Ergonomics from Ethnography: Inclusive Design Insights

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Abstract

As user centred design methods become more important for inclusive design, designers increasingly use methods borrowed from other disciplines such as Ethnography to gain insights into user behaviour. But what are the advantages in using ethnography to understand ergonomic requirements? And what form of insights does it result in? This paper offers findings and reflections from a design ethnographic case study of older people. It found that advantages in using ethnography lies in the depth and breadth of findings, resulting in a broad range of ergonomic and usability insights, and a deep understanding of lead users.

Keywords.

inclusive design, user centred design, usability, older people, aging, ageing, lead users, product design, anthropology, ethnographic research

Introduction

Since the 1960s, inclusive and universal design approaches have offered designers strong guidelines to ensure that they include the greatest extent of users (Mace, 1997). These guidelines are commonly used as the sole procedure in inclusive designing, however with the publication of the European standard I.S. EN 17161:2019, involving users is now seen as a requirement when designing products (NSAI, 2019).

Designing appropriate inclusive products requires deep unbiased understanding of their needs. The user centred design ethos suggests keeping users and key stakeholders central to research and included in methodologies (Don Norman, 1988). Methods in User Centred Design have been shaped by numerous disciplines. The most significant influences have been disciplines with people and cultures at their core. Henry Dreyfuss can be seen as the first influential Industrial Designer to cross disciplines in meeting the demands of people and

design; through simplifying complex anthropometrics he created seminal texts for designers such as *Designing for People* (1955) and *The Measure of Man* (1960).

The 1980s saw the company PARC Xerox utilise anthropological methods for design in industry. At a stage where computer systems were moving from specialised labs into more mainstream applications; researchers noted disparity between what people said and did and hence required a first-hand view of usage (Blomberg, Burrell, & Guest, 2003). In doing this, Ethnography, a branch of Anthropology, was used for its methods and approach. The term 'Design Ethnography' was created by ethnographers Tony Salvador, Genevieve Bell and Ken Anderson who offered this explanation of the emerging field:

> "Design Ethnography focuses on the broad patterns of everyday life that are important and relevant specifically for the conception, design, and development of new products and services" (Salvador, Bell, & Anderson, 1999, p.36)

But what are the advanages in using ethnography to understand ergonomic requirements? and what form of insights does it result in? This paper offers findings and reflections from a design ethnographic case study of older people.

Design Ethnographic Case Study

The purpose of this research was to use ethnographic methods to enquire into future cooking and heating product design for older adults. The research involved design ethnographic fieldwork over twelve months within the homes of forty older adult participants across from various socio-economic groups. Fieldwork was conducted within the domestic environment, understanding how older people cooked food and heated their homes, together with identifying problems (ergonomic and otherwise) they encountered with products. The data collection methods used were: Informal conversational interviews, Participant and Artefact Observation and Participatory Techniques (White, 2012, 2013a, 2013b, 2018; White & Devitt, 2011).

The following is an account of the ergonomic findings.

2.1.1. Physical Ergonomic Needs

For older people, using conventional cooking and heating products requires a great deal of physical effort. Physical effort that younger, more able users may perceive as undemanding such as bending and reaching, this becomes more challenging with age related physical

decline. The physical design and ergonomics of products have a huge bearing on the difficulty level older people have in achieving everyday tasks and should not be overlooked in its importance. In a study of older people and tasks undertaken in the home, Seidel et al., found that physical acts such as bending and stooping accounted for 45 per cent of overall difficulty with cooking (2010). Evidence of the same was pronounced in this fieldwork with all postural movements being problematic.

Reaching up and bending down for product use was a central issue, as was stretching, reaching, hand dexterity (twisting, turning and grip strength) and overall mobility. Sufferers of arthritis, falls victims, and victims of stroke were most afflicted, this was noted to infringe greatly on personal independence. A telling example of this was described by a couple both suffering with osteoarthritis. While bending down to retrieve an item from her cooker, a female participant with both knees bent, could not regain a standing position, her husband in an attempt to retrieve her suffered the same fate. This resulted in both kneeling on the ground in pain unable to get up and stranded 10 metres away from their panic button. This scenario occurred as a result of physical ergonomic design conditions - a low positioned oven with a deep reach inside the oven. These common design features in cooking products also provide problems in cleaning and maintenance.

