Comparison Test of Website Use
with Mobile Phone and Laptop Computer

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Abstract. The study compared user performance and subjective ratings between a mobile phone and laptop computer for accessing the internet. Twenty four participants were required to carry out two equivalent sets of 5 tasks, one set of tasks with a mobile phone and the other set with a laptop. It was found that the task times for the mobile phone were higher than those of the laptop for all tasks but only significantly different for two of the task pairs. The most important reason for this result seemed to be the difference in size of the screens on each device. Participants were also asked to rate the difficulty of each task performed on both laptop and phone. Interestingly, participants did not rate the difficulty of using the mobile phone significantly higher than for the laptop. This seemed to be because of lower expectations when using the mobile phone, good dexterity in zooming in and out of the screen, and spending less time reviewing each page on the phone than on the laptop before moving on another page.

Keywords: Usability evaluation, Website, Mobile phone, Laptop.

1   Introduction

Mobile phones are not just a device for calling and texting people but have become a necessary and indispensable tool in our daily lives. In combination with the internet, mobile phones already have the functions of a personal computer but in a handy portable size. However the relatively small screen and keyboard size of a mobile phone can make an ordinary webpage or ecommerce website difficult to use [1]. Smart phones can display most websites without modification, however the user is often unable to read the text or see useful content without pinch-zooming. Responsive websites can adapt to the device or operating environment although the technology still faces challenges to overcome such as non-fluid advertisements [2]. This study explored the difference between mobile phone and laptop when using them to perform search tasks on the internet. The project was also inspired by the need for Loughborough University information to be easy to obtain via a mobile device which is often student's preferred way of accessing the internet.

2   Aims and Method

This aim of the study was to compare a mobile phone and a computer laptop for accessing the internet. In addition, it was intended to record the user's experience of

the Loughborough University website and ideas for a reduced mobile version of the home screen.

The project used performance testing to compare the difference between the laptop (with a 13.3 inch screen and physical keyboard) and mobile smart phone (with a 4 inch screen and touch screen keyboard). Although a laboratory test has some limitations compared to a field study [3], this style of evaluation is more straightforward for conducting a controlled comparative study.

The testing recorded time to complete five tasks with each device and used a paired t-test used to determine if there was a significant difference between times for the mobile phone and laptop. The five tasks used with each device were designed to be equivalent to make the two sets equivalent in difficulty. The order of presentation of the tasks and device was varied between participants to avoid order effects.

A questionnaire was also developed to collect participants' subjective ratings, opinions and suggestions for tailoring the Loughborough University website to access via mobile phone.

The participants included members of staff and students (PhD and postgraduate students) from Loughborough University; thus they were familiar with the website and could give more useful suggestions about its improvement. A total of 24 persons aged from 25 to 55 years old took part in the study with a median age of 35. Ten participants were female and 14 were male. Most of the testing was carried out in the Loughborough University Design School, although for the convenience of two of the participants, it was carried out in their own homes.

For each task a time limit of 5 minutes was set so if the participant did not complete it within this time, the task was stopped and the time not included in the statistical analysis. The participants also gave a rating about how easy or difficult they found that task (from 1=very difficult to 7=very easy) and the overall satisfaction about using the website on this device (from 1=very unsatisfying to 7=very satisfying). The ratings were also analysed with the Wilcoxon test to see if the difference between the two devices was significant. All the task pairs in this study were designed
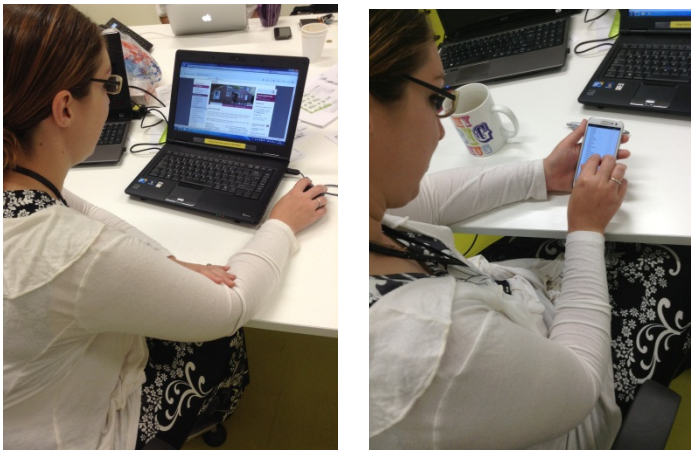

