A DESCRIPTIVE USER STUDY OF BILINGUAL INFORMATION SEEKERS SEARCHING FOR ONLINE INFORMATION TO COMPLETE FOUR TASKS

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A DESCRIPTIVE USER STUDY OF BILINGUAL INFORMATION SEEKERS SEARCHING FOR ONLINE INFORMATION TO COMPLETE FOUR TASKS

This study is about the information-seeking behavior that bilingual users – specifically, native Chinese speakers whose second language is English - exhibit when performing an online search. Bilingual online searching occurs when bilingual users submit queries to search for information in two languages. This study seeks to explore the information-seeking behavior of bilingual users in an attempt to discover possible ways of improving bilingual users' online searching experience. The study focuses on defining the characteristics of bilingual users' information-seeking behavior on the web.

This research employed questionnaire and interview methods to determine (1) The information-seeking behavior of bilingual users; (2) Language's influence on online searching; (3) Bilingual users' opinions on the online searching support they need. The sample was recruited from Chinese native-speaking students in Pittsburgh.

The researcher found that bilingual users tend to select the language that best fits their information needs rather than doing multilingual online searching and that they used search engines as multilingual tools. The researcher also identified five types of search strategies preferred for bilingual online searching. They include: *directly linking*, *keyword searching*, *browsing*, *comparison*, and *externally linking*. *Directly linking* means that the participant has a specific website in mind so he/she just go to the website directly or search for the website in the search engine. *Browsing* means that they retrieved a list of resources first and browse through

them. *Comparison* means that they obtained several search results first and compare them. *Externally linking* strategy means that participants link from the website they accessed originally. This is a descriptive study of users completing four specific tasks and it only emphasizes on users' opinions about the search support given by the bilingual online searching interface.

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PREFACE

I am thankful to my advisor, Leanne Bowler, whose encouragement, guidance and support enabled me to develop an understanding of the subject. I would like to thank my former advisors, Sherry Koshman and Bernadette Callery, who supported and guided my study. Thanks to my committee, who gave me helpful suggestions and guidance.

I would like to thank the participants in my study. This research would not have been possible without them.

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1.0 INTRODUCTION

1.1 BACKGROUND

Multilingual online resources have grown rapidly over the past decade and the need for multilingual web-search engines has grown to match. Those who speak more than one language fluently have the option of choosing to search for different kinds of data using different languages. Among bilingual or multilingual information seekers, Rieh and Rieh's (2005) study found that in conducting an information search, subjects selected the language that represented their information needs most accurately, based on the type of information task, rather than always choosing their native language. For example, they tended to use English resources for their research while retaining their native language resources for personal topics because they can find abundant research related information in English. This study pointed out the features of the bilingual users' information-seeking behavior. Therefore, my research investigated these issues by conducting tasks, questionnaires and interviews. Bilingual users' information-seeking behavior when conducting four specific online searching tasks was described in this study. The rationale for language selection is the emphasis of the research. The researcher discussed bilingual users' language selection and the relationship between language selection and available online support, such as analysis techniques and translation tools from the online searching website based on four specific online searching tasks.

Chung's (2008) study found that post-retrieval analysis techniques (such as summarization and visualization) can alleviate information overload. Therefore, during the interview the researcher asked participants to describe the online searching support they need to understand how to improve users' online searching experience based on their information-seeking behavior.

According to Chung's (2008) study, user studies are needed as a way to allow development of better service to the target audience of their innovative systems as well as suggestions from users. A user study can serve as crucial input in the design of a user-oriented online searching interface. It is also a good way to evaluate the usability of the innovation.

The literature from Rieh and Rieh (2005), Keegan and Cunningham (2005) and Chung (2008) has revealed some features of bilingual users' information-seeking behavior. For example, this population tends to have two favorite search engines, keeping the favorite foreign search engine separate from the favorite native language search engine, and they did not use a web search engine as multilingual tools (Rieh & Rieh, 2005). The definition of web search engine as a multilingual tool is that users use language and translation functions in the web search engine. Sometimes their language preference is related to patterns of activities within the searching sessions (Keegan & Cunningham, 2005). Chung's (2008) research also points out the language bilingual users used can affect their information-seeking behavior. However, there has not been much discussion about the specific behavior of bilingual users such as the language selection of bilingual users when they search online. The research on bilingual users' specific information searching behavior can help to improve the online searching experience of them in the future.

Bilingual language support for online searching such as user control of language selection and translation tools can improve users' online searching experience, but there are only a few studies that have done a user study of cross lingual information retrieval and translation functions. In this research, the researcher used questionnaires, online searching tasks, and interviews to investigate bilingual users' information-seeking behavior and to gather their suggestions to inform the future development of online searching support.

1.2 PROBLEM STATEMENT

Bilingual online searching occurs when bilingual users submit queries to search for information in two languages. Bilingual users often use different search terms and strategies than single-language users do to obtain the bilingual information they need. Zhang and Lin (2007) pointed out that the richness and dynamics of internet information resources have resulted in a fundamental revolution in how individuals search for information. Petrelli et al. (2002) also pointed out that the two main user groups for cross-language information retrieval services are users wishing to obtain a subset of documents to be manually translated and bilingual users who wish to search for documents in all languages they know but from a single query. One issue related to bilingual users' information-seeking behavior is language selection preference. The language selected for the search might affect the online searching process and the online searching websites' availability of features for different languages can also affect the effectiveness of search results. The aim of this research would be to understand the users' information-seeking behavior and information needs in order to improve bilingual users' online searching experience.

Bilingual users have information needs in multiple languages and demonstrate information-seeking behavior which differs from other non-bilingual users. Rieh and Rieh (2005) have conducted research to discuss the bilingual web searching behavior of Korean users from the information-seeking behavior aspect. Their research pointed out not only the differences between the information-seeking behavior of bilingual and English-speaking users, but also discovered areas that needed further investigation. Their study indicated that the participants use the Korean and English resources available on the web but they didn't use web search engines as multilingual tools. Furthermore, users' choice of language was dependent upon type of search task rather than level of familiarity with the language. The design of web search engines and users' familiarity with various search engines might have improved in the past six years, so the results of this dissertation research study might yield different results from those of Rieh and Rieh's research. Unlike Rieh and Rieh's research, this research study analyzed the language choice for searching tasks to discover users' behavior and further discussed the issues about searching behavior during interview. Studying the information-seeking behavior of these particular bilingual users can help the researcher generalize bilingual users' information needs in the information environments.

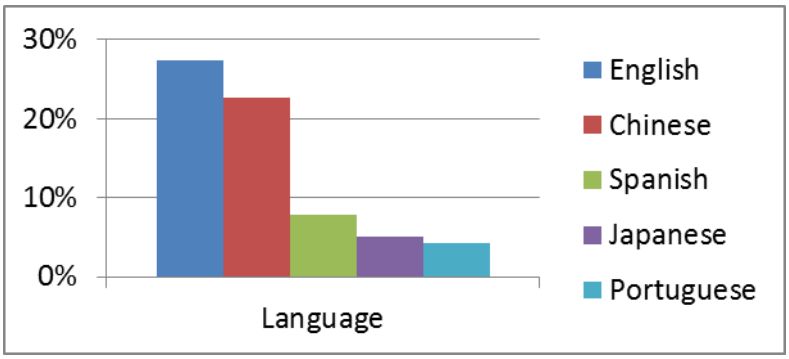

Figure 1. Commonly used languages on the web

In 2010, the top five most commonly used languages on the web included English (27.3%), Chinese (22.6%), Spanish (7.8%), Japanese (5.0%) and Portuguese (4.2%) (Miniwatts International, 2011). English and Chinese are by far the two most popular languages on the web. Chinese is largely used by people from China, Hong Kong, Taiwan, and Chinese people in other areas around the world such as Singapore and the United States. Therefore, the researcher chose bilingual users who use English and Chinese to do online searching to be the participant of this study.

However, because their information-seeking behavior is different from the information-seeking behavior of native English-speaking users in terms of cultural and language differences, bilingual users need to have even more support. For example, Rieh's (2005) research pointed out that users' choice of language is dependent upon type of search task, rather than familiarity with the language. The users might want to have language selection button under the search box. They might need to have translation support during their searching process. The interview design of this research gave the participant a chance to articulate their opinions on this issue.

The study reported on in this dissertation was conducted on native Chinese-speaking students in Pittsburgh who use both Chinese and English to do online searching. The population of this study was graduate students in the information technology field. They all passed the graduate school's English examination requirement and have experience doing online searching as determined by a questionnaire. Although this research has a limited number of participants, the interaction of users, tasks, and online searching tools was observed and the issues about bilingual online searching are discussed in this research. Chung's (2008) study pointed out considerations for interface design from multilingual and multicultural aspects. He suggested that future bilingual online searching interfaces should add browser support, analysis tools, and

information visualization to improve the efficiency and accuracy of such systems. While other researchers have often paid more attention to refining the strategies of information retrieval, his study emphasized the importance of designing a successful interface. Unlike Chung's research, this study investigated the bilingual online searching support such as translation function and language function for bilingual (English and Chinese) users.

1.3 SIGNIFICANCE OF THE STUDY

Due to the rapid growth of multilingual online resources, bilingual users tend to use two languages when they need to search for information. Keegan and Cunningham (2005) conducted log analysis to examine language choices made while using a bi-language digital library (English and Māori, the language of the native people of New Zealand). Their study indicated that the bilingual users' language preference was related to patterns of activities within the searching sessions. The participants' language preference and patterns of activities were observed and conducted when participants are conducting tasks in the proposed study. Rieh and Rieh (2005) also conducted interviews to investigate the information-seeking behavior of English and Korean bilingual users. Their study showed important factors influencing bilingual information behavior: Users tend to select a language that best represents their information needs rather than doing multilingual online searching. This might be another kind of searching style for bilingual users. The participants' language selection and the rationale of it are investigated in this study.

The proposed study explored bilingual users' information-seeking behavior and their information needs when they are doing bilingual online searching. The results of this study reflected the information-seeking behavior of the bilingual graduate student group in Pittsburgh

and contribute to general knowledge about bilingual online searching behavior and the testing of bilingual online searching behavior. This study pointed out the importance of bilingual users' information-seeking behavior and researchers can consider about this factor when they develop the online searching system for bilingual users in the future.

1.4 OBJECTIVES AND SCOPE OF THE STUDY

The goals of this study include: (1) To understand the information behavior of bilingual users, (2) To reveal the characteristics of bilingual users when they are doing online searching.

The main purpose of this study is to explore bilingual users' information-seeking behavior. Furthermore, the researcher would like to gather bilingual users' opinions about online searching interface design. In the future, the researcher expects to expand the research to a larger number of bilingual users in different countries and to design a bilingual online searching system which is guided by the study's results.

1.5 THEORETICAL FRAMEWORK

This study was created to investigate bilingual users' information-seeking behavior as they are doing online searching. The researcher would also like to use English-speaking users' information-seeking behavior theory such as Spink's (1997) interactive feedback model to examine their information-seeking behavior.

This research discussed issues related to bilingual users' online searching from the aspect of information-seeking behavior and the unit of analysis is the individual. Graduate students who are native Chinese speakers and study in the information technology field in Pittsburgh were recruited. The goal of this research is to investigate searchers whose mother tongue is Chinese and who are looking for information on the web in English and Chinese. The main focus of this research includes bilingual online searching and information-seeking behavior.

1.6 RESEARCH QUESTION

The principle research question guiding this study is the following:

What is the bilingual user's information-seeking behavior when they are doing online searching?

The researcher divides the main question into two subcategories:

(1) What is the information-seeking behavior of a Chinese-speaking bilingual user who is a resident of the United States when he/she is doing online web-based searching to answer three specific questions?

(2) What are the bilingual users' expectations for bilingual online searching and other search tools that might arise in the future?

2.0 LITERATURE REVIEW

2.1 CONCEPTS

Keegan and Cunningham (2005) revealed the searching behavior when users are using a bi-language digital library (English and Māori, the language of the indigenous people of New Zealand). The results indicated that browsing was used to a greater extent in bilingual sessions and Māori preference sessions than in English sessions. This study also pointed out that effective browsing required a greater fluency in Māori than does searching, as browsing is primarily over Māori language newspaper titles and content. Furthermore, this study indicated that the language preference was related to patterns of activities such as choice of document format and information-seeking strategy used within the search sessions.

