INVESTIGATING THE SEARCH BEHAVIOUR DIFFERENCES BETWEEN MOBILE AND DESKTOP

A study submitted in partial fulfilment of the requirements for the degree of Information Systems

at

THE UNIVERSITY OF SHEFFIELD

by

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Abstract

Background. While previous studies tried to compare the search behaviour differences by analysing the search engine logs, others research focused on influences of task, scanning behaviour by carrying out the experiment. However, there are only no literatures directly examine searching behaviour differences on mobile and computer. Hence, this study specifically examines the search behaviour differences and its reasons on mobile and computer searching.

Aims. The overall aim of the study is to investigate the search behaviour differences on both mobile and computer. More specifically, it not only examined search differences but also evaluated the differences in terms of task types. Additionally, it explored the search behaviour differences in users’ perception.

Methods. A task-based experiment was carried out for observing the search behaviour differences on mobile and computer. It was followed a semi-structured interview to gather the opinion form users.

Results. The mobile searchers were reluctant to enter more query and modify the query while computer searchers were more willing to inputting and reformulating the query. For the fact finding task, computer searchers spent more time on reading pages and validating the result, but mobile searchers spent less time to do that. In contrast, for information gathering task, mobile searchers consumed more time in locate the result. Additionally, users considered mobile searching is an extension from the computer searching. Because mobile searching has more practical use compared with computer searching. However, few users believe that mobile searching has distinct information need especially in the serious work such as writing a report.

Conclusions. It is concluded that there are some searching behaviour differences on mobile and computer searching. Because of the limitation of usability on mobile constrains the users’ performance, it brings some substantial influences the searching behaviour and and lead to the differences on mobile and computer.
Acknowledgement

I would like to thank my supervisor Dr. Robert Villa for the helps, especially when I was struggling with the designation of the experiment. I would also thank my family for all their support throughout the dissertation. Finally, I would like to thank the participants for the time they offer to my study.
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1 Introduction

1.1 Background

This dissertation focuses on the search behaviour differences between computer searching and mobile searching. The term “Search behaviour” is generally understood as: “the interaction of information users (with or without an intermediary) and computer based information system…” (Wilson, 1999: 258). Previous studies can be divided into two groups: search engine log studies and task-based analysis. All sources are listed in table 1.1.1:

<table>
<thead>
<tr>
<th>Search engine log studies</th>
<th>Mobile</th>
<th>Computer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task-based analysis</td>
<td>Feng (2012)</td>
<td>Marchionini, 1989; Qiu, 1993; Gwizdka &amp; Spence, 2006; White &amp; Marchionini, 2007; Kellar, Watters, &amp; Shepherd, 2007a; Liu et al., 2010; Cole et al., 2011; Liu &amp; Belkin, 2011;</td>
</tr>
</tbody>
</table>

Table 1.1-1 Previous studies about search behaviour

For the search engine log studies, majority of the studies looked into differences in terms of the query and session. For instance, Church et al (2007) concluded that mobile query is shorter (2.06 on mobile compared with 3 on desktop), advanced search features are rarely used in mobile (3 %), and less search engine interaction (only 6 %). However, Kamvar et al (2009) argues that most of the computer log studies were conducted from late 1990 to early 2000. Hence, it is difficult to perform a direct comparison between the mobile search studies and computer search analysis in a different period. In addition, it also pointed out the limitation of the log studies,
which is difficult to deduce the intention of the users such as what drive subjects to abandon the query or formulate the query.

On the other hand, it was found that the types of the task have substantial impacts of the search behaviour. Previous studies explained the search behaviours differences in various types of task. For example, Marchionini (1989) concluded that users tend to consume more time and perform more moves for the open-ended task than the closed-ended task. However, Liu et al (2010) point out that it is difficult to compare the findings, because of variety of task classification.

Recent investigators appeared to be more diversity, only few articles address the attention to the comparison of the computer and mobile searching (see table 1.1.2). The studies conducted by Kamvar et al (2009) provided a direct insight to the search behaviour in terms of query length, number of query and average characters per query for a session level. But it cannot directly provide the reasons behind the figures.

<table>
<thead>
<tr>
<th>Attention of the article</th>
<th>Author(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log-based comparison of search pattern between mobile and desktop</td>
<td>Kamvar et al (2009)</td>
</tr>
<tr>
<td>Good query abandonment on mobile and desktop</td>
<td>Li et al (2009)</td>
</tr>
<tr>
<td>Scanning behaviour of web search engine result pages on small screen and large screen</td>
<td>Kim et al (2012)</td>
</tr>
</tbody>
</table>

Table 1.1-2 Related search behaviour differences on mobile and computer

This research seeks to explore the search behaviour on both platforms from the point of view of the users and investigate the search behaviour differences in terms of the types of task. It adopts both qualitative and quantitative approaches. Initially, it carried out the task-based laboratory experiment, then it followed a semi-structured interview to explore the users’ perception about information search behaviour on both platforms. The study serves as a complement to the previous studies and suggests the search behaviour differences on both platforms, which should benefit
the application developers on mobile for a better understanding of the searching experience from the users’ opinion.

1.2 Research Aims and Objectives

1.2.1 Aims

The overall aim of this research is to investigate the search behaviour differences between mobile and desktop.

1.2.2 Objectives

1) **To survey literature for searching behaviour differences on the computer and mobile searching.**

   Method of accomplishment: A comprehensive literature review about the comparison of the search behaviours on both platforms was conducted by desk research. It will compare and literature from the UK and USA and find out the gaps in the literature for further research questions.

2) **To investigate the search behaviour differences for mobile and desktop.**

   Method of accomplishment: Task-based experiment. It records the screen activities of the participants and analysis the screen activities according to the measurements.

3) **To investigate the search behaviour differences for the types of tasks.**

   Method of accomplishment: Task-based experiment. The tasks are consisted by one information gathering task and one fact finding task. Participants will divide into computer searchers and mobile searchers.

4) **To investigate the reasons for the searching behaviour differences.**

   Method of accomplishment: Semi-structured interview. It will conduct an interview after each experiment. The interview will address the question on the specific behaviour during the experiment.
5) **Generalised the search behaviour differences**

Method of accomplishment: Analysing the data and dialogue from experiment and interview. Then corroborate the result with the previous study and conclude the differences on both platforms.

**1.3 Research Question:**

1. What kind of searching behaviour differences exist between mobile and desktop? (Research question 1, RQ1)
2. How do fact finding task and information gathering task affect search behaviour on both platforms? (Research question 2, RQ2)
3. Does user consider the mobile searching as an extension of computer searching or a tool for distinct subset of information needs? In other word, how do users think about the advantages and disadvantages of mobile searching and computer searching, such as mobility and usability, affect the daily life searching. (Research question 3, RQ3)
2 Literature Review

2.1 Query Analysis on the Desktop and Mobile

2.1.1 The Intention of Mobile and Computer Searching

Once the search engines became well established and popular, the research about the search engine log emerged rapidly. For example, Broder (2002) classified the search goal into three categories: Navigational (The user aims to compass the specific website), Informational (The user aims to compass the specific website), and Transactional (the user aims to perform some activities). Moreover, Rose and Levinson (2004) concluded a more specific framework for the search goals which is consisted of Navigational, informational (directed, undirected, advice, locate and list) and Resources (download, entertainment, interact and obtain). However, the search behaviour on the mobile is different with the pattern on the desktop. The following table illustrates the percentage for each platform.

<table>
<thead>
<tr>
<th>Task Type</th>
<th>Web Queries (%)</th>
<th>Mobile Queries (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Informational</td>
<td>80.6</td>
<td>10.2</td>
</tr>
<tr>
<td>Navigational</td>
<td>10.2</td>
<td>29.4</td>
</tr>
<tr>
<td>Transactional</td>
<td>9.2</td>
<td>60.4</td>
</tr>
</tbody>
</table>

Table 2.1-1 Statistic for the classification of queries for computer and mobile

Note: Table reproduced from (Jansen, Booth and Spink., 2007; Church, Smyth, Bradley and Cotter., 2008)

Hence, the result indicated that the intentions for mobile and desktop were different (see table 2.1-1). Although Ebling and Satyanarayanan (1998) considered the personal context (factors relevant to users who are engaging with mobile internet) as contextual factors that affect the users’ behaviour, Kim et al (2005) maintains that it is also crucial to look into the environmental contexts (such as location of use and number of nearby people). For instance, Sohn et al (2008) demonstrated that 75 % of the mobile information needs are trigger by location, activity ad time and conversation. Both of the context contribute to the differences of the searching. In addition, Kristoffersen and Ljungberg (1999) interview with 40 participants and found that the availability of hand is important contextual for internet using. Because
Mobile searchers tend to do something else simultaneously, when they are searching on the mobile.

2.1.2 Log analysis of Mobile and computer searchers

There are various studies related to query in web search on the desktop. The limitation for the material is that most of the log studies about the computer search was conducted from 1997 to 2002. However, the log material for the mobile studies is from 2006 to 2009. Hence, it is difficult to compare the data between mobile and desktop. However, some pattern can be generalised from the previous studies.

Through the comparison of the Google log studies, Kamvar and Baluja (2007) found that the typing speed is faster, clicking more result on SERPs, have more exploration within a session (see table 2.1-2). Moreover, Church et al (2008) concluded that the mobile search is in the initial stage, and the adult queries the most popular query. Furthermore, Church et al (2007) found that the mobile search is more fragment, which makes it more difficult to locate the information in mobile searching.

<table>
<thead>
<tr>
<th>Source</th>
<th>Device</th>
<th>Query length</th>
<th>Average characters</th>
<th>Time to enter a query</th>
<th>Query view per page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kamvar and Baluja (2006)</td>
<td>Google (2005)-US</td>
<td>PDA</td>
<td>2.3</td>
<td>15.5</td>
<td>56.3</td>
</tr>
<tr>
<td>Kamvar and Baluja (2007)</td>
<td>Google (2007)-US</td>
<td>PDA</td>
<td>2.6</td>
<td>16.8</td>
<td>39.8</td>
</tr>
<tr>
<td>Baeza-Yates et al (2007)</td>
<td>Yahoo-Japan</td>
<td>PDA</td>
<td>2.3</td>
<td>7.9</td>
<td>N/A</td>
</tr>
<tr>
<td>Church et al., (2007)</td>
<td>32 Search engines, European</td>
<td>N/A</td>
<td>2.1</td>
<td>13</td>
<td>N/A</td>
</tr>
<tr>
<td>Church et al (2008)</td>
<td>32 Search engines -European</td>
<td>N/A</td>
<td>2.2</td>
<td>13.8</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Table 2.1-2 The comparison of mobile searching behaviour

Note:

1. Query length refers to the average term for the query.
2. Table is reproduced from (Kamvar & Baluja, 2006, 2007; Baeza-Yates et al., 2007; Church et al., 2007, 2008)

In terms of computer searching there are some consistent studies based on the Excite search engine and Alta vista search engine in American. Initially, the studies demonstrated the alteration of the search query from 1997 to 2002 (see table 2.1-3).

<table>
<thead>
<tr>
<th>Source</th>
<th>Query length</th>
<th>Advanced searching</th>
<th>Only view the 1st page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spink et al (2002)</td>
<td>Excite (1997)</td>
<td>2.4</td>
<td>5%</td>
</tr>
<tr>
<td></td>
<td>Excite (1999)</td>
<td>2.4</td>
<td>5%</td>
</tr>
<tr>
<td></td>
<td>Excite (2001)</td>
<td>2.6</td>
<td>10%</td>
</tr>
<tr>
<td>Jansen et al (2005)</td>
<td>AlltheWeb (2001)</td>
<td>2.4</td>
<td>1%</td>
</tr>
<tr>
<td></td>
<td>AlltheWeb (2002)</td>
<td>2.3</td>
<td>1%</td>
</tr>
<tr>
<td>Beitzel and Jensen (2004)</td>
<td>AOL (2003)</td>
<td>2.2</td>
<td>2%</td>
</tr>
</tbody>
</table>

Table 2.1-3 The change of the search behaviours from 1997-2002

Note: Table is reproduced from: (Silverstein, Marais and Henzinger., 1999; Jansen, Spink and Saracevic., 2000; Hölscher & Strube, 2000 ; Amanda Spink and Wolfram, 2001; Wolfram, Spink and Jansen., 2001; Spink, Jansen and wolfram 2002; Jansen and Spink., 2005)

One of the earliest large scale mobile search engine log studies carried out by Baeza-Yates et al (2007) illustrated that the query length is similar between computer and PDA searching (see table 2.1-4). More recently studies conducted by Kamvar et al (2009) found that the query lengths are similar on IPhone and computer and no
significant differences on the local search for IPhone and computer. Moreover, on a session basis, the computer searching has the larger number of query.

<table>
<thead>
<tr>
<th>Platform</th>
<th>Query Length</th>
<th>Number of characters</th>
<th>Average query per session</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kamvar et al (2009)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computer</td>
<td>2.93</td>
<td>18.72</td>
<td>1.94</td>
</tr>
<tr>
<td>IPhone</td>
<td>2.93</td>
<td>18.25</td>
<td>1.82</td>
</tr>
<tr>
<td>Mobile</td>
<td>2.44</td>
<td>15.89</td>
<td>1.70</td>
</tr>
<tr>
<td>Computer</td>
<td>2.25</td>
<td>7.90</td>
<td>N/A</td>
</tr>
<tr>
<td>PDA</td>
<td>2.29</td>
<td>9.60</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Table 2.1-4 The comparison of the search behaviour between mobile and computer

Note:
1. Table is generated from (Baeza-Yates et al., 2007; Kamvar et al., 2009)
2. The study conducted by Baeza-Yates et al (2007) was based on the Yahoo! Japan query log, but the research carried out by Kamvar et al (2009) was generated from the Google search engine log. Hence, it should not compare both studies directly. Because the language and keyboard inputting are different.

2.2 Task and search behaviour

2.2.1 The classification of Task

“It is important to understand the potential influence of the search tasks assigned to research subjects when studying search behaviour…” (Wildemuth & Freund, 2009). Numerous studies address their focus on the classification of the search task (see table 2.2-1). For instance, Meadow (1992) assorted the tasks as known item, specific information need, general information need and explore database. However, Marchionini (1989) grouped the tasks in terms of closed and open. Similarly, Qiu (1993) classified it as general and specific. More recently, Choo (2001) divided it as undirected viewing, conditioned viewing, information search and formal search. Then, Broder (2002) concluded that it should be information, transaction and navigation. To follow up, Kim (2006) sorted the task as factual, interpretive and exploratory. Marchionini (2006) divided the task into exploratory searching and lookup. Finally, Toms et al (2008) classified it as decision making, fact finding and information gathering.
<table>
<thead>
<tr>
<th>Year</th>
<th>Author</th>
<th>Suggestion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1989</td>
<td>Marchionini</td>
<td>Closed, Open</td>
</tr>
<tr>
<td>1992</td>
<td>Meadow</td>
<td>Know item, specific information need, general information need, explore a database.</td>
</tr>
<tr>
<td>1993</td>
<td>Qiu</td>
<td>General, Specific</td>
</tr>
<tr>
<td>2001</td>
<td>Choo</td>
<td>Undirected viewing, conditioned viewing, information searching and formal search</td>
</tr>
<tr>
<td>2002</td>
<td>Broder</td>
<td>Informational, Navigational and Transactional</td>
</tr>
<tr>
<td>2004</td>
<td>Kelly et al</td>
<td>Fact-finding, information gathering browsing and transactions.</td>
</tr>
<tr>
<td>2006</td>
<td>Kim</td>
<td>Factual, interpretive and exploratory</td>
</tr>
<tr>
<td>2006</td>
<td>Marchionini</td>
<td>Exploratory, lookup</td>
</tr>
<tr>
<td>2008</td>
<td>Toms et al.</td>
<td>Decision making, fact finding and information gathering.</td>
</tr>
</tbody>
</table>

Table 2.2-1 Types of search tasks sort by years

Note: Table is reproduced from (Marchionini, 1989; Meadow, 1992; Qiu, 1993; Choo, 2001; Broder, 2002; Kim, 2006; Marchionini, 2006; Toms et al., 2008)

Based on the previous studies, Toms (2011) classified the search tasks into two categories, which are specific item and general topical search (see 2.2-2).

<table>
<thead>
<tr>
<th>Specific item or information object</th>
<th>General topical search</th>
</tr>
</thead>
<tbody>
<tr>
<td>Closed (Marchionini, 1989)</td>
<td>Descriptive (J Kim, 2006)</td>
</tr>
<tr>
<td>Factual (J Kim, 2006)</td>
<td>General (Qiu, 1993)</td>
</tr>
<tr>
<td>Know-item (Meadow, 1992)</td>
<td>Informational (Broder, 2002)</td>
</tr>
<tr>
<td>Navigational (Broder, 2002)</td>
<td>Instrumental (J Kim, 2006)</td>
</tr>
<tr>
<td>Specific (Qiu, 1993)</td>
<td>Open (Marchionini, 1989)</td>
</tr>
<tr>
<td>Transactional (Broder, 2002)</td>
<td></td>
</tr>
</tbody>
</table>

Table 2.2-2 Two core types of search task

Note: Table is cited from Toms (2011)
In addition, there are excessive extension studies in the field. For example, Rouet (2003) focused on the impacts of task specific to the search behaviour. White and Marchionini (2007) combined both exploratory task and lookup task to form a new query expansion.

### 2.2.2 Characteristics of task

It developed various criterion to characterize the task (see table 2.2-3). For instance, task can be differentiated by attributes, characteristics, dimension and facets (Pharo, 2004; Kim & Soergel, 2006; Li & Belkin, 2008; Toms, 2011; Xie, 2009).

