A Comparative Evaluation of Search Interfaces in Mobile User Applications

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ABSTRACT
A user study was conducted to compare the performance of an *Expanded* search interface with a *Compact* one. Both search interfaces were tailored for Android mobile devices. Eight participants were recruited to perform the experiment tasks. They were split into two groups, reversing the order in which the two search interfaces were tested. Two parameters were evaluated: the time taken for performing a search run, and the number of touches recorded for the search task. It was revealed that information seeking through the *Compact* interface was performed 15% faster than with the *Expanded* one. Furthermore, in contrast with the *Expanded* interface, the mean number of interactions required to complete a given search through the *Compact* one was 39% less. It was noteworthy that the number of failed searches through the *Expanded* interface was twice that of the *Compact* one.

Keywords
Mobile user application, search interface, comparative evaluation

INTRODUCTION
An important rule in the context of human-computer interaction is to understand the capabilities and limitations of the two sides (humans and computers) and how they interact with each other. In order to enhance such interaction, engineering and design must collaborate with each other. However, the main focus of this article is on the design part and how a good design can help to achieve an effective yet efficient product that leads to a satisfying user experience.

In the context of user interface (UI) design for mobile applications, navigation and search facilities play an important role in achieving the design goals mentioned above. Users should be able to search efficiently and receive accurate results. According to the Android design principles, a search panel should only display what is needed and when it is needed. Therefore, unessential options should be avoided. Otherwise, users become confused by too many choices and decisions.

Hearst [2] identified three important features of a well-designed search UI. As for the first requirement, the interface designer should keep the users' series of thought. This could be achieved by the method presented by Lamping et al. [5]. According to them, the focus of the information need should be preserved within the context of the research. The second requirement is about making the search process not harder than the intention for which the information is looked. By means of cost models, it has been shown that an increase in the search cost is likely to increase the risk of query abandonment (see Pirolli [6] and Bates [1]). The third requirement emphasizes the simplicity of the interface. However, Hoare and Sorensen [3] added one more requirement to this. They suggested that as the complexity of the users' search grows, that of the interface should also be allowed to increase accordingly. On the other hand, when a user's information need is simple, they should not be confused by a complex interface.

York University has provided a UI for mobile devices to access the most commonly used features of its Website (Figure 1). The main features are displayed as buttons under the news section. The main focus of this article is about the search panel under the *Directory* feature. The search panel enables users to search for York community members and find their contact information. However, it contains too many text fields and radio buttons, making searches harder than they should be. For instance, to make a simple search based on first and last name, the user must skip several options and scroll down to reach the search button. Moreover, the search options are scattered over the page, forcing unnecessary scrolling. Finally, spinners could assist users if options for some of the search criteria (e.g., department, title) were provided.

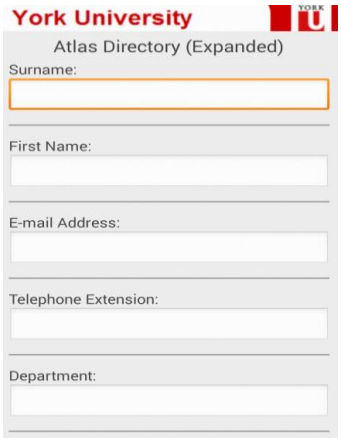

Figure 1. Screenshot of York University *Directory* search

The compact design of UI for the search panel aims to facilitate search and navigation. This is achieved by placing the text fields and other building blocks in a compact form and avoiding unnecessary spaces. Less commonly used text fields have also been eliminated in the new UI. This makes it easier for users to search without being blinded by too many options. Moreover, the new search panel assists users to narrow their search domain through spinners that contain the names of departments. The improved design of the app aims to enhance user satisfaction while providing a more accurate and efficient search result.

Related Work

Hürst and Darzentas [4] compared two thumbnail-based grid layouts to explore their effectiveness in video browsing scenarios for cell phones. The grid layouts were comprised of two types: static, and scrollable. They tested four thumbnail sizes consisting of 80, 100, 133, and 200 pixels. It was shown that for all the different thumbnail sizes, video browsing tasks through the static thumbnail grid layout were achieved with noticeably accuracy (85%). In contrast to the static grid layout, the scrollable one achieved a relatively lower overall success rate of 61%. As for the time required to complete the browsing tasks, the overall average time for the static and scrollable grid layouts across all the thumbnail sizes was 25 and 34 seconds, respectively. One reason for the relatively poor performance of the scrollable grid layout is that the users were to peruse more thumbnails to achieve the same task in contrast to the static layout. Therefore, the scrollable layout increased the time and the number of interactions required to perform a given task in comparison with the static layout.