In Rieh and Rieh's (2005) study, they discussed issues related to bilingual information behavior and considered the bilingual online searching problems from the user's perspective. They conducted interviews with 28 bilingual academic users to discover their online searching behavior and language selection preferences. This study investigated many factors affecting bilingual information behavior such as the task type and the search preferences of users but more research is needed about bilingual users' information-seeking behavior. According to this study, the users selected a language that represented their information need most accurately depending on the types of information task rather than automatically choosing their first language. Subjects

also expressed concerns about the accuracy of machine translation of scholarly terminologies and preferred to have user control over multilingual web searches. Rieh and Rieh's (2005) study also demonstrated the value of studying multilingual search behavior on the web in natural settings by identifying user needs and preferences for integrated multilingual search systems. Therefore, researchers in the Cross Lingual Information Retrieval (CLIR) field should focus on the research of the search behavior of users to identify user requirements to evaluate information systems.

Chung's (2008) framework of multilingual online searching system is described in terms of domain collections, meta-search, statistical language processing, webpage summarization, search results categorization, and visualization. However, he found that a more detailed investigation of user information-seeking behavior is needed to improve his online searching system design. Therefore, this research investigated bilingual users' information-seeking behavior and their needs when they are doing online searching.

These studies from previous literature described the characteristics of bilingual users' online information-seeking behavior and pointed out the directions for future research. Bilingual users have to consider language selection when they need to obtain information in different languages and they might need to use more search or translation websites when they are doing online searching.

2.2 INFORMATION-SEEKING BEHAVIOR

2.2.1 Information-seeking Behavior

Case (2007) defined information-seeking as "a taken-for-granted concept, a catch all phrase that encompasses a variety of behaviors seemingly motivated by the recognition of 'missing information'" (p. 76). Wilson (2000) defined information-seeking behavior as "the purposive seeking for information as a consequence of a need to satisfy some goal" (p. 13). Understanding the user's information-seeking process allows designers to successfully integrate the design concepts of the information system with the user's requirements for a more effective search experience. It is also necessary for researchers finding useful innovative online searching support techniques and concepts to improve users' online searching experience.

Wilson (1999) also defined information searching behavior as "a sub-set of information seeking that is particularly concerned with the interactions between the information user (with or without an intermediary) and computer-based information systems, of which information retrieval systems for textual data may be seen as one type" (p. 263). Therefore, it is useful to review the information-seeking behavior theories first and then focus on the information searching behavior and users' online information-seeking behavior.

There are several information-seeking behavior theories to explain the user's information-seeking process. They include Kuhlthau's (1991) information-seeking process theory, Bates' (1989) Berrypicking Techniques, Wilson's (1999) information-seeking model, and Spink's (1997) model of the IR interaction process. Kuhlthau (1991) took the user's emotional status into account when she presented her information search process (ISP) theory. This theory includes six stages: (1) Initiation, (2) Selection, (3) Exploration, (4) Formulation, (5) Collection,

and (6) Presentation. This theory can also be viewed as a sense-making process because users translate information into useful knowledge when their information changes form during the search stage.

Kuhlthau (1991) generated the ISP from several qualitative and quantitative studies of library users and subsequently formed the above model of the information search process. In the initiation stage, users notice the lack of knowledge or the requirement of information. They feel uncertainty and try to derive a specific topic at this stage and might discuss their problems with other people or browse the library to decrease their feelings of uncertainty. In the second stage, selection, users need to decide on the topic or research they want to pursue. They feel anxiety before they select the topic and become optimistic after they make a decision. Their strategy in this stage includes discussions with other people, preliminary searches and generally scanning a vague overview of possible topics. In the next stage, exploration, users explore the information about their topic selection to find a focus. They feel confused and doubtful in this stage. Therefore, they try to obtain relevant information so that they can form a focus or have a personal point of view. In the fourth stage of formulation, users try to formulate a focus based on the information they have. They feel optimistic and confident about completing the task at this time. They try to construct and clarify their focus at this stage. Next, in the collection stage, they gather the information they defined in the earlier stages. They feel confidence and their interest in the task also increases. They select relevant information and make specific notes at this stage. In the final stage, presentation, they conclude their search and feel a sense of relief. The users feel satisfied if the results satisfy their need and feel disappointment if they do not.

Kuhlthau's (1991) study focused on the emotional state of the users while they are conducting an information search and pointed out the support they need in different stages. In

addition, the feelings of uncertainty are also a sign that the information system is providing insufficient information. A mediator between the users and the information system is needed to solve this problem.

Bates' (1989) berrypicking technique is an information-seeking behavior theory for online information-seeking. In the Information Age, an environment where online information-seeking has become a natural occurrence, Bates (1989) created an online search model to fit the real behavior of information searchers. The traditional model simply matches the query with documents, but Bates' model is different from the traditional model in four areas: (1) Nature of the query, (2) Nature of the overall search process,(3) Range of search techniques used, and (4) Information "domain" or territory where the search is conducted. Bates explained that the formation of a query in real life may start from one topic, but new ideas may be generated during the search process. Furthermore, users may obtain more useful ideas during the search process, multiplying the number of retrieval tasks involved in this search process. Bates (1989) wrote that "the query is satisfied not by a single final retrieved set, but by a series of selections of individual references and bits of information at each stage of the ever-modifying search. A bit-at-a-time retrieval of this sort is here called berrypicking."(p. 410) Users can pursue several search techniques such as footnote chasing, citation searching, journal run, area scanning, subject searches in bibliographies, abstracting and indexing (A & I) services and author searches to find the information they need. This approach implied that users search for information from many other places besides bibliographic databases (Bates, 2005).

Bates' theory offered some hints to the online information system designer as to how to increase user satisfaction. This information-seeking pattern is especially useful for online searching. The berrypicking technique emphasizes features that are especially important

information-seeking behavior in online environments and reminds the information system designer to pay attention to various search techniques and online information resources.

In Wilson's (1999) model, the psychological and cognitive aspects of information needs and information-seeking behavior are addressed. This model related the intervening variables such as psychological, demographic, interpersonal and environmental factors and source characteristics factors with the information-seeking process. The model also listed passive and active types of search behavior. Therefore, researchers need to consider intervening variables when they investigate users' information-seeking behavior and the interaction between the search style and the user group needs to be discussed.

Spink's (1997) model showed interactive feedback during the online searching process including content relevance feedback, term relevance feedback, magnitude feedback, tactical review feedback, and terminological review feedback. Feedback is a concept in information retrieval concept which means users' judgments of the results they get and their query modification. An interactive search process may consist of a serious of search strategies made up of one or more cycles, and one or more interactive feedback loops which mean the interaction between users and the information retrieval system within each cycle. Interactive feedback may include one or more search tactics or moves such as user input or system output, and user interpretation or judgments about the systems output. Spink's (1997) study indicated that online searching is a communicative and interactive process. According to this model, the users might use search tactics or moves to refine the search results to obtain satisfied results. Further research can be conducted to understand how users decide their search tactics or moves. Understanding the users' online search process can also help searching system designers to provide appropriate

support for users in the future. Therefore, this dissertation investigates the influence language has on users' decisions about search strategies.

The user's information-seeking behavior may change because different types of information are needed on different occasions. Therefore, the information providers need to think about solutions for the user's information problems depending on the situation. Studies of information-seeking behavior theories confirm that user-oriented system design can satisfy user information needs. Furthermore, the models of information-seeking behavior theories also encourage researchers to explore the interactivity and searching processes of users. According to the information-seeking behavior theories discussed in this section, user study is the key point to improve the efficiency of information system design. Thus, the proposed study applies them to analyze bilingual users' information-seeking behavior.

2.2.2 Online Information Behavior Theory

As web development flourishes, users' information-seeking behavior changes in terms of search strategy and search pattern. Users can utilize more search strategies such as using different search engine choices or having different language selection and they can obtain many types of information such as blog or online database. The web environment gives users opportunities to access various kinds of information resources such as databases, digital libraries, wikis and blogs. However, the development of web-based tools also makes the information-seeking process more complex. The characteristics of web-based tools include the ability to have interaction, a user-oriented design and accessibility for users. Hsieh-Yee (2001) pointed out factors affecting information-seeking behavior on the web: the user's background and experience with computers, the web, and other information retrieval tools; the information need, domain knowledge,

cognitive abilities, affective states, demographics, and the environment of the information need; the nature of a search task and the quality of search outcomes. These factors should be also considered when investigating bilingual users' information-seeking behavior.

Some aspects of information-seeking behavior for online searching have stayed the same as the general information-seeking behavior concept such as Wilson's (1996) model. Holscher and Strube (2000) presented a process model of information-seeking based on their experiments about search strategies and information-seeking tasks. According to their model, users have information needs so they decide to directly access a website they know or interact with a search engine. Then, they access the resulting documents and examine the contents. Furthermore, they browse the website and may or may not successfully find the information they need. Finally, they can go back to the first step if they don't feel satisfied with the results. The information-seeking process on the web which is described in their paper is similar to Wilson's (1996) second model. However, the results of Holscher and Strube's (2000) experiment showed that expert users can find more relevant information by reformulating existing queries, changing search engines, and requesting additional result pages as well as backtracking to earlier result pages or queries. Their research implied that users can obtain information in flexible ways if they have proficient computer and web use knowledge.

Jansen's (2000) study distinguished between searches using traditional information retrieval systems, Online Public Access Catalogue, and the open web. The users of traditional information retrieval systems use more query terms than regular web users. They have a higher rate of using Boolean logic, but they also have a higher mistake rate when doing online searching than web users have. The similarities in use of the three kinds of systems include the frequency with which users utilized advanced features and the number of documents viewed. Jansen's

study implied that the web can provide users with relevant information even if the users use only a few query terms without Boolean logic. The web has a higher ability to tolerate different types of information-seeking processes. This study showed the effect of different searching system on information-seeking behavior.

Tombros (2004) assigned users three kinds of information-seeking tasks, including performing a background search, decision tasks and multiple-item tasks. His research indicated the important features needed for a useful website, such as organized structure, and good quality; and found that task type has an effect on user information-seeking behavior. The results of this study indicated that participants had frequent use of content, links, numbers and recency when they did background search. Participants also made less frequent use of links to access other pages of related interest when they did the decision task. For the multiple-items task which means satisfying multiple requirement in one search task, participants used links in the webpage to help them locate other pages with enough information and they also made frequent use of query terms, pictures and the authority of the information.

Jansen (2006) pointed out that one cannot necessarily apply results from studies of one particular web search engine to another web search engine. This highlights another complexity influencing web information-seeking behavior which is the difference among search engines. Navarro-Prieto *et al.* (2006) investigated the interaction between the user, the task and the external representation and found that the cognitive strategies developed by participants depended on the way in which the information they sought is structured, as well as their level of expertise. Their study implied that good website design and experienced users are two essential elements of a successful information-seeking process. Kim and Allen (2001) also suggested that the flexibility of the web and web search engines allows different users to complete different

search tasks successfully. However, the efficiency of the searches appeared to depend on how well the individual searcher's search strategy matched the specific task. This research implied that how the hypermedia navigation, keyword searching, and subject directories are combined is crucial to satisfying the users' information needs.

To sum up, we can divide the range of information-seeking behavior into external and internal aspects. The external aspects include the design of system and the types of tasks users have. Users can have different styles of information-seeking behavior for different types of task. However, the system design of an effective web information retrieval tool should tolerate different information-seeking styles. Internal aspects include the web experience and search strategy used. Experienced users can have better results than novices because they are familiar with how to use the web tools and they have the ability to apply complex search strategies. However, the gap between experienced users and novices can be eliminated by providing information literacy education or appropriate online instruction.

Research on information-seeking behavior issues reveals the information-seeking patterns of users and suggests better ways to design user-oriented systems. Although web technology has developed quickly, past insights into information-seeking behavior research can still give us insight into how to improve user satisfaction with online searching website. Most information system research emphasizes the design and technology aspects of online searching website and evaluates system usability and functionality. However, research on the user's perspective is essential for designing a useful system or service.

To study the information behavior of users, there are two common methods: first, researchers might analyze transaction logs from the system. For example, Spink and other researchers (Spink et al., 2002) conducted log analysis to distinguish the differences between the

information-seeking behaviors of U.S. and European users. They used session, query length, structure, mean query length, session duration, search terms per query, and terms in queries to compare the difference between these two groups of users. The research method of this study discovered these issues: (1) Researchers can discover information from the log analysis, but conducting qualitative research in addition is equally important for explaining user information-seeking behavior from a wide range of aspects; (2) Log data is only retrieved on a specific date from a specific search engine.