Fig. 1. Participant within the study

to be equivalent in terms of number of steps and level of difficulty. At the end of the post-test questionnaire, each participant was asked to sketch the design for a reduced home screen for Loughborough University to make it suitable for a mobile phone.

The instructions for the two sets of tasks were as follows:

- **Task Set A**
  - Task 1: Go to the Design School web page and find information about postgraduate course on Ergonomics (Human Factors). Find and read out the entry qualifications.
  - Task 2: Use the Design School gallery and find out who is the contact person for the SAMMIE (workspace modelling) system.
  - Task 3: You wish to go to from the University Library to Loughborough town centre on Monday morning by bus during university holidays. Find the information about what time you could choose.
  - Task 4: Find the opening hours and map location of Faraday Dining Hall during term time.
  - Task 5: Find information about the Polar Film Festival Event (venue location and ticket price) taking place at the University.
- **Task set B**
  - Task1: Go to the School of Business and Economics web pages and find information about postgraduate course on Economics and Finance. Find and read out the entry requirements.
  - Task 2: Use the Design School research pages and find out how many members of staff are in the User Centred Design Research Group.
  - Task 3: Where you should go and what is the card replacement cost is if you lost your University ID card?
  - Task 4: Find accommodation information about John Phillips Hall: map location and occupancy information and what date can new postgraduates come into the hall.
  - Task 5: Find information about the RSPB (Royal Society for the protection of birds) Talk - The Long Journey North by Danny Green (venue location and ticket price) taking place at the University.

3   Results

The chart shown in Figure 2 is a boxplot of task times for each pair of 5 tasks. It can be seen that all the five median values for the mobile phone are higher than their corresponding task for the laptop. The six outlier values shown as numbered points on the chart were excluded from the test.

The range of times taken for task pair 1 and 2 is smaller than the ranges for task pair 3, 4 and 5. The main reason for this might be the clarity of the searching operation and the interference of related information. In task pair 1 and 2, the required information to find is simple and clear so did not cause too much confusion for the user. But in task pairs 3, 4 and 5, there were related information showing on other pages which did not provide the right answer, which may have caused participants to spend
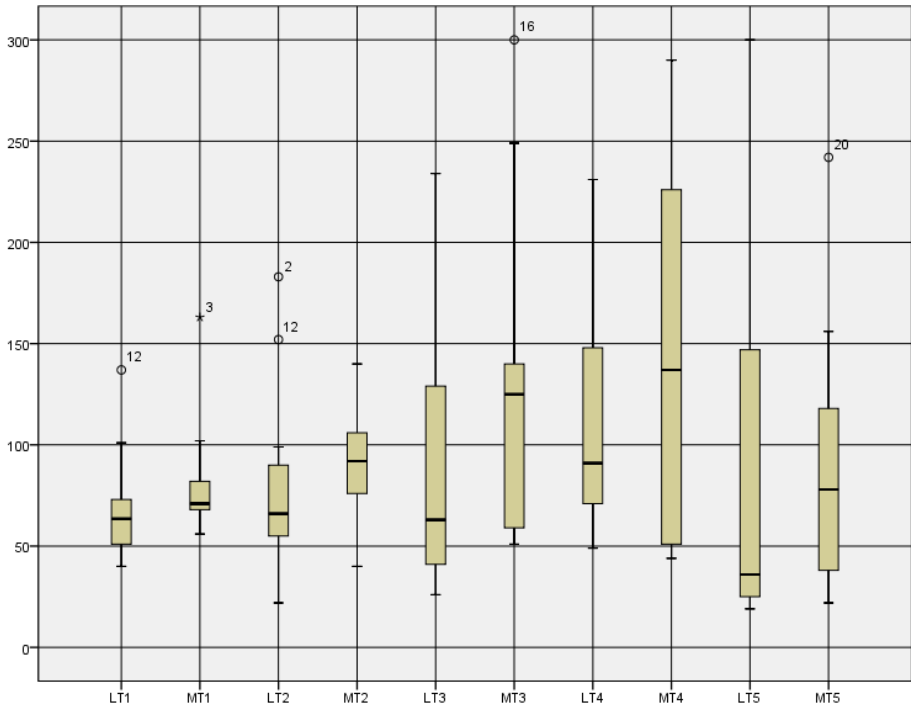
Fig. 2. Boxplot of completion times