<table>
<thead>
<tr>
<th>Author</th>
<th>Criterion</th>
<th>Elements</th>
<th>Detail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pharo (2004)</td>
<td>Attributes</td>
<td>Goal</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Complexity</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Strategies</td>
<td>N/A</td>
</tr>
<tr>
<td>Li and Belkin (2008)</td>
<td>Facet</td>
<td>Source of task</td>
<td>Internal generated, collaboration, external</td>
</tr>
<tr>
<td></td>
<td></td>
<td>User</td>
<td>Individual, group</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Time</td>
<td>Frequency, length, stage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Product</td>
<td>Physical, intellectual, dimension, factual information image, mix product</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Process</td>
<td>One-time task, multi-time task</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Goal</td>
<td>Quality, Quantity</td>
</tr>
<tr>
<td>Xie (2009)</td>
<td>Dimension</td>
<td>Origination of the task</td>
<td>Self-generated, assigned</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Types of the task</td>
<td>Pre-focus, formulation, post-focus</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Flexible of the task</td>
<td>Extremely urgent, urgent, non-urgent</td>
</tr>
<tr>
<td>Kim and Soergel (2006)</td>
<td>Characteristics</td>
<td>Intrinsic task characteristics</td>
<td>Task, type, abstract, characteristic, constraints, goal, product, structure, requirement and process.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Extrinsic task characteristics</td>
<td>Locus of task, imposition, autonomy, significance, urgency, frequency, risk, reward</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Task Performer</td>
<td>Individual, group, interaction of performer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Relationship</td>
<td>Familiarity, novelty, manageability, intrinsic interest, goal acceptance, success salience</td>
</tr>
</tbody>
</table>

Table 2.2-3 The characteristics of search tasks

Note: Table is reproduced from (Pharo, 2004; Kim & Soergel, 2006; Li & Belkin, 2008; Toms, 2011; Xie, 2009)
2.2.3 Influences of the tasks

2.2.3.1 Task types and search behaviour

Most of the previous studies focus on the search behaviour at task session level. As it is shown in table 2.2-4, the searching behaviour differences are various from the task types. In addition, the complexity and difficulty of task also bring potential impact to the search behaviour. For instance, Gwizdka and Spence, (2006) suggested that task difficulty influence the display time, number of pages viewed and deviation from the optimal path when they investigate the relationship between the fact finding task and difficulty.

<table>
<thead>
<tr>
<th>Author</th>
<th>Task type</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marchionini</td>
<td>Open-ended task</td>
<td>Users spend more time and performed more moves</td>
</tr>
<tr>
<td>(1989)</td>
<td>Closed-ended task</td>
<td>Users consume less time and moves</td>
</tr>
<tr>
<td>Qiu (1993)</td>
<td>Specific task</td>
<td>Users adopt more structured search patterns</td>
</tr>
<tr>
<td></td>
<td>General task</td>
<td>Users adopt less structure search patterns</td>
</tr>
<tr>
<td>Kellar et al</td>
<td>Fact finding task</td>
<td>Shorter duration, small number of pages viewed, larger search component, relatively longer queries, little use of browser functions,</td>
</tr>
<tr>
<td>(2007)</td>
<td>Information gathering task</td>
<td>Longer duration, larger number of pages viewed, large search component, Relatively shorter queries, greatest use of browser functions</td>
</tr>
<tr>
<td></td>
<td>Browsing task</td>
<td>Shorter duration, small number of pages viewed, often repeated, little use of browser functions</td>
</tr>
<tr>
<td></td>
<td>Transactions task</td>
<td>Shorter duration, number pages and windows influenced by type e-mail, most often repeated, little use of browser functions</td>
</tr>
<tr>
<td>Li (2008)</td>
<td>Intellectual task</td>
<td>Users involve more IR system consulted, page viewed and have longer queries</td>
</tr>
</tbody>
</table>

Table 2.2-4 Search behaviour in difference task types
2.2.3.2 Tasks complexity and search behaviour

It is shown that task complexity has influences to the searching behaviour. Complexity is defined as “a priori determinably of or uncertainty about, task, outcomes, process, and information requirements.” (Byström & Järvelin, 1995). The early study from Maynard and Hakel (1997) showed that objective and subjective complexities have substantial influences to each other and both affect user performance in different ways. Moreover, Gwizdka and Spence (2006) developed objective and subjective measurement for task complexity. They suggested the complexity is related to the number of unique web pages visited, the time spent on each page, the degree of deviation and the straightforwardness of finding information. Extended from previous studies, Li (2008) demonstrated that objective task complexity affected the search behaviour in terms of the number of search engine result pages, items viewed, query-related behaviour, success, satisfaction and completion time. Additionally, Byström (2002) found that task complexity influences the type and source of information. For instance, the need of information (sources, domain and problem-solving) rises with the increased task complexity.

2.3 Dwell time

The early studies from Morita and Shinoda (1994) suggested that users tend to spend more time in the article they interested. However, Kelly and Belkin (2004) argue that it is inaccurate to predict the usefulness of an article by simply considering the display time. Instead, it should also consider the influences from the task types and users. Most of the previous researches focus on the individual’s scanning behaviour by utilizing the eye tracking devices. There are several studies have classified the pattern for the scanning behaviour. For instance, A study from Klöcknerm et al (2004) classified the scanning behaviour into two category: ‘depth-first’ (the users only review the link above the selected link) and ‘breadth-first’ (users look through all the link then select a link from the result). The latter only accounts for less than 15 % of the users and the former takes up over 50 % of the overall participants.

On the other hand, the study carried out by Dumais et al (2010) extended from the previous study and divided the reviewing pattern into three type: Economic-Results, Economic-Ads and Exhaustive. The exhaustive users tend to review the pages
gradually, but economic users spend less time selecting the result. Moreover, the size of the screen has some influences to the scanning behaviours. The research carried out by Kim et al. (2012) reveal that the individuals tends to spend more time on the small screen. Meanwhile, the frequency of the trackback for small screen is 1.27 per task, compared with 1.95 on the large screen. Hence, it will be necessary to consider the scanning behaviour during the research.

2.4 The limitation of mobile devices

<table>
<thead>
<tr>
<th>WAP</th>
<th>PDA</th>
<th>Conventional</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. Responsiveness</td>
<td>5. Responsiveness</td>
<td>5. Screen size</td>
</tr>
<tr>
<td>6. Colours used in display</td>
<td>6. Colours used in display</td>
<td>6. Colours used in display</td>
</tr>
</tbody>
</table>

Table 2.4-1 Factors affect the users’ interaction with search result

Note: Cited from Jones et al (2002)

Although the deployment of technology such as “Morae” makes the content analysis more smoothly, but the device-related issues are more difficult to catch (Waterson et al, 2002). Previous researches for the limitation of mobile device were primarily based on the interview to WAP, PDA and conventional mobile users. The study conducted by Jones et al (2002) revealed that the users’ performance declines with the reduced size of the screen. It is primary due to the fact thatsearchers cannot have a correct perception about the usefulness of the search engine result. Moreover, it provided a users’ ranking for the factors that affect interacting with the search results (see table 2.4-1). The screen size, navigation facilities, search result description, text
entry facilities, responsiveness were the most popular factors, which influence users’ performances during the searching. Another study, from Kim et al (2005), found out that the users tend to address the attention on the content of the mobile internet. And the deployment of the content shows careless to the mobile Internet environment. However, there is no updated research discuss the limitation of the smartphone. Kamvar et al (2009) assumed the network connection, and screen size and improved text entry on smartphone encourage the people searching on mobile.

To sum up, there are some shortcomings in the log study. More specifically, the log only record statistics data (the date and time for the query) which will not illustrate the users’ pattern for reviewing the pages and how users modify the query in each session. Furthermore, it will not illustrate the process for the individual to retrieve the information in each session. Oh the other hand, although the lab-based experiment studies covers the internal and external factors which affect the searching behaviour of the mobile and desktop users, There is no study in investigating the searching behaviour in session level on the computer and mobile. In addition, there is no updated study investigate the limitation of the smartphone in users’ perception. As a result, it will be necessary to perform an experiment study, which should explore the search behaviour more specifically in both platforms.
3 Methodology

3.1 Introduction
The study involved experiment and interview. During the experiment, it required participants to complete the fact finding task and information gathering task on the computer or mobile. Then participants were asked to complete a short questionnaire for each task. After the experiment, it followed an interview which aimed to ask the questions relate to the research question. 17 participants (including 2 subject for the pilot study) range from different disciplines attend to the study. The data includes questionnaires, videos for screen activity and audio recording. Each video was converted to two log files (one for information gather task, another is for fact finding task) through observation and coding. Then, it extracted the data for 9 measurements (such as query length, number of query and total time) and the data from questionnaires, then use the software called “Statistical Product and Service Solutions (SPSS)” to analyse the data in order to produce the statistical data. On the other hand, with the helps of the software call “Nvivo”, the audios for interview were summarized as the transcript by listening and coding.

3.2 Rationale for Both Qualitative and Quantitative Data Collection
Although it decided to manipulate both quantitative and qualitative methods to collect data, it mainly focuses on quantitative method. The primary reason for this is that log analysis on both platforms is largely involved in previous studies. For instance, the one of the first computer search behaviour study, conducted by Jansen et al (2000), looked into the AltaVista search logs and found out the query and session pattern for the computer-side search behaviours. Even for the mobile searching behaviour studies, Kamvar and Baluja (2006) also performed the log-based analysis for the mobile search. Moreover, extend from the previous studies, Kamvar et al (2009) investigated the search behaviour differences between desktop and mobile. In addition, other studies involved task-based experiment in order to find out the relationship between the task and search behaviours (Marchionini, 1989; Broder, 2002; Rouet, 2003; Gwizdka & Spence, 2006; White & Marchionini, 2007).
Hence, in this study, it decided to perform an experiment in the beginning and focused on the interview after the experiment, because it needs to explore the reasons for the search behaviour differences. As Kamvar et al (2009) pointed out that, they cannot find out the intention of users for the return or abandon search based on the log study. As a result, this study will corroborate with the previous study by interviewing the participants.

3.3 Experimental Design

Before experiment, participants were divided into two groups, which were classifying by odd and even number of the representative number of each participant. For the group with odd number, it required them to complete the task on mobile while another group will perform on the computer. The computer operating system is “Window 7” and the browser is “Internet Explorer (IE)”. The mobile (Lumia 920) operating system is “Windows Phone 8” and the browser is also “IE”. Both groups were asked to complete two search tasks in 10 minutes (5 minutes for each tasks). After the task, participants were asked to fill in two questionnaires (See Appendix E). It was followed with a semi-structured interview which was trying collect user’ opinion for the research questions.

3.4 Data Collection

All experiment and interview were recorded from fifth to ninth in August 2013. During the experiment, it employed the software called “Morae” in the computer to collect data by recording the screen activity when participants executing the search. For the mobile, it decided to record the screen activity directly by the camera (Panasonic Digital Camera Recorder). Regarding to the following semi-structured interview, all the questions for the interview are addressing the research objectives and share the similar pattern. All interviews were recorded by “eXtra Voice Recorder” on MacBook pro. And all the transcript files are attached in Appendix A.
3.5 Search Task.

3.5.1 Justification for the search task

The experiment only allows the participants perform two search tasks because of the limitation of the time. The search tasks include fact finding task and information gathering task. Although Wildemuth and Freund (2009) concluded three classifications of the task (in terms of complexity, specificity and exploratory), it decided to follow the framework (see table 2.2-2) provided by Toms (2011). Because it aims to explore the general differences, instead of investigate the differences in terms of complexity, specificity of the task and learning activities of the individuals—exploratory. More importantly, it has divided the tasks from previous studies into two general categories—specific item and general topical search. As a result, this classification should represent the two general category of searching in everyday-life. More specifically, fact finding task requires participants to locate the specific item or information object while information gathering task tries to ask the participants to perform a general topical search.

3.5.2 Designation of the task

“Experiment studies are intended to isolate particular effect on user behaviours” (Wildemuth & Freund, 2009). Hence, it is suggested that categorized tasks should be assigned in the starting part of the studies. Moreover, in order to enhance the validity of the search task, in the beginning, it should have a similar situation with the real-life problems, which can attract interest from the participants (Katriina Byström & Hansen, 2005; Elsweiler & Ruthven, 2007). In addition, while Borlund and Ingwersen (1997) pointed out that simulated situation should consist by task situation and the indicative request. Katrina et al (2005), on the other hand, explored the situation description into more detail: a contextual description, a situational description, and a topical description and query.
Both tasks are classified as easy task. The tasks are listed below:

1. Fact Finding Task
As a student in the University of Sheffield, we should have at least little knowledge about our university. Our engineering income currently ranks as the second place compared with other university in UK. Can you find the research income during the 2011-12?

2. Information Gathering Task
You intend to have a trip to Maldives during the vacation. But there are so many resorts in Maldives. You are clueless about where to stay. However, you have all your information on the Internet. Can you list 5 resorts where are famous for snorkelling or diving?

3.6 Measures and variables
As is shown in the table 3.6-1, although most of the attributes can be handled easily, the read/scan ration and saccade distance are difficult for evaluate since the limitation of the equipment.

<table>
<thead>
<tr>
<th>Author</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liu et al (2010)</td>
<td>Task completion time, number of pages visited, amount of source, number of query, amount of search source, decision time, read/scan ration, saccade distance</td>
</tr>
<tr>
<td>Marchionini, (1989)</td>
<td>Success, time, number of move, record title, relevant information for search</td>
</tr>
<tr>
<td>Kim (2006)</td>
<td>Time spent, page viewed, pages saved, search engine used, query reformulation</td>
</tr>
<tr>
<td>Feng (2012)</td>
<td>Length of query, number of times modifies the query, number of contents pages, time spent on SERPs, Time spent on view pages, number of touches</td>
</tr>
</tbody>
</table>

Table 3.6-1 the measurement for the experiment
There are nine variables for measuring the differences on both platforms:

- Query recommendation: number of Time for accepts the query recommend from search engine for each task.
- Number of query: number of query searched for each task.
- Length of query: The average length of query.
- Query reformulation: number of time for modifying the query.
- Page view: number of page.
- Total time: the total time for each task.
- Time spent on SERPs: Time spend on Search engine result pages (SERPs)
- Time spent on viewed pages: The average time for viewing pages for each task.
- Average time for pages: average time spends on each page.

It is worth noticing that the page view does not include the revisited pages. However, it counts the query reformulation in to the number of query as well as the length of query.

### 3.7 Interview Question

For the semi-structured interview, the interview questions are listed below:

Regarding to the first research question (RQ1), the following interview questions try to understand the advantages as well as the obstacles for computer and mobile searching.

1. Do you happy with the result of your search (satisfy with your result)? Could you give the reason? (E.g. is anything make it difficult related to the mobile devices? Limitation?)? (Question 1—Q1)

2. Do you think you can have a better performance in the computer? Could you give me some reason? (What make you become more confident or less confident?) (Question 2—Q2)
To solve question address by for the RQ2, it will explore the users’ perception about fact finding task and information gathering task and why participants performing searching in different ways for both task.

1. Can you recall your approach to the result when you were engaging with two tasks? Is the approach similar? What did you perform in this way? (Question 3—Q3)

The final questions should discuss the RQ3. It should explore the how users consider the relationship between mobile and computer searching. More specifically, it will try to understand how users treat mobile searching as an extension from computer searching or have distinct information need from the information need of computer searching.

1. What do you think the main differences when searching on mobile and computer? (Question 4—Q4)

2. How do you consider the relationship between mobile and computer? In other words, do you think mobile searching is an extension from computer searching, or it has distinct information needs compare with computer searching? Then, Is that means you will perform differently (or similar) according to the devices. What do you mean by … (Extension, distinct or something else)? (Question 5—Q5)

3.8 Participant
There were 17 participants recruited through the university volunteer list, including 2 participants for the pilot study. All participants are experienced Internet searcher and have some mobile searching experience. Each participant was given a representative number when he or she agreed to involve in the experiment.

3.9 Pilot Study
Two pilot studies were conducted on two “test” participants in order to validate the task for the experiment and check the questions for the interview. The participant for
computer searching explained the fact finding task is poor design. Because it tends to get confuse between “engineering research income” and “the research income for university of Sheffield”. The previous fact finding task is shown below:

“The University of Sheffield has overtaken the University of Cambridge for engineering research income, confirming the institution as a world-leader in the field. Can you find the research income of the University of Sheffield during 2011-12? ”

As a result of the feedback, it revised the fact finding question for the participants, and it was planned to inform the participants and stress on the “total research income” but not “engineering research income”.

For the mobile searching, the test device is “IPhone 4”. The participant complained the processing speed was extremely slow after launching the application for consumption and performance. Hence, instead of using “screen recorder”, it is decided to use camera directly record the screen activities. In addition, it changed the device from “IPhone 4” to “Lumia 920”.

The total time consumption for the 9 minutes and 24 second on mobile and 7 minutes and 39 seconds on mobile. Hence, for both platforms, it was determined that the time limitation should be 10 minutes. Each task allows the participants to complete within 5 minutes.

3.10 Data Analysis
All the data were coded manually. For the data from the experiment, the analysis consisted by, first, converting the screen activities from the experiment to a log file for each participant. Then, summarizing and calculating the data according to the measurements and put the data into the excel file. Finally, it employed a data analysis software SPSS to calculate the “one sample t-test” in order to have the mean and standard deviation. However, because of the sample group is relatively small. It focused on the mean and standard deviation for each measurement on both platforms according to the tasks, and the “Pearson Value” is not an accuracy way to describe
the statistics. In addition, it employed the qualitative data to describe the reason behind the differences for the searching behaviour on both platforms. The overall time consumption is over 10 hours (around 6 hours for the fact finding task and 4 hours for information gathering task), which is including converting and validating the data from screen activities.

Each audio recording was listened carefully. But the interviews were not fully transcript. Instead, it summarized the key points from the participant for each interview question. In addition, it used an interview analysis software call “Nvivo” to calculate the occurrence of the keyword such as “size of screen”, “keyboard” and “extension” as well as other words with similar meaning. The transcripts are attached in Appendix B. It spent around 10 and half hours in translating the interview to logged interviews.

3.11 Ethical aspects

Ethical approval is obtained before the experiment and interview carried out. The research was categorised as ‘low risk’. Prior to every experiment, participants are asked to read the information sheet and sign the sheet if they consent the requirement and agree to participate into the experiment and interview. The information and consent sheet are attached in Appendix F. The letter of approval is attached in Appendix C.

