Empathy, Design and Human Factors

Andree Woodcock[1(✉)], Deana McDonagh[2], Jane Osmond[1], and Wesley Scott[1]

[1] Centre for Mobility and Transport, Coventry University, Priory Street, Coventry CV1 5FB, UK
{A.Woodcock, J.Osmond}@coventry.ac.uk, scottw@uni.coventry.ac.uk
[2] Beckman Institute of Advanced Science and Technology, University of Illinois Urbana Champaign, Illinois 61820, USA
mcdonagh@illinois.edu

Abstract. With rapid changes to inclusivity, accessibility, technology and the global economy, there is a need to appreciate and understand the way in which real people actually engage and interact with products, systems and services. Designers need to go beyond the merely functional. To do this they need to develop deeper understanding of users, which goes beyond mere categorization of user types and characteristics. They need to have the ability and confidence to try new ways of finding information and gaining 'authentic experiences.' Empathy has been recognized as a key skill by practicing designers. This paper introduces empathy, shows why it is important, and provides evidence for a greater need of empathy during design and research activities. The paper is built around two case studies from our work on design for older user, which illustrate the need for more empathy in codesign activities and insights students gather using experience prototypes.

Keywords: Design process · Education · Evaluation · Older users · Breakdown analysis

1 Introduction

Between 2015 and 2030 the number of people in the world aged 60 and over is projected to grow by 56%, from 901 million to 1.4 billion [7], many of whom will have age related disabilities. With increasing urbanisation, the quality of life for senior city dwellers is often significantly low. Despite the assertion that "healthy older people are a resource for their families, their communities and the economy" [13], most cities fail to appreciate this or realise the opportunities that working with seniors can provide. To be sustainable and attractive, cities must provide the structures and services to support all residents' wellbeing and productivity. Being mobile and having access to transportation is critical to reducing the feeling of isolation and sustaining a high quality of life. Seniors need to be part of consultation processes, listened to, and environments/facilities provided which enable them to take an active place in their cities. This has now been mandated in disability acts [e.g. 19, 26].

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Having witnessed a variety of engagement events - from one to one interviews, focus groups, town hall and committee meetings - we have regretfully found the engagement to be tokenistic and contributions ignored or considered low priority. Seniors should be considered as expert users about products and services designed for them, which is underpinned by their extensive knowledge accrued from successfully living, working and negotiating urban environments. They possess knowledge through formal education and employment; they also have a wealth of tacit knowledge that, if released and valued, could be used for product, service and system innovation. This paper considers the extent to which designers truly understand the perspective of older people and vulnerable user groups, and how this can be improved.

2 Empathy

[1] commented that "empathy is the most important personality trait for a human factors engineer to have". Others have taken a similar perspective, for example [2] suggested that successful design requires the integration of human factors and an empathy with the users, whilst [3] state it is imperative for the creation of user-friendly products.

Empathy is defined as 'the intuitive ability to identify with other people's thoughts and feelings – their motivations, emotional and mental models, values, priorities, preferences, and inner conflicts' [8]. [5] described it as involving crawling inside another's skin, seeing the world through their eyes and experiencing it in the same way. Such an approach provides an insight and understanding of users required in ergonomics and which should be communicated through design [6].

Empathic design refers to products, services and environments satisfying the needs of customers/consumers that goes beyond functional requirements. It assumes that all functional needs are satisfied and focuses upon the 'supra-functional' ones, such as cultural, social, aspirational and emotional needs [9, 10].

Like user centred design, empathic design was born out of a realisation by companies that users wanted more from their products and technology alone would not sell them. In the empathy economy users search for deeper meaning from material objects. Function needs to be enhanced by meeting the ephemeral emotional needs of users [1] and empathy can provide commercial advantage by enabling designers to realize the needs that users themselves may be unaware of or unable to articulate [8].

