Assessment of the book-borrowing service provided by Loughborough University Library with respect to the needs of the disabled and the elderly

Contents

Introduction

The Loughborough University library provides a number of services to students and members of the public over the age of 18 (Lboro, a, b). These include:

- Access to books, magazines and journals
    - Borrowing
    - Browsing
    - Online access
- Learning support
    - Topic-specific workshops and events (e.g. maths skills)
    - General skill development (e.g. note-taking, time management)
- Internet-enabled computers
- Printers
    - Scanning
    - Photocopying
- Working areas
    - Individual
    - Group

A number of provisions have been made with the intent of providing for users with additional needs (Lboro, c), however it is worth investigating how the system as a whole contributes to the independent living of the elderly and people with disabilities.

Persad, Langdon and Clarkson (2007a, 2007b) present a model of usability wherein users have varying levels of ability in a number of dimensions (broken down into sensory, cognitive, motor, and further subcategories), and products (generalisable to services) present a number of demands for some or all of these dimensions in order to be effectively used. The greater the user's abilities are compared to the product/service demands, the greater the ease-of-use therein.

Ability (used here synonymously with 'capability') is defined by Carroll (1993:8) as "the possible variations over individuals in the liminal levels of task difficulty… at

which… individuals perform successfully on a defined class of tasks", which is to say the extent to which one can accomplish a given measure.

User-sensitive inclusive design is proposed by Newell and Gregor (2000) as a paradigm for considering the abilities of less capable potential users, such that the product demands may be decreased to allow effective use by more people. It is also noted that there may be trade-offs between people with different impairments, where decreasing demand in one dimension necessitates increase in another (Newell *et al.*, 2011).

The concept that 'improving design for the disabled tends to benefit those who are more able' becomes more apparent, when considering disability as multi-dimensional and contextual, something that affects everyone to some degree rather than only impacting a distinct minority group (Bickenbach *et al.*, 1999).

Not only do the capability losses associated with age and disability create useful criteria for limiting users, their consideration is particularly important given their already large, and increasing, numbers. People aged 60+ are projected to grow worldwide by 56% between 2015 and 2030, reaching 1.4 billion (UN, 2015). WHO (2011) estimates that approximately 15% of people worldwide, over a billion, are living with disability, up from 10% in the 1970s.

Personas - fictional archetypal users based on synthesis of traits and behaviours of multiple people - are presented as a method for applying inclusive design principles (Newell *et al.*, 2011; Marshall *et al.*, 2015). They provide a realistic synthesis of concerns in a format that designers can appreciate, and a set of capabilities against which the demands of the product can be analysed.

Between 1997 and 2004, consistently at least 70% of activities undertaken by library visitors each year involved borrowing/returning books (Creaser, Maynard, and White, 2006). These data were based on public libraries, so numbers may differ somewhat for an academic library such as Loughborough's, however this provides a useful base from which to work. The same source also showed that 65-74 year olds were consistently the 10-year age bracket with the most use of public libraries (18.1%

average across the 8 years). This corresponds with those who would typically be considered in their ‘third age’ (Hitchcock *et al.*, 2001): those who have retired, but who retain most of their capabilities.

Aim:

Assessment of the Loughborough University library service in terms of its accessibility, usability and acceptability for older and disabled persons - how well it satisfies their needs as users (Nielsen, 1994).

Methodology

The assessment of the library will take the form of an expert evaluation using personas. Reece (2016) used a bottom-up method of assessment for the expert evaluation of a product's design - comparison between product demands and estimated user capabilities. It was reflected that this worked well, but added that additional top-down recommendations may be beneficial. As such, this report will apply much of the same methodology, but incorporate guidelines on web and building accessibility. The method will also consider the impact of humans in the service.

The assessment contained aspects both easier and more challenging than the previous evaluation. The task is determined before the evaluation, and so the context of activity can be better defined, however the number of interacting components in the library service system (Wilson, 2014) preclude an exhaustive analysis. To provide a more feasible analysis, a task was chosen that is both common for the service, and provides a 'vertical slice' of many aspects. Given the previous statistics on libraries, borrowing/returning a book was the obvious choice.

A systematic method should improve test-retest and inter-rater reliability, without eliminating the component of expert judgment. The decided format (details follow) was:

- Create checklist of dimensions of user capability, and estimates of difficulties
- Create a theoretically exhaustive/generalized Hierarchical Task Analysis (HTA)
- Create 2 complementary personas
- Individualize HTA for each persona
- Go through the process for each persona
- For each task note discrepancies between service demands and estimated user capabilities
- Consider top-down recommendations (e.g. web/building audit)