Some personal information was collected before the experiment, including course, program, age, nationality and degree level. Participants were assigned a unique identifier number. All data will be anonymous and keep securely on the personal computer for the research purpose.
4 Result

4.1 Demographic

A total of 15 participants, who are students from university of Sheffield, participated in the study. The age of the participants range from 23 to 48, and the average age of the participants are 25.00. Moreover, 8 of the participants (53.3 % of the subjects) were under 25 years of age. 4 of them were aged between 25 to 30 years old. And two of the users were above 30 years of age.

As shown in figure 4.2, majority of them (73.1 %) are postgraduate (PG), three are Doctor of Philosophy (PhD) and only one is undergraduate (UG). Furthermore, seven of the participants were female, constitute for 46.7 % of the sample group and eight were male.

In addition, five of the participants (33.3 %) were Information school; others came from the music department, engineering department, computer science and architecture department, social and policy department, metallurgy department and management department. Moreover, half of the participants (46.8 %) came from China while other from British, Colombia, Greece, Iraqi, Italy, Japan, Australia and Mexico.

Although fifteen students within university were recruited, only data for 12 participants was analysed for the fact-finding task and 14 for the information gathering task (see table 4.1-1). They primary reason is that The English language skill restraints they performance. For instance, “I think I am not familiar with English which will limit my searching.” (P16, Quote 1) In addition, although it noticed participants when the time for the task comes to the end, some of them (see Appendix A, participant 9, 12 and 16) were keeping searching and ignored the limitation of time.
<table>
<thead>
<tr>
<th></th>
<th>Mobile</th>
<th>Computer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of subjects</td>
<td>8</td>
<td>7</td>
</tr>
<tr>
<td>The number of subjects who finish the fact finding task</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>The number of subject who successfully finish fact finding task</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>The number of subjects who finish the information gathering task</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>The number of subject who successfully finish information gathering task</td>
<td>6</td>
<td>5</td>
</tr>
</tbody>
</table>

Table 4.1-1 The participants who complete, and success for both task on both platforms

### 4.2 Success rate and restrictions for mobile searching

Participants tend to have better performance for the information gather task on both platforms while mobile searchers tend to have trouble when engaging fact-finding task. Table 4.2-1 illustrates that participants on the computer are more likely to success on fact-finding and information finding tasks. More specifically, the success rate for computer searching is slightly higher (8.3%) than mobile searching regarding to the information gathering task.

<table>
<thead>
<tr>
<th></th>
<th>Mobile</th>
<th>Computer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fact-Finding Task</td>
<td>42.9%</td>
<td>80.0%</td>
</tr>
<tr>
<td>Information Gathering Task</td>
<td>75.0%</td>
<td>83.3%</td>
</tr>
</tbody>
</table>

Table 4.2-1 Success rate in both platforms

Note:

1. The success rate: the number of people successfully finishes the task divided by the number of people finish the task.

However, the number is different for fact finding task. Less than half (42.9%) of the mobile searchers successfully finish the task while 80% of the computer searchers achieve the task. Through coded the interview and summary the result, it generated
explanation for the mobile users fail in the tasks. Of 3 participants who fail in the
task, all the users complained about the mobile searching is not comfortable. For
example,

“…It should be more comfortable. Because it is better for me to browse and
record the information. For instance, I can browsing different window at the
same time…” (P1, Quote 1).

They also explained that the usability of mobile brings some negative effects to the
searching. More specifically, all of the participants complained about the screen size
affect their performance. For instance,

“…The size of the screen make it inflexible when searching for information,
and it also have some limitation for browser…” (P1, Quote 2)
“…The size of the screen is easier to view information on the computer, but
in mobile, I have to move the screen…” (P7, Quote 3).

One of the Participants reported that the keyboard limited the performance:

“…The key board is another difficult. I use only one finger and sometimes it
will press the wrong button…” (P7, Quote 4)

Another searcher explained that it was difficult to adapt with the mobile searching:

“…I am not used to searching on the mobile, instead of, I prefer the bigger
screen. And I am not familiar with the touch mobile…” (P7, Quote 5).

Additionally, one of the participants argued about the defect of auto-completion on
mobile searching engine:

“…I spent a lot of times learning how it works. Second, the auto-completion
is bothering me, because, on the computer, I can choose the auto-completion
without searching. But, on mobile, if I click it, it will search and I have to go
back and modify the query. So, I think on mobile, it is restricting my ability…” (P7, Quote 6)

Moreover, participants are more likely to succeed on the information gathering task when compared with the fact-finding task (see table 4.2-2). Primarily, the participants who fail in fact finding task explained that they rely on Google, and they were expecting the SERPs directly show them the result. For example, participant 6 stated that: “…The search engine did not provide what I need…”. In contrast, for participants who complete this task, they predicted that the result is published by university of Sheffield and their queries were focused on “research income”, “university of Sheffield” and “2011-2012”. One of them used the advanced searching (site: sheffield.ac.uk) to limited the result within the university of Sheffield. And the participant 13 concluded that: “for the more specific information question, I prefer the university website compare with Google”. Alternatively, the objective difficulty can affect the searching on both platforms. For instance, participants (participant 7, 12 and 15) find that it is more difficult to perform the first tasks compare with the second one.

On the other hand, it is worth noting that the participants for mobile searching considered that they can have a better performance on computer for both tasks (see table 4.2-2). The reason is that almost all the participants (93.3 %) feel that mobile restraint the performance because of the limitation of the mobile. Figure 4.2-1 illustrates the specific restriction for mobile. Of all the limitation, screen size is the most popular factors (14 of 15 subjects). To follow up, seven participants complained about the network speed is bothering the searching on mobile, and 5 users suggested keyboard, search result differences and lack of features (such as flash, java and picture) are influence mobile searching. In addition, two subjects mentioned about the comfortable, Finger covers the content, advanced search on mobile and process speed. Finally, only one user blamed on the auto-completion and advertisement on mobile. This finding extends the previous studies conducted by Jones et al (2002) and suggests a new set of limitation for the usability of smartphone.
<table>
<thead>
<tr>
<th></th>
<th>Number of participants</th>
<th>Mobile</th>
<th>Computer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fact Finding Task</td>
<td>12</td>
<td>4.29 (0.76)</td>
<td>2.60 (0.55)</td>
</tr>
<tr>
<td>Information Gathering</td>
<td>14</td>
<td>3.88 (0.99)</td>
<td>3.33 (1.03)</td>
</tr>
</tbody>
</table>

Table 4.2-2 The level of confidence of participants for performing the task in alternative platform.

Note:
1. It is 5 points scale. 1 indicates participants have no confident and 5 refer to strong confidence.
2. It excludes the participants who were not finish the task

![Chart showing various limitations on a mobile device](chart.png)

Figure 4.2-1 Limitation of the mobile

Note:
1. The data is generated from transcript of the interview. More specifically, it employed the software called “Nvivo” to locate the key words such as: “size” and “screen” as well as the similar word (“Nvivo” has an option for select the similar word automatically). Finally, it calculated the occurrence of each key word and generated the graph.
Although computer searchers believed that they should have a better result for Fact finding task on mobile, it was opposite for information gather task (See Figure 4.2.2). The primary reason is that although the limitation of mobile restraints the performance on mobile, users tends to consider the limitation will require more time and effort to locate information but not affect the searching behaviour. For instance,

“…Because of (mobile is) scale down system. It is about the difficulty of usability. You may familiar with tabs or Google on computer. Mobile can do that same, but only takes longer time.” (P4, Quote 7)

Additionally, Three participants explained that they tend to search the information on a specific site—“Tripadvisor” in information gathering task. As participants explained that:

“Tripadvisor is more reliable because it is based on the user’s review and I used it before, besides, it ranks the resort for you…I will go to the website which is specifically designed for it” (P15, Quote 8).

The following part will reveal and discuss the finding for each research questions.

### 4.3 The search behaviour differences between mobile and computer

This part will discuss the search behaviour differences in term of fact finding and information gather task. It will also explore the reasons for the differences on both platforms.

#### 4.3.1 The overall result

For the fact finding task, the query recommendation, number of query, query reformulation and page viewed tend to be similar on both platforms. But it is obvious that computer searchers tend to input more word and query for each tasks (see table 4.3-1). More specifically, the number of query is 2.57 on the mobile and it is slightly higher (2.80) on the computer while query length is 5.23 on the computer, but it is much lower (3.62) on mobile. Another figure reflected that mobile searchers need to take more time (57 seconds) to input the query while computer searchers only spend
half of the time to complete the query. The reason is that users considered the limitation of keyboard affect the query input. For example, participant 11 stated: “…the keyboard is irritating. I need to take more time to complete…” and Participant.5 claimed: “I enter fewer queries, which focus on the keyword, on mobile. But in computer, I will enter more queries”.

<table>
<thead>
<tr>
<th>Measurements</th>
<th>Mobile</th>
<th>Computer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Recommendation</td>
<td>0.57 (0.53)</td>
<td>0.20 (0.45)</td>
</tr>
<tr>
<td>Number of Query</td>
<td>2.57 (1.51)</td>
<td>2.80 (1.92)</td>
</tr>
<tr>
<td>Query length</td>
<td>3.62 (0.55)</td>
<td>5.23 (0.55)</td>
</tr>
<tr>
<td>Query Reformulation</td>
<td>1.14 (1.57)</td>
<td>1.80 (1.30)</td>
</tr>
<tr>
<td>Rage viewed</td>
<td>5.86 (3.63)</td>
<td>5.60 (2.88)</td>
</tr>
<tr>
<td>Total Time</td>
<td>234.86 (58.20)</td>
<td>235.18 (64.78)</td>
</tr>
<tr>
<td>Time spend on SERPs</td>
<td>49.00 (27.78)</td>
<td>52.84 (30.07)</td>
</tr>
<tr>
<td>Time spend on viewing pages</td>
<td>126.14 (47.41)</td>
<td>151.83 (93.54)</td>
</tr>
<tr>
<td>Average time for each pages</td>
<td>40.32 (28.23)</td>
<td>44.97 (27.49)</td>
</tr>
<tr>
<td>Query entering time</td>
<td>56.71 (9.83)</td>
<td>28.16 (11.49)</td>
</tr>
<tr>
<td>Average query enter time</td>
<td>29.74 (17.37)</td>
<td>11.71 (3.49)</td>
</tr>
</tbody>
</table>

Table 4.3-1 Search behaviour for Fact Finding task on both platforms

Note:
1. Mean is shown, with std. deviation shown in brackets
2. The data is generated form the log file for participants who finished the task.
3. The time spend on viewing page refers to the time for content pages but not SERPs.

On the other hand, the total time is 3 minutes and 55 seconds on both platforms. But the time spends on viewing page and query entering is opposite. More specifically, it takes mobile searchers 2 minutes and 6 second to read the pages which is relatively longer (2 minutes and 32 seconds) on computer. This finding correlates the hypnosis from Kim et al (2012) about the users in large scr...
the higher success rate on the computer searching. (See table 4.2-1). Because participants on the computer will spend more efforts in checking the result, but mobile searchers tend to locate the information in a rush with less effort to check their selection.

Regarding to the information gathering task (see table 4.3-2), the time for entering query on the computer is slightly larger than it on mobile. However, the number of query, query length, query reformulation are relatively higher for computer searching. For instance, the number of query is 1.13 for mobile searchers while it is nearly doubled (2.00) for computer searchers. And mobile searchers are less likely to modify their query (0.13), but some of the computer searchers prefer to modify the query more frequently (1.00). As a result, the average time for entering query is 14.35 seconds on the computer and 21.06 seconds on mobile. This is largely due to the fact that the limitation of keyboard on mobile constrains the performance of the mobile searchers. Another figure shows that query recommendation is 0.88 on mobile, but it is only 0.33 on computer. This may explain that mobile searchers tend to adopt the query recommended by search engine so that they can avoid inputting the query while computer searchers prefer entering the query by themselves.

<table>
<thead>
<tr>
<th>Measurements</th>
<th>Mobile</th>
<th>Computer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Recommendation</td>
<td>0.88 (0.64)</td>
<td>0.33 (0.52)</td>
</tr>
<tr>
<td>Number of Query</td>
<td>1.13 (0.35)</td>
<td>2.00 (1.26)</td>
</tr>
<tr>
<td>Query length</td>
<td>2.94 (0.78)</td>
<td>3.65 (0.71)</td>
</tr>
<tr>
<td>Query Reformulation</td>
<td>0.13 (0.35)</td>
<td>1.00 (1.27)</td>
</tr>
<tr>
<td>Rage viewed</td>
<td>3.38 (1.06)</td>
<td>5.33 (2.50)</td>
</tr>
<tr>
<td>Total Time</td>
<td>155.25 (50.14)</td>
<td>128.76 (75.32)</td>
</tr>
<tr>
<td>Time spend on SERPs</td>
<td>32.31 (17.19)</td>
<td>33.52 (29.21)</td>
</tr>
<tr>
<td>Time spend on viewing pages</td>
<td>105.13 (42.90)</td>
<td>76.55 (66.19)</td>
</tr>
<tr>
<td>Average time for each pages</td>
<td>42.16 (17.70)</td>
<td>24.60 (23.98)</td>
</tr>
<tr>
<td>Time for entering query</td>
<td>22.63 (3.81)</td>
<td>24.33 (17.15)</td>
</tr>
<tr>
<td>Average query enter time</td>
<td>21.06 (5.06)</td>
<td>14.35 (7.35)</td>
</tr>
</tbody>
</table>

Table 4.3-2 Search behaviour for Information Gathering task on both platforms

Note:

1. Mean is shown, with std. deviation shown in brackets.
2. The data is generated from the log file for participants who finished the task.
3. The time spend on viewing page refers to the time for content pages but not SERPs.

On the other hand, contrary with 2 minutes and 35 seconds on mobile, computer searchers on spend 2 minute and 9 seconds in locating the result. More specifically, although the time spend on SERPs on both platforms is similar, the time for viewing pages is 1 minutes and 45 seconds on mobile but 1 minutes and 17 seconds on computer. Kellar et al (2007) examined that information gathering task requires people collect information from multiple sources. Although participants on both platform need to compare and contrast the information, it is easier to compare the content within or between pages on the computer. Because it can directly compares the result in different tabs or windows (Participant 1, 4 and 16). For instance,

“…in computer, it allows us to use different tab which makes it easier to read. But in mobile, it takes, at least, more times and efforts to switch between tabs…” (P4, Quote 9)

More importantly, because of the limitation of the mobile, the searching performance is constrained by the usability of mobile. Firstly, almost all the participants (93.3 %) complained about the screen size on mobile. For example:

“…the (small) size of screen affected my speed of scanning information, and it is easier to scroll down the pages in a big screen which make me easier to location information.” (P2, Quote 10)

“…I need to zoom in because of the screen size is too small. And when I zoom in, it will also affect me especially on reading the contents…” (P13, Quote 11)

As a result, computer searchers spend half of the time in viewing the content compare with mobile searchers. The following part will discuss the statistics for participants who successfully finish the tasks.
Additionally, each group has one participant employed the advanced searching function (see figure 4.3-1 and 4.3-2). It is also interesting to notice that some of the mobile searchers relied on the result on search engine while others searched the result on the university website. Three of the participant searched within the university website (see Appendix A, Participant 3, 5 and 13). It may due to the fact that mobile searchers are trying to avoid the text entering. Instead, they directly look for the information within the university website. Moreover, several searchers tried to gather the information via Google. Because they have strong confidence for Google and they considered Google as a toolset to organised and gather the information. For instance,

“…I use Google quite a bit. I find it the best search engine. It organised the result nicely. In the first task, I trust the search engine can give me the result…”
(P14, Quote 12)

“...
Modifying Query (4.80s)
142.12s: Query modification-“University of Sheffield” “Research income” 2011-12 shef.ac.uk. Add shef.ac.uk
Viewing SERPs (2.02s)
Modifying Query (16.40s)
160.92s: Query modification-“University of Sheffield” “Research income” 2011-12 site: www.sheffield.ac.uk. Add site:www.sheffield.ac.uk
Viewing SERPs (18.66s)
...”

Figure 4.3-1 Advanced feature in computer searching

Note:
1. The data is from the log file for participant 2.
94s: Back to SERPs.
Viewing SERPs (4s)
Modifying query (16s)
114: Query modification: total research engineering site: Sheffield.ac.uk add engineering
Viewing SERPs (15s)
...

Figure 4.3-2 Advanced feature in mobile searching

Note:
1. The data is from the log file for participant 11.

4.3.2 The search behaviour for participants who complete the tasks.

For the fact-finding task, it is a general trend for the computer-side searchers to enter a longer query (5.41 on the computer compare with 3.41 on mobile) as well as input more query per session level (see table 4.3-3). As it has been discussed above, it is largely due to the fact that mobile searchers are restraint by the limitations of the mobile such as keyboard and screen size (see figure 4.2-1). In addition, the number of time for query modification is triple (2.00 on the computer and 0.67 on mobile) times than mobile searching, but the number of pages viewed on mobile is slight higher than it on the computer. The possible reason is that participants for computer searching tend to spend more time on modifying the query while mobile searching prefer to view more pages instead of entering the query. However, it seems that mobile and computer searchers have different strategies for locating the result.
<table>
<thead>
<tr>
<th>Measurements</th>
<th>Mobile</th>
<th>Computer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Recommendation</td>
<td>0.33 (0.58)</td>
<td>0.25 (0.50)</td>
</tr>
<tr>
<td>Number of Query</td>
<td>2.67 (1.15)</td>
<td>3.00 (2.16)</td>
</tr>
<tr>
<td>Query length</td>
<td>3.42 (0.52)</td>
<td>5.42 (0.42)</td>
</tr>
<tr>
<td>Query Reformulation</td>
<td>0.67 (1.56)</td>
<td>2.00 (1.41)</td>
</tr>
<tr>
<td>Rage viewed</td>
<td>6.67 (4.62)</td>
<td>6.00 (3.16)</td>
</tr>
<tr>
<td>Total Time</td>
<td>243.67 (67.35)</td>
<td>259.95 (38.82)</td>
</tr>
<tr>
<td>Time spend on SERPs</td>
<td>52.67 (36.83)</td>
<td>47.9925 (32.38)</td>
</tr>
<tr>
<td>Time spend on viewing pages</td>
<td>134.67 (59.53)</td>
<td>180.601 (78.40)</td>
</tr>
<tr>
<td>Average time for each pages</td>
<td>34.11 (17.29)</td>
<td>49.40 (29.61)</td>
</tr>
<tr>
<td>Time for entering query</td>
<td>58.00 (3.00)</td>
<td>28.70 (13.19)</td>
</tr>
<tr>
<td>Average query enter time</td>
<td>24.17 (8.50)</td>
<td>11.38 (3.95)</td>
</tr>
</tbody>
</table>

Table 4.3-3 Search behaviour for participants who successfully finish the fact finding task

Note:
1. Mean is shown, with Std. deviation in brackets
2. The data is generated form the log file for participants who successfully finished the task.
3. Time is record as seconds.