The strength of empathic design lies in raising awareness of 'what makes life rich, personal and meaningful' [11]. The term 'empathic horizon' has been used to indicate a designer's ability to empathise beyond certain characteristics of his or her group, such as nationality, background, age, gender, culture, experience and education [12]. This can change over time, e.g. by training and experience. Empathic designers need to be able to reflect on and use their experiences to inform their own design and be able to communicate that to other team members. Our paper looks at the extent to which empathic design has been evidenced in a 'typical' codesign type activity and addresses ways to nurture it during design practice and training.

Despite the human-centred design disciplines being naturally focused on the 'user', empathetic qualitative approaches are needed to inform and inspire designers to help

them understand the personal experience and private context of the 'other' [14, 15]. This concurs with [16] who concluded that designers needed empathy and that this requires making an emotional connection with the user, understanding their situation and why certain experiences are meaningful to them by a range of approaches (e.g. immersion in the life of the users, design probes, imaginative projection) [15, 17].

Empathy in design requires deliberate practice [18]. [20] stressed that the willingness of designers to engage in empathic experiences is key. Given that most designers begin by using an 'I methodology: design for themselves' [41] and most design students are typically aged between 18–21, this group can be expected to have 'limited life experience' [6]. Consequently, given the ageing population, there is a need for methods that can conceptually move students beyond an 'I methodology' so they can expand their empathic horizon [28].

The rest of this paper considers (a) evidence to suggest a lack of willingness and ability to engage empathically with users, and (b) ways in which this might be addressed.

3 Have We Got It Right

Research would suggest that empathic design is not used as fully as hoped. This is evidenced in a range of products and services from furniture design [21] through to the design of assistive technology products [22] and transport services [23]. This is not to say that excellence is not out there. However, lack of empathy by the designs of products, services and systems has the unfortunate consequence of having adverse effects on the quality of life for the most vulnerable members of society. Research [24, 25] indicates an urgent need for the recognition of the needs of SCAN users (Specific, Critical and Additional Needs) to be taken into consideration at all stages of the design process. Part of his recommendations to designers involves the need to better understand the user's lived experience as the foundation on which to build interactions.

Outlined below are two approaches to gathering data from users from an empathic viewpoint.

3.1 Case Study 1: Breakdown Analysis

Breakdown Analysis (BA) provides diagnostic information from rich data created in task focused system usage [29] where users speak or act naturally. A breakdown may be defined as the moment when a user becomes conscious of the properties of the system and has to mentally breakdown or decompose his or her understanding of it in order to rationalise the problem experienced [30].

Although most typically used in computer mediated communication (CMC), this approach is an extension of [31–33] research combining breakdown analysis with Task-User-Tool-Environment (TUTE) [34] analysis to the design of computer systems, teaching materials and international computer mediated communication. Breakdowns were classified as shown in Table 1 [31].

Table 1. Overview of breakdowns

Type of breakdown	Definition
1. User - task	1.1 User has difficulties understanding the task 1.2 User does not have the necessary knowledge to accomplish objectives
2. User - tool	In CMC these related to hardware and software interfaces. In codesign there may be a number of tools provided, but the breakdowns may still be classified as relating to: 2.1 tool failure (where a technical problem occurs) 2.2 user not understanding how to use the tool
3. User-environment	The user becomes aware of an intrusive property of the environment e.g. bright light shining on the screen, noise from other rooms, accessibility
4. User-user	Breakdowns in communication between users in terms of: 4.1 Sufficiency; information provided is not sufficient for understanding intention 4.2 Clarity; message is inaudible or illegible 4.3 Comprehension: cultural differences lead to failures of comprehension 4.4 Attention: loss of attention because of absorption in task or distraction 4.5 Co-ordination: users fail to co-ordinate their utterances/action and interrupt each other 4.6 Feedback: when the source does not receive any acknowledgement from the receiver

This approach was utilised with workshop participants drawn from three groups: (1) seniors (from 50–95 years of age) with a number of disabilities (e.g. mobility and cognitive impairments), age related conditions (e.g. impaired vision, arthritis) and differing levels of education and (2) transport stakeholders (professionals) and (3) designers only workshop. Three workshops were observed with over 50 participants and the key findings are outlined as follows [37].

