

DESIGN PRACTICE AND 'DESIGNING FOR ALL'

Diane E. Gyi^a, J. Mark Porter^a and Keith Case^b

^a Department of Design and Technology, ^b Department of Manufacturing Engineering
Loughborough University, Leicestershire, LE11 3TU, UK

It is essential that all designers with responsibility for the human-machine interface have access to information on the anthropometry and capabilities of the whole population of people who may wish to interact with the design in question. Current databases used by designers typically present only very limited information concerning people who are older and/or disabled. Furthermore, tables of data are known to be largely ineffective and designers prefer to see visualisations of design data. In order to establish the current situation regarding design in relation to the needs of older and disabled people, existing products, procedures and systems were investigated. The objective was to identify current practice and the needs of designers whilst attempting to 'design for all'. This paper will report on the findings from these interviews to date, which will ultimately lead to a requirements specification to aid design for the needs of older and disabled people.

INTRODUCTION

Background

By the year 2005, there will be 10 million older and disabled people in Europe, that is 25% of the European Population, (Sandhu, 1997). However, it is well known that products are not always designed to include the growing needs, for the growing numbers of these user groups. With such a change in demographics, it is becoming essential that all designers with responsibility for the human-machine interface have access to information on the anthropometry and capabilities of the whole population of people who may wish to interact with the design in question. A more comprehensive profile of users means that design teams are more informed and so likely to make the right choices.

A study by Ashworth et al (1994) gives some indication of the extent to which people who are older or disabled experience being 'designed-out'. They report that 21% of US 65-74 year olds and 55% of those over the age of 85 years had at least some difficulty with home management activities, including activities of daily living (ADL) necessary for personal independence in the community. Avlund & Schultz-Larsen (1991) found that no one in their '70 year old' sample could perform such

activities without help. It has also been suggested that consumers are slow to complain about poorly designed goods and services and tend to blame their own loss of ability when they encounter difficulties.

Current databases used by designers, which include Bodyspace (Pheasant, 1996), Adultdata (Peebles & Norris, 1998), Peoplesize (Open Ergonomics Ltd) and Humanscale (Diffrient, Tilley & Bardagjy, 1978, 1981a, 1981b), typically present only very limited information concerning people who are older and/or disabled. A few studies have provided information on the characteristics and capabilities of the latter groups but the majority have shortcomings in that the sample sizes are very small and are not representative of the wide range of disabilities. For example, Humanscale contains information on reach capability of a group of wheelchair users which is based upon a study of 104 paraplegics with normal upper limb function by Floyd et al, 1966. These data thus clearly over-estimate the reach capability of many wheelchair users. Furthermore, Activities of Daily Living tests and disability indices used by clinicians such as the Arm Motor Ability Test (Kopp et al, 1997) give a general indication of disability, but are not sensitive to give a detailed understanding of dysfunction.

In order to truly support the designer when aspiring to 'design for all' and the broader average person, ergonomics data, including access, fit,

reach, vision, strength and posture, needs to be provided in a format which permits efficient integration with the designer's working methods, both now and in the future. Tables of data are known to be largely ineffective and designers prefer to see visualisations of design data (Porter & Porter, 1997, 1999). Most designers now use 3D computer-modelling systems to visualise and develop the physical aspects of their design work. There is consequently a need to also provide 3D information concerning people, including their size, functional reach, vision and strength and the prediction of the range of postures that would be required in order to conduct the specific tasks with the design being developed. Human modelling systems, such as SAMMIE (Figure 1), JACK and SAFEWORK provide 3D models of people that can be manipulated within a computer environment to provide such information (Case et al 1990, Porter et al 1995, 1996, and 1999).



Figure 1. SAMMIE human models

Such systems are well liked by an increasing number of designers as they are highly visual and provide ergonomics information that is completely integrated with the computer based design work. The main limitation of such systems with respect to the 'design for all' approach is that they rely upon the quality of existing databases which, as stated above, do not adequately represent people who are older and are disabled.