It takes mobile searchers 2 minutes and 61 seconds to locate the result page and computer searchers need 2 minutes and 13 seconds. Within the result pages, mobile searchers can find the result more in 1 minutes and 23 seconds while computer searchers have to spend 2 minutes and 6 seconds to spot the answer. In addition, table 4.3-4 illustrates that although mobile searchers spent 2 minutes and 41 seconds in finding the file (2 minutes and 13 seconds for computer-side), they only consumed 1 minute and 23 seconds on locating the result within the file (2 minutes and 9 seconds for computer-side). Once again, this figures correlate the previous prediction by Kim et al (2012). Moreover, it seems that computer searchers tend to locate the result gradually. For example, according to the log for the participant 14 (see figure 4.3-3). The participant looked at the chapter structure page in the beginning, then jump to the “Financial statement 2011-12” and finally located the result within the subchapter “research income”.
<table>
<thead>
<tr>
<th>Measurement</th>
<th>Mobile</th>
<th>Computer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time for locating the file (s)</td>
<td>160.67 (91.31)</td>
<td>133.27 (101.61)</td>
</tr>
<tr>
<td>Time for locating the result (s)</td>
<td>83.00 (81.47)</td>
<td>125.81 (105.58)</td>
</tr>
</tbody>
</table>

Table 4.3-4 Time for locate the file and result for mobile and computer searcher
Note: Data is generated from the log for the participants (N = 7, including 3 mobile searchers and 4 computer searchers) who successfully complete the fact finding task.

"...
157.91s: Back to SERPs.
Viewing SERPs 7.22s
254.56s: Open fourth page from SERPs-Result “Annual Report and Financial Statement 2011-2012”.
Viewing Content
263.23s: Look at the structure chapter
Viewing Content
277.45s: jump to page 241- “Financial statement 2011-12”.
Looking around Our university at a Glance, Corporate governance and Independent auditor’s report to the council of the university of Sheffield.
Viewing Content (sum: 41.36s)
297.98s: Locate the result-Consolidated income and expenditure account
"

Figure 4.3-3 Log file for locating the information within the result page on computer
Note: The data is from the log file for participant 14.

In contrast, mobile searchers seem to view the page randomly then locate the answer in a coincidence. For instance, the log for participant 3 (see figure 4.3-4) illustrates that the participant was trying to have the brief idea of the content by scrolling down the pages in a rush. But he was “coincidently” find the graph and found the “Research Income”. Finally, he locates the result in a relatively short time.
107s: enter query in the search engine within the university: research income 2011-2012.

Viewing SERPS (5s)

112s: Third page selected (PDF file) - Annual financial report 2011-2012

Scrolling up and down

Stop at the graph area, and locate the research income

Viewing Content (54s)

166s: locate the result.

Figure 4.3-4 example of Log for locating the information within the result page

Note:

1. The data is generated from the observation of the screen activities through video and “Morae”.

However, the computer searcher can locate the result in a short time by utilizing the site searching and file search function (“find on this page” on IE browser) when searching in the browser. But only one participant (14.3%) employed this skill while others tend to find the chapter description in the beginning then jump to the research income section (see figure 4.3-5, also See Appendix A, P2 for fact finding task). It also explains the higher std. deviation value on “time spends on viewing pages” on computer for both tasks.

160.92s: Query modification—“University of Sheffield” “Research income” 2011-12 site: www.sheffield.ac.uk. Add site: www.sheffield.ac.uk

Viewing SERPs (18.66s)

179.23s: Click into the PDF

183.32s: site searching: research income

Jump to the research income section

Viewing Content (31.12s)

210.72s: locate the results.

Figure 4.3-5 Example of log for site searching

Note: The data is from the log file of participant 2.
On the other hand, for the information gathering task (see table 4.3-5), the figure seems to be similar for both platforms. Except the time for viewing pages is 1 minute 29 seconds which is slightly smaller compared with the figure in table 4.3.5 (2 minutes and 15 seconds). This may due to the fact that the information gathering task requires more efforts to compare the result from different pages. However, because of the screen size and limitation of browser, it has an impact to the performance of the mobile searcher, especially in reading the pages (see Quote 2 and 3).

<table>
<thead>
<tr>
<th>Measurements</th>
<th>Mobile</th>
<th>Computer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Recommendation</td>
<td>1.00 (0.63)</td>
<td>0.20 (0.45)</td>
</tr>
<tr>
<td>Number of Query</td>
<td>1.00 (0.00)</td>
<td>2.20 (1.30)</td>
</tr>
<tr>
<td>Query length</td>
<td>2.83 (0.75)</td>
<td>3.58 (0.77)</td>
</tr>
<tr>
<td>Query Reformulation</td>
<td>0.00 (0.00)</td>
<td>1.20 (1.30)</td>
</tr>
<tr>
<td>Rage viewed</td>
<td>3.17 (0.98)</td>
<td>5.80 (2.49)</td>
</tr>
<tr>
<td>Total Time (s)</td>
<td>144.17 (46.61)</td>
<td>108.54 (63.45)</td>
</tr>
<tr>
<td>Time spend on SERPs</td>
<td>29.17 (18.65)</td>
<td>36.84 (31.37)</td>
</tr>
<tr>
<td>Time spend on viewing pages</td>
<td>89.17 (28.41)</td>
<td>53.14 (35.92)</td>
</tr>
<tr>
<td>Average time for each pages</td>
<td>39.57 (19.93)</td>
<td>15.48 (9.76)</td>
</tr>
<tr>
<td>Time for entering query</td>
<td>22.83 (4.07)</td>
<td>25.20 (19.03)</td>
</tr>
<tr>
<td>Average query enter time</td>
<td>22.83 (4.07)</td>
<td>13.21 (7.60)</td>
</tr>
</tbody>
</table>

Table 4.3-5 Search behaviour for participants who successfully finish the information gathering task

Note:

1. Mean is shown with std. deviation (in brackets)
2. The data is generated form the log file for participants who successfully finished the task.

Overall, it seems that the participant seems to spend less effort and time for fact find task instead of information gathering task. The following section will provide an explanation for this.
4.3.3 The reasons for participants not complete the tasks.

Apart from the limitation of the usability, there are three causes contribute to the failure of the search task. Initially, some the participants are not skilled English speakers (see Quote 1). As a result, they tend to spend longer time to read the content and get confused by the similar topics. As it is shown in figure 4.3-6, the participant spent 2 minutes and 50 seconds in viewing webpages. Then he located the wrong answer (The research income for engineering). Another example is the fact finding log file for participant 16 who consumed 2 minutes and 54 seconds on reading the content (see Appendix A, P16). Moreover, it seems that the title “engineering researching income” confused both participants and they went back to the previous page (“Cambridge for engineering research income”) and tried to select the result within the page.

```
62s: First query entered. reseRch income seffield
Viewing SERPs (6s)
68s: First page in SERPs-Sheffield overtakes Cambridge for engineering research income.
Viewing Content (160s)
228s: go back to SERPs
Viewing SERPs (20s)
248s: First page in SERPs-Sheffield overtakes Cambridge for engineering research income.
Viewing Content (10s)
258s: Locate the result.
```

Figure 4.3-6 Example of the log file for fact finding task

Note:
1. The data is from the log file for Participant 1.

The second reason is the some of the participants were not used to mobile searching (see Quote 5). As a result, they have trouble to adapt the searching on mobile. In addition, some participants explained that they rely on the result provided by the
search engine. For instance, “… Because the search engine did not provide the information I need…” (P6, Quote 13).

4.4 The search behaviour differences in terms of task type

4.4.1 The overall description for the task on both platform.

The searching behaviour on both platforms seems to be similar. There are no considerable differences according to table 4.4-1 and table 4.4-2. It is interesting to notice that, the total time spent on the information gather task is relatively shorter compare with it for the fact finding task on both platform. More specifically, it consume 2 minutes and 35 second to locate result for information gather task on mobile while the fact finding task take an average of 3 minutes and 55 seconds to complete. Meanwhile, the figure is 2 minutes and 29 seconds for information gathering task on the desktop and 3 minutes and 55 seconds for fact finding task. Other figures for both tasks maintain at a similar level for each platforms. However, it is interested to notice that the time consumptions for information gather task are relatively smaller. It is against the previous finding that information gathering task requires to read more page and consume more time (Gwizdka & Spence, 2007; Kellar et al 2007b). For instance, except for the time consumption, page viewed for information gather task on mobile is 3.38 compare with 5.86 for fact finding task.

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Fact finding task</th>
<th>Information gathering task</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Recommendation</td>
<td>0.57 (0.53)</td>
<td>0.88 (0.64)</td>
</tr>
<tr>
<td>Number of Query</td>
<td>2.57 (1.51)</td>
<td>1.13 (0.35)</td>
</tr>
<tr>
<td>Query length</td>
<td>3.62 (0.55)</td>
<td>2.94 (0.78)</td>
</tr>
<tr>
<td>Query Reformulation</td>
<td>1.14 (1.57)</td>
<td>0.13 (0.35)</td>
</tr>
<tr>
<td>Rage viewed</td>
<td>5.86 (3.63)</td>
<td>3.38 (1.06)</td>
</tr>
<tr>
<td>Total Time</td>
<td>234.86 (58.20)</td>
<td>155.25 (50.14)</td>
</tr>
<tr>
<td>Time spend on SERPs</td>
<td>49.00 (27.78)</td>
<td>32.31 (17.19)</td>
</tr>
<tr>
<td>Time spend on viewing pages</td>
<td>126.14 (47.41)</td>
<td>105.13 (42.90)</td>
</tr>
<tr>
<td>Average time for each pages</td>
<td>40.32 (28.23)</td>
<td>42.16 (17.70)</td>
</tr>
<tr>
<td>Query entering time</td>
<td>56.71 (9.83)</td>
<td>22.63 (3.81)</td>
</tr>
<tr>
<td>Average query enter time</td>
<td>29.74 (17.37)</td>
<td>21.06 (5.06)</td>
</tr>
</tbody>
</table>

Table 4.4-1 The influences of task types to search behaviour on mobile
Note:
1. Mean is shown, with std. deviation shown in brackets
2. The data is generated from the log file for participants who finished the task.

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Fact finding task</th>
<th>Information gathering task</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Recommendation</td>
<td>0.20 (0.45)</td>
<td>0.33 (0.52)</td>
</tr>
<tr>
<td>Number of Query</td>
<td>2.80 (1.92)</td>
<td>2.00 (1.26)</td>
</tr>
<tr>
<td>Query length</td>
<td>5.23 (0.55)</td>
<td>3.65 (0.71)</td>
</tr>
<tr>
<td>Query Reformulation</td>
<td>1.80 (1.30)</td>
<td>1.00 (1.27)</td>
</tr>
<tr>
<td>Rage viewed</td>
<td>5.60 (2.88)</td>
<td>5.33 (2.50)</td>
</tr>
<tr>
<td>Total Time</td>
<td>235.18 (64.78)</td>
<td>128.76 (75.32)</td>
</tr>
<tr>
<td>Time spend on SERPs</td>
<td>52.84 (30.07)</td>
<td>33.52 (29.21)</td>
</tr>
<tr>
<td>Time spend on viewing pages</td>
<td>151.83 (93.54)</td>
<td>76.55 (66.19)</td>
</tr>
<tr>
<td>Average time for each pages</td>
<td>44.97 (27.49)</td>
<td>24.60 (23.98)</td>
</tr>
<tr>
<td>Time for entering query</td>
<td>28.16 (11.49)</td>
<td>24.33 (17.15)</td>
</tr>
<tr>
<td>Average query enter time</td>
<td>11.71 (3.49)</td>
<td>14.35 (7.35)</td>
</tr>
</tbody>
</table>

Table 4.4-2  The influences of task types to searching behaviour on computer

Note:
1. Mean is shown, with std. deviation shown in brackets
2. The data is generated from the log file for participants who finished the task.

4.4.2 The selection of Tripadvisor for information gathering task

Although previous studies point out that information gathering task is time-consuming and requires more cognitive effort than fact finding task (Gwizdka & spence, 2006; kellar et al 2007), the result seems to violating the previous findings. It is partly due to the fact that some of participants (35.7%) prefer to collect information on a website called “Tripadvisor” (see figure 4.4-1). Comparing with collecting information through multi-website, mobile searchers only spend 2 minutes and 25 seconds in completing the task and computer searchers cost 1 minute and 47 seconds to locate the information (see table 4.4-3). It is lower than the average time consumption on both platforms. It is believed that there is no “official website” to publish the information for the information gather task, as a result, participants tend
to find an alternative way to locate the trustful information. The following quote from participant examine the reason for selecting the “Tripadvisor”.

<table>
<thead>
<tr>
<th>Category</th>
<th>Measurement</th>
<th>Mobile</th>
<th>Computer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not Tripadvisor</td>
<td>Total Time</td>
<td>150.50 (54.03)</td>
<td>124.59 (90.35)</td>
</tr>
<tr>
<td></td>
<td>Time spends on viewing pages</td>
<td>90.50 (33.67)</td>
<td>62.33 (35.02)</td>
</tr>
<tr>
<td>Tripadvisor</td>
<td>Total Time</td>
<td>131.50 (40.31)</td>
<td>97.85 (59.52)</td>
</tr>
<tr>
<td></td>
<td>Time spends on viewing pages</td>
<td>86.50 (47.00)</td>
<td>47.01 (44.41)</td>
</tr>
</tbody>
</table>

Table 4.4-3 The comparison for participants using “Tripadvisor”

Note:

1. The data is generated from the log file from the participants 2, 4, 14 (computer searchers) and 5, 13, 15 (mobile searchers).

Figure 4.4-1 Example of website for “Tripadvisor”
Participant does not have experience for “Tripadvisor” before:

“…For the general information, because I do not have any knowledge about it and there is no official website for the second task. So I am comparing the result from Google. The star rating on the website makes me feel confident about the answer.” (P13, Quote 14)

Participant has previous experience for “Tripadvisor” before:

“...I will not look at other result because they are just like the holiday company and selling they own version of holiday…unless the website I recognize is what I want; I will ignore those on the result.” (P14, Quote 15)

“…Tripadvisor is more reliable because it is based on the users’s review and I used it before. Besides, it ranks the resort for you. So if I need some general information, I well go to the website which is specifically designing for it…” (P15, Quote 16)

Another reason for this is that, the difficulty for both tasks is not the same. For example,

“…for the first (task) one, I have to put more keyword to the search engine…its more difficult to find the result, whereas the second require less word so that the search engine shows more results…” (P2, Quote 17)

Additionally, participants tend to looking for the quick answer without checking the validity. But it may due to the fact that they were required to perform searching in a limited of time (5 minutes). The next section will describe and discuss the relationship of mobile and computer searching in users’ perception.
4.5 Users’ perception about the differences between mobile and computer searching

Almost all the participants (86.7%) considered that mobile searching is extended from computer searching. This corroborates the suggestion from (Karmar et al, 2009). As it is shown on table 4.5-1, half of the participants (46.7%) explained that mobile searching remove the limitation of location and make it more convenient especially when they are outside. 33.3% of the participants also considered computer allow more function such as java, picture and flash. Moreover, two participants (13.3%) think mobile searching has less result compare with computer searching. To follow up, one participant regard search pattern on mobile is developed from the computer, and another participant think computer searching involve more technique while mobile have trouble to perform in the same way.

<table>
<thead>
<tr>
<th>Opinion</th>
<th>Proportion of Participant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quick answer (whenever and wherever)</td>
<td>7/15—46.7%</td>
</tr>
<tr>
<td>More powerful on computer (processing speed, more function on computer)</td>
<td>5/15—33.3%</td>
</tr>
<tr>
<td>Less search result on mobile</td>
<td>2/15—13.3%</td>
</tr>
<tr>
<td>Search pattern is based on computer</td>
<td>1/15—6.7%</td>
</tr>
<tr>
<td>Allow more technique on computer</td>
<td>1/15—6.7%</td>
</tr>
</tbody>
</table>

Table 4.5-1 Reasons for considering mobile search is an extension from computer searching

Note: The data is generated from the transcript from all the participants. Similar with the way to generate data for table 4.2.4, it employed the “Nvivo” to locate the key words such as “extension” and “location” as well as the similar words. Finally, it calculated the occurrence of each key word and generated the graph.