User-task breakdowns

1. *Understanding the task*. Workshop participants needed more time to settle into the task, gain an overview of the workshop, its aims, and to understand the flow of sessions. All nonacademic groups struggled with secondary tasks (e.g. registration and ethical compliance forms). Proactive, roving facilitators briefed in the 'workshop journey' and the overall aims provided essential support (e.g. reminding, writing, and recording). Although tasks and schedules were kept on the screen for reference, verbal reminders were essential.

Tasks needed to be reinforced, presented in different ways, using the participant's vernacular, and related to their experience – especially as people joined the workshop at different stages. Workshops had to be adapted and reframed to reflect the abilities/interests and experience of the participants. The language used needed to be non-jargonistic, straightforward with a high level of information redundancy and

presented in different ways. The leader and facilitators needed to be empathic, adaptive and have first-hand knowledge of the users 'world' and abilities.

If there is lack of clarity about the objectives and how to reach them or they change, participants become confused, demotivated, discouraged and use the workshop for other purposes. When participants are interested and engaged in a topic, they will discuss it enthusiastically and exchange information. The rate of production can easily outstrip data capture. Physical modelling, and remodeling outside of the users frame of reference were not understood, and participants (except for the design group) appeared bemused at what was expected of them. Although recording of events on social media is successful with some groups, this was not appropriate for seniors in our workshops, who found new media/ICT difficult to use.

2. *Skills needed to meet objectives*. The workshops required participants to write down key words, tell stories and relate items to each other. Tasks, which require seniors restructuring, and carrying materials, fine or gross motor control, visual acuity, standing and moving around obstacles should be minimised. During the workshop, more age friendly materials were introduced and tasks requiring high levels of dexterity performed in advance or by workshop helpers.

User-tool breakdowns

1. Tool failure: Although the process of writing on tags and joining words/ideas/stories together has proved successful with certain populations, it was not appropriate to the seniors in our workshops. The age appropriateness of workshop materials needs to be considered: e.g. seniors may have impaired vision, arthritic hands, cannot write easily or manipulate small objects, and may become cognitively overloaded when a lot of instructions and alternatives are presented (a notable problem arose with regard to the use of colour coding). Methods which rely on sight and text based communication were perceptually and cognitively challenging.

Not being able to use the materials or retain an oversight of how activities joined together would have led to frustration, disengagement and tasks being completed incorrectly without the intervention of facilitators.

2. User not understanding how to use the tool: notably some seniors did not enjoy experimenting with how different materials could be used together. They were confused by the plethora of material provided which detracted from their ability to concentrate on the task. Workshop materials need to be tested in advance to make sure that they are compatible, usable and fit for purpose (e.g. clips need to be the right size to attach items together).

User-environment. Rooms were selected which were accessible, with large spaces for maneuvering wheelchairs, guide dogs and provision for support workers. Thermal, acoustic and visual comfort was considered in relation to blinds and air-conditioning, noise from machines and movement of large parties in shared spaces. Tables need to be height adjustable, set up in advance with consideration on how they will be reconfigured through the workshop and how people with poor mobility can move round them. Activities that require participants to move round tables, look over tables, read

writing across tables in non-standard orientations, or look at/interact with materials was problematic. Material presented via a computer (e.g. PowerPoint presentations) needed to be clear, in large font sizes, specific to the workshop and should be reproduced beforehand in different formats. A variety of hot and cold refreshments were made available bearing in mind allergies and conditions such as diabetes.

User-user breakdowns. Dialogue in the workshops was purposeful and mostly task related, about sharing experiences and linking ideas. Participants quickly engaged on the task and enjoyed telling others what they had done. However, they did not like being asked to retell their stories if they could not see the point. Additionally it was very easy for one person to dominate working groups. The following points should be considered in reducing user-user breakdowns bearing in mind different disciplines/ stakeholders, the drifting of participants and the need to use information/data after the workshop.

