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Anthropometrics without Numbers! An Investigation of Designers' Use and Preference of People Data

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Abstract

There is still missing knowledge to encourage and support designers in adoption and implementation of inclusive design. Some of this missing knowledge comes in the form of anthropometric data which provides accessible information on users' capabilities and limitations. Support and resources for designers on this type of data seems to be limited and exclusive. This study focuses on evaluating the existing use of anthropometric data by professional designers, aiming to explore means of presenting such data more effectively. Ten UK-based design consultancies were interviewed and completed questionnaires collecting information on designer's current use of anthropometric data, their suggestions on presentation of that data and their preferences on data tools. It is concluded that the use of anthropometric data sources by designers is very limited and minimal; experienced designers tend to rely mainly on experimental methods such as physical prototyping and engagement with people. The results provide insights into designers' existing approaches to data collection and use. This study highlights the need for development of a highly visual, simple and intuitive data tool based on the interviewed designers' preferences and suggestions. This has to be done by carefully adopting the designers' existing approaches to data collection and use and by adapting existing data into that.

Keywords

Anthropometric data, data tool, experienced designers, inclusive design

1. Introduction

Inclusive design needs to be effectively introduced and demonstrated as a positive design philosophy and promoted, supported and facilitated for designers and their

industrial clients. However, studies show that there is "missing knowledge" on both sides prohibiting further and wider uptake of inclusive design.

A piece of this missing knowledge on the side of designers is their data and information on potential and specific users [1], reflecting the variation in their user's capabilities, limitations and aspirations. Anthropometrics, which incorporates data on body size, shape, strength, mobility and flexibility [2], is one main source of such information.

Often, anthropometrics is regarded as the basis of a designer's knowledge [3], especially when they design physical products. Nevertheless, support for this knowledge from designers seems to be limited; tools such as the human modelling tool HADRIAN [4], the Sprout Webtool [5], the Inclusive Design Toolkit [6] as well as the Inclusive CAD tool [7] visualising biomechanical data of older adults, all collect new user data or adopt non-conventional data. None of these tools however, focus on existing anthropometric data that designers might have previously been educated to use as part of their design process. Integrating such data into inclusive design tools is yet to be considered.

Therefore a research project was established aiming at exploring effective means of presenting anthropometric data that facilitate inclusive design for professional designers. The study presented in this paper focuses on understanding the use of anthropometric data by professional designers: the requirements, challenges and opportunities such usage entails.

2. Methodology

In order to allow better understanding of different aspects of designers' use of anthropometric data and to provide comprehensive insights into future development of a data tool, three aspects of designers' general data behaviour in relation to the use of anthropometric data were investigated, including:

- **Data use**
- **Data preferences**
- **Data suggestions**

Both content and presentation of this data were considered in addressing each of the aforementioned aspects.

Interview and ranking questionnaires were adopted as the complementary methods, providing both qualitative and quantitative information. This was in order to prohibit future limitations in the analysis of the collected information [8]. The interviews were conducted between April and August 2008.

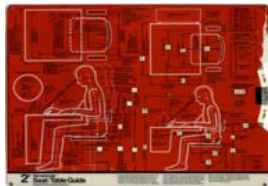
2.1 Interview

The interviews were conducted in a structured but open-ended manner. The questions asked, mainly covered current anthropometric data usage and appealed for suggestions on the ideal presentation of anthropometric data. Design consultancies (versus freelancers and in-house design teams) were targeted and experienced designers with medium/high management roles from 10 UK-based design consultancies were interviewed. The consultancies were selected based upon their main focus (product and industrial design) and for prior experience of working on an inclusive design brief (eight out of the ten design consultancies had attended the DBA Inclusive Design Challenge). In the preliminary stage of the research, a pilot interview was conducted with one design consultancy, resulting in revision and further development of the interview technique and the questionnaire.

