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Translating inclusive capability data for designers

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Abstract

In 2009, the UK government launched a new strategy called 'Building a society for all ages: a choice for older people'. One of the major challenges outlined in this strategy document is for old age to no longer be a time of dependency and exclusion. In relation to product design, accurate and relevant capability data is essential in helping designers overcome this challenge. However, there is a large and growing body of literature that suggests current capability datasets provide little if any assistance to designers in helping them reduce dependency and exclusion.

This paper reports on the process of translating visual capability data into a usable form for designers. It details the need to consider inclusion data as opposed to exclusion data and how capability data can be converted into inclusion percentages using z-scores. The paper also reports on the findings of a design research workshop where 3 data concepts were trialed. Findings suggest that the aesthetics/semantics of a dataset may be one of the key factors that contribute to its use by designers in industry. Also, one of the factors to emerge from this research is the importance of explaining the context of the data and the issues surrounding it.

Introduction

In today's society we are experiencing enormous demographic changes. In short, increased life expectancy and reduced birth rates have resulted in a greater proportion of older adults (65+ years) within today's society. In 2007, it was estimated that there were 9.8 million people aged 65+ years in the UK; this is projected to dramatically increase to 16.1 million by 2032 [1]. As a result of these demographic changes, governments around the world have reviewed their strategies for meeting the challenges of our ageing society. In 2009, the UK government launched a new strategy called 'Building a society for all ages: a choice for older people' [2]. The strategy outlines 'The challenge ahead and a vision for the future' so that everyone in society has the chance to live fulfilling productive lives, whatever their age. One of the major challenges outlined in this strategy document is for old age to no longer be a time of dependency and exclusion.

In relation to everyday products, older adults can become excluded from using them for a variety of reasons (e.g. economic, cultural, social, lack of knowledge and

experience, overly complicated instructions/designs) [3]. However, the most common form of exclusion experienced by older adults is when there is a mismatch between the product demand and user capabilities [4]. More specifically, the capability demand of using the product is greater than the capability of the user, resulting in their being unable to access the product to achieve their goal [5]. The reason this form of exclusion is commonplace amongst older adults is because they have significantly reduced motor, sensory and cognitive capabilities compared to the rest of the population. This reduction in capability is due to the effects of the ageing process and the higher incidence of medical conditions with age. Thus, in order for dependency and exclusion to be prevented, designers have to understand and account for the reduced functional capabilities of older adults in their designs [5]. Older adult capability datasets are one of the key tools that can help designers to achieve this; however, a considerable amount of literature has been published on the impractical nature of such data.

In 2000, a survey was carried out with 50 design professionals who felt that capability data was 'patchy' and rarely sufficient in detail to enable them to make more informed decisions [6]. In 2006, a larger study with 87 industrial companies was conducted; findings identified lack of knowledge and inappropriate tools to be a significant barrier to the uptake of inclusive design in industry [7]. In a more recent survey (2009) it was found that 'out of date, boring and unexplained data' were the major factors contributing to the lack of use of such data [8]. Overall, it would appear that problems with capability data arise due to designers' poor understanding of them, what they are and how they can be applied [9].

It is evident from this large and growing body of literature that current capability datasets provide little if any assistance to designers in helping them reduce dependency and exclusion. In fact, they appear to present a barrier for designers, as opposed to being a tool that can assist in this process. If long established datasets such as Bodyspace [10], Human-scale [11] and Older AdultData [12] do not provide today's designers with the means to consider and apply older adult capability data to design, it begs the question, what is needed?

Capability data...what is required?

Over the past decade, a number of investigations have been conducted to identify what would encourage/aid the uptake of inclusive design in industry. Gyi et al [6] found that if an inclusive approach is to be adopted, then there are two key areas critical to its success:
1. The provision of accurate and relevant data on the target users
2. Efficient and effective support in the use and application of this data during product development

Gyi et al [6] further suggested that an important criterion when adopting the inclusive design approach would be to have the ability to determine who has been 'designed out' and why. In 2003, Dong et al [13] carried out a larger scale investigation into the UK and US industrial perspectives on inclusive design. The study confirmed that analytical design metrics that assess the inclusive merit of a product's design (i.e. the number of people excluded/unable to use a particular product and why) would greatly assist the implementation of inclusive design in business. Furthermore, Dong and Clarkson [14] reported that missing knowledge on potential and specific users' capabilities prohibits the uptake of inclusive design.