1. *Sufficiency*; is the information communicated sufficient for understanding? Personal narratives and joint stories create rich pictures from which an empathic designer can work. However, as narratives become reduced to phrases or words on post it notes without context, misinterpretations and misrepresentations can occur, especially when initial instructions (such as colour coding) have been forgotten and material is merged. This was of key concern to elders, who did not understand that the 'tags' were building blocks and would be discarded/reappropriated later in the workshop.
2. *Clarity*; messages may become inaudible in rooms with poor acoustics, where people speak at the same time on or the speaker has a quiet voice (as with seniors). This also affects the quality of data capture. Where writing is used to convey key points it may become illegible if written quickly, on small pieces of paper, with large sized pens of where people have lost the ability to manipulate writing instruments e.g. with arthritis. Clarity may also be affected by poor/inappropriate word choice. Participants need to be allowed time and space to understand the contributions of others and make their own contributions.
3. *Comprehension*: The data from the two workshops was not combined to avoid issues related to differences in the use of language and cultural issues. However, differences in comprehension might occur within a workshop because of stakeholder involvement (e.g. between elders and transport planners and researchers). One person in a group may understand the task and drive a group, which was seen as distorting power relationships and leading to tokenistic engagement.
4. *Attention*: Loss of attention, because of absorption in task or distraction. In workshops where everyone is talking, has limited attention spans, or is progressing at different rates, attention is a major issue that requires good communication and time management skills from the leader and facilitators to keep the group on track.
5. *Co-ordination*: users fail to co-ordinate their utterances/action and interrupt each other. The seniors worked on different narratives, at different rates, and with different levels of understanding of the task. Here facilitators are needed to ensure methodological rigour e.g. that actions are coordinated, completed and comparable across groups.
6. *Feedback*: Participants and related stakeholder groups need timely feedback about outcomes and how their input contributed to the results and the impact this might have.

This obligation should be addressed as an integral part of all citizen engagement activities and is essential for preserving continued commitment of participants, who may have contributed their time and knowledge for no tangible reward.

The conduct of the workshops clearly showed that more attention needed to be placed in understanding the needs of the users in order to bring out the best from them. Whilst the activities were demonstrably appropriate to some populations (e.g. designers), they were not appropriate to the seniors, who became frustrated and disappointed with the outcomes. Breakdown analysis proved a quick and useful way of analysing what occurred during the sessions.

The focus of the paper now shifts attention to ways in which empathy can be encouraged in designers; the central argument being that designers need empathy and knowledge of end users in order to develop effective research instruments.

3.2 Case Study 2: Low Fidelity Simulation

[35] described three classes of tools that can promote empathy in designers: techniques for direct contact between designers and users (research), techniques for communicating findings of user studies to design teams (communication) and techniques for evoking the designer's own experiences in a domain relevant to the user (ideation).

Low fidelity prototypes were used as empathic modelling devices to enable 5 students (and their companions) to experience travel as an senior person with mobility issues. The aim was to show how experiencing travel with impaired vision/hearing, and/or limited mobility in either hands and/or legs could bring about new perspectives. The inclusion of a companion kept the students safe, but also provided a means of capturing reflection-in-action [36]. Students were able to verbalise, comment and share their experiences and feelings as they occurred. These were recorded for later analysis and were added to an online repository. There were 5 phases to the study:

1. **Receptivity.** A class of over 50 students was introduced to 'empathy' with a motivational lecture (delivered by the second author) and the offer of generous financial compensation for volunteers. Less than ten expressed interest in the programme even though many were undertaking projects that required knowledge of older or vulnerable users.
2. **Discovery.** The five volunteer student designers, making up the final cohort, were provided with tutorial support, written material and a small classroom immersive experience to raise their curiosity. This involved them trying to read labels/open packages and eat with reduced vision, hearing, mobility and tactile impairments. They further explored this in their home environment. Uploading and sharing experiences reinforced group cohesion and added new insights.
3. **Immersion.** At this stage the designer moves out of work space and explores the user's world. As the focus of the project was the design of transport for aging populations, students were required to perform all activities involved in travelling from the university to the main rail station, boarding a train to a local station and returning. To support this 'experience prototyping', low fidelity simulations were

used including a range of visual impairment glasses (to simulate glaucoma, macular degeneration and cataracts), mobility impairments (crutches, wheelchair, and stiffened legs) and hearing loss. A companion looked after the students and taped significant moments. On arrival at the destination, students took on another simulation.