METHOD

Data regarding users' interaction with the app was collected and compared to that of the UI currently used by York University Website.

Participants

There were eight participants (five males and three females) from York community members to perform the experiment tasks. The participants were in the 18-28 age range. Two out of eight participants regularly used York University directory search website. Since the app is to be used by all members of York community, selection of participants was not based on a specific gender, age or title. Rather, it was based on a random order. Participants were not paid, nor were they offered any incentives. The participants were asked to use ISO 9241-9 rating scale for expressing their experience with the search interfaces.

Apparatus

Participants used a Nexus S Android mobile device to take part in the experiment. They ran a *Directory* search on two different UIs. One was a mock-up design of the current York University directory search interface (Figure 1), hereafter denoted by ESI (Expanded Search Interface), and the other one was the Compact Search Interface (CSI) for the new interface as displayed in Figure 2.

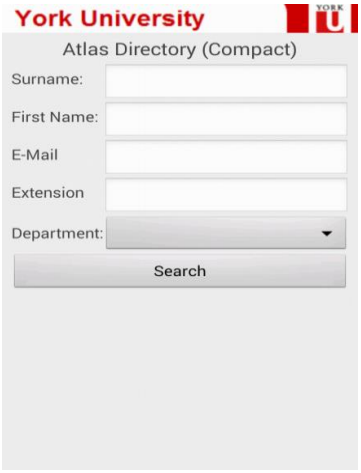

Figure 2. Screenshot of compact interface design for *Directory* search (CSI)

Procedure

The participants were split into two groups (group A and group B), reversing the order in which the two UIs were tested. It took approximately 30 seconds for each participant to do the experiment. Every participant performed five searches through the directory section on each of the two interfaces. They were asked to find information about members of the York community using the provided keywords. Each run of the experiment started as soon as the participant touched the *OK* button on the *Setup* screen (Figure 3).

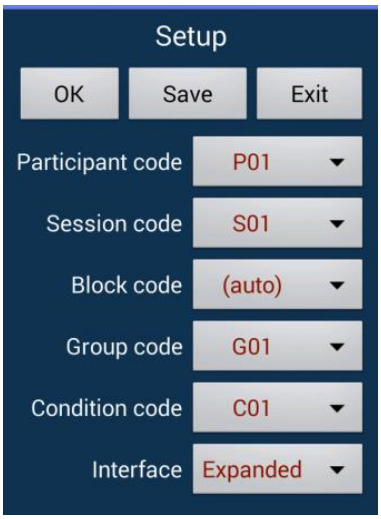

Figure 3. Screenshot of *setup* panel

For each run, five keywords were given to each participant and they were asked to use only two pre-identified keywords for their search. Then, they were asked to verify the accuracy of their search by comparing the result with the other three keywords. Since there were two interfaces, for each group of participants five sets of keywords (each containing first name, surname, e-mail address, phone extension and the name of department)

were provided. Participants were asked to touch the *Yes* button (Figure 4) in front of the relative search result if the target individual was found. Otherwise, the *No* button was touched to indicate the end of the run.