It would appear that the problem is not just related specifically to the type of data, but also in the way that it is presented. Nickpour and Dong [8] investigated designers' preferences for people data and found that it needed to be highly visual, simple and intuitive if they were going to use it. Cassim [15] also found visual formats are better than ones heavy on text for product designers, as such roles attract significant proportions of people with dyslexia.

Further factors highlighted as being important, include:

- Must be accessible (quick and easy access to information) [9]
- Must be presented at the right level of detail [9]
- Must not be too academic or authoritarian [9]
- Must fit with designers' work practices [9]
- Must be informative, inspiring and comprehensive [16]
- Guidance must be provided on data use so that it is applied appropriately and consistently; failure to do this may lead to disappointing results, and mistrust in the data [17]

In review of these findings, it is evident that these are all the things we as consumers, researchers and academics expect designers to achieve when designing everyday products. Why then have tools such as datasets been designed with very little if any consideration of such factors? Surely, datasets have users, who have preferences, abilities, lifestyles, jobs etc. It is apparent from this literature that data tools need to consider such factors if designers are to use them, and thus consider older adult capability in their design process. Also, tools in such a format may stop designers from using 'quick and dirty' methods such as asking friends and colleagues to gain user knowledge [15].

This paper reports on the design and development of an interactive inclusive design capability data resource for product and communication designers in industry. Specifically, it focuses on the translation of older adult (65+years) visual capability data (i.e. the smallest row of letters able to be read at 90%, 70%, 50% and 30% contrast) that was gathered in the initial phase of the research project [18]. The aims of this research were to determine how capability data can be converted into exclusion data, and how such data can be displayed to meet designers' requirements. A user-centred participatory design approach was adopted in order to fulfill the latter aim.

Translating capability data

For capability data to be suitable for exclusion data, precise information is needed on what people can and cannot do. In order to gather precise visual capability data, a fine scale of measurement was needed (i.e. small decrements in letter sizes between each row). Also, because a random proportionate sample was drawn from the population, the range of letter sizes used on each chart had to be large enough to capture the variability of visual capability in the population. One of the issues to emerge was the capability range between what a person can do and what a person cannot do - this can be described as what a person has difficulty doing. In relation to visual capability, it meant that participants began to identify letters incorrectly/make mistakes. As the participants moved down the chart to smaller letter rows, the number of letters read correctly decreased, until no more letters could be identified. This capability decrease can be seen illustrated in figure 1.

As shown in figure 1, there is a considerable gap between a user being able to successfully complete a visual task and being unable to complete it (excluded). Clearly from row 7 onwards the user would become excluded; however, at what point on the

scale would the user be included? In other words, at what point could the user independently complete the task without experiencing any difficulty or having to depend on someone else? At row 6, the capability data indicates that the user would have a 50/50 chance of being able to complete the task; thus, it is unlikely that independent product use could be achieved. However, at row 3 the capability data indicates the user would be able to independently complete the task successfully. Thus, exclusion data, in this case, may be slightly misleading as independent product use does not necessarily occur if demand is slightly reduced before the exclusion point. However, successful independent product use will result from the consideration and application of 'can do' inclusion data. Thus, in relation to the data collected from this study, it would appear that inclusion data would be more appropriate in helping to ensure independent product use and minimise dependency and exclusion.
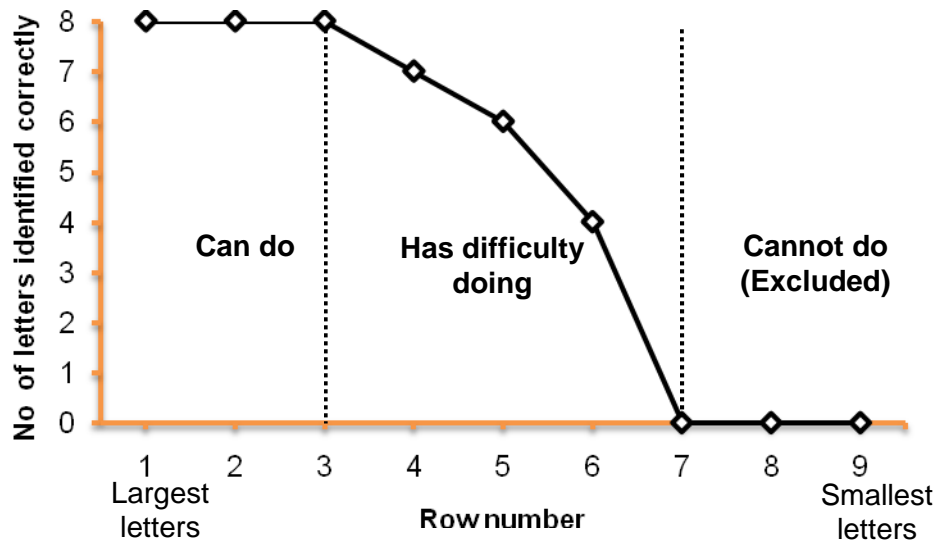

