# Enabling People – Creating Inclusive Human-Computer Interactions

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**Abstract.** Inclusive design has traditionally dealt with physical design and differences in age and ability. However, as information technology becomes more pervasive, the new barriers to inclusivity are increasingly digital. Centring design around people can increase competitiveness and value, especially in fast-moving technology markets, but technology-specific, people-centred strategies need to be developed that build on existing inclusive design processes and go beyond the 'technology-push needs-pull' approach to accommodate the social complexity that surrounds the everyday use of technology. This paper focuses on the challenges of implementing inclusive design in an technology context, illustrating this with examples drawn from the Royal College of Art Helen Hamlyn Centre (HHC). It outlines work done with students within an educational context and projects completed by design graduates working with industry. The case studies aim to demonstrate an approach that brings together the user's voice and the designer's creativity to enable a more inclusive approach.

**Keywords:** Inclusive design, technology, people-centred.

## 1 Introduction

Digital technologies are a growing and increasingly important part of the consumer experience, influencing every area of design from product design to service design. The rapid growth in the number of handheld devices is representative of the significance of this technology and the aspirational value that it can hold for consumers. However, the majority of inclusive design focus has been on the built environment or the design of physical objects and artifacts with an emphasis on accessibility and capability. The Seven Principles of Universal Design from North Carolina State University which have influenced much inclusive design practice are typically aimed at products and environments. Adapting and evolving current inclusive design methods and thinking to create more people-centred, digital technologies that are desirable and fulfill user aspiration becomes a key challenge.

Technology, as used in this paper, refers to information technology (IT), in particular those that provide communications, information and entertainment. These areas of IT are becoming less bespoke, more convergent and more pervasive in both personal and professional lives [1]. They represent the richest area for inclusive design research and the most potential to influence student designers and commercial partners.

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### 1.1 Getting Older and Being Disabled

By 2020, close to half the adult population of Europe will be over 50 [2], and one third of the inhabitants of the United States will be over 55 [3]. Population ageing is a real and demonstrable phenomenon and will result in a body of older consumers who will demand more from technology and be less accepting of its shortcomings. In particular, the baby boomers who are becoming pensioners will want to continue to use IT into later life to maintain their social circle and support their communication needs [4]. They will demand active participation within society, and want to live independent, vibrant lifestyles that are different from the institutionalised thinking that has been prevalent for most of the last century [5].

The physical results of getting older involve multiple, minor impairments affecting eyesight, hearing, dexterity, mobility and memory [6]. IT that is hard use, or difficult to access will not satisfy the needs of older people and this has significant implications for design that is mismatched to functional ability [7]. However, design for older people should go beyond physical requirements to also address personal aspiration and emotional connection, something that people continue to value as they get older [8].

This is very much aligned to the thinking contained within inclusive design, defined as comprehensive, integrated design that encompasses consumers of diverse age and capability in a wide range of contexts [9]. Designs should be 'age inclusive' rather than 'age exclusive' as no older customer will want to buy an IT product or service that singles them out as an age group. They are consumers with contemporary expectations who control significant amounts of disposable income and are valuable participants in the economy.

### 1.2 Technology Push, User Pull

Technology is often associated with rapid technical development and cutting edge innovation in a digital or silicon context and this has resulted in affordable devices and products. However, these are not always designed to account for variance in age and ability. Involving users throughout the development of IT-based consumer products and services is generally not prevalent in the commercial environment beyond the traditional focus group set-up that is used to validate or test a new idea or prototype once it gets close to market. Involving users in more creative ways further upstream in the design development process is rarer. This perceived separation and tension between technology and its users is widely described as 'technology-push, user-pull'.

The terms 'push' and 'pull' originated in logistics and supply chain management [10], but have become widely used in business and marketing. They take on special meaning in an IT context as they articulate the difference between an approach where the technology drives the ideation process or where the market demands it. The latter has historically been referred to as 'user pull', 'needs pull' or 'demands pull'. In the 1960's, strategists realized that 'demand pull' would effectively support programmes biased towards a 'technology push' [11]. In the mid-70's, 'demand pull' grew in visibility to be seen as an equal route towards innovation [12] whilst a decade later, researchers into the stimuli of the innovation process reported that the number of innovations stimulated by 'need pull' substantially exceeded those stimulated by 'technology push' [13]. In critical areas of design such as medical equipment, empirical studies concluded

that 'understanding user need' was a discriminating factor between commercially successful industrial product and process innovations, and those that failed [14].