2.1.1.1.Lead Users

For solutions to product ergonomic issues, it was observed that older adults adapted products and behaviours to suit posture and reach. The scenario just outlined resulted in the participant always having a chair placed adjacent to her to act as leverage in getting up off the ground after using her oven. More direct and permanent solutions were also seen, such as in Figure 1. This shows a solution created by a male participant in adjusting product ergonomics to suit posture, reach and product visibility. These examples displayed characteristics of lead user activity (Von Hippel, 2005). Many examples of which were shown in adjusting the height of or ‘sightline’ of products. Observing lead users offered unique insights into the issues of product physical ergonomics, and design considerations regarding possible redesign solutions. Lead users acting as ‘co-designers’ this study made suggestions for redesign to suit posture; one suggestion was the requirement of side-hinge oven door openings to prevent unnecessary postural extension.

Figure 1 : Examples of lead user adaptations in the home. A cupboard designed to suit posture when using a refrigerator, and a steamer stand designed to be visible at sightline.

Participant quote:"I raised my fridge up so I could see everything in it...you couldn't use it without bending down and trying to be an acrobat every time you wanted something. I would do that to my cooker if I could"

2.1.1.2.Ergonomic Aids

Products that prevent postural stretch and reach, such as reaching aids (informally known as "grabbers"), were essential items in the home. Similar aids are required to be designed to assist hand dexterity: twisting, turning, and gripping, particularly for victims of stroke and arthritis sufferers. This also extended to older people with haptic impairments, for instance, touch, or an inability to feel heat or cold in their fingers and hands. Here it could be possible to design products to compensate through other sensory responses in products e.g. sight or sound. Similarly, compensating for older people with vision or hearing impairments is vital. This demonstrated the need for customising products and controls to compensate for personal physical impairments. A scenario could be if a user had a slight hearing impairment and this prevented her from hearing an audible bell for her cooker timer; this could be compensated for by customising a bright or flashing indicator recognisable by sight.

This customisation follows through to mobility adaptors on products. The inclusion and provision for mobility adaptors are important both in the direct physical operation of products and indirect use. Firstly, it was seen that cooking and heating products are used as stopping or rest points while moving through the home. Secondly they are used as leverage points, for

example using a handle of a cooker or a mantel piece as a means of getting up from a chair. Mobility aids in general greatly aid ergonomic requirements and mobility in the home. The main disadvantage seen from conventional mobility aids and adaptors was that they stigmatised and reflected “disability” in both presence and aesthetic.

2.1.2. Cognitive Ergonomics

Along with physical ergonomic needs, many cognitive requirements also have to be addressed for future products. Research by Lewis et al., demonstrates that our cognitive ability to operate products decline as we age (2007). Therefore, fitting products to user’s cognitive ability or cognitive perception of use is even more pertinent as we age. A broad range of cooking and heating products are completely unusable by older adults. This was not just as a result of cognitive decline but of poorly designed product features, and with non-intuitive functionality. Reoccurring examples were product controls and interfaces, especially heating thermostats (Figure 2. with caption). These were continually referred to as over complicated devices both cognitively and physically, difficult to read, understand, and hence operate.

Cooking and heating product complexity was to blame for many design communication failings such as the following:

- The psychological understanding of product functions not being explicit, leading to ambiguity of meaning.

- Poor layout and composition of important operational controls. Not considering design arrangement to the mental models or learnt conventions of the user or to what the user traditionally associates as the correct means of use. An example of this was the “mapping” (Don. Norman, 1988) of controls on a cooker hob not relating to the actual operational layout.

- Complex terminology of functions, poor graphics and semiotics, ill defined colours textures and contrasts, all lead to sensory confusion and potential to cause serious errors. Additionally, poorly manufactured products and poorly printed interfaces deteriorate with time and lose communication quality with use. For example: graphics and text fading off important controls.