Characteristic	Reference(s)
1. Sensory	
a. Visual	
i. Visual acuity	Pinto *et al*. (1997); Haigh (1993)
ii. Contrast sensitivity	Haigh (1993)
iii. Colour perception	Haigh (1993)
iv. Useful field of view	Scialfa *et al.* (1994)
v. Stereopsis (depth perception)	Haigh (1993)
b. Auditory	
i. Pure tone detection thresholds	
α. (High) Frequency	Haigh (1993)
β. Volume	Haigh (1993)
ii. Speech recognition (for men)	Dubno *et al.* (1997)
iii. Sound localisation	Cranford *et al.* (1993)
2. Cognitive	
a. Working memory (WM)	
i. Storage capacity	Salthouse and Babcock (1991)
ii. Processing speed	Salthouse and Babcock (1991)
b. Long-term memory (LTM)	
i. Recall	Craik and McDowd (1987)
ii. Recognition (to lesser extent)	Craik and McDowd (1987)
c. Mental models (based on WM & LTM)	*Cañas, Antolí and Quesada (2001)**
d. Language processing speed	Brébion (2001)
3. Motor	
a. Upper limb capabilities	
i. Reach ranges for each arm	Smith, Norris & Peebles (2000)
ii. Force exertion	Goodpaster *et al.* (2006)
ii. Grasping, dexterity	Carmeli, Patish and Coleman (2003)
b. Gross body movement capabilities	
i. Bending ranges	Smith, Norris & Peebles (2000)
ii. Locomotion	Prince *et al.* (1997)
4. Anthropometrics	Smith, Norris & Peebles (2000)
5. Errors	Reason (2000); Norman (2002)

Table 1: Characteristics that are negatively affected by age. Disabilities may take the form of impairment of any combination of these. Used as a checklist.
**N.B. Cañas, Antolí and Quesada (2001) discusses the relationship between WM, LTM and mental models, not the influence of age directly. From Reece, (2016)*

User Capabilities

Persad, Langdon and Clarkson (2007a) present a number of dimensions to consider in product (and service) evaluation. Reece (2016) used these as a checklist (Table 1) successfully, so these will be used again here unchanged.

General Hierarchical Task Analysis

A general HTA of the main methods of using the library service was created based on the library website (Lboro, b) and the author's personal use and observations (Appendix A). This was created following standard guidelines in tabular format (Shepherd 1998, 2001; Shepherd and Stammers 2005; Stanton 2006).

Persona Development

In order to broaden the range of results achieved, 2 personas were created that would be challenged in different ways during 'use' of the library. The aim was to create limiting users that would realistically employ the service. Persona creation was informed by Pruitt and Adlin (2010). See Appendix B for full personas.

An elderly male persona called Charles was strongly influenced by examples from 'CURE', a set of elderly personas based on data collected from 12,500 Europeans over 60 (Wöckl *et al.*, 2012). Charles is a recently retired man with osteoarthritis, "the leading cause of disability in later life" (March and Bachmeier, 1997), difficulty with locomotion and bending

Rosie is an outgoing 20-year old sports science student at Loughborough who also plays in a hockey team. She recently broke her ankle and so is now getting around using crutches.

Individualised Task Analysis

The task journeys that both Charles and Rosie would take were subsets of the generalised task analysis, based on their personas, as noted in the left column of Appendix A.

Website evaluation

Website evaluation was not performed rigorously, only issues that presented themselves during the intended task were noted. The general sensory and cognitive demand criteria were added to by research-based guidelines on web design for the elderly (Zaphiris, Ghiawadwala and Mughal, 2005).

On-site evaluation

Each persona's task journey was recreated on site, considering the checklist of capabilities and recommendations for inclusive building design (Lacey, 2004; National Disability Authority, 2014) at each stage.

Results and Discussion

Identifying and locating a book (Charles only)