Figure 1. Example of how visual capability decreases

Generating inclusion percentages

As previously discussed, visual capability data needs to be translated into inclusion data for it to be of use. The next stage of the translation process focused on the conversion of statistical capability data into actual inclusion percentages. This was achieved through:

1. Converting the capability scores into z-scores (a score expressed as the number of standard deviations the score is from the mean of that set of scores)
2. Comparing the z-scores to the standard normal distribution/z-distribution table

The standardised table details the percentage of scores higher than this particular z-score within a normally distributed dataset. For this scenario, it referred to the percentage of people who would 'have difficulty' or could not read (become excluded) a particular point on the scale. How this works can be seen illustrated in figure 2.
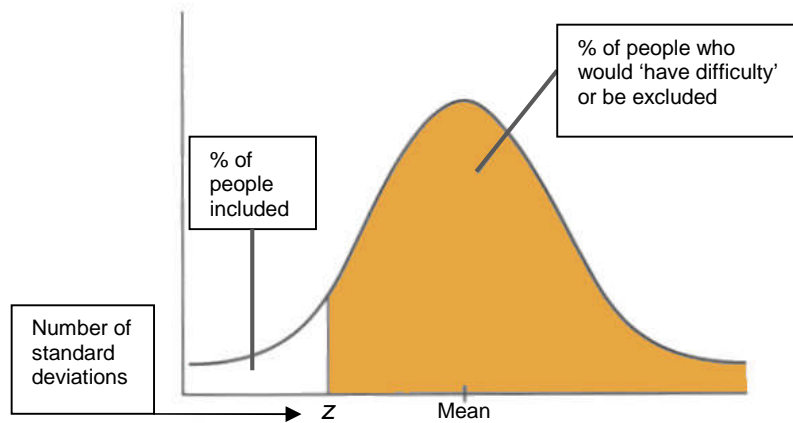
Figure 2. Calculating inclusion percentages through z-scores

As figure 2 illustrates, the standardised normal distribution table assumes the data is normally distributed; thus all data was checked for normality using a significant skew calculation [19] prior to using this method. Through using this translation method it was possible to generate inclusion percentages for all of the visual capability datasets gathered.

Format

The next stage of the research investigated what format the data should take in order for it to appeal to and meet the needs of designers. A participatory design approach was adopted to achieve this. In the initial phase, known as the discovery phase [20], the aim was to clarify the user's needs and agree on a desired format. Three basic concepts were generated: concept 1 was purely text based, concept 2 was mainly visual with very little text, and concept 3 was a combination of visual and text based (see figure 3, 4 and 5 respectively). The reason for having three distinctly different concepts was to agree on a preferred format for the data, i.e. amount of text vs. visual/graphical characteristics. Also, through asking designers to compare these three concepts allowed for past research into designers' preferences to be validated, text formats being unfavorable and visual formats being preferred. The data in each concept refers to the size and contrast of letter and the percentage of older adults (65+years) who could read it (i.e. would be included) (figures based on n=38).

Letter size	90% Contrast	70% Contrast	50% Contrast	30% Contrast
4.7mm	95%	90%	90%	70%
3.7mm	85%	75%	65%	35%
2.9mm	70%	50%	40%	10%
2.3mm	45%	30%	20%	<10%
1.8mm	30%	15%	<10%	<10%
1.45mm	10%	<10%	<10%	<10%