2.2 Questionnaire

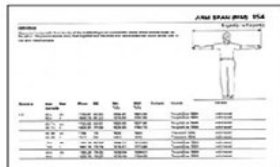
Five anthropometric data tools were presented to the designers which they then graded through use of a ranking questionnaire. The criteria for the selection of the tools were to cover a wide platform of sources, presentation formats, data types and also issues such as familiarity and accessibility. These criteria were chosen in order to provide extensive information on the designer 'preferences' aspect of data. The selected anthropometric data tools included:

Tool 1 – Humanscale (cards)



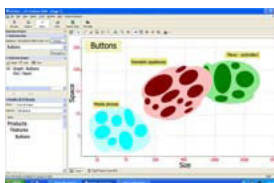
Humanscale [9] is a set of references in three volumes; each with two-sided pictorial selectors with rotating dials and accompanying manuals. The interactive card has dimensioned charts of human figures with factual data which shows the human body in some postures. The main feature of the tool is its rotating analogue wheel interface.

Tool 2 - Older adult data (handbook)

The image shows a page from the 'Older Adult data' handbook. It features a table with columns for 'Age', 'Sex', 'Mean', 'SD', '5th %ile', and '95th %ile'. The table lists various anthropometric measurements for different age groups and sexes. To the right of the table is a simple line drawing of a human figure with measurement lines.

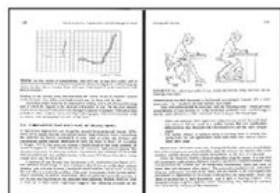
Older Adultdata [10] is a handbook with many data tables and simple illustrations on each page incorporating data on age, sex, MEAN, SD, 5th %ile and 95th %ile of the various populations. It is one of a series of three books on Child, Adult and Older adult data.

Tool 3 - Ergo-CES (software)



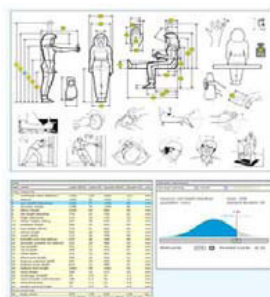
CES (Cambridge Engineering Selector) software was originally developed in the Cambridge Engineering department- It was used as a construction tool to present some ideas on a prototype data tool. As software tool, Ergo- CES enables 2D data visualisation & comparison through 'browse', 'select' and 'search' functions for relevant anthropometric data on products and people.

Tool 4 – Bodyspace (textbook)



"Bodyspace [2] is a book published in many editions and widely used in design schools. The book incorporates data and guidelines and includes data for UK population. It provides insights into the principles and practice of anthropometrics, workspace design etc.

Tool 5 – Dined (website)



Dined [11] is an online web-based data source open for the use of public. The tool incorporates a number of main measurements with the selection of age and gender and visualisation of percentages in an interactive diagram. The tool has been developed by TU Delft University and the data were collected in Netherlands.

3. Results

Ten interview sessions were held with eleven interviewees and ten questionnaires were completed. The results from each method are presented below.

3.1 Interview results

Interviews provided information on two aspects of designers' behaviour in relation to use of anthropometric data:

- **current use and data perceptions**
- **suggestions and ideas for future means of presenting data**

• Current use & perceptions of anthropometric data

Experienced designers' current use and evaluation of existing anthropometric data was investigated through a series of questions addressing their perspectives on the data sources in terms of: type, communication, satisfaction, trust, perceived problems and personal reservations. Table 1 summarises each design consultancy's main field of expertise, the current data sources used by each one, the type of data and information they use and their perceptions of existing anthropometric data sources.

Table 1: Summary of current data use

Design Consultancy	Current data sources	Type of data	Perceptions on existing data
(A) Product design	Measuring people, prototyping, client's data, benchmarking, web search, working with users	Experimental, guidelines, standards	Out of date, irrelevant not useful, not clear, inaccurate
(B) Interior design	Standard diagram of average person, manufacturer templates	Disability regulations, experimental	Out of date, not inspiring, irrelevant
(C) Product design	User feedback, meet real users through the clients, model making, manufacturer's & client's data, web search	Experimental, standards, safety regulations	Out of date, complicated, not appealing, not dynamic
(D) Product & service innovation	Model making, measuring & testing with people in the studio, books, ergonomist	Experimental, guidelines, standards	Out of date, Irrelevant, not useful, hard to work with
(E) Healthcare innovation & design	Working with users & collecting data, prototyping, client's data, measuring and testing	Experimental, standards	Not applicable, out of date, hard to work with, not inclusive, irrelevant
(F) Industrial design	Measuring and testing with the users, prototyping, videos from the focus groups, web search, ergonomist, one book	Experimental, Standards & guidelines	Out of date, unreliable, irrelevant, easily misinterpreted, unavailable
(G) Product design & strategy	Model making & testing with people in the studio & outside, asking experts, client's data, manikins in Auto CAD	Experimental, standards & legislation, guidelines	Out of date, not appealing, unreliable
(H) Industrial design	Prototyping & testing with users, books, web search, British Standards, client's data	Experimental, standards & legislations	Out of date, not applicable, needs to be processed & refined
(I) Product design	Client's data and expertise, model making & testing, web search, professionals' network	Experimental, legislation & standards	Out of date, confusing, Not easy to use
(J) Industrial design	Prototyping and testing with people, web search, client's data	Experimental, standards	Out of date, not appealing, irrelevant, incomplete, confusing