too much time searching on the wrong page. And in task pairs 3, 4 and 5, there were more than one way to find the right information and some of them were more complicated than others, so this needed more time to complete the task.

The results of the t-test, showed that for task pair 1 and 2, the completion time of laptop is significantly quicker than mobile phone at the significance level p=0.01, but in task pair 3, 4 and 5 there is no significant difference between the laptop and mobile phone. Comparing this result with the boxplot (Figure 2), in task pair 1 and 2 the operation of completing the task is clear and did not have too much information to distract the user. So the difference in mean time might reflect the different operation of these two devices. But in task pair 3, 4 and 5, there was more than one way to do the task and some other related information showing on other pages which was not needed for the task which may have made participants spend too much time searching information on the wrong page. Therefore, these factors may have affected the completion time and the test results. Moreover, when people used the mobile phone to search for information they tended to just scan the text in the website instead of reading details information. So if they went to the wrong page, they quickly browsed the page and then returned to the home page to find another path. But using laptop to perform the task, because the larger screen which could show enough text and make it easy to read, participants always liked to read the detailed information on the page they already found when they did not find the right answer of the task. This difference on the two devices may have influenced completing times.

Table 1 below shows the number of people who did not finish each task within the time limit so their time was not included in the analysis (and chart).

Table 1. Number of users not completing task (13 values out of 240)

	Task 1	Task 2	Task 3	Task 4	Task 5	Total
laptop	0	1	1	1	3	6
mobile	0	0	1	3	3	7

The difference between the completion times for each device for each task pair is shown in Table 2:

Table 2. Average task time difference between mobile phone and laptop (seconds)

Task pair	Task 1	Task 2	Task 3	Task 4	Task 5
Average time difference	15.42 s	7.71 s	18.75 s	26.01 s	0.5 s

Participants were also asked to provide a subjective choice of which device was harder to use for each task, either mobile phone or laptop. The results are shown in Table 3. For task pair 3, a clear majority thought that the mobile phone was harder to use than the laptop. However for the other task pairs there were no clear differences between the choices and for task pairs 2 and 5 more participants thought that the mobile phone was easier to use than those who thought the phone was harder. A Wilcoxon non-parametric test was used to test the difference in the choice of more difficult device between the laptop and mobile phone. None of the task pairs showed any significantly differences between the choice of mobile phone or laptop as the easier or harder device to use.

Table 3. Subjective rating of which device was easier or harder for each task pair

Task pair	Task 1	Task 2	Task 3	Task 4	Task 5
Mobile harder	9	6	14	10	8
Mobile and laptop same	10	8	2	5	4
Mobile easier	5	10	8	9	12

Also within the questionnaire, participants gave comments about the two devices for accessing the internet. Some participants reported that even though the mobile phone is more handy and easy to carry when they go out and want to search for some information, most participants still prefer the laptop for accessing the internet which was seen as generally more convenient. Comments about specific features of the devices are summarised below:

Screen Size. 75 percent of participants reported that the screen size was a key problem when using the mobile phone to search for information since during the searching process. They needed to zoom in and out multiple times in order to read the information detail and also browse the whole website. One of the participants suggested that a "word wrap" function may make it easier to read specific text. The "word wrap" function is provided on the Blackberry mobile phone and some HTC mobile phones. So when the user zooms in to the website to read the detailed information, the text will re-format automatically so the user won't need to move left and right across the screen but just scroll the page up and down.