4. **Connection.** This was achieved in the debrief sessions. Students were given 'quick note' sheets to record their thoughts before, during and after the experience. They were required to upload and share their videos and talk about their experiences in a group tutorial. Here the students were required to connect with the user by remembering experiences and what it felt like to be in that position.
5. **Detachment.** This involves the student stepping back into the role of designer, to deploy the new insights into the current design task. As this exercise occurred half way through the design project, it could not shape the initial design. Instead students were prompted to comment and show how their initial design thinking and concept designs would change as a result of their experiences, for example by placing more attention on visual cues for ingress and egress of vehicles, and look at the overall customer experience of getting on to the train.

Student responses included comments such as:

- **Difficulty:** Much more difficult than anticipated. This came as a real shock to the students. They are used to developing personas and characterising 'older and vulnerable users', but experiencing disabilities first hand seemed to come as a 'shock', for example, "I thought it wouldn't be that difficult."
- **Vulnerability:** Students were unaccustomed to feeling vulnerable in a way that a physical impairment made them feel. "I felt so inadequate, frustrated and scared"; "Felt everyone was watching me and judging me"; "I felt so incredibly self-conscious and uncomfortable."
- **Cultural imprints:** Culture issues came to the surface. "It caused a fuss. Being British no one likes a fuss."
- **Normality:** It is a process that disrupts one's experience of activity of daily living.
- **Non-verbal cues:** Impairing vision or hearing or both restricts how a person understands the context within which they are placed making them feel vulnerable. "I couldn't read peoples' faces… or their intentions."

In summary, the students found that moving through public space with impairments was more difficult than they anticipated. Specific issues raised included the length of ramps, difficulties using (seeing) ticket machines, finding lifts and signs, navigating stairs, crossing the road safely. Students felt vulnerable and fatigued even after a two-hour session. They reported feeling embarrassed at being too slow or a hindrance when they could not interact quickly enough to buy bus tickets, they felt isolated and scared when they were not able to see people clearly or read their facial expressions.

They were relieved to be able to shed their 'disabilities' at the end of the session and commented that they would not feel confident enough to go out alone with their particular disabilities. Evidence from student comments showed that their empathic horizon had developed/grown. They had more insights into why someone walked more slowly, needed support, and were unsure where to go, which appeared to translate out

of the classroom, and helped them gain new insights into 'how the world actually worked' for people with mobility issues.

This case study has illustrated that it is possible to temporarily shift the empathic horizons of students through a small-scale design intervention. With work still in progress in this study, it seems that there is also a need to continually reinforce and remind students about what they learnt so that their insights are not lost when they start to consider other design issues.

4 Conclusions: Improving Practice

Best practice in research training and preparation provides opportunities for pilot studies, iterative design of research instruments and mock data analysis. Where possible pilot studies should be conducted on populations that are similar to the end user population. Additionally, almost all data gathering events are concluded with a feedback sheet in which respondents are able to provide feedback. The authors argue that such systems may only be tokenistic and may not sufficiently challenge the level of empathy or understanding the designer/researcher has of their participants. Three methods to address this have been presented in this paper.

Firstly, in case study 1, breakdown analysis was demonstrated as a quick, informal way of understanding where research activities could be improved, specifically through understanding when the needs of the participants have not been sufficiently understood in codesign activities.

Secondly, in his postgraduate studies, Scott [24, 25] has realized the need to provide designers with guidelines to better accommodate users and participants with SCAN in design and requirements gathering processes. These guidelines will encourage researchers and designers to think more carefully about the organization and operationalisation of data collection.

Thirdly, in case study 2 we have demonstrated the way in which empathy modelling can be used to stimulate and encourage empathic thinking in designers and the activities that need to be put in place for them to gain maximum benefit from these experiences.

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