However, three participants explained that it has different information need on the mobile compare with computer. This seems to violate the previous hypnosis suggested by (Karmar 2009) about since the users will treat mobile search as an extension from computer searching but not a device for a distinct subset of
information need. The largely due to the fact that mobile cannot answer the needs for serious work such as writing a report. For instance,

“...It’s not extension because it is not improving computer search, the only improve is that I can search wherever you are...I think it has different information need, I think it (mobile) is search for fun and not for work. For example, for java code, I will not search on mobile but on computer...” (P15, Quote 18)

It seems that participants (participant number 2, 11 and 15) are avoiding the complex task on mobile. As participant 11 concluded that: “I will not perform (a) complex task on the mobile...because is take much more effort to do that on mobile such as I need to compare the result among different pages...” To sum up, user tends to choose to searching on mobile or computer based on their conveniences. For example,

“I would say extension, because I am doing the much the same search and to match the same information. I will use it based on the convenience. Unless the result works better on computer and mobile canoe show it properly. But that distinction is getting less and less anyway. Assuming I have both information organised will on both devices for the screen size or everything. I would not care who to use. So I will choose the most convenient device.” (P14, Quote 19)

And another participant suggested that the gap shirking with the development of the mobile and the Tablet is the example of combination of the two platforms:

“I think, in the future, we would not see any desktop or laptop. It just what we call it post-computers and cell phones. The thing is that nowadays everything you find on the computer, you (can also) find it on the cell phone. And whatever you do on the computer, you can also synchronize on you mobile. So, basically, you get everything on your phone. It just matter of usability...” (P4, Quote 20)
To sum up, users on mobile tend to expect the same result as computer searching, and mobile can ignore the limitation of time and place compare with computer. However, mobile searching is incapable of the serious work. Hence, mobile searching is an extension from the computer searching, but the information need of the mobile and computer searching are different.
5 Discussion and Conclusion

It has presented the comparison of the search behaviour differences of Google search patterns on mobile and computer. Initially, it showed the success rate for fact finding task and information gathering task on both platforms. Then it discussed the reason for the difference on both platforms and tasks according to the users’ perception. To follow up, it illustrated the search behaviour differences in terms of query reformulation, query length, number of query, query recommendation, total time, time spend on SERPs, time spend on viewing pages, average time for each pages, query entering time and average query enter time. Finally, it discussed the users’ perception about the relationship between the mobile searching and computer searching.

More specifically, the success rate for information gather task is much closer but the success rate for fact finding task on mobile is half of the figure on computer. It is believed that the limitation of the mobile such as the screen size and keyboard affect the performance of the mobile searchers, which in turns influence the search behaviour on mobile and lead to the differences on mobile and computer.

I. For the first research question, which is to investigate the differences of search behaviour on both platforms, the findings can be summarized as follows:

1) For the fact find task,

- For mobile, the number of query and query reformulation is slightly lower while the query length is relatively shorter than computer searching. But mobile searcher spends more time on entering query. It is due to the fact that the keyboard on mobile has negative influences on query entering for mobile.

- Computer searchers tend to consume more time on locating the result and check the validity. The time for review content is even longer for those who successfully finish the task. This finding confirm the hypothesis, which is the users in large screen tend to read more content and check the validity of result before committing to it, from the (Kim et al (2012).
• Although the mobile searchers spend less effort on entering query, they tend to read more page. This may due to the limitation of the keyboard on mobile. In compensation, mobile searchers tend to view more content on the SERPs.

2) For the Information gathering task,

• Although the number of query, query length and query reformulation are similar with the pattern for fact finding task, computer searchers tend to read more pages. The reason is that computer can read and compare different pages at the same time while mobile have trouble to do that. Because computer searcher tend to open a new tabs or window while none of the mobile search performs the similar activities.

• It consumes mobile searchers more time to locate the result. Because of the information gathering task requires participant to validate the result from multiple sources. It may due to the fact that the screen size requires mobile searchers spend more cognitive effort to read the content. Most of them zoom in and out on the pages while the large screen has more possibility to show the result on the page without more effort to move the screen.

II. For the second research question, which aims to explore the search behaviour difference for the task types, the findings are violating the conclusion from the previous studies. Because part of the participants (35.7%) gathered the information through the “Trpadvisor”, while others tend to locate the information without validating the reliability. In addition, two interesting findings are listed below:

• For the fact finding task, the experienced searchers tend to search the information for the fact finding task on the official website, and they consider the Google as portal to organised information. If the information on the search engine is insufficient they will go to the official website. But the inexperienced searchers are relying on the result from the search engine. If the result is too limited to locate the information, inexperienced searchers will keep modifying the query before reach the answer.
If there is no “official website” to publish the information for the information gather task, participants tend find an alternative way to locate the trustful information. In this study, instead of comparing the result from different pages, some of participants directly use the information on the website call “Tripadvisor”.

III. For the Third research question, which is to investigate the relationship between mobile searching and computer searching, the findings are listed below:

- Most of the participants consider mobile searching is an extension from computer searching. The reasons are: first, mobile can provide them quick answer and ignore restriction of the time and place. Second, mobile searching is constrained by its limitation such as processing speed, network speed, and screen size.

- Few participants considered that the information need on mobile is different with the information need on computer. Because they think they cannot deal with the “serious work” such as searching for an article and a java code on mobile. Instead, they consider the mobile is simply for the entertaining purpose.

Based on the finding, it offers the following suggestions for improving the search experience access mobile devices:

- It should provide various formats for the webpages so that the mobile browser can view the content without zooming in or out. Moreover, it should also ensure the plug-in such as the flash and picture working properly or mobile.

- For the webpages, it should make the introduction and content more brief and concise. Especially for the searchers who engage with the information gathering task and mobile searchers who tend to look for quick answers.
result, it can be much easier to locate and validate the information as well as compare the information on different pages.
6 Limitations

The limitations of the methodology are listed below:

First, the size of sample group is relatively small. More specifically, it only recruited 8 participants for mobile searching while there are 7 subjects for computer searching. Of all the computer searching, one cannot finish the both of the task because of the language skills is poor. However, with the semi-structured interview, it can explain the reason behind the

Secondly, it used the camera to recording the screen activities on mobile. The mobile was fixed on the desktop. It was not allow the mobile searcher to perform searching in prefer position. Furthermore, some of the participants were not familiar with the mobile device, although it leaves 5 minutes for the subjects to get familiar with the mobile. As a result, it may affect the query input speed as well as other performance.

Thirdly, it is extremely difficult to evaluate the difficulty for both task. As a result, it has avoided providing two sets of questions and ask the participants to perform on mobile and computer. However, it still cannot directly compare two tasks for each group. Instead, it will use the word “trend” to describe the searching differences between mobile and computer.

Fourth, Because of it was a small-scale experiment. It set up the time limitation for both tasks. Hence, for the information gathering task, it was relatively urgent to complete because subjects needs to compare the results from different pages. But it was difficult to recruit participant if the duration for experiment and interview is too long.
7 Future Work

Based on the limitation of this study, future work can recruit more subjects so that it can generate sufficient data for each measurement and analyse the distribution of the data for each measurement on both platforms. It can perform a diary study to investigate the relation of computer and mobile searching. The dairy study can focus on how mobile searching and computer searching cover the information need on daily life as well as the what kind of information need will only be complete on the computer or mobile searching. In addition, it can investigate the searcher behaviour on the tablet and compare the differences with the mobile and computer searching.

(Word count: 13015)
References


Feng, Z. (2012). STUDYING THE SEARCH BEHAVIOUR OF IPHONE USERS.


Appendix A-Log file for the Experiment

1. Fact Finding Task

1.1 Mobile Searching

1.1.1 Participant 1

Finish: Yes  Success: No  Overall time: 258s

62s: First query entered. research income sheffield
Viewing SERPs (6s)
68s: First page in SERPs-Sheffield overtakes Cambridge for engineering research income.
Viewing Content (160s)
228s: go back to SERPs
Viewing SERPs (20s)
248s: First page in SERPs-Sheffield overtakes Cambridge for engineering research income.
Scrolling down slowly
Viewing Content (10s)
258s: Locate the result.

1.1.2 Participant 3

Finish: Yes  Success: Yes  Overall time: 166s

23s: First query entered. Sheffield university research income
Viewing SERPs (20s)
30s: First page in SERPs-Sheffield finance-university of sheffield.
Viewing Content (16s)
46s: Second page selected within the first page-Research Finance.
Viewing Content (5s)
51s: Back to first pages.
Viewing Content (11s)
62s: Back to SERPs.
Trying to modify the query, but text box is difficult to control (10s)
Viewing SERPs (12s)
84s: back to first pages.
Entering query (23s)
107s: enter query in the search engine within the university: research income 2011-2012.
Viewing SERPS (5s)
112s: Third page selected (PDF file)-Annual financial report 2011-2012
Scrolling up and down
Stop at the graph area, and locate the research income
Viewing Content (54s)
166s: locate the result.

1.1.3 Participant 5

Finish: Yes      Success: Yes      Overall time: 279s

25s: First query entered. University of Sheeff
Viewing query recommendation
25s: select recommendation query: university of Sheffield
Viewing SERPs (6s)
31s: First page in SERPs-university of sheffield.
Viewing content (18s) (find the search box)
Around 5 seconds –trouble with search box
Inputting the query (36s)
91s: Second query entered: research income 2011-2012
Viewing SERPs (in university of Sheffield search engine by google + 1)(13s)
104s: Second pages selected in university search engine: Annual report & financial statement
Scrolling up and down
Stop when it comes to the report of treasurer 2011-2012 and research income.
Zoom in,
Viewing contents (11s)
115s: locate the report of treasure chapter
Scrolling up and down
1.1.4 Participant 7

**Finish:** Yes  **Success:** No  **Overall time:** 162s

40s: First query entered. Research income university of sheffield
Viewing query recommendation
45s: selecting recommendation query from the search income - University of Sheffield Research income
Viewing SERPs (8s)
53s: First page in SERPs - Research finance-university of sheffield.
Viewing content (zoom in) (38s)
Viewing the menu
Selecting the Research finance
91s: Back to SERPs.
Viewing SERPs (26s)
117s: Second page in SERPs-Written evidence submitted by the university of Sheffield and…
Viewing Contents (zoom in) (45s)
162s: Locate the results.

1.1.5 Participant 9

**Finish:** No  **Success:** No  **Overall time:** 300s

13s: First query entered. Research income sheffield
Viewing SERPs (4s)
17s: First page in SERPs - Sheffield overtakes Cambridge for engineering research. University of sheffield
Viewing Content (45s)
62s: Back to SERPs.
Viewing SERPs (12s)
73s: Second page in SERPs – Sheffield overtakes Cambridge for engineering research.
From news
Viewing Content (14s)
Zooming in and scrolling down then scrolling up
87s: Back to SERPs.
Waste on wait for responds (32s)
Viewing SERPs (28s)
152s: Query modification- Research income, delete sheffield
152s: select query from the recommendation list provided by search engine. Research income uk university.
Viewing Content (2s)
154s Third page in SERPs – Golden triangle - wikipidia
Scroll down and open the tab-Researching income
Viewing Content (26 s)
180s: Back to search engine
Viewing SERPs (17s)
197s: Fourth page in SERPs –Russell Group research
Viewing Content (81s)
278s: Back to search engine
Viewing SERPs (22s)
300s: Time is up

1.1.6 Participant 11

Finish: Yes Success: No Overall time: 197s

11s: First query entered. Total research
11s: Select the query from recommendation: total research. (to correct)
Modifying the query (miss type the word for three time, time consuming) (44s)
55s: query modification: total research site: Sheffield.ac.uk add site: Sheffield.ac.uk
Viewing SERPs (24s)
79s: First page in SERPs-research finance terminology-university of sheffield.
Scrolling down
Viewing Content (25s)
94s: Back to SERPs. Viewing SERPs (4s)
Modifying query (16s)
114: Query modification: total research engineering site: Sheffield.ac.uk add engineering Viewing SERPs (15s)
129: Second page in SERPs-Research-ACSE-The university of Sheffield. Viewing Content (24s)
Click within the university webpage
153s: jump to third site (within university website)- Departments. Viewing Content (11s)
Scrolling down
164s: Jump to Faculty of Engineering Viewing Content (7s)
171s: Jump to Research Viewing Content (14s)
197s: locate the result.

1.1.7 Participant 13

Finish: Yes     Success: Yes     Overall time: 286s

14s: First query entered. Research income of Sheffield Viewing SERPs (14s)
28s: First page in SERPs-Research finance-university of sheffield. Viewing Content (zoom in) (28s)
Scanning the menu
52s: Second page selected within the first page-budget management Viewing Content (zoom in) (22s)
Scanning the menu
74s: Third page selected within the second page-help on. Viewing Content (zoom in) (9s)
Scanning the menu
83s: Fourth page selected within the Third page-Insurance Viewing Content (zoom in) (11s)
Scanning the menu
94s: back to first page selected within the fourth page-budget management.

Viewing Content (zoom in) (18s)

112s: jump to fifth page- University of Sheffield

Viewing content (12s)
Finding the search box and input query (13s)

140s: Second query entered: research income.

Viewing SERPs (17s) (University of Sheffield)

Query modify 178s (21s)

178 s: Query modification: research income of Sheffield university. add of Sheffield university

Viewing SERPs (12s)

190s: Back to Google

Entering query (10s)

200s: Query modification:: research income of Sheffield university. add university

Viewing SERPs (49s)

249s: Sixth page selected-Funding and income

Viewing Content (zoom in ) (14s)

263s: seventh page selected-Financial statement

Viewing Content (zoom in ) (3s)

266s: eighth page selected – PDF file- Annual report & financial statement 2011-12

Scrolling down
Locate the Report of treasurer 2011-2012

Viewing Content (zoom in) (20s)

286s: Locate the result.

1.1.8  Participant 15

Finish: Yes       Success: No       Overall time: 296s

8s: First query entered. University of sh

Viewing query recommended

9s: select query from the recommendation list provided by search engine. University of Sheffield
22s: Query modification: university of Sheffield research inc, add research inc
22s: select query from the recommendation list provided by search engine. University of Sheffield reseach income
Viewing SERPs 10s
Modifying query 8s
40s: Query modification: university of Sheffield research income 2011, add 2011
Viewing SERPs (1s)
41s: First page selected: Sheffield overtake Cambridge for engineering research income.
Scrolling down and reading the paragraphs
Viewing Content (44s)
85s: Back to SERPs
Viewing SERPs (10s)
Modify the query (5s)
100s: Query modification: university of Sheffield total research income 2011, add total
Viewing SERPs (34s)
134s: Second page selected About-Biomedical science- The university of sheffield
Viewing Content (17s)
153s: Back to SERPs.
Viewing SERPs ( 13s)
166s: Third page selected: Russell Group-Wikipedia
Viewing Content (22s)
198s: Back to SERPs
Modifying query (21s)
220s: Query modification: uk universities research income 2011, delete university of sheffield add uk universities
Viewing SERPs ( 14s)
234s: Fourth page selected: Golden triangle (universites)-Wikipidia
Viewing Content (42s)
276s: Sixth page selected PDF file: Financial data for UK higher education institutions
Viewing Content (10s)
Modifying the URL-change the 2010-2011 to 2011-2012. (5s)
Go back to the: Financial data for UK higher education institutions (5s)
296s: locate the result.
1.2 Computer Searching

1.2.1 Participant 2

Finish: Yes Success: Yes Overall time: 213.25s

13.26s: First query entered. University of Sheffield research income 2011-12
Viewing SERPs (10.42s)

23.68s: First page in SERPs selected-Sheffield overtake Cambridge for engineering researching income

24.19s: Site Searching used-“Research Income”
Viewing Content (9.77s)

Entering Query (4.95s)

38.78s: Second query entered, on the search engine within the University of Sheffield. Research income 2011-12
Waiting respond…

42.18s: Abandon the query and return to the search engine.
Viewing SERPs (7.12s)

50.11s: Second page in SERPs selected.
52.71s: Site Searching used: research income
Viewing Content (20.90s)

71.14s: Return to SERPs.
Viewing SERPs (2.71s)

Modifying query (3.53s)

77.37s: Query modification-University of Sheffield “Research Income” 2011-12. Add “” to the research income.
Viewing SERPs (6.11s)

83.81s: Third page in SERPs selected- Estates & Facilities Management
Viewing Content (2.23s)

85.13s: Back to SERPs
Viewing SERPs (21.55s)

Modifying query (4.32s)

112.52s: Query modification-“University of Sheffield” “Research income” 2011-12. Add “” to the university of Sheffield.
Viewing SERPs (19.12s)
131.65s: move to the second page in SERPs.
Viewing SERPs (6.26s)
Modifying Query (4.80s)
142.12s: Query modification-“University of Sheffield” “Research income” 2011-12 shef.ac.uk. Add shef.ac.uk
Viewing SERPs (2.02s)
Modifying Query (16.40s)
160.92s: Query modification-“University of Sheffield” “Research income” 2011-12 site: www.sheffield.ac.uk. Add site:www.sheffield.ac.uk
Viewing SERPs (18.66s)
179.23s: Click into the PDF
183.32s: site searching: research income
Viewing Content (31.12s)
210.72s: locate the results.
213.25s: Change to the page-Report of the Treasurer 2011-2012

1.2.2 Participant 4

Finish: Yes  Success: Yes  Overall time: 248.38s

16.72s: First query entered. University of Sheffield research income.
Viewing SERPs 5.24s
21.96s: open first tab from the result in browser-Research Finance
Viewing SERPs 1.38s
22.35 s: open second tab from the result in browser-Sheffield overtake Cambridge for engineering research income
Viewing SERPs 0.96s
24.31s: view the content on the first tab.
Viewing Contents 18.13s
42.45s: Back to SERPs.
Modifying query 9.62s
Viewing SERPs 7.23s
58.52s: Open the result (PDF) in a new tab (third).
Viewing SERPs 1.40s
59.93s: switch to the tab (third) of PDF,
Viewing Contents
64.27s: View the content, the chapter structure.
Viewing Contents
93.42s: go to the report of the treasurer chapter (correct).
Viewing Contents
203.10s: go to the research income section
205.86s: Comparing the result with the research section.
Viewing Contents (sum: 188.45s)
238.10s: Go back to the Report of treasurer 2011-2012
248.38s: Locate the result.