Secondly, researchers may integrate qualitative methodology such as interview or observation into their research to discover the user's perspective. For example, Tombro (Tombro et al., 2004) recruited 24 participants who did pre-test questionnaires, finished three information-seeking tasks, completed think alouds [verbal protocol] to discuss their perception of the website, and provided their opinion of the task in a closing questionnaire. The researchers also used Camtasia® (a screen video capture program) to record the users' activities. They divided the participants into two groups to compare the search results, grouped by different time restrictions. The study results gave Tombro et al. different perspectives into investigating the relationship between information-seeking task and the structure and quality of a web page. This research found that people have different information-seeking processes when they face different tasks. Qualitative and quantitative research methods are used in this study. The qualitative research method usually has fewer subjects, and the data must be further transcribed and analyzed by the researchers. Statistical methods can analyze the numerical data quantitatively, while the qualitative method can reveal the hidden truth behind the data.

2.2.3 Recent Research

To discuss the relationship of language and information-seeking behavior, Chung's (2008) study discussed the influence of using multiple languages on online user information-seeking behavior. In Chung's (2008) paper, he examined Chinese, Spanish, and Arabic search engines. There are primarily two kinds of search engines widely used: (1) international search engines such as Google®, Yahoo®, and MSN®, which provide services as well as translations to users using different languages; and (2) search engines designed by local companies, which provide more localized information and services. Chung's study suggested that web searching system designers need to solve different problems when they deal with different languages. For instance, Chinese is the primary language used in mainland China, Taiwan, and Hong Kong, but each of these locations has different language encodings, vocabularies, social strata, and economic situations. Therefore, different search engines are favored in each of these areas. Spanish is widely used in the United States. It is also the primary language used in Spain and Latin American society and there are several web searching systems providing web directories and various kinds of services in Spanish or both Spanish and English. Arabic speakers have large populations all over the world, especially in the Middle East and North Africa, but web use in this area is not as popular as in Chinese- or Spanish-speaking areas. As a result, Chung (2008) summarized the characteristics of search engines in different languages and designed an interface which satisfied language and cultural requirements for Chinese-speaking users, Spanish-speaking users and Arabic-speaking users.

Moreover, he also conducted an experiment to compare the usability of web portals versus the benchmark system design based on the web searching interface mentioned in his paper. Results confirmed that the web searching interface is especially useful in its ability to visualize a

large number of search results. Chung's study pointed out some issues affecting the design of multilingual or bilingual web searching interfaces, such as cultural differences, the characteristics of languages, interface preferences, translation issues, degree of support for information visualization, and bilingual users' needs.

Recent research in the information-seeking behavior field examines classic information behavior theory from different perspectives and uses different approaches. For example, researchers can discover information about online user's information-seeking behavior by studying transition logs and user feedback from a questionnaire or interview. They can improve users' searching experience by revising the current searching system or developing new techniques to meet the user's needs.

Spink and Cole (2006) summarized different information-seeking approaches, including the sense-making approach, the information-foraging approach, and another approach based on the theory of information use; they also discuss the advantages and disadvantages of each. Furthermore, they integrated these theories and proposed how to integrate the information-seeking approaches. The researchers claimed that combining different aspects of information-seeking behavior is necessary in a behavioral model. Their research implied that there are various kinds of information-seeking behavior style in terms of the information-seeking process and goal. Although there might be a general model for the information-seeking process, the researchers in this field still need to study specific kinds of information-seeking behavior for different user group in specific situation separately.

Rose and Levinson (2004) discussed user goals during web search in their paper. They divided online searching queries into different types according to the searching goal: navigational queries, informational queries, and resource queries. Their results showed that users

seek different kinds of information when they have different kinds of searching goals. Rose and Levinson analyzed the query log in order to discover the users' thoughts and behaviors when they are searching online and they found that users are not always doing navigational queries. Their research reminds us to consider not only the results of the online searching but also the user's goals when we are doing information-seeking behavioral research.

2.3 BILINGUAL ONLINE SEARCHING

2.3.1 Overview

Bilingual online searching is an essential function for users who want to obtain global information online. The factors for an efficient bilingual online service include users' cultural background, interface design, translation system, language issues, and the user's perspective of the system design.

Researchers confront issues about design preference and various specific needs when they are dealing with online searching system design for users from different countries. According to Callahan's (2005) paper, there are several solutions for accommodating cultural diversity within interface design preferences, such as removing all culture-specific content from the interface, developing a system which can be adapted to any culture, and providing support to diverse cultures. For example, the researcher can use universal icon in the interface and avoid complicate design. Researchers need to consider users' cultural background when they design a novel interface. If they can design a standardized, universal interface, the interface would be easier to adapt to different cultures.

An appropriate interface is a critical part of human computer interaction design. The interface layout preferences may be varied due to cultural differences, information behaviors of specific user groups, and language characteristics. As a result, it is crucial to understand the preferences of the users to design a user-friendly interface. Besides, an ideal system design allows users to spend less time learning the system while having more satisfactory results. For example, the researchers need to design a search interface with a clear search box and organized information. More research is needed on the different layout preferences for different languages, in order to develop a user-friendly interface. Bilingual users' information-seeking behavior and information needs are also crucial factors for online searching interface design but there are not many studies about their online searching addressed these issues.

The research on bilingual users' online searching process is needed because the bilingual users' online searching process has several key features including the translation functions, interfaces for bilingual users, and language issues in addition to the online searching feature to monolingual users. Translation functions can affect the usefulness of the online searching system and the design of the interface for bilingual users' needs to take care of the language and translation problems. The language issues of an online searching system are crucial because more language selections can fit more users' need. The language selection makes bilingual users' online searching behavior different from users who only use single language and also gives the online searching system more functions such as being a multilingual tool.

2.3.2 Translation Feature for Bilingual Users

Translation issues can affect the usefulness of a multilingual system. Systems in different languages have different issues due to the characteristics of the language. For example, Chinese

characters arrange differently from English words. Therefore, my research emphasized the users' information-seeking behavior and their needs when they are doing Chinese and English bilingual online searching. There are many studies on automated translation systems and cross lingual information retrieval. User studies and system evaluation by users are necessary to bilingual online searching so researchers can improve future bilingual online searching system based on the user study results. However, most research was conducted by computer experts who did their research from a system development perspective. For instance, most recent research on cross lingual information retrieval discussed issues such as the complication of bilingual online searching, the semantic challenge of data translation, and the efficiency of functionality but recent research didn't discuss issues about user studies and system evaluation by users a lot.

For example, Zhang and Vines (2004) examined the automated translation extraction on the web and explained a method to translate Chinese and English data efficiently. Cheng et al. (2004) discussed the issues of translating unknown queries for cross-language web search and cited experiments evaluating the results of their method. Zhang and Lin (2007) evaluated three search engines from five aspects: the number of languages used, the visibility of multiple language support features, translation ability, help file quality, and interface design. Their study conducted a survey on search engines with multi-language support features. Furthermore, they analyzed and compared the search engines' evaluation criteria to discover the strengths and weaknesses of each search engine.

Translation ability and the number of languages a system supports are two of the most important factors for a successful multilingual search engine. Former study (Cheng et al, 2004; Zhang & Lin, 2007) gave an overview of the current status of the development of multilingual search engines and how researchers can gain an in-depth understanding of multilingual search

engines by using their survey and analysis. The evaluation criteria are useful for search engine evaluation but are not the focus of this study.

This section discusses the flexibility of query specification and effectiveness of the translation system. Although the translation functions play an important role in a successful bilingual system, further research on bilingual online searching is still needed to discover other factors such as the users' information-seeking behavior and their information needs.

2.3.3 Interface Design

Interface design is the design of websites, systems or software to allow users to interact with them straightforwardly and it is one of the crucial factors in improving the usability of bilingual online searching systems and helping bilingual users understand the functionality of the system. For example, Google® has a simple and straightforward design for their searching interface. Google®'s interface has a search box in the center and navigation bar on the top. It is clean and easy to understand. On the contrary, its competitor, Yahoo®'s interface provides a complete navigation system and categorical information.

The International Children's Digital Library (ICDL) is another example of a search system which includes multi-lingual and multi-cultural interface design. In order to design an interface that can be understood by children from different countries, Bilal (2007) conducted an experiment with Arabic-speaking children, to test the usability of their interface. In Bilal's research, the researcher used icons and graphical designs to improve the visual representations in the interface, and the results showed that the children didn't have any problems understanding most of the design. However, the children failed to understand some icons such as "trash can" due to different perceptions of trash can in different country. This research implied that

appropriate icons and interface designs can improve the usefulness of an interface, regardless of the country and language used of its target audience.

There are not many studies concerning user preferences within a bilingual searching interface. The issues include language characteristics such as word arrangement and term usage, layout preferences and other special requirements for translation and language options. Petrelli (Petrelli et al., 2004) designed a user-centered cross lingual information retrieval system prototype and followed users' suggestions to redesign the preliminary design in an improved version. The study found that: (1) although showing the translation process can encourage users to modify their queries because they can have more understanding about where the translation come from, they prefer to see the original retrieved document on the results page instead of merely a translation of it; (2) cultural background can affect the query terms users choose and the results they desire; (3) the user's knowledge of a language can improve their search results. The researchers interacted with users during different stages of system design and the study revealed that knowing their users can help them to design a user-centered information retrieval system. This study confirmed that interface design factors which can affect the usefulness of an online searching system include adaptations for cultural background, language influence, and other user characteristics.

The studies mentioned in this section pointed out that good interface design is crucial for users' using experience. A good interface design needs to be easy to understand, simple, and universal. For example, a bilingual interface might need to put the translation function in a clear position and allow users to choose the language of the interface and search results by themselves. Therefore, the questionnaires and interview of the proposed research also ask participants about their opinions on interface design of bilingual online searching website.

2.3.4 Cross Lingual Information Retrieval

The development of cross lingual information retrieval system is another crucial issue for bilingual online searching. The development of translation tools on information retrieval systems and the quality of the translation can influence the efficiency of a cross lingual web searching system. Cross Language Information Retrieval (CLIR) deals with retrieval situations when users form queries to search in one language, but expect to receive search results in another language (Rieh, 2005).There are two primary kinds of cross lingual text retrieval: dictionary-based and corpus-based cross lingual translation. Dictionary-based CLIR uses a bilingual electronic dictionary to replace source language query words with their target language equivalents (Rieh, 2005, p. 252). Corpus-based CLIR uses text corpora which contain examples of usage patterns in the query language and match the query term into it (Ogden, 2000).

Cross lingual information retrieval strategy has an effect on the usefulness of a multilingual web searching system. The researcher can improve the accuracy of a multilingual web searching system by combining the dictionary-based and corpus-based CLIR techniques. Ogden (2000) conducted a series of interface design tests and proposed “keizai,” a cross lingual text retrieval prototype. This system allowed users searching in English to retrieve Korean and Japanese results with English translation of summaries. They listed the Japanese or Korean translation of the English query term with equivalent Japanese or Korean terms so users could choose the most appropriate query term for their queries. This study implied that researchers can combine cross lingual information retrieval with a user-centered interface to improve search accuracy.

Oard, He, and Wang (2008) also design a user-centered CLIR system called MIRACLE and did a user study on the use of MIRACLE system for bilingual users. The research revealed

that experienced users can retrieve information effectively when they use both their new interactive CLIR system and CLIR system with fully automatic translation techniques. They found that examining users' online searching behavior while they use CLIR system and examining the effectiveness of those machines in producing desired results are both essential in improving the effectiveness of an CLIR system. Therefore, the proposed research emphasizes on exploring users' information-seeking behavior.

Cross lingual information retrieval can be applied on the bilingual users' search if they are using one language to search for the information in the other language. If cross lingual information retrieval strategy can be combined with user-centered system design, it can be a useful solution for the design of bilingual online searching system. However, the proposed research is mainly about the information searching behavior of bilingual users. The system design of a bilingual online searching system is the other field of study.

2.3.5 Other Issues

Other researchers mentioned other issues in dealing with non-English or multilingual searching websites. Chau and other researchers (2007) pointed out the characteristics of query term usage when users do online searching in Hong Kong in their study. Bailal (2007) and Chung (2008) pointed out the importance of visual design and summarization in multilingual online searching website design.

