 6	5	13	14
Missing	3	8	Missing

Table I.25: Overall Family preference (Netherlands and Belgium)

Family	Frequency	%	Valid %
Family 1	18	18	18
Family 2	6	6	6
Family 3	29	29	29
Family 4	33	33	33
Family 5	6	6	6
Family 7	7	7	7
Missing	2	2	Missing

Table I.26: Overall Family preference (Netherlands and Belgium without normal hearers)

Family	Frequency	%	Valid %
Family 1	9	13	13
Family 2	2	3	3
Family 3	25	36	37
Family 4	24	35	35
Family 5	3	4	4
Family 7	5	7	7
Missing	1	1	Missing

Table I.27: Overall Family preference (All except Finland all subjects)

Family	Frequency	%	Valid %
Family 1	22	14	16
Family 2	13	8	9
Family 3	49	31	35
Family 4	46	29	33
Family 5	11	7	8
Missing	17	11	Missing

Table I.28: Overall Family preference (All except Finland without normal hearers)

Family	Frequency	%	Valid %
Family 1	9	8	10
Family 2	4	4	4
Family 3	42	39	45
Family 4	33	31	35
Family 5	6	6	6
Missing	14	13	Missing

Table I.29: Overall Family preference (All countries)

Family	Frequency	%	Valid %
Family 1	43	20	24
Family 2	13	6	7
Family 3	69	32	38
Family 4	57	26	31
Missing	34	16	Missing

Table I.30: Overall Family preference (All countries without normal hearers)

Family	Frequency	%	Valid %
Family 1	21	14	17
Family 2	4	3	3
Family 3	56	38	46
Family 4	41	28	34
Missing	25	17	Missing

Annex J (informative): Videotelephone comprehension test - Detailed results

Table J.1: United Kingdom Results - 1

F	Answer	Sex/age	Category
1	Telephone available in area for common use	M31	5
2	Audio facility	M50	5
3	Video Phone	M31	1
4	Telephone and typing available	M31	5
5	Payphone service available	M31	5
6	Phone available?	M31	5
7	Public telephone	M15	5
8	Phone and visual link	F31	1
9	Private telephone	M15	5
10	Mobile phone point	M15	5
11	Don't Know	F15	6
12	Telephone video link	F50	2
13	Don't Know	M15	6
14	Private telephone	M15	5
15	Private telephone	M15	5
16	Emergency	M50	5
17	Phone for the disabled	F50	5
18	Don't Know	M50	6
19	Computer telephone	M15	5
20	Television telephone	M31	2
21	Public telephone	M31	5
22	Don't Know	M31	6
23	Don't Know	M31	6
24	Do not Know	F50	6
25	Emergency telephone	F50	5
26	Emergency phone (free)	F31	5
27	Shopping by phone	F50	5
28	Person operated telephone	F50	5
29	Mobile phone	M50	5
30	Videophone	F31	1
31	Help/information service here	M31	5
32	Public telephone	M31	5
33	Disabled telephone	M50	5
34	Payphone	M50	5
35	Telephone help box	F15	5
36	Telephone	M31	5
37	Video telephone	F31	1
38	Telephone	F50	5
39	Courtesy phone	M31	5
40	Telephone for deaf	M50	5

Table J.2: United Kingdom Results - 2

M	Answer	Sex/age	Category
1	Manned telephone	M50	5
2	An emergency phone service	M50	5
3	Robotic phone	M50	5
4	Video link	M50	3
5	Telephone for the disabled	F50	5
6	Public telephone (for public use)	F50	5
7	Video phone	?31	1
8	Public telephone	M15	5
9	Video phone	M15	1
10	Video conferencing	M31	2
11	Public telephone	M15	5
12	Information telephone or Public telephone	F15	5
13	Don't Know	M15	6
14	Emergency phone	M15	5
15	Video phone	F31	1
16	Mobile phone	F50	5
17	Telephone conference facility	M50	5
18	Video phone	M50	1
19	Don't Know	F31	6
20	Telephone	F31	5
21	Public telephone	F31	5
22	Visual phone	M50	1
23	Don't Know	M50	6
24	You may telephone from here	M50	5
25	Public call box	F15	5
26	Don't Know	M50	6
27	Videophone	F50	1
28	Don't Know	M31	6
29	Telephone on train	F50	5
30	Public telephone	M50	5
31	Children can use it	F50	5
32	Computer terminal	M50	5
33	Vision phone	M50	1
34	Public telephone in men's toilets	F15	5
35	Telephone for all sexes	F15	5
36	Ordinary use of telephone	F50	5
37	Public telephone	F15	5
38	Telephone	M31	5
39	Telephone/rest rooms	F15	5
40	Public pay telephone	F31	5