1.2.3 Participant 6

Finish: Yes Success: No Overall time: 136.12s

19.79s: First query entered. Sheffield University research income.
Viewing SERPs 12.96s
33.48s: open first tab from the SERPs-Research Finance
Viewing SERPs 6.54s
Query modification 6.24s
46.27s: Query modification- Sheffield University research income 2011-12. Add 2011-12.
Viewing SERPs 14.5s
61.27s: Switch to the first tab.
Viewing Content 15.84s
77.11s: Go back to the SERPs.
Viewing SERPs 19.8s
96.92s: Switch to the first tab.
Viewing Content 4.95s
101.87s: Close the first tab, and back to SERPs
Viewing SERPs 12.85s
114.72s: Open a result from SERPs to a new tab (second)-Sheffield overtakes Cambridge for engineering research income
Viewing SERPs 5.6s
120:32s: Switch to the second tab
Viewing Content 15.93
136.12s: Locate the result.
1.2.4 Participant 8

Finish: Yes          Success: Yes          Overall time: 282.70s

Viewing SERPs 17.22s
33.31s: Click the suggest query from google, cause the word is incorrect. University of Sheffield research income 2011 2012.
Viewing SERPs 7.52s
40.75s: Click the PDF (Annual Report & Financial Statement 2011-2012)
Viewing Content 16.76s
57.60s: Look at the content structure.
Viewing Content 35.50s
72.49s: Move to the Report of Treasurer 2011-2012
Scanning the pages
82.40s: Go back to the content structure
93.10s: Jump to 41 pages-Financial Statement 2011-2012.
Scanning the pages-Consolidated income and expenditure account, consolidated cash flow statement and Notes to the account
147.82s: Locate the result-within the Consolidated income and expenditure account
Scanning the pages-Consolidated income and expenditure account, consolidated cash flow statement and Notes to the account
Viewing Content (sum:189.59s)
282.70s: Confirm the result.

1.2.5 Participant 12

Finish: No          Success: Yes          Overall time: 300s

15s: First query entered. Academic+income+university+Sheffield+2011
Viewing SERPs 18.73s
33.73s: Open first page from the SERPs-Institutional profiles-university of sheffield
Viewing content 35.53
69.26s: Go back to the SERPs.
Viewing SERPs 5.51
74.77s: open second page from the SERPs-pay & grading0 the university of sheffield
Viewing SERPs 4.55s
79.32s: Go back to the SERPs.
Viewing SERPs 12.45s
Modifying query 4.3s
96.07s: Query modification- income+university+Sheffield+2011. delete academic
Viewing content 16.65s
112.72s: open first page from the SERPs-Institutional profiles-university of sheffield
Viewing content 36.11s
148.83s: Go back to the SERPs.
Modifying query 3.83s
154.19s: Query modification- research+income+university+Sheffield+2011. Add research.
Viewing SERPs 11.92s
166.11s: open third page from the SERPs-estates & facilities- the university of sheffield
Viewing content 23.5s
189.61s: Go back to the SERPs.
Viewing SERPs 19.92s
209.53s: open fourth page from the SERPs-university is second for engineer research funding
Viewing content 38.87s
248.4s: Go back to the SERPs.
Viewing SERPs 22.04s
Modifying query 8.8s
279.24s: Query modification- research+income+university of Sheffield+2011. Add of.
Viewing content 15.02s
294.26s: open fifth page from the SERPs-university of Sheffield overtake Cambridge for engineering..
Viewing content 6s
300s: Time is up.
1.2.6 Participant 14

Finish: Yes  
Success: Yes  
Overall time: 297.98s

17.60s: First query entered. research income Sheffield university.
Viewing SERPs 6.93s
24.54s: open first page from the SERPs-sheffield overtakes Cambridge for research income.
Viewing Content 35.98s
60.05s: Go back to the SERPs.
Modifying query 3s
64.30s: Query modification- total research income Sheffield university. Add total.
Viewing SERPs 7.81s
71.60s: open second page from the SERPs-russell group.
Viewing Content 85.76s
157.91s: Back to SERPs.
Modifying query 4.5s
Viewing SERPs 25.47s
188.68s: open third page from the SERPs-World University Ranking 2011-2012.
Viewing Content 57.07s
157.91s: Back to SERPs.
Viewing SERPs 7.22s
254.56s: Open fourth page from SERPs-Result “Annual Report and Financial Statement 2011-2012”.
Viewing Content
263.23s Look at the structure chapter
Viewing Content
277.45s: jump to page 241- “Financial statement 2011-12”.
Looking around Our university at a galance, Corporate governance and Independent auditor’s report to the council of the university of Sheffield.
Viewing Content (sum: 41.36s)
297.98s: Locate the result-Consolidated income and expenditure account
1.2.7 Participant 16

Finish: No          Success: No          Overall time: 300.00s

26.08s: First query entered. research income of the university of Sheffield during 2011-12. Viewing SERPs 13.92s
39.24s: open first page from the SERPs-Sheffield overtake Cambridge for engineering research income.
Viewing Content 69.91s
139.15s: Go back to the SERPs. Modifying the query 6.27s
145.73s: Query modification- overall research income of the university of Sheffield during 2011-12. Add overall.
Viewing SERPs 6.26
151.94s: open second page from the SERPs-World University Ranking 2011-12
Viewing Content 39.42s
192.44s: Go back to the SERPs.
Viewing SERPs 7.25s
198.83s: go back to first page from the SERPs-Sheffield overtake Cambridge for engineering research income.
Scrolling up and down
Viewing Content 63.52s
263.38s: Go back to the SERPs. Viewing SERPs 36.62
300s: Time is up.

2. Information Gathering Task

2.1 Mobile Searching

2.1.1 Participant 1

Finish: Yes          Success: No          Overall time: 232.00s

20s: First query entered. Maldives diving
Viewing SERPs (4s)
24s: First page selected-Best Maldives dive sites (advertisement)
Viewing Content (70s)
94s: Locate the result (Maldivian)
Viewing Content (10s)
94s: Back to SERPs.
Viewing SERPs (13s)
107s: Second page selected-Diving centre Maldives (advertisement).
Viewing Content (81s)
127s: Locate the result (Ranguli)
Viewing Content (20s)
208s: Back to SERPs.
Viewing SERPs (10s)
Modifying query (5s)
215s: Query modification- Maldives diving place. add place
Viewing SERPs (8s)
223s: Third page selected-Maldives Diving resorts-Tripadvisors.
Viewing Content (9s)
232s: locate the result (Kuredu, Gili lankanfushi, angaga).

2.1.2 Participant 3

Finish: Yes Success: Yes Overall time: 154.00s

18s: First query entered. Maldives d
Viewing query recommendation
18s: select query from the recommendation list provided by search engine. Maldives diving
Viewing SERPs (6s)
24s: First page selected-Diving centre maldives (advertisment)
Viewing Content (zoom in) (23s)
Looking at the subtitle
47s: Back to SERPs.
Scrolling down to the bottle
Viewing SERPs (25s)
Then scrolling back to the top
72s: Second page selected- Maldives Diving|Maldive Dive Holidays.
Viewing Content (zoom in) (37s)
109s: Back to SERPs.
Viewing SERPs (5s)
114s: Third page selected-Best Diving in the Maldives
Zoom in a little bit.
Viewing Content (40s)
Confirm the result
154s: locate the result

2.1.3 Participant 5
Finish: Yes Success: Yes Overall time: 187.00s

21s: First query entered. Maldives d
Viewing query recommendation
22s: select query from the recommendation list provided by search engine. Maldives diving
Viewing SERPs (10s)
32s: First page selected-Best Maldives Dive Sites (advertisement)
No zooming
Viewing Content (21)
53s: Back to SERPs.
Viewing SERPs (9s)
62s: Second page selected- Maldives Diving|Maldive Dive Holidays.
No zooming
Viewing Content (50s)
112s: Back to SERPs.
Scrolling down slowly
Viewing SERPs (30s)
142s: Third page selected- Maldives Diving Resort-Tripadvisor
Viewing Content (45s)
187s: locate the result.
2.1.4 Participant 7

Finish: Yes  Success: Yes  Overall time: 73.00s

27s: First query entered. Maldives diving re
Viewing query recommendation
28s: select query from the recommendation list provided by search engine. Maldives diving resorts
Viewing SERPs (4s)
32s: First page selected-All diving top 7 Maldives Resorts
Viewing Content (zoom in) (41s)
73s: Locate the results

2.1.5 Participant 9

Finish: Yes  Success: No  Overall time: 145.00s

19s: First query entered. 5 resortd
Viewing query recommendation
19.5s: select query from the recommendation list provided by search engine. Tip 5 resorts in Maldives
Scrolling down
Scrolling up again
Viewing SERPs (4.5s)
24s: First page selected-The best five resorts in the Maldives
Viewing Content (80s)
104s: Back to SERPs.
Viewing SERPs (44s)
109s: Second page selected- 10 Best Luxury resorts in the maldives
Viewing Content (36s)
145s: locate the result
2.1.6 Participant 11

Finish: Yes    Success: Yes    Overall time: 188.00s

19s: First query entered. Maldives diving resortz
Viewing query recommened (correct query)
20s: select query from the recommendation list provided by search engine: Maldives diving resorts
Scrolling down then go back to the top.
Viewing SERPs (26s)
46s: First page selected - All diving top 7 Maldives Resorts
Zooming in and scanning the paragraphs
Scrolling down to the resorts part
Viewing Content (72s)
118s: locate the result.
Writing down (31s)
149s: Back to SERPs
Viewing SERPs (6s)
Verifying the result
155s: Second page selected- Maldives Dive Resorts
Viewing Contents (comparing result) (33s)
188s: Back to SERPs.

2.1.7 Participant 13

Finish: Yes    Success: Yes    Overall time: 165.00s

28s: First query entered. Resorts for diving in maldives
Viewing SERPs (9s)
37s: First page selected-All diving top 7 Maldives resorts
Viewing Content (zoom in) (94s)
Reading the paragraphs
121s: Back to SERPs.
Viewing SERPs (comparing the result) (36s)
157s: Back to First page - All diving top 7 Maldives resorts
Viewing Content (zoom in) (10s)
160s: Locate the result.
165s: go back to the SERPs
Verifying the results.
END

2.1.8 Participant 15

Finish: Yes  Success: Yes  Overall time: 103.00s

5s: First query entered. Mald
Viewing query recommendation
6s: select query from the recommendation list provided by search engine. Maldives
Modifying query (18s)
24s: Query modification: Maldives Scuba Diving res add scuba diving res
Viewing query recommendation
25s: select query from the recommendation list provided by search engine. Maldives scuba diving resorts
Viewing SERPs (5s)
30s: First page selected - Diving Resort Maldives
Zooming in and out, Scrolling down and up
Viewing Content (zoom in) (38s)
68s: Second page selected within the first page-accommodation.
Viewing Content (10s)
78s: Back to SERPs.
Viewing SERPs (4s)
82s: Third page selected within the first page-Maldives Diving Resorts-Tripadvisor.
Reading the resort information one by one (comparing the result)
Viewing Content (zoom in) (21s)
103s: locate the result.
2.2 Computer Searching

2.2.1 Participant 2

Finish: Yes      Success: Yes      Overall time: 95.37s

3.98s: First query entered. Tripadvisor
Viewing SERPs (8.34s)
Modifying query (6.01s)
19.70: Query modification-Tripadvisor best beach maldives. add best beach maldives
Viewing SERPs (13.51s)
33.22s: First page selected-Best resort in malfives
Viewing Content (4.74s)
37.95s: Back to SERPs.
Viewing SERPs (3.76s)
42.41s: Query modification- best beach maldives. Delete Tripadvisor
Viewing SERPs (12.38s)
Modifying query (11.39s)
65.64s: Query modification-beaches ranking maldives. add ranking, delete best
Viewing SERPs (3.04s)
68.56s: Second page looked into-The Maldives high five: Top resorts to splash out on the Indian Ocean’s luxury isle
Viewing Content (7.70s)
79.33s: Site Searching used: diving
Viewing Content (19.10s)
95.37s: Locate the result.

2.2.2 Participant 4

Finish: Yes      Success: Yes      Overall time: 39.61s

21.06s: First query entered. Maldives dive resort review
Viewing SERPs 6.21s
27.20s: Open a result from SERPs on the new tab (first), for Maldives diving resorts-Tripadvisor
Viewing SERPs 1.73s
28.93s: Switch to the first tab.
Viewing Content 10.67s
39.61s: Locate the results.

2.2.3 Participant 6

Finish: Yes   Success: Yes   Overall time: 188.47s

25.78s: First query entered. Maldives 5 resorts diving.
Viewing SERPs 38.22s
Modifying query 10.81s
49.03s: Query modification- Maldives 5 resorts star. (delete diving then)Select the suggested query from search engine: star.
Viewing SERPs 26.37s
52.16s: Open a new tab (first) from the SERPs and switch to the tab.-Maldives 5 star resorts
Viewing Content 14.41s
68.46s: Back to SERPs.
Entering Query 32.45s
100.91s: Second Query entered: Which villa is good for diving in Maldives.
Viewing SERPs 5.82s
106.74s: Open the second tab from SERPs-Best diving in Maldives
Viewing SERPs 6.17s
112.91s: Open the Third tab from SERPs-Maldives Accommodation, and switch to the second tab.
Viewing Content 17.01s
129.92s: Open the fourth tab (dive the central maldives) from the content in the second tab.
131.44s: Open the fifth tab (dive the Maldives by liveboard) from the content in the second tab.
140.15s: switch to the fifth tab (dive the Maldives by liveboard).
Viewing Content 25.57s
154.34s: Close 2,3,4,5 tabs and switch to the first tab.
Viewing Content 16.46s
171.96s: Back to SERPs.
Viewing SERPs 2.86s
174.95s: Click into the result from SERPs.
Viewing Content 13.64s
188.47s: Locate the result.

2.2.4 Participant 8

Finish: Yes  Success: Yes  Overall time: 60.70s

15.13s: First query entered. Maldives Diving Resorts.
Viewing SERPs 6s
21.14s: Click into the Result (Diving top 7), first page.
Viewing Content 6.83s
27.97s: Click into the resort pages (Kuredu).
Viewing Content 6.44s
33.30s: Go back to the result page (Diving top 7).
Viewing Content
34.42s: Click into the resort pages (Helengeli).
Viewing Content 3.39s
37.84s: Go back to the result page (Diving top 7).
Viewing Content
39.34: Click into the resort pages (Maayafushi).
Viewing Content 1.57s
39.85s: Go back to the result page (Diving top 7).
Viewing Content
40.96s: Click into the resort pages (Vilamendhoo).
Viewing Content 2.76s
43.47s: Go back to the result page (Diving top 7).
Viewing Content
45.48s: Click into the resort pages (Filitheyo).
Viewing Content 1.11s
49.11s: Go back to the result page (Diving top 7).
Viewing Content
51.19s: Click into the resort pages (Angaga).
Viewing Content 5.32s
54.65s: Go back to the result page (Diving top 7).
60.70s: Determine the result.

2.2.5 Participant 12

Finish: No  Success: No  Overall time: 300.00s

18.63s: First query entered. Maldives resorts diving.
Viewing SERPs 13s
31.63s: Click into the result (First page)-Maldives Diving Resort Tripadvisor.
Viewing Content 16.58s
48.21s: Go back to the SERPs.
Query Input 20.1s
68.68s: New session: Second query entered. Most famous resort for diving.
Viewing SERPs 5.84s
(Query Input 5.93s)
80.45s: Query modification- most famous resort for diving Maldives. Add: maldives.
Viewing SERPs 5.3s
85.75s: Second Page clicked into-Best Diving Maldives.
Viewing Content 33.7s
143.06s: Back the SERPs.
Viewing SERPs 13.53s
156.59s: Third page clicked into-Scuba diving in the Maldives.
Viewing Content 2.77s
159.36: Back to SERPs.
Viewing SERPs 48.79s
208.15s: New session: Third query entered. Top 5 diving resorts maldives.
Viewing SERPs 6.29s
214.44s: fourth page clicked into- tripadvisor “what are the best dive resort for advanced diver”
Viewing Content 85.56
300s: Time is up.
2.2.6 Participant 14

Finish: Yes        Success: Yes        Overall time: 159.57ss

7.79s: First query entered. Maldives diving resorts.
Viewing SERPs 11.21s
Modifying query 2.42s
21.44s: Query modification- Maldives dive resorts recommendations. Select the suggested query from search engine: Maldives dive resorts recommendations.
Viewing SERPs 29.9s
51.35s: Open a first pages from the SERPs-Tripadvisor-“Maldives Diving Resorts”.
Viewing Content 2.82s
54.17s: Back to SERPs
Viewing SERPs 6.41s
60.49s: Open second pages from SERPs-dive Maldives.
Viewing Content 24.96s
84.18s: Open third pages from SERPs-Find a PADI Dive Centre or Resort in the Maldives.
Viewing Content 22.44s
107.99s: Back to the SERPs.
Viewing SERPs 4s
112.71s: Back to first pages from the SERPs-Tripadvisor-“Maldives Diving Resorts”.
Viewing Content-Comparing the results from Tripadvisor 46.86s
159.57s: Confirm the result.

2.2.7 Participant 16

Finish: Yes        Success: No        Overall time: 229.87

15.83s: First query entered. Resort in Maldives for.
Viewing query …selecting toooo slow
20.02s: Select the recommendation query from search engine- best Resort in Maldives for diving.
Viewing SERPs 10.77s
31.09s: first pages selected-Maldives diving holidays.
Viewing Content 153.81
184.63s: Back to SERPs.
Viewing SERPs 6.17s
190.02s: Second pages selected - Top maldives resorts.
Viewing Content 39.83s
229.84s: locate the result.
Appendix B Interview Transcript

1.1 Participant 1—Cantonese Speaker and translate by author

Question 1:
Participant: it should be half-half. I don’t satisfy with the first one, but the second one is okay. For the first one, I cannot locate the information. The only information I can find is the number of research income extra portion of income compared with University of Cambridge. (Reason for not satisfy) It should be limited by time and mobile is not comfortable compare with the mobile phone, the size of the screen make it inflexible when searching for information. Moreover, It not comfortable compare with the mobile phone, the size of the screen make it inflexible when searching for information, and it also have some limitation for browser. In the computer, it allows me to click between tabs while mobile. For the first task, it is inconvenient to keep jumping between the pages. For the second one, more clear and easy, because it direct show the result after enter the words.

Question 2:
Participant: it should be more comfortable. Because it is better for me to browse and record the information. For instance, I can browsing different window at the same time. Moreover, I can copy and paste on the computer but it more inconvenient to do it on mobile because I need to switch the application when I want to paste it on a note.