Table 2 reports typical quotes from the interviewees, mainly addressing their perceptions of ergonomics, anthropometrics and the relevant issues regarding them.

Table 2: Selected interviewees' quotes on ergonomics and anthropometric data

Design Consultancy	Interviewees' quotes
(A) Product design	<i>"For me, going to a booklet of stuff is very useful sometimes, but I would use it not very often. I would tend to rely on my experience and the discussion and feedbacks from the person who I am actually talking to".</i>
(B) Interior design	<i>"There is no inspiration in the available data right now, and aspiration is what gets the people excited."</i>
(C) Product design	<i>"Ergonomics is a complicated science but actually it is also common sense so there are certain top line things to know; we need the tip of the iceberg!"</i>
(D) Product & service innovation	<i>"With anthropometrics, a lot of the data tends to work with maximums and minimums, but it doesn't relate to how someone perceives that. It doesn't give you any sense of the perception of the quality; there is no data on perceptive and cognitive feedback of the user. "</i>
(E) Healthcare innovation & design	<i>"A designer doesn't think in numbers. What we do is an intuitive emotive thing. And I think basically all these (anthropometric) tools are given for scientists. Ergonomics is a science!"</i>
(F) Industrial design	<i>"I think our typical projects do not demand this data (anthropometric); we can do % 99 of our commissions on gut feeling and common sense genuinely!"</i>
(G) Product design & strategy	<i>"At least after 10 minutes, I want getting something useful out of that (anthropometric data tool), not spending half an hour and not finding any thing, not to have to absorb every bit of it!"</i>
(H) Industrial design	<i>"For the purpose of inclusive design, you need data that is linked to an explanation of the data and provides an understanding."</i>
(I) Product design	<i>"We have a sort of pragmatic approach to it. The data is fine but you have to understand what you are looking at, it is not just fine if you have all the data but you do not really understand how to interpret it!"</i>
(J) Industrial design	<i>"Ergonomics is not something we often call specialists for. We have got reasonable idea of what is good and what is bad and that is based on our experience. So it is approaching through twenty years of industry experience!"</i>

• Suggestions on data presentation

The designers were asked about their suggestions and ideas on effective and desirable means of presenting anthropometric data. Table 3 summarises the main suggestions from each design consultancy on anthropometric data presentation.

Table 3: Summary of suggested means for anthropometric data presentation

Design Consultancy	Suggestions on effective means of presenting data
(A) Product design	3D software simulating a person determined by age, gender and physical and mental capabilities

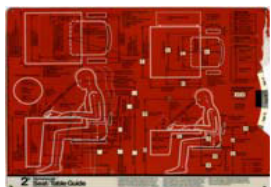
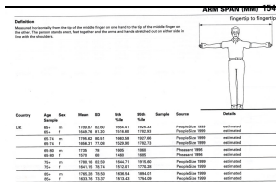
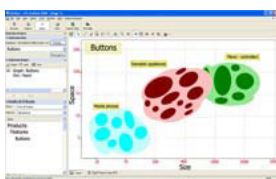
(B) Interior design	2D tool with an easily adjustable person to be dragged and dropped in various designed environments
(C) Product design	A PlayStation version of a tool to simulate a person with specific age, gender and physical abilities in a specific position
(D) Product & service innovation	2D Software enabling documentation of consultancy's own collected data
(E) Healthcare innovation & design	Software presenting a set of examples of best and worst practice products versus each other enabling comparison and seeing the percentile each fitted
(F) Industrial design	Ergonomic Facebook with confidential immediate access to millions of people
(G) Product design & strategy	Fully equipped up-to-date lab with adjustable products and services for test
(H) Industrial design	3D software simulating a flexible human body with changing figure, capable of producing new measurements of unmeasured body parts
(I) Product design	3D CAD model of person to be put into Auto CAD showing how the human and environment relate to the CAD modelling of the product
(J) Industrial design	2D software capable of adding and sorting already collected data to be shared by all designers