Figure 3: Concept 1 – text based format
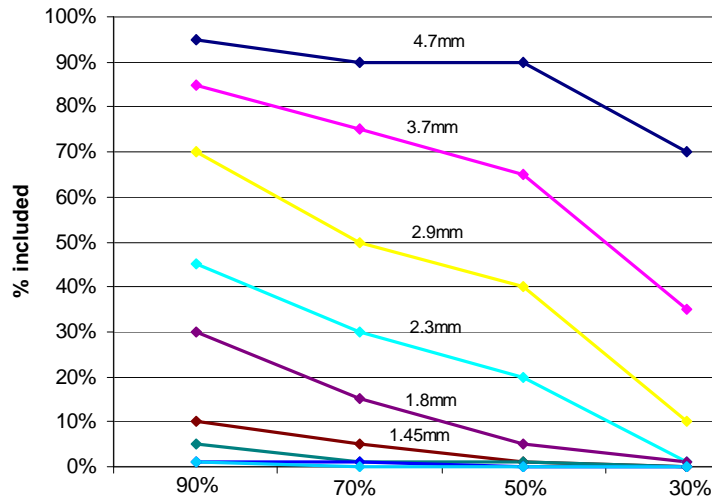
Figure 4. Concept 2 – visual format

	30% Contrast	50% Contrast	70% Contrast	90% Contrast
4.7mm	A 70% included	A 90% included	A 90% included	A 95% included
3.7mm	A 35% included	A 65% included	A 75% included	A 85% included
2.9mm	A 10% included	A 40% included	A 50% included	A 70% included
2.3mm	A < 10% included	A 20% included	A 30% included	A 45% included
1.8mm	A <10% included	A <10% included	A 15% included	A 30% included
1.45mm	A <10% included	A <10% included	A <10% included	A 10% included

Figure 5. Concept 3 – visual and text format

The three concepts were trialed during a design research workshop at the Include conference (London) in 2009. The workshop had 33 attendees, which included academics, researchers and professionals all with a design related background. The workshop consisted of 3 main stages:
1. Introduction to the data
2. Tool efficiency (participants were asked to complete tasks using each of the concepts)
3. Format preference (individuals were asked to vote for their preferred choice and give verbal feedback on their initial impressions)

Stage 2 was incorporated into this phase of research to determine the practical value of each of the data formats. Failure to incorporate such an activity runs the risk of the concepts being evaluated solely on their semantics and graphical qualities as opposed to their usefulness and usability [16]. During stage 2 participants were set a total of six tasks, completing two tasks per concept. For each task, a record was kept of which concept produced the fastest response. From this it was possible to suggest

which format was the most accessible and usable. The results from this are detailed in figure 6.
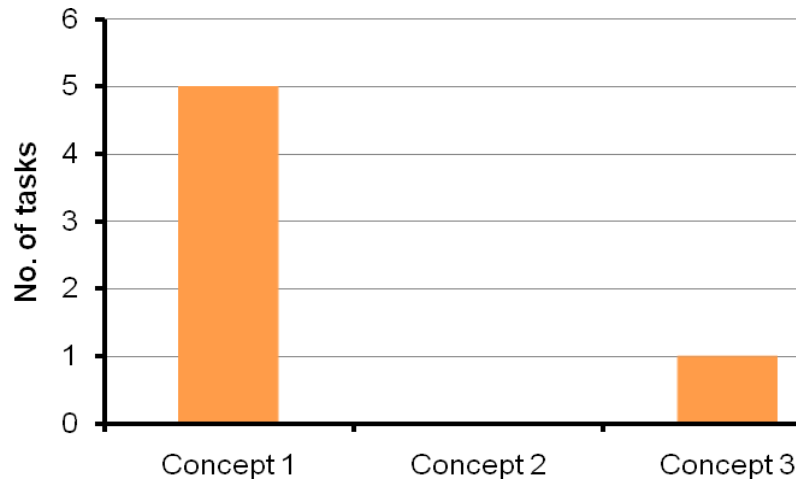