Chau and other researchers (2007) studied the characteristics of non-English online searching and compared their results to English online searching. They analyzed log data from the Timway® search engine in Hong Kong and found that: (1) 50% of the sessions only use one query term and 90% of the sessions use seven or fewer query terms in one query; (2) the mean

character terms used in one query is higher than for the English search engine because of the characteristics of Chinese characters; (3) a plus (+) symbol is the most common operator used in Chinese search. These results imply the difference information searching behavior among Hong Kong online searching users and other online searching users.

This study compared the research on Chinese search engines to Spink (Spink *et al.*, 2001) and other researchers' findings on English search engines. The researchers pointed out some issues people may encounter in Chinese online searching, such as the number of query terms and the use of operator within a query. The researchers also conducted research on users from different countries and areas and discovered that language difference has an influence on users' information-seeking behavior.

In bilingual online searching, a visual interface design can be used to eliminate the difficulties causing by unfamiliar languages. Bailal (2007) mentioned about the role of icon and color in interface design in her study about International Children's digital library. Although "language" could have been a barrier to the children users' understanding of the meaning of the content of an interface, the icons that represented them should have facilitated the participant's understanding nonverbally. Icon and color can support bilingual interface design and layout design can be adjusted to a style which is familiar to the special user group. Chung's (2008) study also pointed out that post-retrieval analysis techniques (such as summarization and visualization) can alleviate information overload. Since the bilingual online searching system can also use classification, all these functions help users to organize bilingual information.

2.3.6 The Future of Bilingual Online Searching Research

Bilingual online searching is an emerging trend in the development of online information retrieval. To sum up, an efficient bilingual online searching system needs to have the following features: (1) Sufficient translation support, to help users retrieve accurate information; (2) Interactivity with users, to help users refine the search results and filter out uninteresting information; (3) User control over the online searching function, to allow users to set up the system in a comfortable way; (4) User-centered interface design, to help users understand the function and usage of the system. Therefore, this research explores bilingual users' information-seeking behavior by conducting user studies.

2.4 SUMMARY

Bilingual online searching and information-seeking behavior are the main parts of the literature review. In past research, bilingual online searching research often emphasized the usability of translation issues, interface design, and the effectiveness of cross lingual information retrieval. Translation support is an essential service for bilingual online system and researchers develop various kinds of translation techniques for better searching experience. Interface design needs to be concerned with user preferences and this issue is especially essential for bilingual interface design. Cross lingual information retrieval is another issue for bilingual online searching system and the CLIR design can affect the search results of the online searching system. There are many issues affecting the search results of bilingual online searching systems.

Information-seeking behavior can be explained by different theories and it is diverse between user groups. Former researchers investigated approaches and goals of information-seeking behavior, and collaborative information-seeking behavior. The researchers also discussed the effect of language and cultural aspects on users' information-seeking behavior. The proposed study used the online information-seeking behavior theories to explain the user study results and discuss about bilingual users' information-seeking behavior issues in-depth.

3.0 RESEARCH DESIGN

This chapter describes the research questions, research sample and the research method to investigate the research problem. Furthermore, it describes the data collection procedure and data analysis for this study. The pilot study is also discussed in this chapter.

3.1 RESEARCH QUESTIONS

This study seeks to understand the information-seeking behavior of bilingual information seekers (native Chinese speakers who also speak English) as they search online using self-selected information-retrieval tools. The study also seeks to explore bilingual information seekers' perspectives on attributes of online search interfaces that help or hinder the progress of searching in two languages. The principle research question guiding this study is the following:
What is the bilingual user's information-seeking behavior when they are doing online searching?

The researcher divides the main question into two subcategories:

(1) What is the information-seeking behavior of a Chinese-speaking bilingual user who is a resident of the United States when he/she is doing online web-based searching to answer three specific questions?

(2) What are the bilingual users' expectations for bilingual online searching and other search tools that might arise in the future?

3.2 SAMPLE

Convenience sampling was used in this research. Convenience sampling means that the researcher drew the sample from a population which is easy to approach but not random. The researcher posted fliers online and on physical message boards to recruit participants. The researcher also brought fliers to classes in the School of Information Sciences to recruit participants. All participants received a five dollar gift card from a coffee shop after they participated in the research.

Table 1. Participant number and study date

	Participant number	Study date
Pilot study 1	3	12/27-12/28, 2010
Pilot study 2	5	1/16-1/19, 2011
Main study	21	1/24-2/18, 2011

The sample population was recruited from the population of native Chinese speaking graduate students studying in the information in Pittsburgh, use Chinese and English to do online searching, and who study in the information technology field. Here native Chinese speaker is defined as a person who had an elementary and middle school education in a Chinese-speaking school. A native Chinese speaker knows how to speak, read and write Chinese. It was assumed that graduate students in the information technology field would have a similar level of English proficiency and online searching skills. They passed the graduate school's English examination requirement and experienced doing online searching according to the pre-questionnaire applied

in this study. Their answers to the questions in the general information part of the questionnaire confirmed their English proficiency and online searching skills. The students have many chances to acquire new information and they are also sensitive to new technology. Therefore, the student population is perfect for this research.

The sample for the main study contains twenty-one participants from the Pittsburgh area. According to Tullis (2008), sample size should be based on two factors: the goals of your study and your tolerance for a margin of error. The goals of the proposed study are to understand the information behavior of bilingual users and reveal the characteristics of bilingual users when they are doing online searching. The sample size is appropriate for understanding the information behavior of the user group of bilingual users studying in graduate school in Pittsburgh area. The researcher interviewed 21 participants and found that the finding was repeating and didn't have new information. Therefore, the data reached data saturation. Furthermore, Rieh and Rieh's (2005) study interviewed twenty-eight participants so this study use it as an example to recruit similar number of participants.

3.3 APPROACHES AND METHODS

The study used a qualitative methods approach with descriptive statistics. The combination of questionnaires, tasks and interview helps to improve the credibility of this study.

Pilot study 1, with three participants, was conducted on 12/27 to 12/28 in 2010 at the graduate student lab in the school of information sciences building, followed by a second pilot study with five participants from 1/16 to 1/19 in 2011 and also conducted at the graduate student

lab in the school of information sciences building. The main study was conducted from 1/24 to 2/18 in 2011 at the graduate student lab in the school of information sciences building.

For the main study, four instruments were applied: a pre-questionnaire, a searching task, questionnaire and follow-up interview. The search tasks involved looking for information about a technology, U.S. holidays, Chinese holidays and a movie. The technology task involved finding a smartphone with specific features; the holiday tasks, a U.S. holiday task and a Chinese holiday task, involved finding basic information about specific types of holidays in these countries, and the movie task involved searching for news and reviews of the movie Avatar.

For questionnaire results, a descriptive statistics method was used. The data collected from the questionnaires were compiled using the statistical software. For task observation and interview results, content analysis was used and the qualitative data was coded and analyzed by the researcher using the same coding method as the pilot study.

3.4 SOURCES OF DATA

Sources of data included two parts of questionnaire, screen recordings of the task process, a task work sheet and recordings of interviews. The subjects needed to complete the questionnaire to provide the researcher with background information, computer capability and language ability. Furthermore, they also need to complete the assigned tasks and answer the second part of the questionnaire about their searching process and their level of satisfaction with the task results.

Camtasia® Studio was used to screen capture the searching process while they are completing the tasks on a computer. At the end, the researcher interviewed the subjects to gain more insight into participants' information-seeking behavior and their feelings about the search

process. In addition, the interview was recorded using voice recording software. The study used descriptive statistics to summarize the questionnaire results and content analysis to analyze the interview's transcribed notes. The questionnaire results are organized into tables and the interview results are coded and grouped.

3.4.1 Questionnaire

According to Gay and Airasian's (2009) definition, a questionnaire is a written collection of self-report questions to be answered by a selected group of research participants. It is time-efficient, expense-saving and possible for large data collection.

The questionnaire in this research includes two parts (see appendix A for the questionnaire). The first part of questionnaire is about the participants' educational background information, computer capabilities, and language ability. We could define the user characteristics from this part of the questionnaire.

The second part of the questionnaire is about the bilingual users' searching experience and behavior after completing the assigned tasks. Questions about users' familiarity and satisfaction with the task results, and the relevancy of the results they obtained from English and Chinese queries were asked, and their comments about the search engine they chose were elicited. The researcher can relate the questionnaire results to interview results. Furthermore, the researcher can also have complete understanding of participants' response from different perspectives after analyzing questionnaire results and interview results.

The design of the questionnaire includes questions with several unordered choices and open-ended questions, so the researcher can obtain both quantitative and qualitative data. The

numerical data from the questionnaire can be analyzed by statistical methods and the open-ended answers can be analyzed by qualitative methods.

3.4.2 Task

Participants were asked to complete four online searching tasks in this research on the search engine of their choice on the computer the researcher provided. The tasks include technology task which is choosing a smartphone, holiday tasks which is information of Chinese and U.S. holidays and movie task which is news, review and director of a movie. They were listed in a random order. The goal of these tasks was to understand user behavior when users need to search for different types of Chinese and English information online. The task was designed at different difficulty levels and two different task types. According to the task type description from Tombro et al. (2004), the technology task is a decision task. Participants need to search for a smartphone which meets the requirements in the task description when they are doing technology task. The holiday tasks and movie task are background tasks. Participants needed to search for background information according to the task description to complete the task. The movie task is an easy task because the task description is straightforward. The task descriptions are listed in task and setting section later.

Observation of search behavior was conducted in a lab in the School of Information Sciences. The participants chose a two hour period to participate in conducting tasks from 1/24 to 2/18 in 2011. The participants were given general instructions for the research process. Four tasks were given in random order and the participants needed to solve the problems in task description using the online searching websites they choose. The tasks don't have correct answers and the participants can use different languages and search strategies to obtain the most

satisfactory answers. Observation of their searching process can give the researcher an indication of the influence of different factors such as the influence of language on their language selection and information-seeking behavior. The relationships between language preferences, the subject's online searching experience, and the information obtained is the main goals of this research. The researcher also observed the factors in changing language and the search strategies for obtaining information in both languages. The researcher stayed beside the participant when they did the task and didn't interrupt the task, but the participants could always ask question when they needed to. Therefore, the researcher could notice any unusual behavior or any problems during the task.

These tasks were used to observe users' online information-seeking behavior when they have information needs. The participants decided on the language they wanted to use, the search engine, the order of the tasks and the time they spent on each task. They were asked to find at least three online resources in Chinese and English for each task. However, there was no time restriction for each task. The three assigned tasks are related to technology, holidays and movies. The descriptions of the three tasks are provided below:

- Task 1: Technology topic:

Task	Task description	Purpose
Technology Topic	• Buy a smartphone with built-in GPS, a high quality camera, and a good looking appearance • Released after June, 2010 and available from a reliable seller	Make a decision when the participant buy a smartphone

The purpose of the Technology task is to investigate the participants' searching behavior when they need to obtain technical information. The participant needs to make a decision after they search for information about the smart phone and meet the requirement in the task description. The influence of restrictions in the task description such as budget and release date

and the technical terms about the smartphone on participants' language selection and information-seeking behavior was observed. The participants might want to use a language they are familiar with to search for information about technology task so they can understand the meaning of technical terms relating to the this task.

- Task description: You want to buy a new smartphone so you need to find reviews and other related information about it. The features you need include built-in GPS, a high quality camera, and a good looking appearance. Furthermore, it would be better if the cell phone is up-to-date (released after June, 2010) and available from a reliable seller. Your budget for this smart phone is $200 U.S. dollars. Which smart phone will you choose? _____

  Please list the websites you used in your search concisely.

- Task 2 and 3: Holiday topic:

Task	Task description	Purpose
U.S. holiday Topic	• Find out information about the traditions and special events related to U.S. holidays • Find out information about the holidays and celebrations which have ethnic and religious origins	Obtain information about holidays and celebrations in the United States
Chinese holiday Topic	• Find out information about the traditions and special events related to Chinese holidays • Find out information about the holidays which have "ancestor worship" tradition.	Obtain information about the holidays which have "ancestor worship" tradition

The purpose of the Holiday task is to explore the relationship between the task and language selection. There are two sub-tasks under the holiday task. One is about holidays in the United States and the other is about Chinese holidays. The influence of U.S. and Chinese related

questions on participants' language selection and information-seeking behavior was observed. For example, the participant might want to use English for U.S. related questions and Chinese for Chinese related information to obtain the related results. Furthermore, they might need to use translation or other language tools to help them to understand the specific terms about tradition and religion.