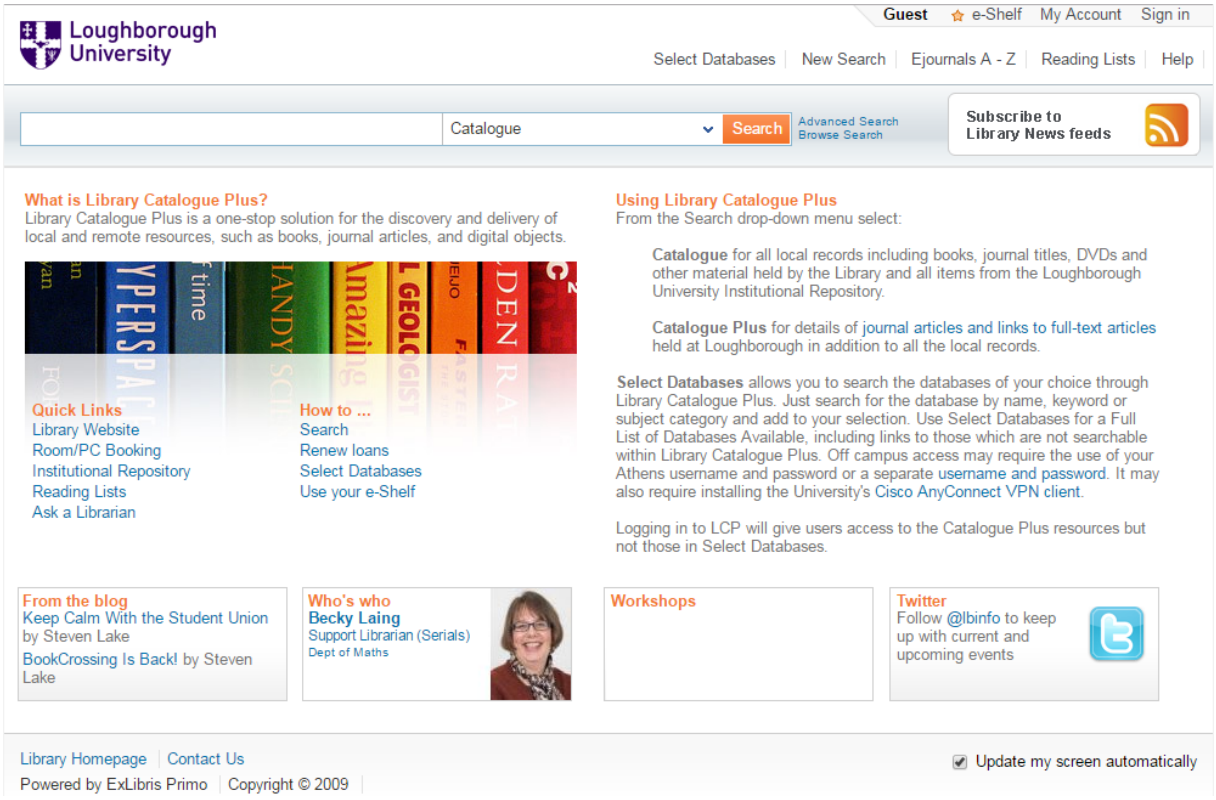

Figure 1: Library website front page

Charles only goes to the library to pick up books he already knows he wants, so his first step is to try to find a book he wants on the library website.

Key points:

- There is a lot of explanatory text, which is mostly small and not obviously resizable.
- The search box starts with focus when the page opens, which is helpful for drawing one's eye to it, however the only indication of this is the blinking caret. This is insufficient.
- Colour is mostly used well to distinguish key features (e.g. the search button), but the most colourful and eye-catching element on the page is merely decorative (the colourful book spines). This distracts from the rest of the page.