The research presented forms part of a larger project whose focus is the physical aspects of a particular design so that the whole population, including those who are older or are disabled, can be considered when evaluating multivariate issues

including access, fit, reach, vision, strength and posture. An important criterion when embracing the 'design for all' approach is the ability to predict the percentage of the population that will be catered for in a new design. Furthermore, the ability to determine who has been 'designed out' and why, is a necessary prerequisite to the iterative improvement of the design, possibly involving more adjustment, modular components or a new perspective on the solution entirely. To this end the project is concerned with a computer based design tool which will consider multivariate issues in a design situation and allow design teams to maximise the percentage accommodated by a particular design, including consideration of older and disabled people.

SURVEY OF CURRENT DESIGN PRACTICE

In order to establish the current situation regarding design in relation to the needs of older and disabled people, it was deemed necessary to conduct a survey of designers and other professionals involved in designing. The purpose was to investigate existing products, procedures and systems. It was also important for the success of the computer based design tool, to identify the needs of designers whilst attempting to 'design for all'. This paper will report on findings from these interviews to date.

Sampling

Publicly available lists were used to obtain a random sample of designers and other professionals for example, those produced by The Design Directory, Design Week and on the World Wide Web, thus avoiding selection bias. Companies were then contacted in order to screen them for selection for the telephone interviews.

Fifty individuals took part in the telephone interviews. Sampling issues included the size of the design group; the type of products designed (small domestic products, large appliances, fixtures etc); their experience in designing for older or disabled people; and their current use of CAD/CAM.

Designers were randomly selected to make up five sampling groups (Figure 2) roughly within the strata of size and product types to achieve as wide a

representation as possible, although the authors recognise that such a small sample cannot be truly representative.

Sample group	N
Large design companies/consultancies	10
Small design companies/consultancies	10
In house design teams	10
Designers of specialist products	10
Others (clients, architects, OT's)	10

Figure 2. Sampling groups

Interview Schedule

The interviews were semi-structured in nature, guided by carefully prepared questions around the issues to be explored, but neither the wording nor the exact order of the questions, were pre-determined. The majority of the questions were 'open ended' for flexibility and depth of information. The interviews were also exploratory, allowing discussion around the subject to evolve. Consequently, some of the interview dialogue reflected the views of experienced individuals rather than those of a particular company. The central questions and issues explored include the following: current practice; information sources regularly used (e.g. publications, Standards, the Internet); methodologies used (e.g. user trials, focus groups, questionnaires); technical data used (e.g. force data, anthropometric data); preferred format of data (paper based, computer based) and knowledge of user needs were explored particularly in relation to older/disabled individuals. Specific questions were also asked regarding their use of computer modelling systems (e.g. packages used, preferred platform, training needs). In addition, methods of evaluating product performance; quality; customer satisfaction; value for money and the need for modular products were discussed. Copies of any relevant material such as product information, proformas and data sources were also requested to enrich information obtained from the interviews. The interviews were recorded on audiotape, transcribed and then erased, assuring anonymity and confidentiality.

Several techniques were used to ensure truth-value or credibility of the work (Erlandson et al, 1993). For example, triangulation supports credibility by using multiple data sources to provide information about the same question. Also, member checking in the future will allow the interviewees to respond to interpretations from the interviews, for example, by verifying conclusions in reports and by discussing the results during meetings.

PRELIMINARY RESULTS

The interviews are currently taking place, but preliminary findings have indicated the following:

- i) Design teams do not often involve users in the design process until the product is near completion, or else they only involve a few users who may not reflect the variety of different users.
- ii) Surprisingly, design teams rarely evaluate early prototypes or existing designs themselves with awareness of the different types of user and in the environment in which the product would be used. Empathetic modelling would enable the identification of the types of problems with existing products.
- iii) Design teams follow the specification placed by the client and, unless specifically requested, they do not attempt to include the needs of older and disabled people.
- iv) Available data tends to be patchy and rarely in sufficient detail (e.g. task specific forces, grip strength) to enable professionals engaged in product design to make more informed decisions.
- v) Existing data tools are not in a format or language that designers can access and relate to easily. Diagrams, modelling, interactions with users are preferred.
- vi) Designers indicated that they preferred quick, easily accessible data gathering methods due to constraints on their time.
- vii) The majority of designers used at least one CAD/CAM package and most of these designers used more than one.