- Task description:

  Task 2-U.S. Holiday: you want to find out information about the traditions and special events related to U.S. holidays. You are especially interested in the holidays and celebrations which have ethnic and religious origins.

  What are the ethnic and religious holidays and celebrations in the United States? (list four of them)

  _____

  _____

  _____

  Please list the websites you used in your search concisely.

Task 3-Chinese holiday: you want to find out information about the traditions and special events related to Chinese holidays. You are especially interested in the holidays which have "ancestor worship" tradition.

What are the holidays which have "ancestor worship" tradition?

(list four of them)

_____

What should one prepare for ancestor worship?

_____

Please list the websites you used in your search concisely.

- Task 4: Movie topic:

Task	Task description	Purpose
Movie Topic	• search for reviews from three different sources • search for an interview with the director, and news about the movie.	find out more information about the movie “Avatar”

The purpose of the Movie task is to explore the participants’ online searching behavior when they need to obtain general information. They need to find information from three different resources. The influence of the number of resources on participants’ language selection and information-seeking behavior was observed. They might want to choose resources in different languages. This is also an easy task compared to the other two tasks and the influence of difficulty level of a task was observed.

- Task description:

You just saw the movie “Avatar” and want to find out more information about this movie. You want to search for reviews from three different sources, see an interview with the director, and find news about the movie.

Please list the websites you used in this search concisely.

3.4.3 Post-search interview

An interview is a purposeful interaction in which one person obtains information from another and it can be divided into structured interview and unstructured interview. (Gay & Airasian,

2009). The interview questions are follow-up of the questions from the questionnaire and the task results. There are two types of interviews: structured or unstructured. Structured or survey interviews are those where "the questions and the answer categories have been predetermined" by the interviewer. Unstructured interviews are often referred to as in-depth or intensive interviews (Gorman & Clayton, 2005). The design of this interview is structured so as to allow for comparisons across the participants. The goal of the post-search interview is to reveal the participants' thoughts in addition to their answers on the questionnaire. For example, the questionnaire has a question about the satisfaction of the task results and one of the interview questions is also about the reason of satisfaction of the task results.

The researcher used voice-recording software to record the interview and the interview content was coded and grouped by researcher to analyze the results. The researcher transcribed the interview data first. Then the researcher used a code scheme created by her a priori to code the transcriptions of interview. In a second level of analysis, open coding was used to focus the data further. Microsoft® Excel was used to organize the data into meaningful themes and answer the research questions.

The interview method was used in order to collect data for understanding bilingual users' information behavior, language choice, and comments for technical support for bilingual online searching systems. With this instrument, the researcher can discover specific opinions and hidden issues which are difficult to obtain from quantitative data. The researcher asked participants to describe their search process, the reason why they chose to use a certain language and the technical support they need when they are doing online searching. As a result, the participants had a chance to explain their information-seeking behavior during the online searching task.

First, the researcher asked the participants to describe their search process for each task so they had a chance to recall their search process and strategies to answer the researcher's interview question further. Second, the researcher asked them about their language selection when they were doing online searching. They were asked to describe their language selection in different situation for different online searching task and the reason why they chose a particular language in detail. Third, the researcher asked them about their search engine selection. They could use any search engine they want. The reason these questions were asked was to discover the relationship between language selection and search engine preference. The participants might have different search engine preferences based on language. Finally, the researcher asked about their satisfaction level with the search process overall and with the online search support they needed as they were doing the bilingual online searching such as visualization support, translation support, and instruction support. These questions were asked to help discover the key functions for a successful bilingual online searching system.

3.5 DATA COLLECTION PROCEDURES

Twenty-one participants were recruited from the Chinese-speaking student population in Pittsburgh. The procedures of this study primarily consisted of filling out the questionnaires, performing the tasks and participating in post-search interviews. Specifically, the procedures are as follows:

1. The participant received a consent form which briefly explains their participation, confidentiality, and rights/protections under the University of Pittsburgh Institutional Review

Board (IRB) Human Subjects Research guidelines. He or she needed to read and sign the form to confirm their understanding of the study.

2. The participant filled out the first part of the questionnaire to provide their education background, computer capabilities, and language ability.

3. The researcher provided general instructions for the tasks. The instructions pointed out that they need to obtain 3 or more Chinese and English websites to finish the task; they can use Chinese, English or a combination of both to finish the task.

4. The participant began the tasks and started to videotape the screen when he is ready. They were asked to write down their search results on the task work sheet. The researcher stayed with the participant to answer the questions they might have and observe their searching behavior. They were to complete online searching tasks which are technology task, holiday task and movie task, assigned to them in a random order. They could complete these tasks using their choice of searching websites. The purpose of having them complete the tasks was to understand users' information-seeking behavior when they are searching for different types of information, such as professional information and general information.

5. After completing the tasks, participants took a rest for a few minutes while the researcher saved the video file.

6. Participants filled out the second and third part of the questionnaire about user satisfaction with their task results and about language selection and search engine selection, respectively. They were interviewed by the researcher at the same time. The interview questions include follow-up questions about the questionnaire, the searching experience during the task, the reasons for their behavior and their outlook on bilingual online searching design. An interview was completed with each participant to discover more detail about the user's information-seeking behavior, their language selection choice, their general satisfaction with their bilingual online searching experience and what they expect of it. The interview process is recorded using voice recording software.

3.6 DATA ANALYSIS

The data analyzed included that collected from the questionnaires, screen recordings, task work sheets and transcribed interviews. Descriptive statistics were used to analyze the numerical data collected from questionnaire, compiled using SPSS® and Microsoft Excel® software. Once the interview transcripts had been transcribed, the researcher assigned number codes to the data that corresponded with a set of codes determined a priori (See Table 2). The code structure included eight categories: search strategy, language, search engine, tool support, satisfaction, specific website, familiarity (with the topic), and credibility. These categories were derived from an analysis of the literature and as a reflection of the focus of this study. In a second round of analysis, open coding was used to develop richer themes and move toward a model of bilingual information seeking behavior. As a result, a set of sub-categories emerged which helped to

provide a rich picture of the phenomenon of bilingual information seeking as well as uncover new themes and variables.

The researcher made detailed notes about the questionnaire responses from participants and the screen recordings of participants' search process. Furthermore, she also used Microsoft® Excel program to do thematic coding to link the quotations from interview transcriptions with other data such as questionnaires and task observation notes. The purpose of doing thematic coding was to refine data into meaningful themes and answer the research questions. The researcher assigned attributes to quotations and put related notes, interview results and questionnaire results together. Some attributes are about the bilingual users' behavior such as to know how to obtain information (familiarity), clearly search strategy plan, extracted useful information from the task description, chose a language because of the relevant results the participant wanted to obtain, chose a language because of the task description, chose a language because of the relevant results the participant wanted to obtain, chose a language because of the participant's language preference, to understand the meaning of a word, to make sure they obtain relevant results, tried to mix the language to get information in Chinese and English, and used the search engine as a translation tool. Some are about suggestions for a better bilingual online searching interface such as automatic translation help, combined translation/dictionary with search function, list Chinese and English results side by side, user control over search results, good list, and user control over language selection. Some are about the relationships among different codes such as familiarity and satisfaction, familiarity and directly linking and familiarity and language. Therefore, she can discover the relationships among these data sets and make sense of the research results.

The research methodology helped the researcher to obtain a more thorough view of user information-seeking behavior and bilingual information-seeking behavior, the specific focus of this study and allowed for a deep, rich picture of the phenomenon under investigation on the search behavior of bilingual, native-Chinese speakers.

Table 2. Code definition

Code	Definition
Search strategy	users' explanation of their online searching strategies
Language	users' explanation of their language selection
Search engine	users' comments on the search engine(s) they used
Tool support	users' comments on the online searching support of the search engine
Satisfaction	information related to users' satisfaction with the results of the task
Specific Website	users' comments on specific websites
Familiarity	comments indicating a relationship between users' familiarity with the topic and their search strategies
Credibility	users' opinions on the credibility of websites and their choices for a credible website

Table 3. Attributes of sub-category

	Attributes
bilingual users' behavior	*to know how to obtain information (familiarity) *clearly search strategy plan *extracted useful information from the task description *chose a language because of the relevant results the participant wanted to obtain *chose a language because of the task description *chose a language because of the relevant results the participant wanted to obtain *chose a language because of the participant's language preference *to understand the meaning of a word *to make sure they obtain relevant results *tried to mix the language to get information in Chinese and English *used the search engine as a translation tool
suggestions for a better bilingual online searching interface	*automatic translation help *combined translation/dictionary with search function *list Chinese and English results side by side *user control over search results, good list *user control over language selection
the relationship among different codes	*familiarity and satisfaction *familiarity and directly linking *familiarity and language

3.7 LIMITATIONS

This research was conducted on native Chinese-speaking students in Pittsburgh who use both Chinese and English to do online searching. The results offer general knowledge about bilingual online searching behavior based on their information-seeking behavior when conducting four specific online searching tasks. However, since the participant group is restricted to graduate students who are native Chinese speakers in the United States, there may be individual differences on information-seeking behavior between different user groups such as users with different language proficiency. This user group might have better online searching skills than general bilingual users. They are bilingual users in the United States so there might be differences from bilingual users in other countries. Although the participant group is restricted, this study can still offer some general insight into bilingual users' information-seeking behavior. Furthermore, it can also highlight issues related to bilingual online searching for future research.

The results are restricted to participants' information-seeking behavior when conducting four specific online searching tasks. Therefore, there might be different results when the bilingual users conduct different types of online searching task.

This research focuses on users' information-seeking behavior and users' opinions about the search support given by the bilingual online searching interface. Other issues such as the system design and cultural issues are not discussed in-depth in this study. These issues can be discussed in another independent study.

3.8 PILOT STUDY

3.8.1 Pilot study 1

The researcher conducted pilot study 1 with three participants on 12/27 and 12/28 in 2010 to test the research design and measure the time needed to finish the data collection process. The data is not a part of main data analysis because the research design is different from the main study. The pilot study participants were selected from the population, graduate students from the School of Information Sciences at the University of Pittsburgh who are bilingual (Chinese/English) users and familiar with online searching. The research process for the pilot study was similar to the research procedure for the actual study: the participant first received a consent form, and then filled out the first part of the questionnaire; the researcher provided general instructions for the task; the subjects started their tasks and the researcher recorded their searching process. After that, they filled out the rest of the questionnaire and were interviewed by the researcher.

The participants in Pilot Study 1 spent 43 minutes on average to finish the three tasks. They spent most of the time on modifying query terms and browsing through the search results. Once they obtained satisfied search results, they just moved on, feeling satisfied with their results. They tended to use search engine to search for the information they need first and modify the search terms to narrow down the search results. Sometimes they just used the query terms as suggested by the keyword suggestion feature in a search engine in order to obtain satisfactory search results.

The interview results were categorized and number-coded by topic by the researcher manually. Participants' search process varied. It depended on the search topic and participants' search strategy. However, the researcher still could find trends from their search process. They

tended to use more keywords in a query to limit their results. They limited the search results to a specific website using advanced online searching feature if they are familiar with the search topic. Participants pointed out that language selection depended on the search topic. If the search topic is not language related, Chinese would be their first choice.

The transcribing and note taking process for each participant took about two and half to three hours. The number coding is used to analyze the interview results. There is a coding list and it would be a structure of the future coding. The researcher categorizes the interview script by related topic. The code structure includes six categories: search strategy, language, search engine, tool support, information visualization support, and satisfactory level. The researcher added more codes in the coding chart after she transcribes interview scripts for the formal study.

One participant suggested that the task sheet should be defined more clearly. For example, the “website” column should be “searching website” or “destination website” to make it clear to participants. Therefore, the researcher revised it. The completion time for the whole study was quicker than expected. The average completion time was one hour and twenty minutes. One participant pointed out that online searching not only happens when using a search engine, but also when searching in specific website or database. The researcher found that although the task instructions were very clear, the participants might not follow the instructions. They might have unexpected behavior during their searching process and their unexpected behavior can be discussed in this study. For example, the instruction instructed them to use Chinese and English to complete the task, but they might still use only one language. Therefore, the researcher revised the instructions, interview questions and task description to make them clear according to pilot study participants’ suggestions.