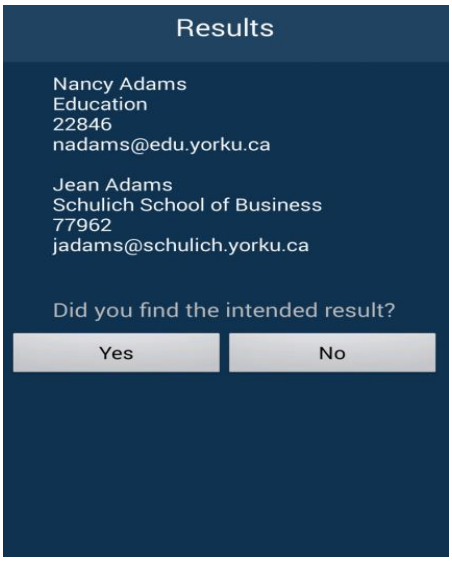

Figure 4. A screenshot of the result screen

Design

The design of the user study was a within-subjects independent variable design. The independent variable was search interface, with two levels: *Expanded*, and *Compact*. The order in which the two search interfaces were tested, was counterbalanced to minimize learning effects. There were two dependent variables: the time taken for performing a search run and the number of touches recorded for the search run. The time was measured according to the task completion time which commenced once the participant launched the search panel and terminated when the *Search* button was clicked. The number of touches was measured based on the number of interactions between the participants and the app until the target result was found. Hence, the number of touches was recorded in each run. After finishing the experiment, each participant was given a questionnaire for qualitative assessment.

RESULTS AND DISCUSSION

The data from the trials and questionnaire were entered into a Microsoft Excel 2010 spreadsheet, charts were produced and simple statistics such as arithmetic mean and standard error of mean (SEM) were calculated. No statistical analysis was performed as this was beyond the scope of the study.

Search interface trials

The time taken to perform the assigned tasks to each participant is shown in Figure 5. Generally, the participants completed their search on the CSI markedly faster than they did on the ESI, with the exception for Participant 5 and Participant 8. These exceptions are likely to be outlying data and if more trials were achieved, it was expected that the consistency of the outcomes would have been improved.

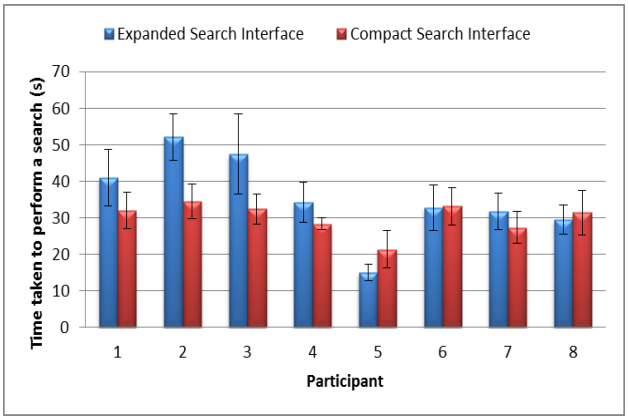

Figure 5. Search times measured for individual participants

The search times were averaged and the associated standard errors of the mean were calculated for both interfaces (Figure 6). In contrast to ESI, it took 15% less time to get the search results with CSI. Moreover, SEMs calculated from the data for ESI and CSI were 2.694 and 1.644 seconds, respectively, indicating a larger variability in the data with the former interface. Apparently, the difference in operation time between the two interfaces is attributed to the difference in their layouts.

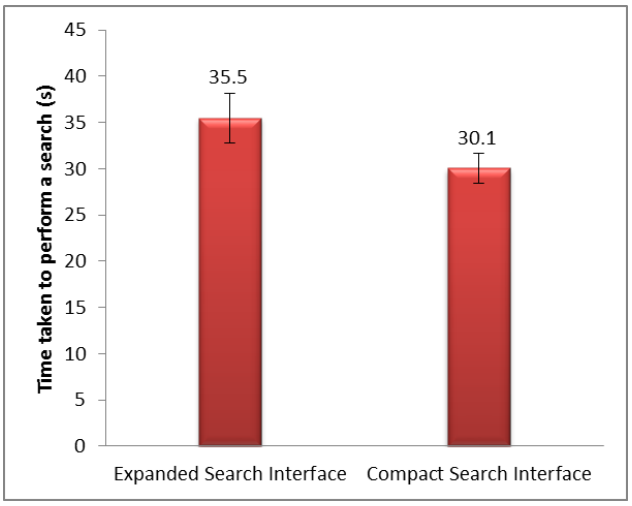

Figure 6. Mean time for performing a search run

The number of touches for performing a search run on either interface, for individual participants is shown in Figure 7. In contrast to the ESI, consistently fewer touches were required to perform the same search through the CSI. Moreover, the variability in the number of touches measured on the ESI was consistently larger than the corresponding data measured on the CSI.