The 1990's saw technology developing rapidly as well as the industrial innovation process which was driving this change. An integrated model of industrial innovation grew from the simple linear 'technology push' and 'need pull' models of the 1960s and early 1970s and the 'coupling model' of the late 1970s and early 1980s [15]. Fourth and Fifth Generation models of innovation responded to an increasing pace and the multi-layered nature of technology processes. Innovation in this sector was no longer sequential – it became parallel and even complex [16].

### 1.3 Complexity and Community

The need to include complexity when designing IT solutions can be further understood by trying to define what 'user pull' means in the context of the relationship between technology and society [17]. People are complex and their relationship to a technological device or service has this complexity as a background. People do not buy a technology device – they buy an artifact to support their lifestyle and if this technology fails to engage and support them on multiple levels and provide perceived benefit to their life, it becomes less useful. 'User pull' in today's context can carry the implication of needing to understand the intricate and complex nature of human beings and their lifestyles. Designers working in IT have the challenge of engaging with this context, projecting user needs into the future and appropriating technologies that support their aspirations. The methods and learning afforded by an inclusive design approach can provide one way of balancing 'technology push' with 'user pull', and promote an understanding as to what 'pulls' or attracts users to a particular type of technology in today's context.

Some aspects of IT have a history of collaborating with people. Software designers have tended to include users throughout the design and development process seeing active participation as a way of iteratively moving towards design solutions. Since 1970, Cooperative Design has involved designers and users as equals in the design of IT products and devices [18]. Co-design is prevalent in architecture and business but is also used when designing information systems and mobile phone development [19]. Working with communities can establish focus not just on commercial products but also new understanding of technology's use [20]. This becomes important in moving the designer's view beyond the artifact or the technology and onto the rich area of designing to support communication, lifestyle and information exchange for the users.

## 2 Method

The Helen Hamlyn Centre (HHC) based at the Royal College of Art (RCA) in London focuses on people-centred design and innovation. Its multi-disciplinary team of designers, engineers, architects, anthropologists and communication experts undertake practical research and projects to advance an approach to design within the RCA that is people-centred and socially inclusive. The research looks at developing the practice and theory of inclusive design and working with older and disabled people has remained a central activity over the last ten years.

The HHC works with a range of external business, academic, government and voluntary sector partners. Its programmes engage with four design communities: students, new graduates, professional designers and academics. The case studies described in this paper draw on two of these programmes. The first looks at work completed with RCA Masters students and the second outlines projects with industry carried out by new RCA design graduates.

### 2.1 Working with People

An important part of HHC practice is to involve users within the design process so that projects have social relevance and value for the end user. Students and new graduates are encouraged to work with people in their own space to empathise with their lifestyles and understand their context as nothing can replace this type of direct contact [21]. This is especially important when a young designer is tasked with designing for a person who might be more than 50 years older than them. The designers are schooled in a range of research techniques including questionnaires, expert consultation, user diaries, interviews, observation 'in situ', testing with prototypes, and research 'kits' that can be left with people to gather responses without the designer being present.

Users are selected carefully to challenge the scope of the project and are involved from the outset to provide initial inspiration and insights rather than just acting as 'test subjects' to validate the designers own thoughts at the end of the process. People are seen individually or in small groups to encourage a richer exchange of information and opinion, which in turn, can become a powerful instigation for creating new design insights and inspiration. Working in this manner allows designer and user to act as equals, an important factor in maintaining 'user push' over 'technology pull' and in understanding the complexity of the particular context that the resultant IT designs will have to function in for the user.

## 3 Case Study 1

The 'Design for Our Future Selves' (DFOFS) awards programme is a three-term programme for all Masters students in their final year at the RCA. The programme is divided into three stages: Define, Develop and Delivery. In the first stage, students from different art and design disciplines submit their own design proposals that aim to address some aspect of social change. Fifty to sixty students are then shortlisted and invited to join the develop stage, where groups of users, with different disabilities, ages and occupations, will challenge the design briefs and encourage the students to stretch the creative envelope in unanticipated ways. Finally, in the delivery stage, twenty-five to thirty students are selected to present to an international panel of judges who look carefully at how they have transferred the user research data into creative design solutions. The programme ends with an awards ceremony at the end of the academic year for selected, winning designs.

### 3.1 YuType

The project started with the student defining a social issue to investigate as part of their final year work on the RCA Industrial Design Engineering Masters degree. Computer technology can improve the quality of life and promote independence for older people. However, the primary point of interface, the keyboard, presents some difficulties. Touch-typing is a relatively underused technique, with 79 per cent of keyboard users, a disproportionate number of these being older, adopting a two-fingered approach (or 'hunt and peck') to typing. This requires users to locate keys by sight, shift their gaze to the screen to check for errors then return their attention to the keyboard to continue as shown in Fig. 1. Not only is this approach slow and less accurate, it also provokes repetitive head movements, sometimes aggravating neck muscles, and puts unnecessary strain on the overused digits. Although these issues affect users of all ages, the negative effects of repetitive strain, muscle ache and joint immobility can be over-emphasized in an older age group.