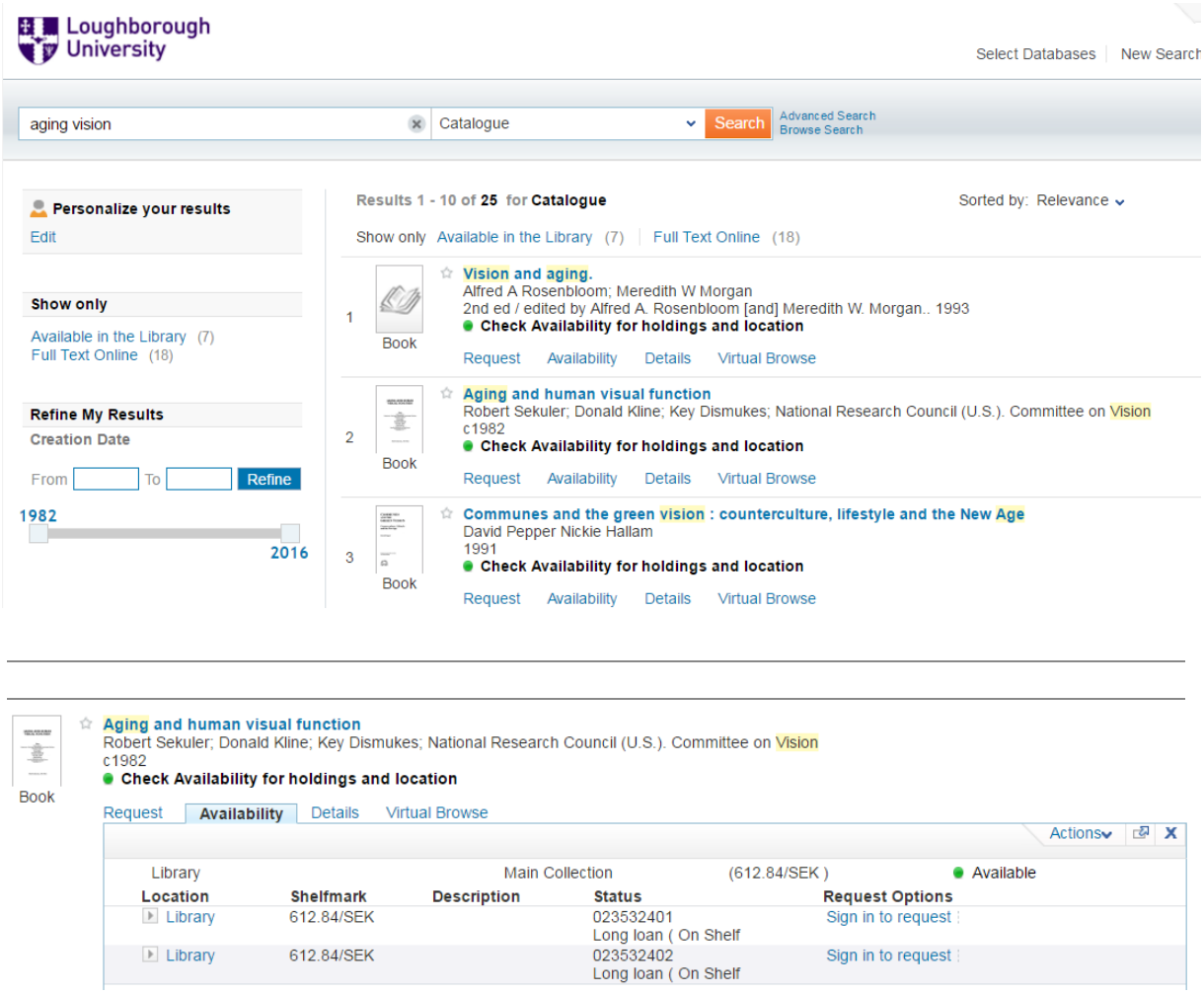

Figure 2: A) Search results B) Shelfmark under availability tab

The search results page has understandable structure and shows a suitable book (Vision and Aging), however the green circle followed by “Check Availability for holdings and location” could just as easily give the information that is likely being sought - “Available at Shelfmark 612.84/SEK” - rather than requiring an extra step that may be missed if the text is not fully attended to.

Arrival

Figure 3: Handicapped parking space and bus stop immediately outside the library

Arrival is easy for both Charles and Rosie - there are disabled parking bays in the carpark immediately across from the library and also bus stops as close as possible from both directions. The only difficulty here is in crossing the road.

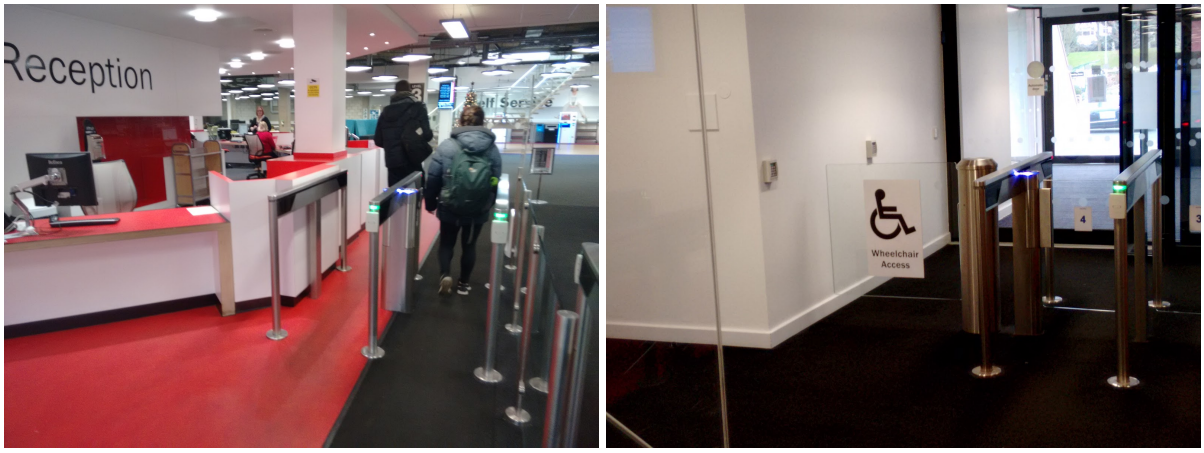

Figure 4: Entrance/exit to library A) card-scan barriers and B)wheelchair access door

Charles has a membership card, so was able to scan this and go through the normal barriers. The lights over the scanning areas help to draw one's eyes to them.

Rosie's crutches make it awkward to get through the normal barriers, as they are too narrow. She is still able to get in, as the librarian at the desk can let her through the disabled access door at the opposite side. This lessens her sense of independence,

and the need for assistance is slightly embarrassing (Newell, 2003). She then goes to do some revision on exercise physiology on floor 3 (unrelated to the main task).

It is also worth noting that when coming in, anyone in a wheelchair would be required to make 2 sharp turns in a small space to get from the entrance door to the wheelchair access door.

Navigating to the right floor

Figure 5: The floor plans by the entrance on level 3 and on level 1

For Charles, the maps of the area were quite confusing - the ‘up’/‘forward’ direction of the map does not correspond with the direction one is facing when looking at it, nor with any obvious landmarks, so the area has to be scanned for less obvious landmarks and the map mentally rotated, a substantially cognitively challenged task. Indeed the researcher, purportedly ‘mentally capable’ and moderately practiced at map reading, went the wrong way multiple times sequentially. An additional oddity is coming at seemingly the ground level and seeing that one is on ‘Level 3’. The human element of the library system rescued the situation. After approximately 10-20

seconds of looking at the map, a librarian from behind the desk asked, “can I help you find anything?”. Charles then asked directions to the lift and was able to make it there without further issue. A more positive, although not immediately apparent, feature of the map, is the direct correspondence of map area colour to carpet colour in the real world.