- Limited sensory feedback: “Seeing is believing” was a reoccurring statement from the field research. For example in oven cooking, cooking at eyelevel and having the ability to clearly view food being cooked through a glazed panel empowered users.

Figure 2 : Cognitive Ergonomics: troublesome thermostats

Participant Quotation: “I don’t understand how to use it so I just leave it on”

2.1.2.1.User Experience Extremes

In this research, experience extremes were ‘measured’ as to a participant’s prior experience, knowledge, and confidence of product usability. One characteristic example of an ‘experience extreme’ was observed in levels of cooking experience. On one extreme, experienced cooks, usually (traditionally) women with lifelong cooking skills, in some instances over eighty years experience cooking for large numbers. In contrast to this, on the other end of the ‘extreme spectrum’ was the complete novice, in some instances with only six months experience

In later life, lack of experience in using products and technology leads to negative usability experiences (Grincell, White, & Dempsey, 2017, White et al, 2020). Even in participants with a desire to learn, lack of experience was commonly seen to knock confidence. Observed was a mixture of fear, apathy and feelings of being ‘outwitted’ when learning to use and operate

products. Many occasions demonstrated that older people learning to use a new product or technology felt "foolish" and often felt outsmarted (illustrated in Figure 3. with caption).

Figure 3: Negative experiences in learning technology: A male participant learning to use his laptop and his struggles with technology

Participant Quotation: "When I do something wrong [on the laptop] I always feel there is someone in there thinking I'm an old eejit for not knowing what to do next"

2.1.2.2.User Capability Extremes

In this research, capability extremes were 'measured' by levels of physical or cognitive capability a participant had in using a product, or in their ability to complete tasks. 'Capability extremes' were closely aligned with 'experience extremes' observed specifically in ergonomic factors of products. Contrasts in user capability extremes were typically as a result of levels of motor, cognitive decline, or mobility impairments a participant had. For example, on one end of the 'user capability extreme' older people with excellent cognitive and motor functioning excelled at product understanding and use. On the other end of the extreme older people with very poor mobility, vision and hearing who struggled to operate fundamental products and therefore had reduced independence.

Most evident were usability issues based on sensory responses e.g. visibility, audibility, or in the fundamental understanding of controls and interfaces. These issues of communication

between products and users were especially common place with poor sensory feedback from products. It is here that usability crossed over into emotive and cognitive streams. Norman describes these as the "behavioural" aspects of products (2004). When a product fails to meet a sensory feedback or behavioural need, this leads to frustration, instilling negative emotions. There is a real need for cooking and heating products to act more in a behavioural sense, by communicating fully and clearly to the user, making usability and interaction an intuitive experience rather than a negative one.

2.1.3. Conclusions and Reflections

In this ethnographic study it was found that there is a major ergonomic requirement to compensate for the physical and cognitive decline we encounter as we age, meaning designers continually need to fit products to the older user more, both in body and in mind. Findings from this study reinforced the importance of user centred design approaches in understanding ergonomic needs for older people. New knowledge and insights from ethnography can lead to many new ergonomic improvement measures in design of products, uncovering many unforeseen possibilities to improve ergonomics, usability, allowing them to be more inclusive.

In reflecting on this study (Gibbs, 1988) it was found that the advantages in using ethnography to understand ergonomic requirements lies in the depth and breadth of findings; resulting in a broad range of ergonomic and usability insights, and a deep understanding of lead users. Ethnography offers an empathic view and understanding of the spectrums of users for example 'user extremes' and 'capability extremes' and can lead to a better understanding of mental models of users and understanding first-hand when features are overly complex.

Ethnographic research methods offer insights into real situations, real users in the context of use. They are qualitative in nature, capturing an unfiltered voice of the user. This can be especially useful when sharing ergonomic insights with other designers and engineers, acting as probes or prompts in the design process. Design ethnographic studies are particularly useful at the early stage of understanding ergonomic needs or in conceptual work, supplementing inclusive design guidelines. The contextual nature of ethnography, listening to the voice of the user and seeing actions and movement of users, can ensure inclusive insights are captured and adapted early in the design process. This also exposes designers to problem

areas difficult to reach and understand within usual work setting, such as lab and studio based work environments.

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