Focussing on Extra-ordinary users.

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Abstract. "Universal Access" is often focused on modifying main-stream products to respond to the demands of older and disabled people – which implies an extremely wide range of user characteristics. "Accessible" system design can produce systems which may be "accessible" but are in no sense "usable". Many system developers also seem to believe that a consideration of older and disabled people mean the abandonment of exciting and beautiful designs.

In contrast, we recommend driving inclusive design from the margins not the centre, and that designers should consider a number of "extra-ordinary users" in depth as individual people, rather than as representatives of an age group and/or disability, and design for their desires, and tastes as well as their needs. This provides a reasonable design brief, and the consideration of extremes acts as an effective provocation within the design process. A number of case studies will illustrate the effectiveness of this approach. Ways in which communication with extreme users can be most effectively conducted are also described.

Keywords: older and disabled, user centred design, theatre in design, extra-ordinary users

1 Universal Access and older people.

In 1986 CHI Schneiderman commented that " we should be aware of subtle design decisions that make usage more difficult for people with physical and mental difficulties … and not create a situation where the disadvantaged become more disadvantaged, ...[23]. In a keynote to the 1993 InterCHI, in a presentation entitled "Ordinary and Extra-ordinary HCI", [published as 11 and more recently as 14]. Newell described why this was an important research area for the HCI community. Universal Access, also called "Design for All" has been a very important concept in raising awareness amongst the human interface design community of the importance of considering a wider range of users than is traditionally the case, and has focused mainly on people with disabilities. There is no doubt that the Universal Access movement has had a very positive effect - an increasing number of HCI conferences contain papers addressing these issues, and it is

heartening to see that the 2007 HCI conference has sessions which include this aspect of HCI. In addition many countries now have legislation which makes discrimination towards people with disabilities illegal, including lack of provision of, or in-accessible, equipment and services.

Thus a great deal has been achieved, but there is much still to achieve. In particular the HCI community needs to respond to demographic trends of an increasingly ageing population, and take advantage of the challenges and advantages of designing for older people. There are now more people over sixty years of age than under sixteen in the UK and 1.1 million over eighty [24]. It is predicted that by 2030 in the UK there will be 2.3 million people over eighty, rising to 5.5 million in 2050. This pattern is a world wide phenomenon: Japan in 2002 had 18% of the population over 65, which is predicted to rise to 25% in 2014 and 35% in 2050. There is, of course, some overlap between older people and people with disabilities, and 42% of 64-74 year olds have one or more disabilities limiting their quality of life. There are, however, major differences between older people and the more traditional "disabled person" for whom assistive information and communication technology has tended to be designed.

Most older people have multiple minor impairments, which can be inter-dependent as far as HCI is concerned. The range of functionality of older people is also very great - high functioning older people have similar functionality to middle aged people, whereas low functioning older people have much lower functionality than middle aged people. There is much more pronounced minor cognitive impairments (e.g. memory and ability to learn new processes) even in high functioning older people than is found in young and middle aged people. Older people's minor impairments can make traditional assistive technology solutions to their major impairments inappropriate (e.g. hearing impairment and reduced cognitive capacity, can reduce the effectiveness of speech synthesis as an aid for severe visual impairment). Older people are much less confident with and accepting of information technology. In a recent report it was claimed that 65% of people over 65 "voluntarily exclude" themselves from new technologies [16], but Newell, argued that this "voluntary exclusion" is a symptom of new technologies not being designed for older people [12].

2. Concerns about older people and Universal Access

On the basis both of the increasing percentage of older people in the population, and the specialist HCI requirements of this group of people, one should, perhaps, expect a greater proportion of this conference, and HCI research in general, to include these groups of users. Although "Universal Access" has had an impact on the HCI research community, there is still not sufficient serious research in the field. The community thus needs to reconsider the messages it is sending the "mainstream" research community and to designers and manufacturers of communications and information technology software and equipment.