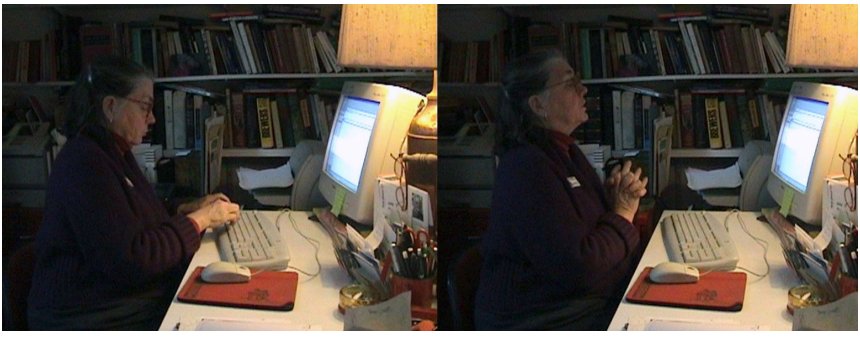

**Fig. 1.** User research with older people revealed a range of neck movement when typing

A variety of existing systems such as single-handed keyboards and instructional software were evaluated with the need of older users in mind. A series of ideas were then generated to address the main issues identified and these were further evaluated with older people. The most successful of these ideas was then refined and a working prototype was constructed. This prototype was taken to one of the users who had been involved in the project from the beginning in order to validate and optimise its effectiveness and to receive further feedback. This improved the aesthetics and allowed the designer to test the results in the complexities of a ‘real’ situation.

Users were involved throughout the project. This started with an online survey to gauge opinion and gather early data and was followed by home visits to a number of different computer users over the age of 55 in order to develop the hypothesis and see the daily difficulties that people have with IT devices. Informal interviews were initially conducted to develop an overview of daily computing habits, aspirations and perceived difficulties. Observation and filming was carried out with a specific user who fitted the strict test criteria of this project. This person was a daily computer user who had tried to learn touch-typing but was unsuccessful, and had subsequently

adopted the two-fingered approach. They had arthritis and stiffness in the neck, which became aggravated during computer usage. This individual was selected as the lead user for the project as they had the most challenging condition.

The result was a device that allows the typist to see what they have typed without having to shift constantly their glance from the keyboard area to the screen. It has the potential to reduce neck movement and strain whilst increasing typing speed and accuracy. The device is a small LCD high contrast screen, which connects directly to the computer and displays the most recently typed text within the users' immediate field of vision. It can be repositioned to suit different people and does not require any set-up procedure or software to use (see Fig. 2).


**Fig. 2.** The final design attached to the keyboard

## 4 Case Study 2

The HHC's Research Associates (RA) Programme demonstrates a process in which academia can work with business to transfer design knowledge, capability and understanding, allowing companies to use inclusive design as an organisational asset to invent, create and improve. It works by taking new RCA graduates from a range of design disciplines and partnering them with an industry organisation. Throughout the year, they draw on the creativity of the RCA whilst developing user-centred design skills through the Helen Hamlyn Centre network. Each yearlong project addresses an area of interest for the partner organisation, where an inclusive design approach can be practically implemented within a 'real world' business context. As well as realising the design concepts and exemplars, each designer produces an extensive report cataloguing the research process and results typically including an assessment of potential business impact.

The programme maintains a core interest in working with IT companies to improve their consumer offer and work with older or disabled communities. Between 1999 and 2009 the HHC has undertaken over 100 projects with 75 companies including many from the technology sector. The Research Associates Programme operates on an annual basis, running from October to October. Each year ends with a symposium and exhibition launch event for research partners and collaborators. Around 300 people attend the symposium, and there are more than 1000 visitors to the exhibition.

### 4.1 TwoTone Phone

The project was partnered with UK telecoms company and service provider BT with a focus on developing creative new ways to connect the over-60s to the communication benefits of broadband. Two new graduates from the RCA department of Industrial Design Engineering were employed to conduct this work. The resulting designs had to enable non terminal-based access to the Internet and explore more ambient and pervasive methods of information handling. BT was looking for marketable products that addressed a future of five years from the project start date in 2006.

More than 14 million people in the UK can be termed 'digitally excluded' and the majority of these are older people. Some have never had access to a computer and many are never likely to. Many older people cannot justify the costs of buying a computer or the complications of learning to use one. This means that they cannot access services and communications that are becoming increasingly dependent on the Internet whether it is shopping for the best deals, communicating to a dispersed family network or obtaining impartial healthcare advice. The project aimed to bring the older user into the foreground and push the technology into the background. The focus was on promoting independent living and choice instead of simply providing another hard-wired, telecare solutions.