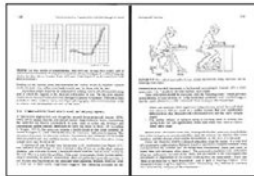
3.2 Questionnaire results

• Preferences on existing data tools

Table 4 summarises the designers' preferences of the five data presentation tools. The numbers in the 'highest' cell shows how many designers ranked the tool the highest (i.e. most preferred) and the numbers in the 'lowest' cells shows how many designers ranked the tool the lowest (i.e. least preferred).

Table 4: Summary of the designers' preferences on existing data tools

Anthropometric data tool	Highest	Lowest	Comments
	2	3	Holistic, interesting presentation of data, outdated, irrelevant, too much information
	2	1	Simple, easy to use, boring, unexplained, separated data
	5	0	Complex, good features, unprofessional graphics, too analytic, time-taking to work with



Tool 4
Book incorporating data
and guidelines

0 6

Comprehensive, too
much text, academic,
student-oriented, lacking
colour, too scientific



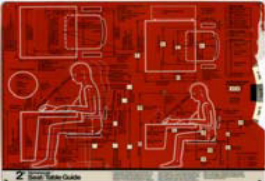
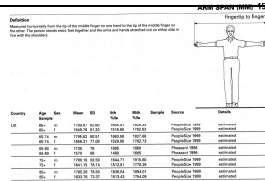
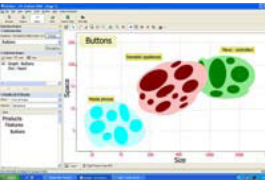
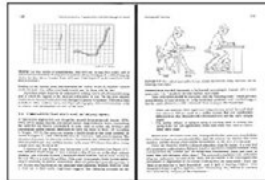

Tool 5
Web-based resource
enabling selection of
data and visualisation
of percentages

1 0

Interactive, accessible,
visually unprofessional,
irrelevant data, useful
features

Table 5 presents selected comments made by interviewees on the five anthropometric data tools. Two quotes have been chosen for each tool, demonstrating the range and variety of positive and negative responds received from the designers interviewed.

Table 5: Selected interviewees' quotes on the existing data tools

Anthropometric data tool	Interviewees' quotes
	<p><i>"How many products do we design where such data is relevant?"</i></p> <p><i>"I think there is something tangible about this tool that is immediately fascinating!"</i></p>
	<p><i>"What is this measurement? Is it in units or? What does it mean?!"</i></p> <p><i>"I'm crap at reading books and data! It just bores me!"</i></p>
	<p><i>"I do not think I would ever get involved in that level of data for what I do, It's a bit scary!"</i></p> <p><i>"It has a PowerPoint feeling which I don't like, not good quality professional graphics! However, it is quite comprehensive and diverse."</i></p>
	<p><i>"Every designer should read this book, and I should read it again. Well... if I have time!"</i></p> <p><i>"I hate it! This green book is like a math book and math is a big NO! I wouldn't bother text, I want pictures and sizes."</i></p>
	<p><i>"It's PC language, not Apple language; a Mac would do that better!"</i></p> <p><i>"This interactive graph is brilliant!"</i></p>

4. Discussion

• Designers' current use & perceptions on anthropometric data

When asked about their current sources of anthropometric data, designers hardly mentioned any existing data tool they would use as part of their design process. Many interviewees reported they had not used such data tools for a considerable time. Comments such as *"I don't think I have actually used an ergonomic chart for ten years or so!"* were very common amongst the interviewees.

Instead, the designer's main stated methods of data collection, highlighted in the summarised results in Table 1, were practical, pragmatic and included prototyping (model making, rig building, mock ups) and working with people (both measuring and asking for user feedback).