Further quantitative analysis will be presented at the conference.

ACKNOWLEDGEMENTS

The authors would like to thank the EPSRC for funding this research. We are also very grateful to the designers and other professionals who gave up their time to support us.

REFERENCES

- Ashworth, J.B., Reuben, D.B. and Benton, L.A., 1994, Functional profile of healthy older persons. *Age & Aging*, 23, 34-39.
- Avlund, K. and Schulz-Larsen, K., 1991, What do 70 year old men and women actually do? And what are they able to do? *Aging*, 3, 39-49.
- Case, K., Porter, J.M. and Bonney, M.C., 1990, SAMMIE: A Man and Workplace Modelling System. In: *Computer-Aided Ergonomics*, eds. W. Karwowski, A. Genaidy and S.S. Asfour, 31-56, Taylor & Francis Ltd.
- Diffrient, Tilley & Bardagjy, 1978, *Human Scale 1/2/3*. Cambridge, Mass.: MIT Press).
- Diffrient, Tilley & Harman, 1981a *Human Scale 4/5/6* Cambridge, Mass.: MIT Press).
- Diffrient, Tilley & Harman, 1981b *Human Scale 7/8/9*. Cambridge, Mass.: MIT Press).
- Erlandson, D.A., Harris, E.L., Skipper, B.L. and Allen, S.D., 1993, *Doing Naturalistic Inquiry*, California: Sage Publications Inc.
- Floyd, W.F., Guttman, L., Wycliffe-Noble, C., Parkes, K.R. and Ward, J., 1966, A study of the space requirements of wheelchair users. *Paraplegia*, 4 (1), 24-37.
- Kopp, B., and Kunkel, A. et al , 1997, The arm motor ability test: Reliability, validity and sensitivity to change of an instrument for assessing disabilities in activities of daily living, *Archives of Physical Medicine and Rehabilitation*, 78, 615-620.
- Peebles, L. and Norris, B. 1998, *Adultdata, The Handbook of Anthropometric and Strength Measurements – Data for Design Safety*. Department of Trade and Industry, London.
- Peoplesize, 1998, Open Ergonomics Ltd., Loughborough, Leics., UK.
- Pheasant, S.T., 1996, *Bodyspace: Anthropometry, ergonomics and the design of work*. Taylor & Francis.
- Porter, C. S. and Porter, J. M., 1999, Designing for usability: input of ergonomics information at an appropriate point, and appropriate form, in the design process. In: *Human factors in Product Design*, eds. P. Jordan and W Green, 15-25, Taylor & Francis.
- Porter, C.S. and Porter, J.M., 1997, The interface between ergonomists and product designers. In: *Proceedings of the 13th Triennial Congress of the International Ergonomics Association*, Finland, eds. Seppala, P., Luopajarvi, T., Nygard, C-H. and Mattila, M. 2, 240-242. Finnish Institute of Occupational Health. ISBN: 951-802-189-9.
- Porter, J.M., Case, K. and Freer, M.T., 1996, SAMMIE: a 3D human modelling computer aided ergonomics design system. *Co-design Journal*, s2 07, 68-75.
- Porter, J.M., Case, K. and Freer, M.T., 1999, Computer aided design and human models. In: *Handbook of Industrial Ergonomics*, eds. W. Karwowski, and W. Marras, 479-500, Florida: CRC Press LLC.
- Porter, J.M., Freer, M., Case, K. and Bonney, M.C., 1995, *Computer Aided Ergonomics and Workspace Design*. In: *Evaluation of Human Work : A Practical Ergonomics Methodology*, 2nd edition, eds. J.A. Wilson and E.N. Corlett, 574-620, Taylor & Francis Ltd.
- Sandhu, J., 1997, Profit by design. In: *Proceedings of a conference organised by the British Institute for Design and Disability*, London, Oct 1997 12-13, ed. I. McLaren, Glasgow School of Art ISBN 0 901904 66X.