Table J.3: United Kingdom Results - 3

S	Answer	Sex/age	Category
1	Videophone service	M50	1
2	Telephone information service	M50	5
3	Video phone	M31	1
4	Video phone	M31	1
5	Video conferencing	F15	2
6	Video conferencing	M31	2
7	Public fax machine	M15	5
8	Touch tone phone	M15	5
9	Video phone	M15	1
10	Don't Know	M15	6
11	Video phone	M15	1
12	Video phone	F15	1
13	Operator	M15	5
14	Don't Know	M15	6
15	Personal phone service	F50	5
16	Phone with video picture (heaven preserve us!)	F50	2
17	Telephone for hard of hearing	M50	5
18	Don't Know	F31	6
19	Don't Know	M31	6
20	TV for the deaf	M50	5
21	Don't Know	F31	6
22	Visual phone	F50	1
23	Visual phone	F50	1
24	Don't Know	M31	6
25	Friendly telephone	F50	5
26	Telephone	M31	5
27	Child's telephone	M31	5
28	Video phone	M15	1
29	Telephone for deaf people	F31	5
30	Public telephone	F50	5
31	Speaking clock	F50	5
32	Video phone	F31	1
33	Don't Know	M31	6
34	Video phone	M50	1
35	Voice telephone	M31	5
36	Video telephone	F15	1
37	Telephone for deaf	F15	5
38	Telephone box	F31	5
39	Telephone for hard of hearing	M50	5
40	Telephone available	M31	5

Table J.4: United Kingdom Results - 4

X	Answer	Sex/age	Category
1	Videophone	M15	1
2	Video telephone	M31	1
3	Videophone service	M50	1
4	Videophone	M50	1
5	Visual telephone	M50	1
6	Public pay phone	M31	5
7	Video phone	M50	1
8	Telephone	M15	5
9	Telephone available	M31	5
10	Telephone	F50	5
11	Video phone	F15	1
12	Video conference via Internet	F15	3
13	Don't Know	M15	6
14	Telephone services	F31	5
15	Don't Know	M15	6
16	View phone	M50	1
17	Video telephone	F31	1
18	Videophone	M31	1
19	Special needs	F31	5
20	Telephone booth	M15	5
21	Video phone	M15	1
22	Teletext telephone	F15	5
23	Telephone	F50	5
24	Videphone/Internet service	F31	2
25	Disabled telephone	F15	5
26	Videophone	M31	1
27	Video-phone	M31	1
28	Videophone	M31	1
29	TV Talk	F31	2
30	Video telephone	M31	1
31	Video-phone	M31	1
32	Public telephone	M50	5
33	Video phone	M50	1
34	Telephone Booth	F31	5
35	Loudpeaking telephone	M50	5
36	Video telephone	F31	1
37	Telephone operator	M50	5
38	Videophone	M31	1
39	Phone card only	F50	5
40	Public Video Phone	M31	1

Table J.5: Norwegian Results - 1

F	Answer	Sex/age	Category
1	Don't know	M15	6
2	Telephone room	M31	5
3	Telephone box	F50	5
4	Telephone with sligenu?/Picture telephone	M31	2
5	Telephone box	F31	5
6	Don't know	F31	6
7	Videotelephone	M31	1
8	Answering service/Directory enquiry	M31	5
9	Telephone kiosk	M31	5
10	Videotelephone	F31	1
11	Telephone kiosk	F31	5

Table J.6: Norwegian Results - 2

M	Answer	Sex/age	Category
1	Don't know	F31	6
2	Telephone kiosk	F31	5
3	Videotelephone	F31	1
4	Telephone kiosk	M31	5
5	Public Phone	M31	5
6	Videotelephone	M31	1
7	Telephone kiosk	M31	5
8	Private telephone	M50	5
9	Videotelephone	M50	1
10	Place where you take a call	M31	5
11	Public telephone	M50	5
12	Videotelephone	M15	1

Table J.7: Norwegian Results - 3

S	Answer	Sex/age	Category
1	Public telephone with picture transfer	M15	3
2	Videotelephone	M15	1
3	Telephone exchange	M15	5
4	Videotelephone	M15	1
5	Videotelephone	F15	1
6	Videotelephone	M31	1
7	Telephone box	M31	5
8	Telephone kiosk	M31	5
9	Videotelephone	F31	1
10	Telephone kiosk	F31	5
11	Don't know	F31	6

Table J.8: Norwegian Results - 4

X	Answer	Sex/age	Category
1	Don't know	F31	6
2	Videotelephone (Public)	M15	1
3	Videotelephone	M31	1
4	Telephone room/bugged	M31	5
5	Telephone with operator	M31	5
6	Videotelephone	F31	1
7	Telephone kiosk	F31	5

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