2.1 Universal access as an add-on extra

Is it possible that the message given to mainstream designers by the "universal access" concept is no longer achieving its aims, and the potential downside of this concept is that, in its full sense, it is virtually impossible to achieve for any particular system or

product. If the requirement to provide a universal product is considered during the initial concept development and requirements gathering stage, the designer is faced with a user group who have an extremely wide range of characteristics and disability - very much wider than traditional user centered design is capable of including. It is difficult enough to conduct requirements gathering with a known and highly specified group of users – it can become impossible if the characteristics for which one is designing, in terms of physical, sensory, motor and cognitive abilities, to say nothing of culture, knowledge and motivation, seem to be intended to include the whole population. An additional concern is that the impression can be given universal design is focused on modifying main-stream products, recommending that, somewhere in the design cycle, designers should take account of the unusual demands of marginalized people such as older users [14] This suggests applying the "universal design" concept towards the end of the design cycle, leading to the requirements of marginalized groups being considered as an "add-on" extra to an otherwise well designed product. Not only does this patronize older and disabled people - a technological version of offering "crumbs from the rich man's table" – but is also likely to lead to significantly increased costs, and possibly to inappropriate compromises, which are bad for both the traditional and the marginalized groups of users.

2.2 Accessibility, usability, and aesthetics

A worrying aspect of a focus on "access" for people with disabilities, is that there is evidence that many products which have been designed to be "accessible", are in no sense "usable" by the groups for which they are apparently designed [21]. Petrie found many web sites which were claimed to be "accessible" - e.g. follow the W3C guidelines - but were virtually unusable via the accessibility options which are provided [22]. E.g. a web page, designed to be read with the eyes, which can be listened to using a screen reader – and is thus "accessible", but the text of which is incomprehensive in an auditory form.

A further concern about the concept of "universal access" is that it can bring with it some of the less useful attributes of "rehabilitation technology". In particular the lack of aesthetic considerations in the design process. Many such products show evidence that the teams that design them do not engage emotionally with the users groups and assume that older and disabled people lack any aesthetic sense, and, unlike other user groups, are motivated entirely by the functionality of products. Hocking [9] reports that in the US 56% assistive technology is quickly abandoned, and 15% are never used. It is possible that the lack of aesthetic considerations and empathy between the designers and the customers is a factor in this very high level of abandonment of assistive technology products. There can be an assumption that the additional constraints involved in considering older and disabled people mean the abandonment of novel and beautiful concepts, and, if these attitudinal constraints are over emphasized, the team will be focused exclusively on the ergonomic and technical aspects of the product.

Much computer and communications based rehabilitation technology and software based accessibility options are exclusively focused on a single disability. In contrast, an elderly user will have many minor disabilities, and may or may not have a major

disability. In addition older users have reduced memory and other cognitive abilities. Although significant research effort has been put into software for people with major cognitive deficits [5] much less attention is paid to the requirements of the older user whose memory and cognitive processes have somewhat declined. The effects of these minor disabilities can be inter-dependent when they are trying to use technology. Thus, for example, speech synthesis, which is a very successful accessibility option for people with visual impairment, will not work for many older people because of reduced hearing coupled with the high cognitive load needed to cope with the reduced comprehensibility of synthetic compared with natural speech. Older users typically have reduced capacity for learning new techniques, forget them more easily, and are often much less prepared to devote a long period to learning such techniques. However, the "older user" in particular has such a wide range of characteristics that this category is not very useful as a design brief also these characteristics are subject to much more rapid change with time than is usually the case with younger people.

3. Designing for extra-ordinary users

Newell [15] has raised the issue of whether it is necessary to move on from the concept of Universal Usability to a message which is more appropriate to the needs for technical support for older people in the future. He comments that true "Universal Access" - i.e. systems which can be used by everyone - is very rarely achievable, and this can have the effect of designers simply paying lip-service to an unachievable goal. Thus instead of a message which can be interpreted to say “if you are designing a new product, take account of the needs of older and disabled users (if you can) we believe that older and/or disabled users should be seen to have a different place in the design process. We argue that, rather than develop methodologies for “universal access”, we should be developing methodologies to assist in the design of products and systems for specific groups of older and/or disabled people, as an integral part of universal design. This we believe can lead better products for all users as well as for older users. In an earlier paper Newell has suggested the concept of designing for “extra-ordinary” users, and listed the advantages which this can produce not only for extra-ordinary (older and disabled) user but also for “ordinary” users in “extra-ordinary environments” (such as high work load and stress situations) [14]. Pullin uses the term “resonant design” to describe designs where the needs of the people who have a particular disability coincide with particular able bodied users in particular contexts.