Figure 6: The interior of the elevator

The floor numbers are arranged oddly (anticlockwise starting at the bottom-left), despite seemingly enough space to align them vertically. The arrangement also does not correspond with the map layout on floor 1 (Figure 5), leaving neither a consistent nor a logical layout. This creates additional mental challenge unnecessarily. 3 is usefully marked as the ‘home’ floor. The elevator helpfully has a sign with the book number ranges on each floor, so as Charles already knows the shelfmark number, he can find the right floor. The floor numbers are not contiguous (Level 2: 000-499 and 700-999, Level 3: 500-699, however, again creating unnecessary confusion. There may be reasoning behind this, perhaps 500-699 are accessed less frequently than the others, but this is unknown to a user at the time.

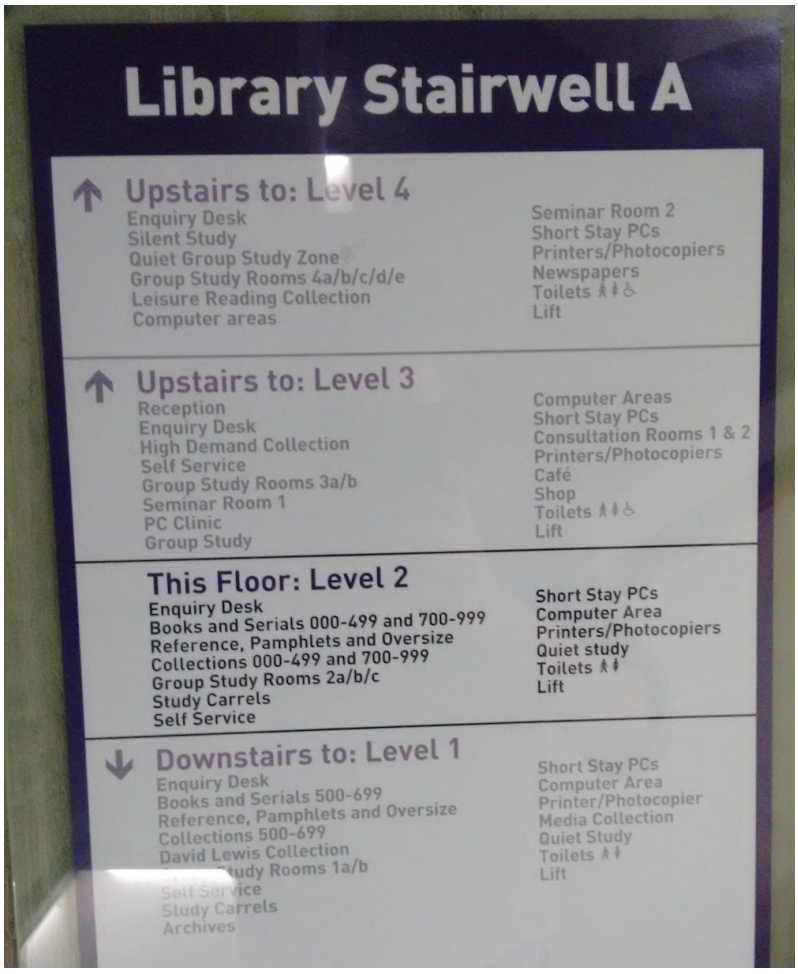

Figure 7: Floor levels sign in stairwell A

Rosie, deciding she needed more reference material, and already having used the library multiple times, knew that she had to go downstairs to find a physiology book. She also knew where the staircases are. The door to the staircases is a fire door, and with crutches, it requires a lot of force to open. This is doable, but again difficult. Given that she only knew the topic she wants (physiology/human biology/natural sciences), the numbers give no indication as to the genres available on each floor.

Figure 8: Stairs in the library stairwell

The stairs are in short segments, well lit and with contrasting colour on the edges, making them easy to get down in crutches as well as for people with other disabilities (Lacey, 2004).

Once she arrived at level 1, Rosie was still not sure of the exact book she wanted, so she asked the librarian at that level if she had any advice. For topics on which they are not experts, they end up checking the same website that library users have access to; helpful for people with technological difficulties, but with no additional benefit. Having librarians at every level greatly reduces the distance needed to travel to find one, particularly helpful for people with locomotion difficulties. The same is true for having multiple staircases around the area.