Question 3:
Participant: I don’t think it have any differences and I am selecting the keyword from the topic when I performing both tasks. And I think the first one is more difficult because it limited on 2011-12.

Question 4:
Participant: Again, it should be related to comfortable and performance. But not related to the speed of network and process speed, which were really fast when I was searching.

Question 5:
Participant: I think mobile should be the secondary product for the computer. Compare with computer, mobile should be the “deformity”. Because, I think the limited on the function for
search engine on the mobile. I think the operation system or the screen cannot satisfy me compare with computer. So I think the function on mobile cannot reach the same level with the computer. And I don’t think it a distinction. It is extension, which I think mobile is extending from the computer, and it is powerful compare with computer. For example, I can use mobile to perform searching wherever and whenever I needed.
1.2 Participant 2

Question 1:
Participant: 80 percent of it. For the task one, I find the information on the official website.

Question 2:
Participant: I think it is more difficult. Because, first, the screen size is smaller which make me difficult to read. Second, sometimes it is hard to open some website on mobile. But regarding to the task, I think the second is easier because it only requires reading. But for the first question, it is harder to define the search in a specific way.

Question 3:
Participant: it is the same approach, copy the query from the topic and paste on search engine. The site searching is used in both tasks.

Question 4:
Participant: First, The size of screen affected my speed to scan the information and it is easier to scroll down the pages in a big screen which make me easier to location information. Sometime, it is not working well in the smart phone. Second, it cannot use the advanced search in the smart phone. Third, the network is slow if it is not connect with WiFi.

Question 5:
Participant: It depends, it is distinct device when I try to search information for completing my report and other serious search, and I will search on the computer. But for the casual information, I just search via mobile which allows me to have a quick answer. Mobile is the extension from computer because mobile cannot satisfy my information need sometimes especially when I try to write a report and thesis. And I can use more technique when searching on the computer. I
1.3 Participant 3—Chinese Speaker and translate by author

Question 1:
Participant: I am satisfy with the result, because, for the first task, I have data from the official website.

Question 2:
Participant: It may be better if I use computer for the tasks. First, Large screen make it easier to locate information. When engaging pdf file, it is difficult to read because of the size of the screen. Second, computer support more file format. Although some mobile can do that, but I do not think it is common on people to use it. And it depend on people’s behaviour when using mobile phone. Third, the network speed may frustrate sometimes.

Question 3:
Participant: I don’t think is it similar, because people tend to search information which is open to the public. But if we need to search for reports inside the organisation. And official website is the better website to explore. For the travel information, I prefer to visit the website of travel agent.
In addition, I don’t think there any influences from the search tasks.

Question 4:
Participant: First, the speed of the network is different. Second, we can search the location-related information on mobile. Third, mobile is portable compared with computer. And it is more convenient.

Question 5:
Participant: I think the mobile is the simple version of the search engine on computer. Mobile has less search result compare with computer. Mobile is an extension from computer. Because, the processor is not allow the mobile to search quickly.
1.4 Participant 4

Question 1:
Participant: Yes, because you get the result from the official website. When I searching, I will look at URL to identify whether the website is trustful.

Question 2:
Participant: using mobile is more difficult because Usability is different. In the computer, it allows us to use different tab which makes it easier to reading. But in mobile, it takes, at least, more times and efforts to switch between tabs. Mobile is for casual things.

Question 3:
Participant: the approach is similar, because is only using keywords. For the second task, I used the “Tripadvisor” many time, and I trust it.

Question 4:
Participant: because of the scale down system. It is about the difficulty of usability. You may familiar with tabs or google on computer. Mobile will do the same, but only takes longer time. Usability refers to using more than one tab, check multiple URL. The screen size have some influence for it. But the keyboard was not affect my usability.

Question 5:
Participant: mobile is an extension from the computer. Just like a new born babe. Everything is logged in mobile. So it is easier to use the mobile.
1.5 Participant 5—Chinese Speaker and translate by author

Question 1:
Participant: it is okay. But I enter less query on mobile. Because I feel that it has some differences between both devices. And I just select the top results.

Question 2:
Participant: It should be. The result should be similar as it uses the same search engine. But the benefit of computer is the larger screen allow me to locate more information and view more result. The limitation of mobile is the small size keyboard screen affect my query entering speed. And it may also makes me input the work letters sometimes because the tiny keyboard.

Question 3:
Participant: I just enter the keyword from the topic. No differences.

Question 4:
Participant: First, I prefer to view the top result on mobile. But in computer I can make it further (to next few pages). Second, I enter less the query, which is the focus on the keyword, on mobile. But in computer, I will enter more query. Third, mobile allows me to find the location-related information.

Question 5:
Participant: Mobile is an extension, because the search pattern on mobile is developed based on the computer search. I think the search behaviour is similar on both devices.
1.6 Participant 6—Chinese Speaker and translate by author

Question 1:
Participant: I am not satisfying with the first one. Because the search engine did not provide the information I need. If I am not satisfy with the search result, I will keep modifying the query and look for the result from the search engine.

Question 2:
Participant: it is troublesome to search on mobile. Because, firstly, the size of the screen on mobile limited amount of information. Secondly, the network speed is slower on the mobile. Thirdly, on the computer, I can have a better modification of query after viewing the result. But in mobile. I am limited by the number of result and it makes me inconvenient. Thirdly, I can manage many tabs on computer easily, but in mobile, it is more difficult.

Question 3:
Participant: Basically the same. In the second task, I need to find the best diving resort. So most of the information such as WiFi, famous for diving can be listed on the travel website. However, I do not think search engine can give me such detail information. I more willing to look into the travel website when I performing this task.

Question 4:
Participant: First, I can compare the result on different pages at the same times. But it is difficult to do it on mobile. It can be done, it is troublesome to do that on mobile. Second, I think it is less result on the mobile compare with searching on computer.

Question 5:
Participant: mobile is an extension for computer. Although the function is getting richer on mobile, but the processing speed is comparatively slower than computer. Mobile still cannot replace the computer especially when I try to write the paper work.
1.7 Participant 7

Question 1:
Participant: Generally, yes. But I cannot find the information for the first one. The information on the screen is not relevant. Because, I am not used to searching on the mobile, instead of, I prefer the bigger screen. And I am not familiar with the touch mobile. For the simple question, I can search on the mobile, but for the more complex question, I prefer the computer.

Question 2:
Participant: yes, First, I am used to search on the computer. Second, the size of the screen is easier to view information on the computer, but in mobile, I have to move the screen. Third, the mobile webpage is the abbreviation for computer-side web site page.

Question 3:
Participant: The second one is more straight forwards, and I can locate the information more easily because the keyword. But for the first one, I have to put more keyword to the search engine. I think if you put more word in search engine, its more difficult to find the result, whereas the second require less word so that the search engine shows more result. And I think it depends on how clear you know what you searching for. If you are more clear, you may need a more specific result and make it difficult to locate the information. But for the less clear question, it more easily to find the answer.

Question 4:
Participant: For me, first, the keyboard is another difficult. I use only one finger and sometimes it will press the wrong button. Second, the screen size. Third, the option on the mobile is limited.

Question 5:
Participant: mobile is an extension from the computer, it is helpful if you have mobile elsewhere. You can access the information at any time. For the search, I can search everything on the computer, but, on mobile, I prefer some quick answer. The mobile extend the location of the computer. But it need to consume more time, more effort on mobile. Such at the function is not sufficient, and the screen require to zoom in sometimes.
Participant 8

Question 1:
Participant: Yes, because I trust google.

Question 2:
Participant: nope maybe not that fast as computer. The website may not well-design on mobile. Basically, the size of the screen is crucial.

Question 3:
Participant: The approach is the same. If the site is clear, I do not use site searching. If not, I will use it. When I was searching, I will focus on the title, the abstract for the website and the

Question 4:
Participant: First thing is the size of the screen. Because you cannot see the all the websites. Second, sometimes it is more difficult to navigate some website. Because sometimes you cannot flash, pictures and java. For search, I don’t think there is any differences. I think, probably, the search engine may rank the web differently.

Question 5:
Participant: For the devices, Mobile is distinct from computer, because mobile is not powerful enough. For searching, it is an extension, because they can give me the same result, it is more like a complementary. Of course, I prefer to use the computer.
1.8 Participant 9— Chinese Speaker and translate by author

Question 1:
Participant: so-so, because I did not clear about the topic. But I think my search and keyword is correct. And I am experienced in computer searching, so I think it will not be difficult in mobile searching.

Question 2:
Participant: generally, it can be better. Because the time is shorter and I can have more result. Because, firstly, the size of the screen is larger in the computer which can show more results. Secondly, The processor (CPU) on the computer is faster, and it will affect my usability.

Question 3:
Participant: What I search is the same. For the second task, there are lots of tick box and flash for selecting the travel information on computer. But for mobile, it may not have such functions.

Question 4:
Participant: It is more comfortable when searching on a computer. The size of the screen, processor and the flash or plugin on the computer makes me more convenient.

Question 5:
Participant: Mobile is an extension from the computer. There is some limitation on mobile. First, the respond speed include network and the processor is not good compare with computer. Second, the number of search result on mobile is smaller than it on the computer. Third, I am already got used to the computer searching which in turns will affect my usability on mobile. Because the functions on the computer is better than mobile. For searching, I can use the mobile when it is urgent as I cannot reach the computer at that time. And mobile helps me searching when I cannot reach the computer.
1.9 Participant 11

Question 1:
Participant: The first one is fine. The second one needs more efforts to record the information. For the second one, although I find the result, but I am not sure about it that is why I was compared the result with others.

Question 2:
Participant: It can have better performance.

Question 3:
Participant: With the first task, because of I have some previous knowledge. So I just go to the university of Sheffield website and search for the information. But for the second one, I have little knowledge for it, so I just search it and compare the result on google.

Question 4:
Participant: The search box is not working. First, I looked a lot less sites. Second, the keyboard is irritating. I need to take more time to complete.

Question 5:
Participant: I don’t treat them differently and I tend to do the search on mobile before TV. And I will expect the same result from mobile compare with compare. Mobile searching is more likely to be triggered by a social situation. I will not do some complex work on mobile such as task 2. Because it takes much more effort to do that on mobile such as I need to compare the result among different pages. The mobile can perform some easy question, which cannot break what I am doing. I treat it as an extension because I would not expect to only show me the mobile site. And I will expect to search in the whole web. I expect to able to do the advanced search or other functions. And the result should be the same.
1.10 Participant 12

Question 1:
Participant: no really, miss understanding the topic. The research engine did not give me the results.

Question 2:
Participant: the mobile is more difficult. Eventually, mobile satisfies most of the information need

Question 3:
Participant:

Question 4:
Participant: First, the keyboard and the device. Second, the network speed is different. Third, mobile allow me to perform the searching on the road. Fourth, the advanced feature on the computer is better development on the computer such as “define”.

Question 5:
Participant: I think mobile is to help you when you in a rush. It gives you the quick answer. The computer is more everything. Mobile is an extension from computer searching. They are similar.
1.11 Participant 13—Chinese Speaker and translate by author

Question 1:
Participant: Yes, the number is from the university website. For the second task, the “star rating” on the website makes me feel confident about the answer.

Question 2:
Participant: Yes. It is inconvenient to conduct searching on the mobile. First, the keyboard is too small on the mobile hence sometimes I may enter the wrong letters and waste my time. Second, I need to amplify the webpages on mobile because of size of the screen is too small. And when I zoom in, it will also affect me especially on reading the contents. Third, I do not use the search on mobile a lot. Usually, I am searching on mobile when I am trying to find the road or travelling.

Question 3:
Participant: for the first task, I think the information should within our university website. And I have previous knowledge about the finance, so I know the financial report should include the income statement. For the more specific information, I prefer to go to the official website in the beginning. If I cannot find the information on the official website, I will consider viewing the result on google. For the general question, because I have little knowledge and there is no official website for the second task. So I am comparing the result from google. For the second task, the “star rating” on the website makes me feel confident about the answer.

Question 4:
Participant: First, the size of the screen on the computer is larger so that the result may already shown on the screen, while, on mobile, I need to move the screen and find the information. It is easier to find the information on a big screen. Second, the network speed is slower on the mobile. But I understand that mobile is portable devices. Third, for searching, on the computer can show the integrated result and mobile cannot do it. Fifth, I can manipulate the tabs more easily on computer while mobile has some trouble with it.

Question 5:
Participant: Computer have more functionality compared with mobile. I think they are independent with others. Because, I think when I am studying and some other situation, mobile cannot replace the computer. Maybe it is because I am relying on the computer. But for mobile, I seldom searching on the mobile, more commonly, I just look the map on mobile.
1.12 Participant 14

Question 1:
Participant: Yes, I use google quite a bit. I find it the best search engine. It organised the result nicely. In the first task, I trust the search engine can give me the result. The second task is easier because I looked into the “Tripadvisor” and there are a lot of company on it and more the user feedbacks from it is helpful.

Question 2.
Participant: mobile can be difficult. Because it is reading a pdf file. On mobile, I found, depending on the screen size, operating system.etc, that anything actually website based as a web page can be difficult to access. Because I know where to go now, but I do not want to read on mobile, so I just go to computer and read the file. For the second task, you just need to have a basic idea about it without the need to scroll down a lot and the mobile will get as easy as a desktop and it just need to scroll down a bit. Sometimes, the web sites are revised and make it suit on the mobile. Generally, mobile site tends to lack some features from the main site. For example, the web page designer limited the usability of the website when design the pages because of speed or something others. It just some of the function from the main site just been took across. so mobile may not be less easy. For the first task, although the data on the first task can across mobile and computer, but it leave problems with mobile to handle the file.

Question 3:
Participant: For the first task, I know there to end-up, but the google can give me a better of what is out there. For the second task, because I know the sites to go, for the “peddy” site I though they may have the option for me. So I went back to trip advisor. Because it has the “user rank system”. And I will not look at other result because they are just look like the holiday company and selling they own version of holiday. So in this task I know what to search, so what I want is a comparison sites (user rating). Unless the website I recognize is what I want (genuine), I will ignore those on the result.
Question 4:
Participant: the main difference is the interface in generally. I think it is quite similar, you are just looking for the information to come back so as long as it is readable and gives me what I need. So I don’t think there is some differences

Question 5:
Participant: it is a distinct device. I don’t know. But until you go to the web site or the search engine are operating pretty much the much. I would say extension, because I am doing the much the same search and to match much the same information. I will use it based on the convenience. Unless the result works better on the computer and mobile cannot show it properly. But that distinction is getting less and less anyway. Assuming I have both information organised well on both devices for the screen size or everything, I would not care who to use. So I will choose the most convenient device.
1.13 Participant 15

Question 1:
Participant: for the first one, I am not happy. Because I find the 2010-2011. And I though once I find the different year, I just change the URL to 2011-12. But it is not working.

Question 2:
Participant: yes, I am not so confident, first, it spend a lot of times learning how it works. Second, the auto-completion is bothering me, because, on the computer. I can choose the auto-completion without searching. But, on mobile, if I click it, it will search and I have to go back and modify the query. So I think on mobile, it is restricting my ability.

Question 3:
Participant: For the first task, although I know the result it from the university of Sheffield, the top result is about “Sheffield overtake Cambridge…”. And I remember quite well that our university website is not good at searching. So it is better to search in google. My second though is to find information on “TIMES”, because I think it should contain some information about the research income. But that news is on the top place and not relate to my interest. For the PDF I locate, it is good and it is well organised which is more trustful compare with news. I enter 2010 and I thought if I find 2010-2011 I can find the 2011-2012 version as well. For the second task, I don’t trust the first page because I think it is an advertisement. The second page—“Tripadvisor” is more reliable because it is based on the users’s review and I used it before, beside, it ranks the resort for you. To sum up, if I need some general information, I will go to the website which is specifically designed for it.

Question 4:
Participant: I think if I want to know the specific information, I will use computer. As I said, first, they have different interaction tools—keywords selection. On the computer, I can let it finish for me, but on mobile it not working well. Second, sometimes when I am selecting, my finger covers the words. So it makes me fell difficult to read sometimes. Third, Sometimes it is fine, but sometimes, the speed of the network is slow and affect my usability. Fourth, I do not like zoom in/ zoom out. Mobile has trouble to read PDF file. Sixth, some websites is not working on mobile. Seventh, for the mobile, I prefer some quick answer such as the search for bee something else. In addition, although the advertisement on computer on mobile is the
same, but because of the size of the screen on the computer and mobile is different. So on computer, it fine because I can ignore them, but on mobile, I have to scroll down to read the information. I just saying that it is little disappoint and affect my usability. Because I do not want to lose time for advertising.

Question 5:
Participant: I think it is not extension because it is not improving the computer search, the only improve is that I can search wherever you are. But it is something for you really need. And I think it has different information need, I think it is search something for fun and not for work. For example, for the java code, I will not searching on mobile but on the computer. I like the phone to be connected with internet but not use it. I think the screen size, maybe I can open a PDF and reading directly without scrolling and pitching.
1.14 Participant 16—Chinese Speaker and translate by author

Question 1:
Participant: Not really, the result from the google is not what I expected. Because, first, I thought if I enter the time, university and research income, google will show me the result. Second, my English is not good. So it is hard for me to read the content.

Question 2:
Participant: I don’t think it will have better performance on mobile. First, the size of the screen limit the content, and I can only view one window on the mobile. Second, I can switch the windows on the computer, but it is more difficult on mobile.

Question 3:
Participant: I don’t think it will have any differences. For the second task, I choose the high price resorts on mobile.

Question 4:
Participant: First, I think the result is different on mobile and google.

Question 5:
Participant: it more convenient to use mobile when we are outside. If I find it difficult to search the result on the computer, I may search it on mobile. My preference is different between mobile and computer.
Appendix C Ethic Approval Letter

Information School Research Ethics Panel
Letter of Approval

Date: 12th July 2013

TO: Zhicong Xue

The Information School Research Ethics Panel has examined the following application:

Title:
Investigate the differences of the search behaviours between mobile and PC

Submitted by: Zhicong Xue

And found the proposed research involving human participants to be in accordance with the University of Sheffield’s policies and procedures, which include the University’s ‘Financial Regulations’, ‘Good Research Practice Standards’ and the ‘Ethics Policy Governing Research Involving Human Participants, Personal Data and Human Tissue’ (Ethics Policy).