Figure 6. Chart to show which concept produced fastest response in stage 2

As shown in figure 6, in 5 out of 6 tasks (83%) the fastest response was given from participants using concept 1. Concept 2 did not produce the fastest response in any task and concept 3 only produced the fastest response for 1 task. This is interesting when compared to the results from stage 3 which investigated participants' preferences. After using each of the concepts, participants were asked to vote which they preferred; results from this can be seen in figure 7.
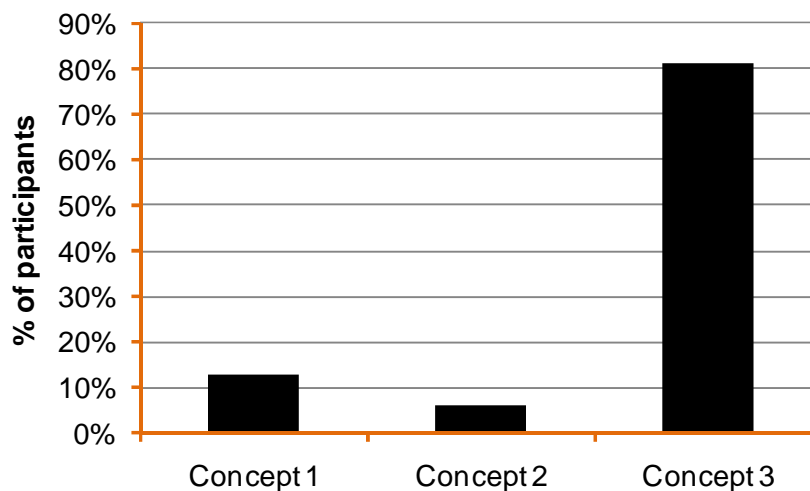

Figure 7. Participants' preference of Concepts 1, 2 and 3

It can be seen from figure 7 that only 11% of participants preferred concept 1, 6% preferred concept 2 and interestingly 81% preferred concept 3. What is surprising about this result is that concept 1 appeared to be the most accessible and usable of all concepts; however, the vast majority of participants preferred concept 3. This may be something that can be explained by the 'Aesthetic –Usability Effect' [21] whereby aesthetic designs are perceived as easier to use than less aesthetic designs. However, the extent to which participants considered usability when making their preference was

unknown. What is known is that aesthetic designs are more effective at fostering positive attitudes than unaesthetic designs, and make people more tolerant of design problems [21]. Also, designs that foster positive attitudes can evoke loyalty and patience which are all significant factors in the long-term usability and overall success of a design [21]. These findings were further supported by the five face-to-face interviews that were carried out with practicing designers after the workshop. Comments included "*It's got to be visually appealing, as I said we are all designers, and everyone has their own opinion but we all prefer things visually than in data/text,*" and "*if we are to use the data then it's got to look professional, it's got to look as if it has been designed for us, it has to communicate in our language, which is very visual.*" Based on these findings it would appear that the aesthetics/semantics of a dataset may be one of the key factors that contribute to its use by designers in industry.

Following the vote, participants were asked to give feedback on their initial impressions. The main points to arise were:
- Concept 1: "*dull, boring and looked much the same as any other dataset*"
- Concept 2 : *"difficult to interpret, the way it looked had little relevance to the data being presented, looked like a science graph"*
- Concept 3 : *"most visually appealing, puts the data in context, not sure what the colour scheme means"*

The most significant issue to arise from the discussions related to the context of the data. Participants stated that the first part of the workshop made them aware of the issues surrounding the data. This included factors to do with the ageing eye, ambient illumination and contrast. From this explanation, participants felt that they had been made fully aware of all the issues and could see why considering and applying such data was important. However, they expressed concerns that if presented with the data table alone, they would not be aware of such issues and thus may disregard the data. Overall, it would appear that explaining the context of the data and the issues surrounding it is a key factor in this translation process. However, this raises the question of how can this be achieved and embedded into a design tool?

Conclusions and future work

This paper has given an account of the process of translating older adult capability data into a form that is suitable for designers. In this investigation the aims were to determine how capability data can be converted into inclusion/exclusion data, and how such data can be displayed to meet designers' requirements.

The translation of statistical capability data into inclusion/exclusion percentages can be achieved through converting the data into z-scores and comparing it to the standard normal distribution table. However, consideration needs to be paid to whether inclusion or exclusion data is most appropriate. In relation to the visual capability data, inclusion percentages were felt to be most appropriate for ensuring independent product use of the visual characteristics.

Through adopting a participatory design approach it has been possible to verify what designers prefer from the onset, as opposed to prescribing what is perceived to be useful [16]. Out of all the designer requirements detailed, it would appear that the aesthetics/semantics of a dataset may be one of the key factors that contribute to its use by designers in industry. One of the factors to emerge from this research is the importance of explaining the context of the data and the issues surrounding it. Participants that attended the research design workshop felt that this was crucial if they

were to consider and apply the data. However, how this is communicated in a data tool is the next question that this research must answer. Prior to this, further work will be conducted with designers regarding the aesthetic format of the data.

Acknowledgements

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