Navigating to the book

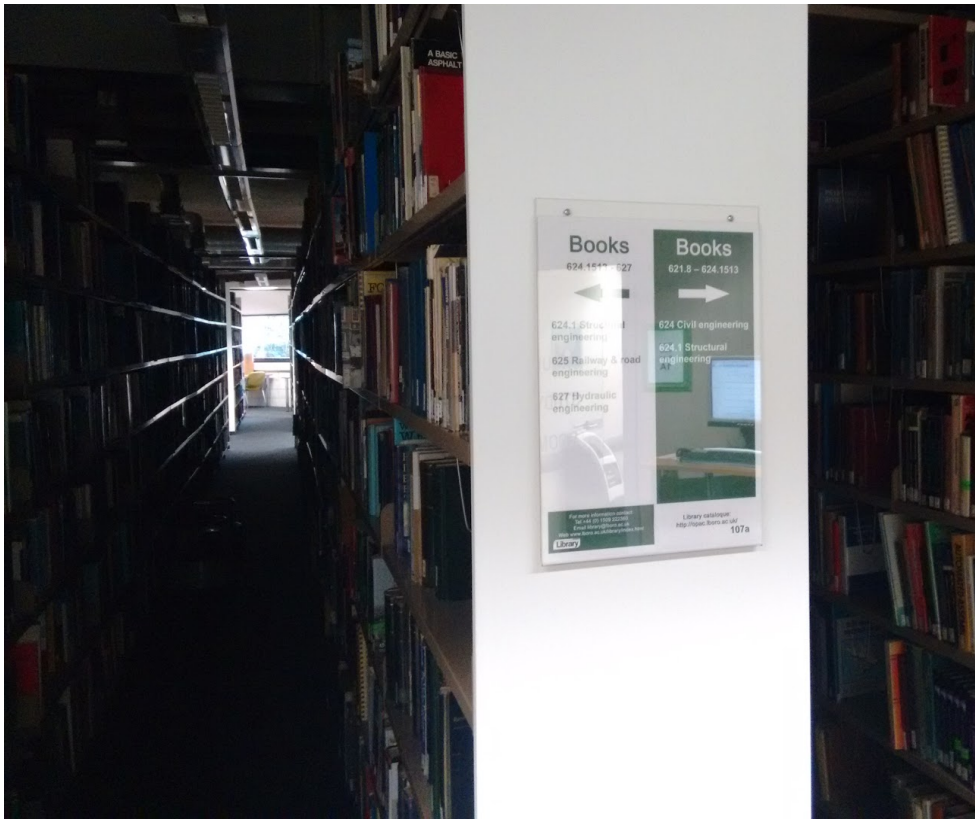

Figure 9: Shelf labelling

The signs labelling each shelf have an acrylic front, reflecting the lights, causing glare, and making them more difficult to read for Charles. The elderly tend to struggle more with glare due to increased light scattering caused by nuclear sclerosis (structurally similar to cataracts), which occurs with age (Salvi, Akhtar and Currie, 2006).

Figure 10: Kick stool in the middle of an aisle

Given the already narrow aisles, the stools placed in the middle of most of them provided an extra challenge to Rosie's locomotion on crutches. This is perhaps an unlikely candidate for replacing - nothing so cost-effective can easily allow reaching the top-level books. At a human level, these could be moved to unobtrusive areas near each aisle by library users/staff.

Figure 11: Shelfmarks on a number of books

Once the right shelf had been found, finding the book itself was made easier for Charles by the monotonically increasing shelfmarks on books, all visible without any physical interaction. The font size on these varied, for many it was too small.
With limited ability to bend down, both users had difficulty seeing books on the bottom shelf - the visual angle was very steep (Figure 10). Charles also had difficulty reaching the top shelf.

Rosie browsed until she had found a particular book that she wanted, then put it in her backpack so that she could take it to check it out

Figure 12: View back towards lift

There was no automated checkout on the way back to the lift, despite this being the clear route of travel for people with locomotion difficulties. As a result, Charles had to wander without signage until he found one (he could also have checked out on the top floor).

Figure 13: Automated checkout

The automated checkout was accompanied by a useful surface for Rosie to leave her bag on and lean her crutches against while checking out her book. The functions were at a convenient height for standing users.

A Christmas theme had been implemented at the time of evaluation. As a novelty, it had perhaps received less consideration than the normal theme - the snowflakes added visual noise and the red background no longer contrasted with a red arrow indicating usage (Figure 14).