3.8.2 Pilot study 2

The researcher did pilot study 2 on five participants from 1/16 to 1/19 in 2011 to test the research design and revised the tasks and interview questions according to the pilot study results. Therefore, the results need to be analyzed separately from the main study. All of the participants were graduate students in the information sciences and technology field who are bilingual (Chinese/English) users and familiar with online searching.

In the second pilot study, participants took twenty-one minutes on average to finish the tasks. They went to a specific website directly if they were familiar with the topic. For example, a wireless service provider website was used for the technology task and Wikipedia was used for the holiday task. Instead of using a searching engine one participant tended to go to the specific website directly and use the search function within the website. Participants did Chinese and English searches to complete most of the tasks. The task question was not restricted so participants could search for information in a wide range from different aspects. They didn't have any problems when they were doing the task so they took less time to finish the task than the researcher expected.

The search process of participants varied depending on the task. If the participants were familiar with the task, they tended to go to a specific website directly. They also used the keyword extracting from the task description to search using a searching engine. Some of them pointed out that they feel more comfortable using Chinese to search so they did the search using both Chinese and English keywords even if the topic of task is English related such as U.S. holiday. One participant said he/she used English to finish all of the tasks because the task description is in English. Two out of five participants selected the language according to the topic of the task. They used English to search for English information about U.S. holidays,

Chinese for information about Chinese holidays and Chinese and English to get information about the movie. One participant chose to use the advanced search interface in the search engine to change the language settings so he/she could retrieve the information in a specific language. All of them tried to search in Google because it's reliable and the search results are always relevant. They mentioned during interview that language control and keyword suggestion functions might be useful for bilingual users when they are searching for Chinese and English information. For information visualization question, most of the participants said they don't think it is useful or that they don't like it. " One participant said information visualization would be useful if users needed to search for answers to complicated questions and the others mentioned that ideal information visualization should use different visualize type for different concept. These issues are interesting but irrelevant to my research questions. The information visualization of online searching is a separate concept from bilingual users' information-seeking behavior. Therefore, I decided to remove the information visualization part of the research.

After this second pilot study, the researcher found that the task design is flexible and open enough to elicit natural information-seeking behavior on the part of the participants. The advantage of this design is the participant can choose the specific topic they want to search and the researcher can observe their natural information-seeking behavior. However, some participants can't decide any specific topic when doing online searching task and do one or two simple search to complete the task. If this occurs, the researcher can't observe their information-seeking behavior and searching strategy. For example, when one participant did the technology task, he/she went to Amazon® website directly. Then, he/she searched for "smart phone" and browsed the website. The participant just searched for one query and used two search strategies in a short time.

Therefore, the researcher rewrote the task description and gave the participants some task-related questions to answer in the revised task description. For technology task, participants need to make a decision on buying a smartphone instead of searching for smartphone information generally. For holiday task, participants need to search for background information about specific holidays and list the holidays they found. For movie task, participants need to search for news, reviews and interviews to fulfill the requirement in the task. The advantages of this design are the participants have a target problem to solve and the researcher can have a chance to know the participants' searching behavior when they try to solve a problem. For example, they need to choose a smartphone based on the task description when they did technology task. Therefore, they can't search for a query "smart phone" and complete the task. They need to use search strategies to search for related information. The disadvantage of this design is that the participants' information searching behavior might be restricted by the task-related questions.

Furthermore, the researcher decided to remove the information visualization questions from this research design because the questions are not directly related to the other questions in this research. The researcher will do another independent research about information visualization issues in the future.

4.0 RESEARCH RESULTS FOR THE MAIN STUDY

For the main study, as for the pilot studies, pre-questionnaire, a searching task, questionnaire and interview were used. The search tasks involved looking for information about a technology, U.S. holidays, Chinese holidays and a movie. Each participant was asked to fill out the questionnaire, conduct three tasks and be interviewed by the researcher. While the task was being conducted, their computer screen was recorded by Camtasia® Studio and later the interview was recorded using voice recording software. The interview, a follow-up to the post-questionnaire, was transcribed and analyzed. The researcher used statistical computer programs to analyze the questionnaire results and content analysis to analyze task observation and interview results. The task description, questionnaire, and interview questions are in Appendix A.

4.1 QUESTIONNAIRE RESULTS

A total of 21 subjects participated in this study. The participants were Chinese speaking graduate students in Pittsburgh area. All of them were studying in an information technology related program including information science, library and information science, computer science and other related field. They had more than 4 years of searching experience and do online searching daily. They had studied English for more than 4 years and had met the English requirements for entering a graduate school in the United States. Although their self-report English proficiency

varied, their TOEFL scores were within a certain range. Their age range was from 21-40 years old. Table 4 below provides a summary of the characteristics of participants in the main study.

Table 4. Background Information for main research participants

Subject ID	Searching Experience	Age	Search Frequency	English Learning	English Proficiency
n01	more than 4 years	26-30	daily	more than 4 years	very proficient
n02	more than 4 years	21-25	daily	more than 4 years	proficient
n03	more than 4 years	21-25	daily	more than 4 years	somewhat proficient
n04	more than 4 years	31-40	daily	more than 4 years	somewhat proficient
n05	more than 4 years	21-25	daily	more than 4 years	somewhat proficient
n06	more than 4 years	26-30	daily	more than 4 years	very proficient
n07	more than 4 years	26-30	daily	more than 4 years	proficient
n08	more than 4 years	21-25	daily	more than 4 years	somewhat proficient
n09	more than 4 years	26-30	daily	more than 4 years	proficient
n10	more than 4 years	21-25	daily	more than 4 years	proficient
n11	more than 4 years	26-30	daily	more than 4 years	proficient
n12	more than 4 years	26-30	daily	more than 4 years	proficient
n13	more than 4 years	26-30	daily	more than 4 years	proficient
n14	more than 4 years	31-40	daily	more than 4 years	somewhat proficient
n15	more than 4 years	26-30	daily	more than 4 years	proficient
n16	more than 4 years	26-30	daily	more than 4 years	proficient
n17	more than 4 years	26-30	daily	more than 4 years	proficient
n18	more than 4 years	21-25	daily	more than 4 years	proficient
n19	more than 4 years	26-30	daily	more than 4 years	somewhat proficient
n20	more than 4 years	26-30	daily	more than 4 years	somewhat proficient
n21	more than 4 years	21-25	daily	more than 4 years	proficient

Fifteen of the participants expressed a preference for using Google®, two of them for Google® and Yahoo®, three of them for Google® and Baidu®, and one of them for Google®, Yahoo®, and Bing®. The language setting they generally use includes English, traditional Chinese, simplified Chinese, and Japanese. Only five of them typically use a single language setting while they search online, leaving sixteen who usually use multiple language settings when they search online. "Multiple language settings when they search online" implies that the users use English language setting when they are searching for information in English and Chinese language setting when they are searching for information in Chinese. Seven participants usually use simplified Chinese setting and twelve participants usually use traditional Chinese setting. All of them said they usually use English setting. They didn't report their country in the questionnaire. Users who use the traditional character Chinese setting tend to search in Google® and Yahoo®, and users who use the simplified character Chinese setting tend to search in Google® and Baidu®. The participants reported that they usually visit diverse kinds of websites including search engines, social networking websites, blogs, news, online forums and online bookmarking website. Table 5 below highlights some of the participants' preferred search engines and language settings.

Table 5. Favorite search engines and language setting for main research subjects

Subject ID	Online Searching Website	Language Setting	Website Usually Use
n01	Google	English; Traditional Chinese	search engine; social network website; blog; news
n02	Google	English; Traditional Chinese	search engine; social network website
n03	Google	English	search engine; social network website
n04	Google; Yahoo	English; Traditional Chinese	search engine; social network website
n05	Google	English; Traditional Chinese	search engine
n06	Google	English	search engine; social network website; blog
n07	Google	English; Simplified Chinese	search engine; social network website; blog; online forum
n08	Google	English; Simplified Chinese	search engine; social network website; online forum; bookmark website
n09	Google; Baidu	English; Simplified Chinese	search engine; social network website; online forum
n10	Google	Traditional Chinese	search engine; social network website
n11	Google	English; Traditional Chinese; Simplified Chinese	search engine; social network website
n12	Google; Yahoo; Bing	English	search engine; social network website; blog
n13	Google; Baidu	English; Traditional Chinese; Simplified Chinese	search engine; social network website; blog; online forum; bookmark website
n14	Google	English; Traditional Chinese; Simplified Chinese	search engine; social network website
n15	Google	English; Traditional Chinese	search engine
n16	Google; Yahoo	English; Traditional Chinese; Japanese	search engine; social network website
n17	Google	English	search engine; social network website; blog
n18	Google; Baidu	English; Simplified Chinese	search engine; social network website; online forum
n19	Google	English; Traditional Chinese	search engine
n20	Google	English	search engine; Social network website
n21	Google	English; Traditional Chinese	search engine; Social network website; e-mail

Table 6 below shows the participants' familiarity with the topic of the tasks, the difficulty they assigned to the task, and their satisfaction level with the results they obtained from the task. The questionnaire asked participants to rank their familiarity with each task, their perception of the task difficulty, and their level of satisfaction with the results. (See the questionnaire in Appendix A). Table 6 also shows the mean of the results. They can represent the center location and the spread of the data. Analysis of the results shows that the participants are more familiar with the technology and movie task. The movie task was the easiest one for them based on their response in questionnaire because the task is straightforward. Most of them were satisfied with their results for the movie task.

Table 6. Familiarity, difficulty and satisfaction of the task for main research results

	N	Minimum	Maximum	Mean
VAR00001	0			2.9048
familiarity_technology	21	1.00	4.00	1.7143
difficulty_technology	21	1.00	3.00	2.3333
satisfaction_technology	21	1.00	4.00	2.3333
familiarity_holiday	21	1.00	4.00	1.5714
difficulty_holiday	21	1.00	3.00	2.9048
satisfaction_holiday	21	2.00	4.00	3.0952
familiarity_movie	21	2.00	4.00	1.0476
difficulty_movie	21	1.00	2.00	3.4286
satisfaction_movie	21	2.00	4.00	
Valid N (listwise)	0			

On the post-task questionnaire, the participants listed more relevant English results than Chinese results on the task answer sheet as they were doing the tasks. To complete most of the tasks, all of the participants chose Google® to be the online searching website. The reasons they usually chose Google® are: the results are relevant (n01), keyword help function is helpful (n14), and the interface is clean and simple (n21).

The participants also provided information about what makes online searching page layouts easier to use. They pointed out that the ranking of search results and putting relevant search results on the top is helpful because they can obtain the relevant results easily. Furthermore, five of them also pointed out that the clean layout is helpful because they can concentrate on their online searching. However, some of them mentioned that in general they choose to use a search engine based on its being fast and able to provide the most relevant results. Table 7 below provides the participants' ranking of the relevance of their search results, in either English or Chinese.

Table 7. Relevance of search results in English and Chinese

Subject ID	Relevant English results	Relevant Chinese results
n01	4	4
n02	4	1
n03	3	2
n04	4	4
n05	3	3
n06	4	4
n07	4	3
n08	4	4
n09	3	3
n10	4	2
n11	4	4
n12	4	2
n13	3	3
n14	4	3
n15	2	3
n16	4	4
n17	4	1
n18	3	2
n19	3	3
n20	4	1
n21	4	2
Average	3.619047619	2.761904762

4.2 TASK OBSERVATION

The task observation was conducted in a lab in the School of Information Sciences from 1/24 to 2/18 in 2011. The participant chose a two hours period to participate in conducting tasks in one month period. The participants were given general instructions for the research process which is in the appendix. The four tasks were given in random order and the participants needed to complete the tasks using the online searching websites of their choice. The researcher stayed beside the participant when they did the task and didn't interrupt the task, but the participants could always ask question when they needed to. In this way, the researcher could notice any unusual behavior or any problems during the task.

As described earlier, the tasks include technology task which is about choosing a specific smartphone, holiday task which is divided to U.S holiday sub-task and Chinese holiday sub-task, and movie task which is about searching for the news and review of movie Avatar. The technology task is a decision task. Participants need to search for a smartphone which meets the requirement in the task description. The holiday tasks and movie task are background tasks. Participants needed to search for background information according to the task description and answer the question. The query term coding sample list lists the original query term the participants used. The researcher coded the query term derived from the participants' video log. Below the results for the four tasks are described.