It is not easy to be certain that one’s sample of users is representative even with a very constrained user group, but, for the reasons adduced above, it would be impossible to produce a set of older users who were truly representative of this population. We thus recommend that, instead of trying to satisfy the requirements of as great a variety of users as possible - and move towards a “universal” solution from this direction – design teams (which should include industrial designers, interaction designers human factors specialists and engineers working together) should be encouraged to consider a number of specific “outriders” in depth – and, initially at least, design for them in particular. These “extra-ordinary users” should contain the characteristics which are particularly relevant to user groups for whom the product is being designed. Each “extra-ordinary user” should not be considered as representing a specific disability, but should be considered as an individual person who happens to have a specific disability as well as a

range of other characteristics which are important for defining them as a person, but may not be related to their disabilities. In this way the designers are given a clear picture of a person, or small group of individuals, for whom they are designing, and can develop an empathy with these potential users. Thus the design process is "user centered" in the full sense of the concept, but the lack of a truly representative sample is recognized by the team. This methodology will encourage the team to address access issues from an empathetic viewpoint. Engaging with such users can also provide a richness to the design process, and a consideration of "extreme" users act as an effective provocation within the design process, which inspires the user-centre design methodologies of design groups such as IDEO [10]

This first iteration is something of an hypothesis: if we were to design for this person (for a change!) what radical new ideas might arise? Even if the approach does not directly result in a solution for a broader population, it should challenge convention and provoke new trains of thought. As such, this process may occupy a role somewhere between traditional concept design and the techniques of critical design: "designs which ask questions rather than propose solutions"[6]. Dunne also made the point that "populations can validate a design, but individuals can inspire new thinking, therefore are invaluable at the beginning of a project"[6]. We suggest that the specific use of older people as part of the design brief can be a very powerful way of provoking designers to address important and radical issues in the design space within which they are working. Such "extreme users may have the multiple minor disabilities associated with old age, plus possibly some major disabilities, but they can also be used to provide examples of extremes of the continuum of people's knowledge of and comfort with new technologies.

3.1 From extra-ordinary users to a more universal solution

At a later stage in the design iterations, it may become clear that the solutions the team arrive at can be brought together and provide a more universal solution, and we would argue, however, that such a design solution may well be superior to solutions based on "ordinary" users which are simply extended to take into account the requirements of "extra-ordinary" users. More radical starting points are likely to inspire more radical solutions, whereas the process of expanding or fixing mainstream products is a much more constraining. Inclusion, particularly for older users needs to be based on simplicity, and thus beginning the design process with a relatively narrow description of the user base is advantageous [19]. The alternative of having too wide a design brief leads to products with a vast array of functions and are thus bewildering and difficult to learn for everyone, but especially for older people [4]. There are many historical examples where the approach we are suggesting has been very successful.

3.2 Designs for older or disabled people which led to mainstream products

A number of products, which were initially designed for niche markets of older or disabled people, have led to either industry standards or universally popular product ranges. In many cases this was not a planned strategy but the products produced were so easy to use compared to conventional products that they gained a significant market share. One of the most successful of these was the cassette tape recorder, the first of

which was designed specifically for blind people, and initially was not thought to have any future as a universal product because of the relatively poor sound quality [15]. The predictive typing systems now found in all mobile telephones was developed, by the authors colleagues and others, initially as an efficient alphanumeric input device for people whose physical disabilities prevented them using more than a small number of keys [1]. The UK company BT produced a large button telephone, again intended for a niche market, but which had an appeal beyond its intended user group. These are examples of products which started off with a very specific design brief, but became very successful universal products. The Ford motor company followed a version of the process suggested in this paper for their Focus car. In order to ensure that the car should be accessible to older users – the design team were provided with specially designed clothing which simulated some of the physical effects of old age by inhibiting movement. The Ford Focus is not marketed as a car for old people, but the authors would argue that, had the design team been asked to design a car and, as the final stage of the design, put on the suits to see if it was drivable by older people, and make changes as appropriate, the design process would have been more expensive and the final product, possibly less fit for purpose.