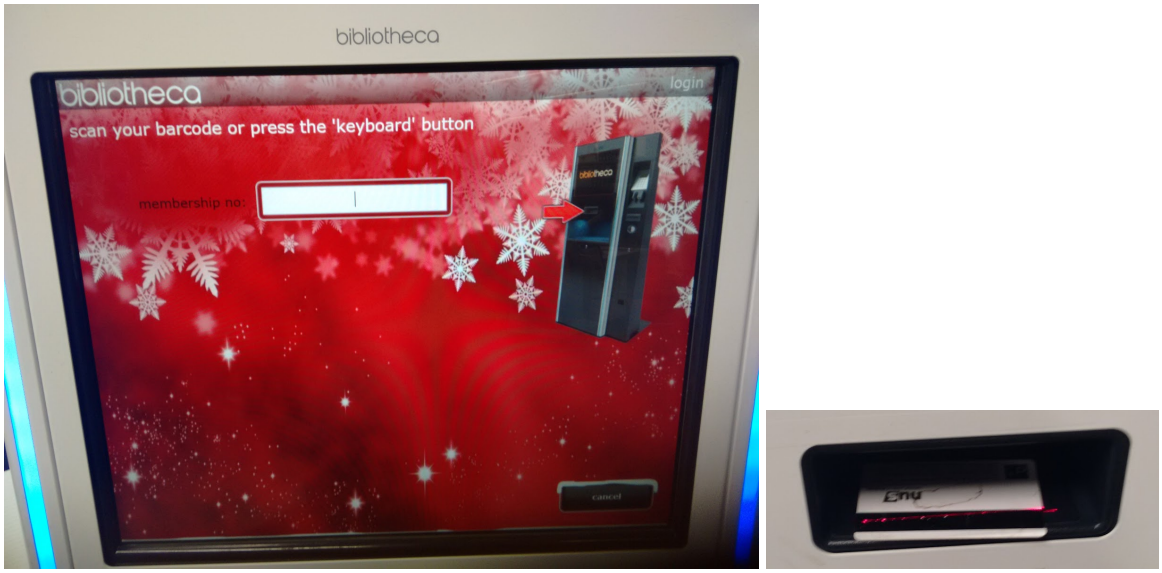

Figure 14: A) Logging in to the automated checkout B) scanning the 'barcode'

The request during login (Figure 14) was another source of confusion: there is no apparent 'barcode' on the card, nor is there an obvious keyboard button.

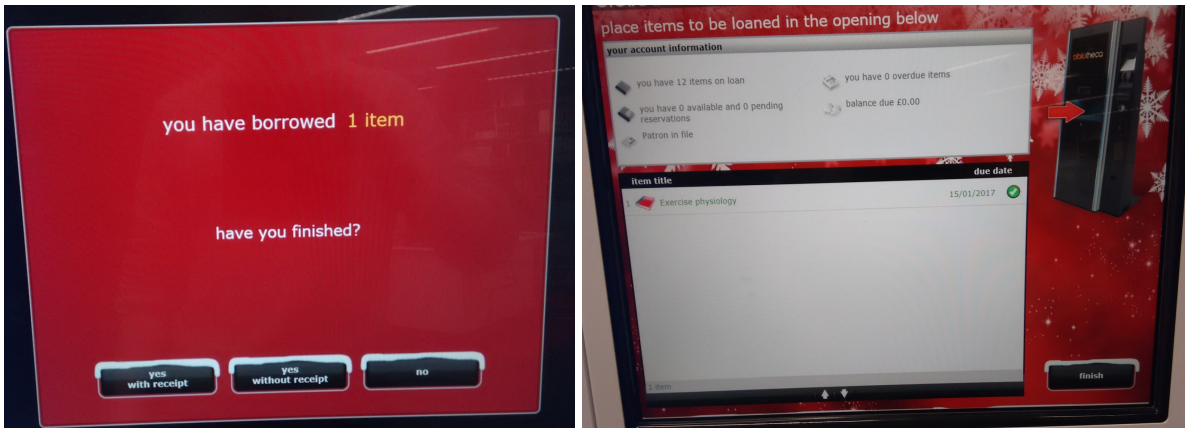

Figure 15: Automated checkout feedback

Despite low dexterity capability and osteoarthritis, Charles did not struggle with the touchscreen's corresponding demands. It responded to a light touch, unlike some resistive screens that require a firmer press. Both users' mental models of the system were assisted by the clear feedback given at all points during the checkout process. The personas left as they came in.

Returning the books

Figure 16: Book dropoff by the entrance

To determine the return time, Rosie used the website without new issues, and Charles phoned to ask. Returning the books placed little demand on the personas. The automated checkout machines are used (there are some near the entrance), or the book dropoff can be used if needed (including outside of opening hours).

Recommendations

Web

- Move/reduce text that is not immediately necessary.
- Provide the ability to enlarge text (and make it obvious for those with visual impairment).
- Give the search bar a thick coloured outline when focused.
- Remove/desaturate the image of colourful book spines to minimise distraction.
- Make the availability and location obvious without opening submenus
  e.g. “Available at Shelfmark 612.84/SEK”.

On-Site

- Putting the wheelchair door in the middle would be less ostracizing, reduce the wheelchair turning problem and would be unlikely to affect other users.
- Orient the maps in the same direction as the viewer is facing, and indicate more clearly that the colours correspond to the carpet colouring.
- Reorganise the lift buttons vertically.
- Shiny sign coverings could be replaced with the material used for the lift’s sign.
- Make the shelfmark font larger.
- Tilt the bottom shelf up to reduce the visual angle (the inverse is not safely possible for the top shelf).
- Make directions to the exit and checkouts more apparent, perhaps with signs or routes on the floor.
- Improve the clarity and accuracy of the automated checkout’s instructions.
- Provide an automated checkout by the lift

Reflections on Methodology

Building on Reece (2016) with additional top-down guidelines and an HTA, the methodology employed in this study was overall very successful for providing actionable results. It only provided a vertical slice of the service, further study could be performed of other aspects.

Personas provided a concrete set of characteristics against which to compare the service demands. The persona creation process could have been improved by becoming more data-based, and thus less assumption-based. Interviews of real/target users could have been carried out. (Pruitt and Adlin, 2010)

Although this was minimised with the checklist on guideline user capabilities, the study still somewhat relied on the ability of the researcher to empathise with the difficulties of age and and disability. Using 3rd age simulation (Cardoso and Clarkson, 2012) or involving people with these difficulties could mitigate these issues.