Clients and manufacturers were also an important source of data, and they often provided information such as guidelines, standards and legislation. The majority of the designers interviewed reported relying on their common sense, intuition and experiences as the inherent source of data; therefore the major type of data implemented into their design process was experimental. The other major type of data was the ever-increasing rules and regulations introduced by governing institutions.

The anthropometric data was considered just a "starting point". Most designers had largely negative and passive perception on the existing data. Table 2 clearly addresses some of the main concerns from the design industry regarding the existing data. The data being "out of date", "irrelevant" and "hard to understand and work with" were the main comments made repeatedly by almost all the designers. Compared to designers' own practical methods of collecting data, referring to anthropometric data tools was considered as neither an effective nor efficient way of working.

• Designers' suggestions on means of data presentation

Various ideas were explored and suggested; 3D data representation was preferred against 2D data and designers expressed enthusiasm for simulations of people which might take into consideration variants such as age, gender as well as user physical and mental capabilities. However, some challenged their own suggested ideas by questioning the feasibility of such complicated 3D human simulations and the subsequent level of complexity of such software. Most designers stated they would prefer a simple, intuitive, highly visual tool which is fast, easy to learn and easy to work with.

• Designers' preferences on anthropometric data tools

In terms of the ranking of anthropometric data tools, each interviewee had very different ideas, making it hard to derive conclusions about the tools based on simply adding up the ranking scores. The qualitative comments on each tool - as seen in Table 5 - also had a considerable diversity. However, by looking at the most and least preferred tools in Table 4, some conclusion could be drawn. For example, Tool 3; software enabling 2D visualisation and comparison of data received the highest score. It was ranked first (1) by 50% of interviewees. In contrast, Tool 4, a book with unstructured information and data, received the lowest score; it was ranked last (5) by 60% of interviewees.

The remaining three tools received a combination of contradictory rankings from the lowest to the highest. All the tools received both negative and positive comments and in some cases a feature considered as highly positive by one designer was evaluated as distracting by another. However, features such as having too much text and lacking in colour and pictures were considered dissatisfying by all the designers. On the other hand, features such as being simple and interactive were specified as requirements by all designers.

5. Tool specifications & further work

• Tool specifications

Based on the findings from the interviews and questionnaires, a series of specifications for potential data tools were developed [12]. The tool specifications were put under the three categories of Usefulness, Usability and Desirability as the main elements in the hierarchy of user experience [13]. Table 6 summarises the data tools specifications in each category.

Table 6: Specifications for potential data tools

Category	Specification
Desirability	Inspiration – inspirational as well as informative for the user Interactivity – high level of user engagement Professionalism – high graphic and visual quality Flow – balance between user's skills and complexity of tasks
Usability	Ease of learning – learning curve Simplicity – simple to use and work with Intuitiveness – intuitive to work with Accessibility – accessible to all users Adaptability – capability of data manipulation Level of detail – right level of detail for the user Compatibility – compatible with other software packages used by designers
Usefulness	Relevance – content of the data Reliability – source and up-datedness of the data Clarity – explanation of the data Availability – cost / access of the data

• Further work

After the investigation stage, based on the raised issues regarding designers' data use, evaluations, preferences and suggestions, a number of tool concepts were formulated and further developed into mock-up data tools.

In order to communicate the findings of the study, get the designers' feedback on the formulated tool concepts and involve designers as users to co-design the tools, a series of workshops with designers were planned and feedback was received from two early workshops.

6. Conclusion

This study shows that experienced designers' use of existing anthropometric data tools (i.e. books, handbooks, software packages, online sources, etc) in design consultancies is minimal and limited.

The study also highlights the dominant role of experimental methods i.e. physical prototyping and engaging with people to provide designers with data and information during their design process. Experienced designers perceive and evaluate such methods as more effective and useful compared to referring to anthropometric data sources.

However, based on the designers' suggestions and preferences, there is potential for data tools to be designed and developed specifically for designers and with the intention of them being better accommodated within their design process. This has to be done by carefully adopting designers' existing approach to the collection and usage of anthropometric data and by adapting existing anthropometric data sources into that workflow.

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