**Fig. 3.** Four of the six users interviewed

The research consisted of two phases. The first selected six lead users aged over 60 and interviewed them in their homes (see Fig. 3). This group represented a mix in terms of age, gender, physical proximity to their family, living alone or with a partner, and urban and rural location. The interviews were video-recorded and consisted of an informal, but guided discussion within which a holistic impression of the participant's lifestyle and their attitude towards technology could be discovered. The topics discussed aimed to cover the complexity and diversity of each user's life and topics included attitudes to technology, lifestyle, healthcare, social networks, organization of personal information and communications. The key aim of this was to assemble a series of insights that the designers could relate to, and make reference to throughout the design process to inform the decision making from the point of view of the users.

The second phase addressed the difficulty in exploring the potential of broadband with a group of people who have minimal grasp of the internet and are therefore unable to fully understand the technical jargon associated with IT devices and services.

Six tester design concepts that visualised different ways in which the internet could be accessed without using a standard computer terminal were developed so that users could visualise potential benefits and react to new ideas. These concepts ranged from a 'piggy bank' that displays credit or debit card information to a simplified keyboard that groups keys alphabetically and into logical clusters. Visuals depicting these imaginary concepts were taken to the interviews with the existing group of six older people and used to provoke reaction. Feedback was gathered on the participants' understanding of each concept, the relevance of the concept to their lifestyle, the way in which the product functions and the aesthetic quality of each.

The interviews were run during the early stages of the design process allowing the designers to respond to early feedback and evolve the concepts in between visits. This approach meant that designs were directly challenged by the users from the briefing stage, allowing the creative process to move unhindered into spaces that the designers had not previously considered. This research highlighted a number of issues in terms of who the outcomes should be aimed at and what technology should be used. In its latter stages, the project focused on the over-70s for whom cost is especially important, as is ergonomics of use such as tactility of buttons and easy-to-read displays. This group wanted any new devices to build on familiar interfaces and any benefits to be self-evident.

**Fig. 4.** The final design showing the black internet 'face' when docked and the white landline 'face' in use

The main design outcome of the study, the TwoTone Phone, addresses these issues. It is effectively two phones in one unit. The white face acts as a normal, cordless house phone but the black face is a Voice Over Internet Protocol (VoIP) phone that utilises existing VoIP services to allow calls to be made over a broadband connection (see Fig. 4). Turning over the phone activates its different modes: the VoIP mode does not have a screen but simply has six large buttons on which users can write the names of their contacts. The buttons turn orange if the person is online and flash when that person calls, with the added benefit of indicating who is available to chat.

Whilst designed with the older person in mind, the concept is also aimed at the mainstream market. Users can connect the phone to their television in order to make video calls and the base unit also acts as a wireless router. Although the TwoTone Phone has a large number of functions, these are presented in a way that does not intimidate or confuse. The user can choose the level of functionality and adapt the

phone to suit their needs. For digitally excluded older people, it provides a simple way to communicate freely, using previously unattainable broadband services.

## 5 Conclusion and Discussion

The work described has provided RCA students and new graduates with the tools to see IT designs in the broader scope of social context, and interaction with user groups as a way of successfully achieving that. This was done in a way that did not present inclusive design practice as a token practice or special process. Instead, it was used as a vehicle for rethinking and reinvigorating the creative process, to understand the complexity of 'user need' and 'user pull' and put it before the binary approach of 'technology pull', allowing the designers to create IT solutions that meet user aspiration whilst remaining grounded in the context of everyday life.

People acquire technology for the purpose of supporting their lifestyle and because of this they need shades of communication from the design that is appropriate to their need and easily understood. Using binary language or technical jargon alienates rather than empowers the older user. Involving people upstream challenges designers throughout the design process and means that user insights can be used for inspiration and help to define key directions rather than just passively validating a designer's own thoughts towards the end of the project. This is especially important for the fast-moving IT sector where new software, devices and typologies are developed at a rapid pace. Small groups of carefully selected users can help to orientate work at critical developmental stages, providing early inspiration for designers and saving time and cost for manufacturers and makers.

Designers have to look for the convergent points where 'technology push' meets 'user pull' and where users' needs can be met by technological progress. Technology should not fight the user and the user should not have to significantly adapt their learnings and lifestyle in order to access technology. Designers need to develop clever and interesting ways to engage older users as equals within IT research and build on existing inclusive design methodologies to create new ways to talk about digital technology to an analogue-minded audience.

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