Conclusions

Overall, the Loughborough University library is generally usable, accessible and acceptable for the elderly and disabled, with multiple methods for achieving the intended task, including human assistance available wherever difficulties are faced. There are a number of areas where change would be beneficial to all and some where improvements to one dimension of demand may negatively affect others. The cost of implementation of recommendations is necessarily a concern, although for some, a cost/benefit analysis may not deem them worthwhile, many others could be achieved with minimal time and effort, or gradually. The personas tested (and people with similar capability levels on any dimension) would not be alone in considering the proposed recommendations an improvement. Other people who may benefit include people carrying large (e.g. sports) bags, people in wheelchairs, not to mention everyday users without any apparent disability.

Word Count: 3000/3000

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Appendix A: Hierarchical Task Analysis

Super-ordinate number	**Goal** *Plan*	
Persona	Operations	Notes
0)	**Borrow a book from the library**	
	Plan: 1 and (2 or 3) either order, 4, 5, 6, 7, 8, 9	
C & R	1) Enter the library	
C & R	2) Identify the book	
C & R	3) Identify a topic	
C & R	4) Locate the book/topic	
C & R	5) Acquire the book	
C & R	6) Register the book reservation with the library	
C & R	7) Leave the library	There may be other (non-goal related tasks done before here)
C & R	8) Check the return date	
C & R	9) Return the book	
1)	**Enter the library**	
	Plan: (1 or 2), 3	
C	1) Scan ID card on the barrier	
R	2) Ask the librarian	
C & R	3) Walk through	
2)	**Identify the book**	
	Plan: 1 or 2 and/or 3	
C	1) Identify the book from the website	
R	2) Physically browse the books in the library	
	3) Ask a librarian	

2.2)	**Physically browse the books in the library**	
	Plan: 1, 2	
R	1) Find the correct floor	
R	2) Find the correct bookshelf	
4)	**Locate the book/topic (know where it is)**	
	Plan: 1 or 2 and/or 3	
C	1) Locate the book on the website	
R	2) Physically browse the books in the library	
R	3) Ask a librarian	
5)	**Acquire the book**	
	Plan: 1, 2, 3, 4, optionally 5	
C & R	1) Go to the correct floor	
C & R	2) Go to the correct bookshelf	
C & R	3) Locate the book on the bookshelf	
C & R	4) Take the book off the bookshelf	
R	5) Put the book in a bag	
6)	**Register the book reservation with the library**	
	Plan: (none)	
C & R	1) Self-service machines	
	2) Take the book to the desk	
6.1)	**Use the automated checkout**	
	Plan: (none)	
C & R	1) Find a machine	
C & R	2) Put the book into the machine	
C & R	3) Follow the checkout instructions	
C & R	4) Remove book from machine	

6.2)	**Take the book to the desk**	
	Plan: 1, 2	
	1) Find an appropriate desk	
	2) Ask the librarian	
7)	**Leave the library**	There may be other (non-goal related tasks done before here)
	Plan: 1, 2	
C & R	1) Locate the exit	
C & R	2) Get through the barrier	
7.2)	**Get through the barrier**	
	Plan: (1 or 2), 3	
C	1) Scan ID card on the barrier	
R	2) Ask the librarian	
C & R	3) Walk through	
8)	**Check the return date**	
	Plan: 1 or 2	
C	1) Ask the librarian over the phone	
R	2) Check on the website	
9)	**Return the book**	
	Plan: 1 or 2 or 3	
	1) Return the book to the desk	
	2) Use a self-service machine	
	3) Drop into outside box	

Appendix B: Personas

Rosie

http://www.ehow.co.uk/how_8369802_make-short-leg-cast-comfortable.html

“I can get around without help”

Disabilities/Difficulties

Broken ankle - using crutches

Diseases

Asthma

Age

20

Occupation

Sports Science Student

Location

On-campus halls

Technical skill/interest

Uses her phone and social media on her laptop, but not much else.

Characteristics

Hard on herself in attempts toward self-improvement, independent, outgoing, friendly

Task Goals

- Revise for upcoming exams
- Avoid damaging ankle further, so that she will be healed ASAP for BUCS

Experience Goals

- Not feel any capability loss
- Fit in with her peers

Charles

https://static.pexels.com/photos/100583/pexels-photo-100583.jpeg

“I may not be any good, but I’ll give it a go”

Disabilities/Difficulties

Stooping, crouching; climbing several flights of stairs; hearing aid; glasses, presbyopic, increasing nuclear sclerosis; thinking feels slow, poor episodic memory.

Diseases

Osteoarthritis, diabetes

Age

72

Occupation

Retired Designer

Location

Loughborough Town

Technical skill/interest

Has been shown the basics of internet use by his daughter, would like to know more.

Characteristics

Introverted, self-effacing, curious, satisfied with his life

Task Goals

- Find out what is happening to his eyesight and what the prognosis might be
- Minimise interaction with other people

Experience Goals

- Novelty
- Not to feel stupid, like he’s making obvious mistakes