This letter is the official record of ethics approval by the School, and should accompany any formal requests for evidence of research ethics approval.

Effective Date: 12th July 2013

Dr Angela Lin
Research Ethics Coordinator
## Appendix D Ethic Application Sheet

### The University of Sheffield. Information School

**Proposal for Research Ethics Review**

#### 7.1.1.1

<table>
<thead>
<tr>
<th>Students</th>
<th>This proposal submitted by:</th>
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<tr>
<td></td>
<td>Undergraduate</td>
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<td></td>
<td>Postgraduate (Taught) – PGT</td>
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<td>X</td>
<td>Postgraduate (Research) – PGR</td>
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<td></td>
<td>Specific research project</td>
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<td></td>
<td>Generic research project</td>
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This project is funded by:

**Project Title:**

1.15 Investigate the differences of the search behaviours between mobile and PC

| Start Date: | 17/05/2013 | End Date: | 04/09/2013 |

**Principal Investigator (PI):**

(student for supervised UG/PGT/PGR research)

<table>
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<th>Email:</th>
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**Supervisor:**

(if PI is a student) Dr Robert Villa

<table>
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<th>Email:</th>
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</table>

r.villa@sheffield.ac.uk

**Indicate if the research:**

(put an X in front of all that apply)

| Involves adults with mental incapacity or mental illness, or those unable to make a personal decision |
| Involves prisoners or others in custodial care (e.g. young offenders) |
| Involves children or young people aged under 18 years of age |
| Involves highly sensitive topics such as ‘race’ or ethnicity; political opinion; religious, spiritual or other beliefs; physical or mental health conditions; sexuality; abuse (child, adult); nudity and the body; criminal activities; political asylum; conflict situations; and personal violence. |

<table>
<thead>
<tr>
<th>Please indicate by inserting an “X” in the left hand box that you are conversant with the University's policy on the handling of human participants and their data.</th>
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<tr>
<td>X</td>
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7.1.1.2 Part B. Summary of the Research

B1. Briefly summarise the project’s aims and objectives:
(This must be in language comprehensible to a layperson and should take no more than one-half page. Provide enough information so that the reviewer can understand the intent of the research)

Summary:
Aims:
To investigate whether the mobile and desktop search behavior differs from each other

Objectives:
1. Investigate the differences of time and query between the desktop and mobile in each session.
2. Investigate the type of queries in both platforms.
3. Investigate how individuals review the result in different devices.
4. Investigate the obstacles (such as the size of the screen and keyboard) for information seeking in both platform.
5. Investigate the influence of task to the search behaviors in both platforms.

B2. Methodology:
Provide a broad overview of the methodology in no more than one-half page.

Overview of Methods:
It is decided to use a qualitative method to collect data for the dissertation. I will set up an experiment study in order to investigate the questions about the session, query, page reviewing. Then, a semi-structure interview will be conducted in order to understand the logic and strategy for searching and try to explain the information seeking process base on the previous information behaviour and seeking models. The experiment will be carried out in the iLAB in the Regent Court. The estimated number of the participants is 20-30 people. Several tasks will be created, which are expected to be organised in different level of difficulties, for each participant to complete.

If more than one method, e.g., survey, interview, etc. is used, please respond to the questions in Section C for each method. That is, if you are using both a survey and interviews, duplicate the page and answer the questions for each method; you need not duplicate the information, and may simply indicate, “see previous section.”
C1. Briefly describe how each method will be applied

Method (e.g., survey, interview, observation, experiment):

Lab based experiment

Description – how will you apply the method?

The experiment is based on observation and analysis of the search behaviour of the participants. It will utilize the camera and software to record the search behaviours of participants on pc and mobile phone. During the experiment, the participants are required to complete two tasks. One is general task which is to find the travel information on the internet. Another is specific task which is to retrieve the financial information of the University of Sheffield.

About your Participants

C2. Who will be potential participants?

Most likely:

1. Undergraduates in the university.
2. Postgraduates in the university.

Other potential participants:

1. Citizens in the Sheffield.
2. Researchers or Lecture teachers in the university.

C3. How will the potential participants be identified and recruited?

An invitation will be sent via the volunteer mailing list.

In addition:

A “snowball” method of recruitment, via social media, may apply in the project. The existing participants may recruit further subjects from among their acquaintances.

C4. What is the potential for physical and/or psychological harm / distress to participants?
The potential for physical harm to the participants is very low, the study being carried out in an office environment. However, it needs to pay attention to some psychological distress.

1. The tasks may not be appropriate for participants. (Although controversial or personal topics will not be used, it may leave some unnoticed issues to which should address some attention.)

C5. Will informed consent be obtained from the participants?

<table>
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<tr>
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<th>Yes</th>
<th>No</th>
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<td>✓</td>
<td>Yes</td>
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If Yes, please explain how informed consent will be obtained?

Yes, an information/consent sheet will be administered. Before the experiment starts (After the participants arrive at the iLab), they will be required to read the information sheet and consent form. If they sign on the consent sheet, the experiment can carry on. If not, it should terminate the experiment for the participant. Participants will be free to withdraw from the experiment at any time, at which point all data relating to that participant will be deleted.

If No, please explain why you need to do this, and how the participants will be debriefed?

C6. Will financial / in kind payments (other than reasonable expenses and compensation for time) be offered to participants? (Indicate how much and on what basis this has been decided)

No
C7. Briefly describe how each method will be applied

Method (e.g., survey, interview, observation, experiment):

Interview

Description – how will you apply the method?

After the experiment, a semi-structure interview will be carried out, while allowing the participant to watch their screen activity. The objective is to understand the strategy and reason for participants to perform the information seeking behaviour.

About your Participants

C8. Who will be potential participants?

Most likely:

3. Undergraduates in the university.
4. Postgraduates in the university.

Other potential participants:

3. Citizens in the Sheffield.
4. Researchers or Lecture teachers in the university.

C9. How will the potential participants be identified and recruited?

An invitation will be sent via the volunteer mailing list.

In addition:

A “snowball” method of recruitment, via social media, may apply in the project. The existing participants may recruit further subjects from among their acquaintances.

C10. What is the potential for physical and/or psychological harm / distress to participants?

The potential for physical harm to the participants is very low, the study being carried out in an office environment. However, it needs to pay attention to some psychological distress.
1. Some participants may not be comfortable with being filmed.
2. Some participants may not happy with sound recording.

C11. Will informed consent be obtained from the participants?

| ✔ | Yes   |
|   | No    |

If Yes, please explain how informed consent will be obtained?

Yes, an information/consent sheet will be administered before carrying out the experiment. However, any additional requirements (such as avoid video recording) regarding to the interview should be satisfied.

Participants will be free to withdraw from the experiment at any time, at which point all data relating to that participant will be deleted.

If No, please explain why you need to do this, and how the participants will be debriefed?

C12. Will financial / in kind payments (other than reasonable expenses and compensation for time) be offered to participants? (Indicate how much and on what basis this has been decided)

No

About the Data

C13. What data will be collected? (Tick all that apply)

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<tr>
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<td>Audio recording</td>
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<td>Video recording</td>
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<td>Computer logs</td>
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<tr>
<td>Questionnaires/Surveys</td>
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C14. What measures will be put in place to ensure confidentiality of personal data, where appropriate?

Overall process of experiment:
It will collect the confidentially and personal data on a background information sheet in the beginning. The video acquired from the experiment will be store my computer (a back-up in private hard disk). The data will be anonymous and encrypted. After the experiment, it should convert the background information sheet to a digital version and store in my private account (Microsoft’s Skydrive). Then, it should destroy the background information sheet.

Notes point:
1. All data will be used for analysis purpose only
2. All information will be anonymous.
3. The video will never be make freely accessible on.
4. If the videos are shown in academic venues, any video will anonymise the filmed participants.

C15. How/Where will the data be stored?
After the experiment, all data should be securely store in the private computer and computers at the University of Sheffield.

C16. Will the data be stored for future re-use? If so, please explain
The data will be used for your dissertation, and other academic research purposes.

About the Procedure

C17. Does your research raise any issues of personal safety for you or other researchers involved in the project (especially if taking place outside working hours or off University premises)? If so, please explain how it will be managed.

It is less likely to cause any personal safety for researcher. The experiment will conduct in the iLab within the university.
About the Data

C13. What data will be collected? (Tick all that apply)

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<td>Other:</td>
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C14. What measures will be put in place to ensure confidentiality of personal data, where appropriate?

Overall process of Interview:
It will avoid mention any private information from the participant. Such as the name, age, occupation.
The video and audio will be named as number. In addition, the audio and video acquired from the Interview will be store my computer (a back-up in private hard disk). The data will be anonymous and encrypted.

Notes point:
1. All data will be used for analysis purpose only
2. All information will be anonymous.
3. The video will never be make freely accessible on.
4. If the videos are shown in academic venues, any video will anonymise the filmed participants.

C15. How/Where will the data be stored?
After the experiment, All data should be securely store in the private computer and computers at the University of Sheffield.

C16. Will the data be stored for future re-use? If so, please explain
The data will be used for your dissertation, and other academic research purposes.
C17. Does your research raise any issues of personal safety for you or other researchers involved in the project (especially if taking place outside working hours or off University premises)? If so, please explain how it will be managed.

It is less likely to cause any personal safety for researcher. The Interview will conduct in the iLab within the university.
The University of Sheffield.
Information School
Research Ethics Review Declaration

1.16 Title of Research Project: Investigate the differences of the search behaviours between mobile and PC

We confirm our responsibility to deliver the research project in accordance with the University of Sheffield’s policies and procedures, which include the University’s ‘Financial Regulations’, ‘Good Research Practice Standards’ and the ‘Ethics Policy Governing Research Involving Human Participants, Personal Data and Human Tissue’ (Ethics Policy) and, where externally funded, with the terms and conditions of the research funder.

In submitting this research ethics application form I am also confirming that:

- The form is accurate to the best of our knowledge and belief.
- The project will abide by the University’s Ethics Policy.
- There is no potential material interest that may, or may appear to, impair the independence and objectivity of researchers conducting this project.
- Subject to the research being approved, we undertake to adhere to the project protocol without unagreed deviation and to comply with any conditions set out in the letter from the University ethics reviewers notifying me of this.
- We undertake to inform the ethics reviewers of significant changes to the protocol (by contacting our academic department’s Ethics Coordinator in the first instance).
- we are aware of our responsibility to be up to date and comply with the requirements of the law and relevant guidelines relating to security and confidentiality of personal data, including the need to register when necessary with the appropriate Data Protection Officer (within the University the Data Protection Officer is based in CiCS).
- We understand that the project, including research records and data, may be subject to inspection for audit purposes, if required in future.
- We understand that personal data about us as researchers in this form will be held by those involved in the ethics review procedure (e.g. the Ethics Administrator and/or ethics reviewers) and that this will be managed according to Data Protection Act principles.
- If this is an application for a ‘generic’ project all the individual projects that fit under the generic project are compatible with this application.
- We understand that this project cannot be submitted for ethics approval in more than one department, and that if I wish to appeal against the decision made, this must be done through the original department.

Name of the Student (if applicable):
Zhicong Xue

Name of Principal Investigator (or the Supervisor):

Date: 04/07/2013
Appendix E Background information sheet

Participant’s Background Info

Gender: Male / Female
Age: _______________________
Nationality: ________________
Course: ______________________
Degree Level: UG/PG/PhD

Please complete in 10 minutes

Task 1:

As a student in the University of Sheffield, we should have at least little knowledge about our university. Our engineering income currently rank as the second place compare with other university in UK. Can you to find the research income during the 2011-12?

Answer:

1. Do you think you have successfully finished the task?
   Not at all 1 2 3 4 5 Definitely

2. Do you think you will be better when performing search on computer?
   Not at all 1 2 3 4 5 Definitely

Task 2:

You intend to have a trip to Maldives during the vacation. But there are so many resorts in Maldives. You are clueless about where to stay. However, you have all your information on the internet. Can you list 5 Resorts which are famous for diving?

Answer:

1. Do you think you have scored a good result?
   Not at all 1 2 3 4 5 Definitely

2. Do you think you will be better when performing search on computer?
   Not at all 1 2 3 4 5 Definitely
Appendix F Example of Information Sheet

<table>
<thead>
<tr>
<th>The University of Sheffield</th>
<th>1.17 To investigate the differences of the search behaviours between mobile and PC</th>
</tr>
</thead>
</table>

Researchers

Name: Zhicong Xue
Email: zxue3@sheffield.ac.uk

Purpose of the research

The research will investigate whether the mobile and desktop search behavior differs from each other. It will look into the query, consumption of time and obstacles for information-seeking in both platforms. Moreover, it also hopes to find out how individual review the contents and how search behaviour in both platforms is influenced by the tasks.

Who will be participating?

It will invite volunteers (in volunteer list) who have adequate online searching experiences.

What will you be asked to do?

You will be invited in to carry out searches, which will be followed by an interview. During the searching session, I will ask you to complete two tasks (general and specific) in the PC or mobile. For instance, the general task is to find some travel information on the internet. And the specific task is to seek for the financial information of the University of Sheffield. Moreover, it will record the query, log and screen activities in the devices. In addition, it will perform a semi-structured interview after all the physical test. The overall duration should be around 30-40 minutes.

What are the potential risks of participating?

The risk of participating are the same as those experienced in everyday life. In addition, some distress should be addressed:

1. The tasks may not be appropriate for participants. (Although it will try to avoid the religious or personal invasion topics, it may leave some unnoticed issues to which should address some attention.)
2. Some participants may not comfort with camera shooting.
3. The questions for the interview after the experiment may lead to some discomfort for the participants.
4. Some participants may not happy with sound recording.

What data will we collect?

For the search part of the experiment:
A software will record the screen activity and generate a log file (all the actions when you use the computer).

For the interview:
Video and audio recording will be made of the interviews.

What will we do with the data?

Data obtained will be used only in my master’s dissertation and will be accessible only to the researchers involved in this project. The data will not be shared, and will only be used for research purposes.

Will my participation be confidential?

The interview will only focus on the question for the experiment. In other words, all the private information (such as name, age and occupation) will not be mentioned in the experiment and interview. Furthermore, it should use the number instead of the name when analyze the data in the latter phases of the research. All data will be in digital version, which will be securely stored on my private computer, and computers at the University of Sheffield. All data collected will be anonymised, with each participant being given an ID.

What will happen to the results of the research project?

The result should be included in my dissertation which will be publicly available. Please con the school in six months.

I confirm that I have read and understand the description of the research project, and that I have had an opportunity to ask questions about the project.

I understand that my participation is voluntary and that I am free to withdraw at any time without any negative consequences.

I understand that I may decline to answer any particular question or questions, or to do any of the activities. If I stop participating at all time, all of my data will be purged.
I understand that my responses will be kept strictly confidential, that my name or identity will not be linked to any research materials, and that I will not be identified or identifiable in any report or reports that result from the research.

I give permission for the research team members to have access to my anonymised responses.

I give permission for the research team to re-use my data for future research as specified above.

I agree to take part in the research project as described above.

Participant Name (Please print) ___________________________ Participant Signature ___________________________

Researcher Name (Please print) ___________________________ Researcher Signature ___________________________

Date ___________________________

Note: If you have any difficulties with, or wish to voice concern about, any aspect of your participation in this study, please contact Dr. Angela Lin, Research Ethics Coordinator, Information School, The University of Sheffield (ischool_ethics@sheffield.ac.uk), or to the University Registrar and Secretary.
Access to Dissertation

A Dissertation submitted to the University may be held by the Department (or School) within which the Dissertation was undertaken and made available for borrowing or consultation in accordance with University Regulations.

Requests for the loan of dissertations may be received from libraries in the UK and overseas. The Department may also receive requests from other organisations, as well as individuals. The conservation of the original dissertation is better assured if the Department and/or Library can fulfill such requests by sending a copy. The Department may also make your dissertation available via its web pages.

In certain cases where confidentiality of information is concerned, if either the author or the supervisor so requests, the Department will withhold the dissertation from loan or consultation for the period specified below. Where no such restriction is in force, the Department may also deposit the Dissertation in the University of Sheffield Library.

To be completed by the Author – Select (a) or (b) by placing a tick in the appropriate box

If you are willing to give permission for the Information School to make your dissertation available in these ways, please complete the following:

☐ (a) Subject to the General Regulation on Intellectual Property, I, the author, agree to this dissertation being made immediately available through the Department and/or University Library for consultation, and for the Department and/or Library to reproduce this dissertation in whole or part in order to supply single copies for the purpose of research or private study

☐ (b) Subject to the General Regulation on Intellectual Property, I, the author, request that this dissertation be withheld from loan, consultation or reproduction for a period of [ ] years from the date of its submission. Subsequent to this period, I agree to this dissertation being made available through the Department and/or University Library for consultation, and for the Department and/or Library to reproduce this dissertation in whole or part in order to supply single copies for the purpose of research or private study

Name: Zhichong xue
Department: Information School
Signed: Zhichong xue
Date: 31.08.2013

To be completed by the Supervisor – Select (a) or (b) by placing a tick in the appropriate box

☐ (a) I, the supervisor, agree to this dissertation being made immediately available through the Department and/or University Library for loan or consultation, subject to any special restrictions (*) agreed with external organisations as part of a collaborative project

☐ (b) I, the supervisor, request that this dissertation be withheld from loan, consultation or reproduction for a period of [ ] years from the date of its submission. Subsequent to this period, I agree to this dissertation being made available through the Department and/or University Library for loan or consultation, subject to any special restrictions (*) agreed with external organisations as part of a collaborative project

Name
Department
Signed
Date

THIS SHEET MUST BE SUBMITTED WITH DISSERTATIONS IN ACCORDANCE WITH DEPARTMENTAL REQUIREMENTS.