Miss Clicking. In the questionnaire, almost 30 percent of the participants stated that it was not so convenient when they wanted to click a specific link on the touch screen. This problem also related to the relatively small size of the screen, so that users frequently clicked the wrong button or link on the web page. Possibly a touch screen stylus could solve this.

Keyboard. 25 percent of participants reported that the keyboard on the mobile phone was harder to use than that on laptop, especially the male participants who generally had larger fingers than the female which hampered typing on the touch screen keyboard. Some smart phones which have both a real keyboard and a touch screen may improve on this situation.

4   Discussion

The analysis of task performance shows that across all the five task pairs, performance with the laptop was greater (or faster) than with the mobile phone. This was in general due to the smaller size of the mobile phone screen and consequently smaller size of information, web-links and touch-screen keyboard.

4.1   User Behaviour with the Smaller Screen

The mobile phone's smaller screen could just show some part of the website while the laptop could show the whole width of a home page on screen. Therefore, if people wanted to find particular information with mobile phone, it would take longer to look around and scroll across the screen to find the information. Moreover, for older participants who might have poorer vision, to read the text in the small screen, they had to zoom into the text. However, once they enlarged the text font they could not see the whole information of the website. So to then check the whole page, they had to

decrease the font size. This problem meant that participants had to repeatedly enlarge and decrease the font size when they were looking for specific information with the mobile phone, which increased the completion time of each task.

4.2   Wider Spread of Performance Results with Mobile for Map Task

For task pair 4, the spread of performance times was noticeably broader with the mobile phone than the laptop. As the smaller mobile phone screen was only able to show part of the map, participants needed to zoom in and out to find where the building was. However with the mobile phone participants sometimes scanned information less thoroughly than on the laptop and if they thought they might be on the wrong page (or part of the map) and could not find the information they wanted, they just returned to the search page and started the task again. For this reason some participants might have found the location of the building for task 4 on the mobile phone as quickly as on the laptop.

4.3   Difference between Task Performance Times and Subjective Perception of Difficulty

From the average time difference (Table 2), it shows that when using the mobile phone all tasks took longer than using a laptop. But in terms of difficultly rating, Table 3 shows that participants did not necessarily consider using the mobile phone harder to use than the laptop and the Wilcoxon test showed no significant difference in participants' selection of either device as being easier or harder. There might be several reasons for this. Firstly, even though using a mobile phone may take longer to finish the task, it does not mean that it is perceived as harder to use than a laptop. Even if the user spent more time using a mobile phone to search for information, if the process was going smoothly, they may have thought that mobile phone was as easy to operate. Secondly, the outlier values shown in the boxplot in Figure 2 may have disproportionately affected the average time differences. Because of these outliers, the results show that the mobile phone took longer than the laptop to complete each task when people may not have felt that the mobile phone was harder to use than laptop. Thirdly, participants may have not liked to admit or consider that a task was harder for them when they realised that they just missed some information that they felt they should have seen or recognised that there was an easy way to complete the task. Thus they may have given a more positive rating.