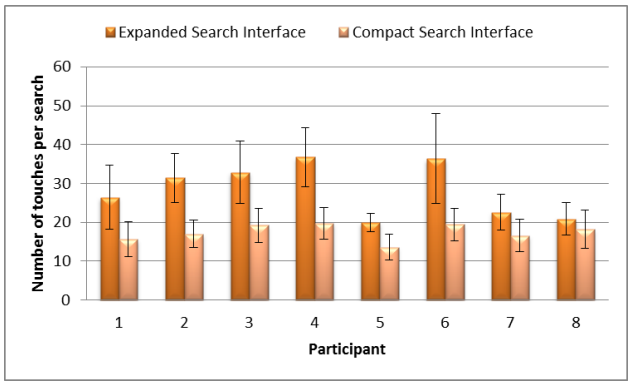

Figure 7. The number of touches to perform a search run measured for individual participants

The number of touches to perform a search run for both interfaces was averaged and the result is shown in Figure 8. In comparison with ESI, approximately 39% fewer touches were done to perform a search run with CSI. It is not surprising that doing a search via ESI resulted in a higher number of touches than with CSI. Indeed, access to a certain field of an expanded interface implies more interactions between the user and the interface contrasted to a compact interface where relatively more fields are accessible on the screen. Furthermore, the data from ESI exhibited a larger variation in terms of SEM than the data recorded CSI (2.501 vs. 1.371). In addition, it was found that the number of failed searches with ESI was twice as much as that with CSI. The same reasons mentioned in the previous paragraph apply to this result, as well.

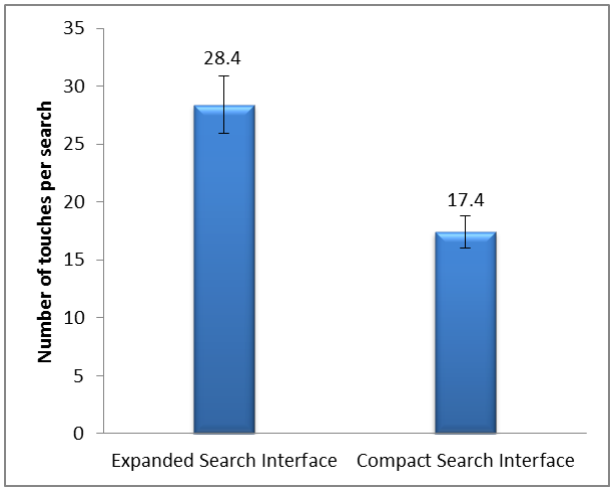

Figure 8. The mean number of touches to perform a search run

Questionnaire

It was revealed that English was the first language of half of the participants. The mean age of the participants was 22 years and on average, they used their cell phones for 10 hours per day. The user experience is summarized in Figure 9, indicating that working with CSI was markedly more comfortable and easier than with ESI.

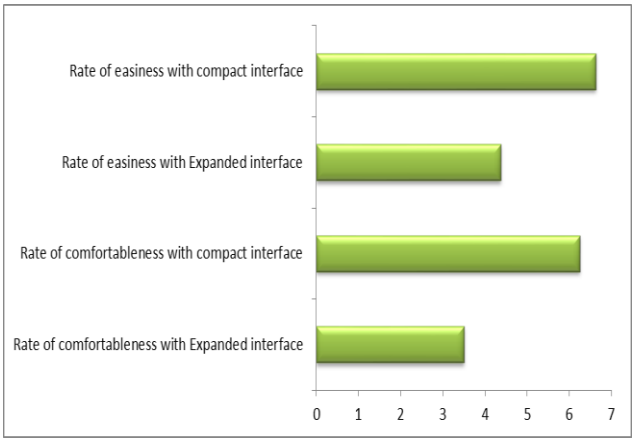

Figure 9. User interaction experience of the two search interfaces

CONCLUSION

This study compared and contrasted the differences between two search interfaces, an *Expanded* versus a *Compact* one. The *Compact* interface consistently outperformed the *Expanded* one in terms of the search time and number of touches per search. Quite clearly, the *Compact* interface provided the users with more and easier access to the field searches thereby leading to obtaining faster and better results. Furthermore, the users reported a more comfortable and easy interaction with the *Compact* interface compared to the *Expanded* one. For future improvement it is suggested to add autocomplete feature for text fields in order to reduce time and number of touches required to perform a search.

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