Most commercially available email and word processing packages have a great many functions. There are very few, if any users, who take advantage of the full functionality offered by such packages, and Smith [4] had calculated that it was possible to perform over 250 actions on the first page of a popular email package. The over abundance of generally unused features make finding and using a required feature difficult. There seems to be little or no evidence, however, that major manufactures are reducing the functionality, and thus increasing the usability of such packages. In contrast, a number of authors who have designed email systems, particularly for older people, have found that large amounts of functionality completely confused older people. Arnott [2], Dickinson [4], and Hawthorne [7] used techniques similar to those described in this paper, and all cases a clear design requirement was to substantially reduce the functionality. Other requirements included larger buttons, better contrast and larger font size than normal commercially available systems. All these characteristics make for an easier to use system for all but the most extreme “power users”.

The OXO Good Grips kitchen products provide another example of successful universal design based on starting at the extremes [17]. The designer wanted to produce a universal design, but the initial design brief he set was a person with arthritis and Sam Farber’s wife provided the inspiration - his first designs being specifically for her. Although a single individual was used as the initial design brief, the final product range is clearly a very successful example of universal design.

Assistive technology tends to be seen as niche products, and rarely gives the impression of being exciting and beautiful. An example of such an approach is the electronic hearing aid, which developers have attempted to make as invisible as possible. This is a major contrast to non-electronic ear trumpets, some of which were striking and beautiful. This has led to "in the ear" aids which provide greater miniaturization challenges, but are less noticeable. This designed-in invisibility has the further disadvantage of deliberately hiding the fact that the user is hearing impaired; thus conversational partners are not alerted to the need to speak more clearly and provide the conditions which facilitate lip reading. The invisible design is thought to be favored by customers, but this is particularly ironic as not realizing that a conversational partner

cannot hear what one is saying can, in itself, be a significant a barrier to conversation. Walking sticks are another product where beauty plays little or no part of the design brief. There was a time when a walking stick was a fashion accessory, a very wide range of very beautiful walking sticks were available, their use indicating a person of fashion. In the 21st century, the walking stick is a symbol of incapacity or of a hill walker – both of which may be inappropriate for some users – and, on the whole, are designed for function rather than for fashion or beauty. In contrast it is interesting to note that the spectacles have moved from being prosthetic devices to fashion statements during roughly the same time period [20]

As an encouragement to re-introduce a more creative approach to design into the hearing aid market, the UK RNID (Royal National Institute for Deaf and Hard of Hearing People) in co-operation with the Blueprint design magazine and the Victoria and Albert Museum offered a competition "HearWear", in which the design brief was to re-conceive the hearing aid and hearing technology [8] This led to a number of innovative designs some of which included the hearing aid as a piece of jewellery which people would want to wear as well as acting as an assistive device.

The HearWear entries suggested revolutionary new possibilities in hearing products for everyone, not just people who are deaf or hard of hearing, and introduced the possibility of new products which allowed everyone to control and enhance the sounds around us. For example a remote control which could block out the sound of noisy builders or a screaming child. IDEO's TableTalk concept, which allows users to hold a clear conversation in a noisy bar, was inspired by the experiences of hearing aid wearers, but helps both hearing impaired and hearing people in ways they may never have thought to ask for, despite having similar negative experiences in noisy public places. The HearWear display shows how consideration of the challenges of hearing impairment can lead to revolutionary thinking and in exciting new product designs. It also highlights the massive potential for industry to create innovative, stylish and desirable hearing products which, if they were available on the high street, would be very popular with both people with intact and impaired hearing. Such an approach would be appropriate for a wide range of assistive technology, and accessibility products.