4.2.1 Technology task observation

For the technology task, users tended to go to the mobile service provider's website directly. When performing the search, they used the smartphone's name or service provider's name such

as “Google nexus” or “t-mobile” to find a website. Furthermore, they tended to search for more specific information about the smartphone using query terms such as “smartphone released in 2010 200 us dollar” or “smartphone gps camera less than 200 HTC”. Some of these terms were included in the task. The technology task is a decision task and the participants need to buy a smartphone based on the requirement in the task description. Therefore, they need to obtain detailed information to make a decision. They used more query terms than other tasks such as “cell phone gps camera” because the task has more requirements.

4.2.2 Holiday tasks observation

For the U.S. holiday task, users tend to search for a list of holidays and find the information they wanted from the list using query term such as “US holiday calendar” or “special events us holidays ethnic religious”. Several users went to Wikipedia which is a web-based and multilingual encyclopedia to obtain the general information about the holiday because it is well-organized and provides information in multiple languages. They tried different terms from the task description to obtain answers to satisfy the task such as “U.S. holiday ethnic religious” and “traditional us holidays”.

For the Chinese holiday task, users tended to search using Chinese and English keywords. For instance, user n06 used “Chinese ancestor worship” and “Chinese ancestor worship holiday” in Chinese as query terms when she was searching for the information about Chinese holiday. Participant n04 used “”Chinese” “ancestor worship”” as query terms in English and found a Chinese holiday list in English. Then, she searched for Chinese holiday information in Chinese using the holiday’s Chinese name as search term. Users used similar keywords in

Chinese and English because they want to make sure that they get identical information in two different languages. They also indicated the language they want when they issue a query. For example, they search for “New Year’s Eve English” in Chinese to obtain the English translation or information of New Year’s Eve. They used Chinese and English terms such as “qingming” in English and “qingming” in Chinese to do the search and read the content to make sure they got the information they wanted. Figure 1 below is a screen shot of the Chinese holiday task, as Participant n04 tries to obtain a Chinese holiday list in English.

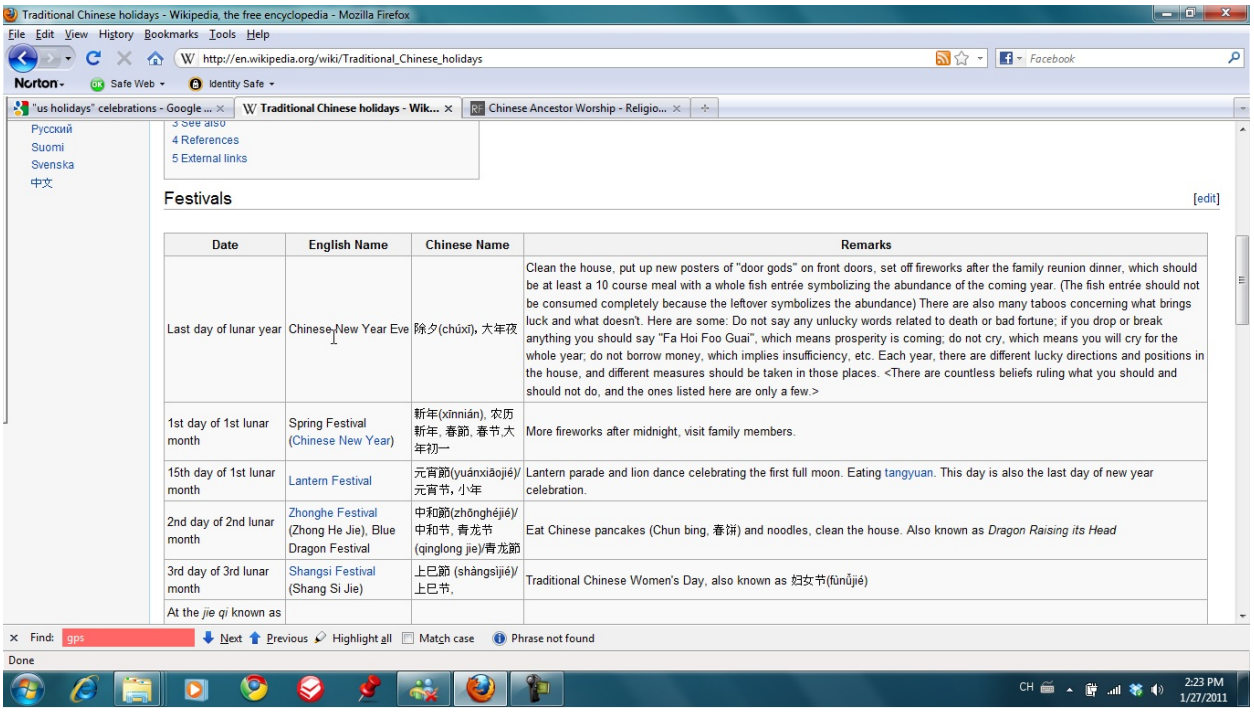

Figure 2. Chinese holiday task observation

4.2.3 Movie task observation

For the movie task, some of the participants went to a movie review website they are familiar with directly such as IMDB and Rotten Tomatoes. Others searched for “avatar review”, “avatar news” or “avatar interview” in Chinese and English. Some of the participants were familiar with the movie task so they could use fewer search strategies to complete the task. Figure 2 below shows Participant n12 tries to go to a movie review website using *directly linking* search strategy.

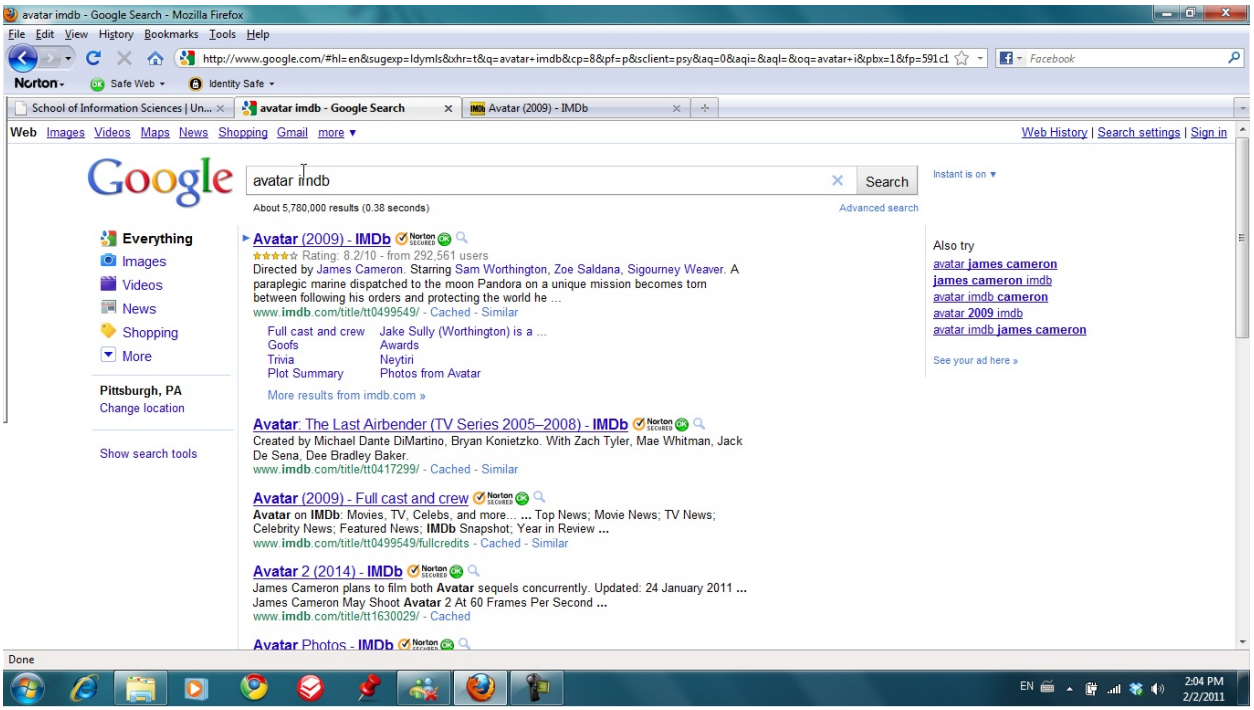

Figure 3. Movie task observation

4.2.4 Search strategies observation

The participants used different strategies to finish the tasks including *directly linking*, *keyword searching*, *browsing*, *search results comparison* and *externally linking*. Most of the participants

used multiple search strategies to retrieve the search results they want. The meaning of *directly linking* is that the participant has a specific website in mind. It is also a kind of known item search. He/she just goes to the website directly or searches for the website in the search engine. For example, when the participants were searching for information about smartphone, they might go to mobile service provider's website directly. When the participants were searching for information about movie review, they might go to the movie review website they are familiar with. *Keyword searching* means using keywords to search for the results they need. For example, the participants used "US holiday tradition" as keywords when they searched for information about US holidays, and they might revise their searching terms if they didn't obtain satisfied results. Another example is that the participants searched for "Qingming" or other holiday's name to retrieve relevant information when they are searching for information about Chinese holiday.

Browsing means that they retrieved a list of resources first and browse through them. For example, the participants went to Wikipedia by key in "wiki" or "wikipedia" as a search term and browsed the holiday list to find the holiday information they wanted to know when they were searching for information about holidays. Participants also went to online shopping websites and browsed through a list of on sale cell phones when they were searching for a smartphone for the technology task. *Comparison* means that they obtain several search results first and compare them. Some websites provide comparison tools for their users. For example, Google® shopping provided a function to compare prices when the participants were searching for smartphone information. There is another situation of the use of *comparison* strategy. For example, the participants also searched for the same query term in Chinese and in English to compare the results when they were searching for information about Chinese holidays because

they wanted to make sure they obtained identical information in Chinese and in English. Wikipedia is useful for this situation because the users can switch languages by clicking the language button in the interface. *Externally linking* strategy means that participants link from the website they accessed originally. For example, they can access other movie reviews from a review website when they are searching for a movie review. They also used externally linking with online shopping websites to the smartphone provider to view the details of the smartphone when they were searching for information for the technology task.

Table 8. Search strategy definition

Search strategy	Definition
Directly linking	The participant has a specific website in mind so he/she just goes to the website directly or search for the website in the search engine
Keyword searching	They use keywords to search for the results they need
Browsing	They retrieved a list of resources first and browse through them
Comparison	They obtain several search results first and compare them. Some websites provide comparison tools for their users
Externally linking	Participants link from the website they accessed originally

4.2.5 Query terms observation

The participants used English and Chinese query terms to retrieve the information they wanted. They tended to use English first because they could extract keywords from the task description easily and they then decided to use English or Chinese to do further searching according to the topic and their search strategies. Their behavior is similar to the pilot study participants. They tried 3.4 searches on average to obtain the results they needed. The query terms they used include: (1) the keywords from the task description. For example, they used “avatar review” as keywords to search for movie information; (2) the name of the website they wanted to visit. For example, they used “t-mobile” for the technology task and (3) keyword suggestions from the search engine. For example, the search engine suggested they use “smartphone” as a keyword

instead of “smart phone”. The search engine also suggested searching for “ancestor worship holiday” instead of “ancestor worship”.

Unexpectedly, the participants didn’t mix Chinese and English query term together. Most of them used Chinese and English separately and had good reasons for choosing the language they chose. Some participants chose to search in Chinese when the topic was related to Chinese as with the Chinese holiday task. These participants then used English to search for the same topic again to see if they could retrieve similar results. If the participant wants to retrieve Chinese and English information, they use one language first. They switched to another language by linking to Chinese website from their bilingual search results such as information from Wikipedia or issued a query term in that language. For example, participant n01 used “ancestor worship Chinese” in Chinese as keyword to search for Chinese information about Chinese holiday. Then she used “ancestor worship chinese” to search for English information about Chinese holiday. Furthermore, participant n16 used “avatar review” in Chinese as keyword to search for Chinese information about movie Avatar and used “avatar interview” and “avatar interviews imdb” as keyword to search for English information. The participants usually search for the information in different language separately. They decided the search strategies they want to use after they decided the language they want to use. The participants tend to choose a language to search and start a new search if they want to search for information in another language. (see the query term list in appendix B)

4.3 INTERVIEW RESULTS

The interview results were categorized by topic and number were used to code them. The coding divided the data into eight topics: search strategy, language, search engine, tool support, satisfaction, specific website, familiarity (with the topic), and credibility. Included in "Search strategy" is users' explanation of their online searching strategies. "Language" includes users' explanation of their language selection. "Search engine" includes users' comments on the search engine(s) they used. "Tool support" includes users' comments on the online searching support of the search engine. "Satisfaction" includes information related to users' satisfaction with the results of the task. "Specific Website" includes users' comments on specific websites. "Familiarity" includes comments indicating a relationship between users' familiarity with the topic and their search strategies. "Credibility" includes users' opinions on the credibility of websites and their choices for a credible website. Several sub-codes are divided under each code to classify the data. The researcher also groups the quotes for different tasks together.