5   Suggestions for Mobile Phone Website Designs

After the user trial each participant was invited to design a reduced home screen for Loughborough University to be suitable for a mobile phone. Although smart phones already have relatively large screens for phones, the information of a typical website is still too much to display for comfortable use. Thus a reduced mobile phone version home screen might be useful and necessary.
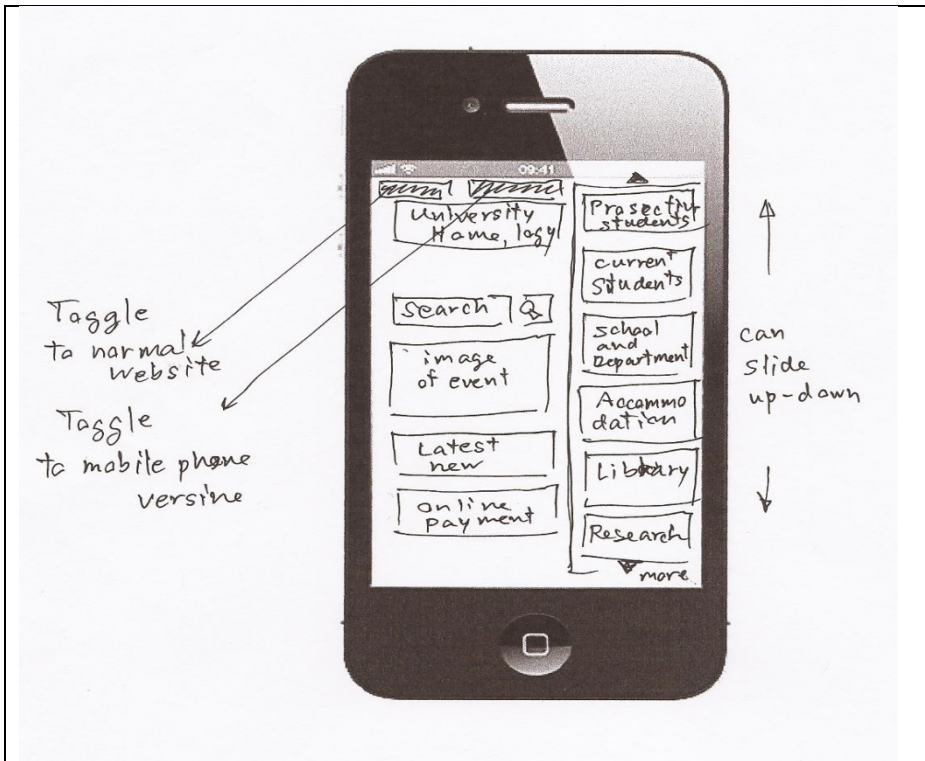
Fig. 3. Example of a redesigned home screen for mobile phone

From the sketches made by the participants, most people chose to include a search bar, school and department tabs or links, and current student and staff functions on their mobile home screen. An example sketch is shown in Figure 3. This shows a mobile version which incorporates a split screen with fixed, generally useful, options on the left and a scrolling list of more specific options on the right. Tab buttons are also provided at the top of the screen to allow the user to swap between the normal full screen version and the mobile version as they wish.

6   Contextual Aspects of Study

This study had certain characteristics that could have affected the results. Firstly, as all the participants were from Loughborough University Design School they might have already used the School webpages before, so the completion times may have been affected by their previous experience. However this was not a noticeable effect during the study. Secondly, although the shortest path for each task made each task pair equivalent, there were different ways to complete some of the tasks, so the number of steps followed varied depending on the route followed which may have affected the equivalence of the task pair for a particular participant.

7   Conclusions

The purpose of the study was to explore the differences between a mobile phone and laptop for accessing the internet by asking users to complete 5 tasks with each device. The results show the completion times for the mobile phone were only significantly longer than the laptop for task pair 1 and 2 and not the other three. There was no statistical significance in subjective rating of whether the phone or laptop was easier or more difficult so that while using the mobile phone may have taken longer to perform a task, it was not necessarily seen as harder than the equivalent task on the laptop.

Most participants reported some problems in using the mobile phone including: small screen size, missed clicks and inconvenience of the touch screen keyboard. These problems could be addressed with some extra functions or tools to reduce the content on screen which would make it easier to view the information. "Word wrap" would also be helpful when reading detailed information on a website. A pen or stylus for input when the buttons and links are smaller and a combination of touch screen and physical keyboard could also make the phone easier to use for internet access. Voice is also an alternative for keyboard input. It is likely that there will be further innovation in the future to assist users of smart phones to be as efficient as laptop users when accessing the internet.

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