3.3 Older people as an integral part of the design process

How then should we go about designing for older people? Because of their wide ranging physical, sensory and cognitive characteristics this group do not provide a particularly useful design brief. An alternative approach is thus needed. We suggest that, rather than aim for an unachievable "universal" solution, the design brief be restated as a small set of specific users. This is somewhat similar to the idea of developing personas which describe a particular user. However, we recommend that the designers first consider what characteristics of older users are particularly relevant for the product/system or service for which they are designing, and, rather than strive towards developing the description of "representative users", they deliberately chose to describe "extreme users". It would also be very valuable to connect the designers with real people who possess the particular characteristics of each "extreme user" such as is done, for example, in the DBA "Design Challenge" [3].

The design brief consists of a small number of users, who may seem to have very little in common, but together map out the "user space". The first design interaction may be a number of individual solutions each tailored to a specific "extreme user". It is at this point, and not until this point, that the design team attempt to bring together the various designs which they have developed to produce a final design, or limited number of designs. We suggest that this approach is likely to inspire more radical solutions and lead to designs which are truly innovative without compromising their accessibility.

Depending on the application, the design should be assessed as a product for younger, non-disabled people, as a later design iteration. This could lead to a product which does not require any modification, as occurred with the large button telephone (primarily designed for people with dexterity problems but purchased by a much wider range of people). Alternatively, a final design iteration may be needed to respond to particular requirements of a non-disabled young user, which had not previously been considered important in the design process. We suggest that, in both cases, this is more likely to lead to a product which more closely approached "universal access" than a more traditional design journey towards "universal access" may have achieved.

4. The use of theatre

To ensure that designers develop empathy with users with whom they do not normally interact, it is desirable for them to interact with people who embody the characteristics for which they are designing. This however may not be feasible for a range of reasons such as availability and/or cost. Newell et al [13] suggest a solution to this challenge which is to use well briefed professional actors working to a well crafted script. Versatile theatre professionals will be able to provide a personification of the particular user, or set of users within the design brief, and, if these actors are experts in improvisation, will be able to interact in character with designers, and with any prototypes which are produced as part of the design process. Newell et al point out other advantages of this approach which include a removal of ethical issues which can arise when the design brief includes fragile people, either physically, mentally, or in terms of self-confidence. An actor's ego is not involved in the character they are playing and thus the design team can be much more probing or even brutal in their questioning. An acted performance can also be a very powerful and valuable way of presenting a design to clients, with, again, the safety which comes with the use of actors.

5. Conclusions

Older people have different characteristics to those of younger disabled people for whom much assistive and accessible technology has been designed. Demographic trends show an ageing population throughout the world, for whom technological support is becoming both an economic and social necessity. The interaction challenges of older people have tended to be addressed either by a simple "universal design" brief and/or by providing "access technology" to otherwise main-stream products as an "add-on" extra. There is an understandable tendency for designers to design for their peer group, and the unfortunate stereotypes of older people (such as them having no aesthetic sense, interest in sex, requirement to be fashionable or disposable income) make this mismatch

particularly great. This paper suggests that designers be given the brief of designing for specific examples of older people, with the remit to produce a usable and beautiful product for these particular people. A number of case studies, which include very well known and respected products have been described which support these hypotheses,

As an alternative approach to the traditional approach of "universal accessibility", the authors suggest design specifically for individually specified older and disabled people, with a later design iteration which brings together alternative designs, and considers their application to young non-disabled people They suggest that this can lead to more radical, and often more appropriate, final products, and give examples where this has been the case.

The authors recommend that opportunities should be provided to encourage (usually young) designers to empathize with the user group. They recommend that the design team closely interact with people who could be considered to have the characteristics of the "extreme users" for which they are designing. They also suggest the use of theatre as a complement to direct engagement with users.

References

1. Arnott, J.L., Javed, M.: Probabilistic Character Disambiguation for Reduced Keyboards Using Small Text Samples, Journal of the International Society for Augmentative and Alternative Communication (A.A.C.), Vol.8, No.3, Sept. 1992, pp. 215-22
2. Arnott, J.L,. Khairulla, Z., Dickinson, A., Syme, A., Alm, N., Eisma, R., Gregor P.: E-mail Interfaces for Older People, Proceedings of the IEEE Conference on Systems, Man & Cybernetics (SMC 2004), The Hague, Netherlands, 10th.-13th. October 2004, pp. 111-117.
3. DBA Design Challenge: http://www.designcouncil.org.uk/AutoPdfs/DesignCouncil_1407.pdf
4. Dickinson, A, Newell, A.F., Smith, M., Hill, R.: Introducing the Internet to the over-60s: Developing an email system for older novice computer users. Interacting with Computers 17, 6. December 2005: pp. 1-22
5. Designing Technology for People with Cognitive Impairments Workshop CHI 2006 Montreal, Quebec, Canada, 22-27 April 2006.
6. Dunne, A., Raby, F.: Design Noir - the secret life of electronic objects. Birkhauser, 2001
7. Hawthorn, D.: Possible implications of aging for interface designers, Interacting with Computers, Vol. 12, No. 5, 2000. pp. 507-528.
8. Hearwear – the future of hearing20th Century Gallery - Victoria and Albert Museum (V&A) dates http://www.rnid.org.uk/information_resources/hearing_aids/hearwear/
9. Hocking, C.: Function or feelings: factors in abandonment of assistive devices . Technology and Disability 11, 1999, pp 3-11
10. Myerson, J.: IDEO: Masters of Innovation, Laurence King, 2004
11. Newell, A.F.: Extra-ordinary Human Computer Operation, in Extra-ordinary Human-Computer Interactions by A. D. N. Edwards (Ed.), Cambridge University Press 1995
12. Newell, A.F.: Extending Horizons: Invited Lecture, European Conference on Accessibility to the Next Generation Networks, BT Centre, London 16th Jan 2007
13. Newell, A.F., Carmichael, A. Morgan, M., Dickinson, A: The use of theatre in requirements gathering and usability studies. Interacting with Computers, Vol. 18, 2006. pp. 996- 1011

14. Newell, A.F., Gregor: P.: Human computer interfaces for people with disabilities, in Handbook of Human-Computer Interaction, Helander, M., Landauer, T.K. and Prabhu, P. (eds), Elsevier Science BV, 1997. pp 813-824.
15. Newell, A.F.: Older people as a focus for inclusive design, Gerontechnology 4 (4) 2006 pp.190-199
16. Office of Communications Media Literacy Audit. U.K. Stationary Office, 2006
17. OXO good grips http://www.designcouncil.org.uk/AutoPdfs/DesignCouncil_1407.pdf
18. Pullin, G.**:** I can't talk now and other design stories: Four assistive technologies for people with and without disabilities, Universal Access and Assistive Technology, Keates, S., Langdon, P., Clarkson, P. J. Robinson P.(Eds.). Springer, 2002
19. Pullin, G.**:** Inclusion, inspiration and lightness of touch, Inclusive Design: Designing for the Whole Population,. Clarkson, J., Coleman, R., Keates, S., and Lebbon, C. (Eds.), Springer, 2003. pp.558-566.
20. Pullin, G: When fashion meets discretion, Include 2007, Royal College of Art 2nd -4th April 2007.
21. Sloan, D., Gregor, P., Rowan, M., Booth, P.: Accessible Accessibility. In: Proceedings of the First ACM Conference on Universal Usability (CUU 2000), Arlington, VA. 2000
22. Petrie, H., and Hamilton, F.: The Disability Rights Commission Formal Investigation into Web Site Accessibility. In Dearden, A. and Watts, L. (Eds.), _Proceedings HCI 2004: Design For Life (Leeds, UK), pp. 157-15
23. Shneiderman, B.: +/- 2 Central Issues in H.C.I. in Proc of CHI 86, Human Factors in Computer Systems Conference New York, ACM Press
24. US Census Bureau International Data Base