4.3.1 Search strategies and language selection

The participants indicated that they decided on their search strategies according to the relationship between the language and the task topic, their familiarity with the topic, and the type of information they wanted to obtain in the interview. Participants indicated that "Most of the task I choose English to search because the requirements such as movie, technology and USA holidays is about the English information so I …the task I use English to search." "But for the Chinese holiday, I think there is more Chinese information in the website so I will choose the Chinese language."(n15) The other participants mentioned that "I only use Chinese query in

Chinese holidays but…it's because when I try to use English to search the Chinese holiday, somehow it didn't provide me satisfied results so that's why I search in Chinese."(n12) Their response confirmed that the factors affecting the participants' language selection included the topic of the task and the language of the question. They used one language to search because the language is related to the topic or the question. Furthermore, the participants tended to use one language as their primary language during their online searching but they might search for information in the other language to obtain more search results. This situation confirms that most of the participants didn't mix Chinese and English in one query. The participants believe they can obtain relevant results if they search for the information in different language separately.

Some of the participants mentioned a relationship between their familiarity with the topic and the language they liked to use, but their strategies varied. Participant n05 said, "If I am familiar with that topic, I will use Chinese. If I am not familiar with that topic, I choose English." In the contrast, participant n13 said, "I think if you want to (search for) some topics you are not familiar with and I think maybe your mother tongue is the best choice. It's because it's better for some terminology. " The researcher noticed that participants' familiarity with the topic affect their language choice. Most of them used both Chinese and English to complete the task but they tended to not mix Chinese and English in one query. Six participants out of twenty-one mentioned that they decided to use English to start their search because the task description is in English. Participant n02 said," Your question is also in English so it's easier to get the keywords in English and just use it as a search term." "If your question is in Chinese I will use Chinese cause that's the easier way you got the keywords." Participant n14 also said, "Cause these tasks are all in English, so I will first use English keyword." The participants' response confirmed that the description of the task might affect participants' language selection, too.

They used five search strategies when they were doing online searching tasks: *directly linking*, *keyword searching*, *browsing*, *comparison*, and *externally linking*. They provided examples of search strategies usage during the interview. Participant n06 used direct linking when she was searching for the movie task; she said, "For the movie task, it's pretty straight forward because I kind of know where I can find the answer, so I just type in the website …three of them." Participant n12 used *keyword searching* for all of the tasks; he said, "Actually, for most of the task, I just…when I read the text, I sort of searching for some keywords. Then I just put the keywords as a query when I search it." Some participants used the *browsing* strategy when they are searching for the answer to the technology task. Participant n06 said, "I kinda need to browse through especially those technology one. Given the limited budget, I really have to search for the specific answer." Furthermore, some participants also used *comparison* strategy when they are searching for the answer for technology task. Participant n07 said, "Finally, the final procedure is going to the Google shopping then compare the prices." One participant mentioned about the usefulness of the externally link list on Wikipedia page, saying, "I think I go for Wikipedia and get some externally link information all from there."

4.3.2 Search engine and language

With respect to search engine preference, all of the participants mentioned they prefer to use Google®. They like to use it because its searching interface design is simple and clean. Furthermore, it also provides more results relevant to their search than other search engine. Participant n15 said, "I use Google because it's very simple and you just key in some terms and most of the results can match the answer and Google provides the relevant recommended terms to you." Participant n11 also pointed out that "my primary use is Google and it's just because it's

fast and it's clean also clean list and most of time I will find my desire website in the first page or second page so that's why I always use Google." Some of them mentioned that the keyword support feature in Google® is really helpful. Participant n21 said, "So I just type in and they have a recommendation keyword feature, so I, sometimes I just key in a word and it might return a whole sentence for me." In addition, the shopping feature and its international scope are mentioned by participants as helpful characteristics.

Some participants expressed a preference for Yahoo® and Baidu® when doing Chinese searching. The participants who searched for information in traditional Chinese used Yahoo® Taiwan and the participants who searched for information in simplified Chinese used Baidu®. Participant n16 said about Yahoo®, "But my second preference will be yahoo (he meant Yahoo Taiwan), I use these two sites, and for yahoo, I always search for some Chinese data because I think they have more data in Chinese." Participant n09 said about Baidu®, "It (Baidu) did better than I mean searching the Chinese word in Google."

4.3.3 Online search support for Chinese and English online searching

In the interview, when we discussed what online searching support they needed when they were doing Chinese and English online searching, most of participants thought a translation feature in search engine is needed for bilingual users' online searching. However, their opinions on ideal translation support varied. Some of them mentioned the multilingual structure in Wikipedia as a good example. They focused on the precision and reliability of the translation feature. Participant n07 suggested, "Same webpages have bilingual search results especially like Wikipedia. Although the content may be different, but you can stick on the same topic, at exactly same page, just click English or Chinese. And that's why I like the English dictionary with

bilingual explanations like Chinese explanations and English explanations." Participant n17 suggested, "In my case, if there would be some translation assistance that would be much better for me. Because I am not quite sure about several vocabularies in the questions, I have to open another website to search what does this mean in Chinese."

Other online searching support features such as user-centered layout were also discussed. One participant mentioned that the highlight feature which highlights the query term in the search results is useful. Two participants described their ideal online searching layout. They think it would be convenient if the return results for both Chinese and English could be listed side by side. One participant believed that it would be useful if the search results could link related pictures and text together.

The researcher organized the interview transcript, questionnaire results, and observation notes in one list in next level of coding and the table is in the appendix. The researcher compared the participants' questionnaire and interview response with their task observation. In this level of analysis, the researcher found that the participants used a search strategy, chose a language and used a search engine because they want to obtain relevant results. The researcher also noticed the relationships among different categories. The participants' familiarity of the topic related to their choice of the language and search strategies. If they were familiar with the topic, they can directly go to the appropriate website to obtain relevant information. The participants combined several strategies when they searched for the information for a task based on the task topic and the information they want to obtain. According to observation notes, they tended to go to the manufacturer's website when they searched for information about smart phone. Then, they browsed a list of smartphone in the website. At last, they went to the review website to compare the function of different smartphones. Furthermore, the participants' familiarity of the topic

related to their satisfaction of the task search process. If they were familiar with the topic, they tended to obtain satisfied results during their search.

There are some unique features of bilingual users' online searching process. Bilingual users (1)used the search engine as a translation tool, (2)extracted useful information from the task description and translate them, (3)chose a language because of the results the participant want to obtain, (4)chose a language because of the task description, (5)chose to use a search engine because of the language they use, and (6)compared the results in two languages. Bilingual users use the search engine as a translation tool because they want to clarify the meaning of a word. There is abundant information online to fulfill their need. They extracted useful information from the task and translated the information so they can obtain information in English and Chinese. The researcher sought to discover the relationship between the bilingual users' online searching features with the interface design they suggest. They chose to use a language because they want to obtain information in that language. Thus, they need to select a language before they start to search. Sometimes they extracted useful information from the task description and just used the information to search for more relevant information. They chose to use a search engine because of the language they use. They have different preference on search engine when they search for different languages. The bilingual users compared the results in two languages. This behavior allowed them to make sure they obtained identical information in English and Chinese. Furthermore, it also helped them to make sure they have relevant information.

There are several interface design suggestions to improve bilingual users' online searching experience according to their response during interview, their questionnaire answers and their online searching behavior during the task. Bilingual users need to have good list, list

Chinese and English results side by side, have user control over language, combine translation/dictionary tools with search function, have keyword suggestion, have automatic translation help, and have user control over search results. The researcher related bilingual users' unique features to the interface design they need. They tended to use the search engine as a translation tool and extract useful information from the task description and translate them so they need to have translation/dictionary tools when they are doing online searching. They need to have user control over language so they can choose a language based on the task and the results they want to obtain. It would be easy for them to compare the results in two languages if Chinese and English results can be listed side by side.

4.4 SUMMARY

This study used a combination of questionnaires, task analysis and interviews to investigate bilingual users' information-seeking behavior. The questionnaire results described the participant's characteristics and their opinions on task results. The task observation revealed the participants' searching behavior and the search strategies they used. The interview results offered participants' explanations of their search strategies, language selection choices, and search engine preferences. Furthermore, they also provided participants' opinions on the online searching support they feel they need such as translation features like those offered by Wikipedia. The researcher found five types of searching strategies preferred by bilingual online searchers: *directly linking*, *keyword searching*, *browsing*, *comparison*, and *externally linking*.

5.0 DISCUSSION

This chapter answers the research questions and discusses issues about bilingual users' online searching behavior found in this study. The researcher relates bilingual users' online searching behavior to information-seeking behavior theories and demonstrates it in a concept model. The researcher also points out bilingual users' expectations of future bilingual online searching.

5.1 RESEARCH QUESTION (1): WHAT IS THE INFORMATION-SEEKING BEHAVIOR OF A CHINESE-SPEAKING BILINGUAL USER WHO IS A RESIDENT OF THE UNITED STATES WHEN HE/SHE IS DOING ONLINE WEB-BASED SEARCHING TO ANSWER THREE SPECIFIC QUESTIONS?

The information-seeking behavior of a Chinese-speaking bilingual user is more complicated than the information-seeking behavior of monolingual user due to the fact they can choose from more than one language to do a search. According to the interview, the language they select seems related to the language most relevant to the topic they are searching, their familiarity with the topics, and the type of information such as official website or review website they want to obtain. They extracted keywords from the task description to search for the information. Sometimes they used English to search for a topic and use Chinese to search for the same topic again. Therefore,

they can compare search results for the same topic in two languages and obtain relevant information from Chinese and English.

The participants' English proficiency has slight influence on their information-seeking behavior. There are five participants have higher TOEFL score (higher than 100 in 120 scale) than other participants. Two of them only use English to complete the online searching tasks. However, they explained that they used English to complete the tasks because the task description is in English.

5.1.1 Language selection and use of search engines

Many participants in this study used different search engines to do online searching in different languages. For example, one participant used Yahoo® Taiwan to search for Chinese information because the participant thought Yahoo® Taiwan has more Chinese information than Google®. The other participant used Baidu® to do online searching in Chinese because she felt Baidu® has more information than a standard search engine. Some participants did choose to use Chinese interface when they need to obtain Chinese results and English interface when they need to obtain English results. Others used different search engines to search for information in different languages. The research results pointed out that language selection affects participants' online searching website preferences. The participants chose to use the search engine and language setting which can help them retrieving relevant information. However, in this study, some participants tried to use international edition of online searching websites such as Google® without language preference setting to complete the Chinese and English searching because they prefer to use the website. Some participants open another dictionary or translation website when they need to have translation help during their search process. The interview response from the

participants reveals that if an online searching website provides language tools to fulfill users' bilingual information need, they would use it.

5.1.2 Search strategies

Spink's (1997) interactive search process model which demonstrates information seekers' online searching process can explain bilingual users' searching process to some extent. According to Spink's model, user input follow by a strategy can relate their judgment of the search strategy to the search results they obtain and the search strategy they choose can also influence the subsequent query. Bilingual users have similar search process to Spink's model because they also use strategy related judgment to decide their search strategy. Bilingual users decide the language they want to use first. Then, they use searching strategies including *directly linking, keyword searching, browsing, comparison, and externally linking* to complete the task to accomplish their searching task. Furthermore, they also use translation tools to improve their search results. Some of the participants in this study pointed out that they translated the term by themselves because it would be easier than using a translation tool. This circumstance suggested that current translation tools are not easy to use during users' search process. Others used the search engine itself as a translation tool depending on the online searching task. That is, they searched for the same topic in different languages and compared the results they got. They didn't really want to get a full-text translation of the search results but information related to the search results in Chinese to help them in their search. This behavior implied that participants can obtain useful translation and information from search engine and they have needs to have translation help when they are doing bilingual online searching.

5.1.3 Information-seeking process

Wilson's (1996) model and Holscher and Strube's (2000) model can also be used to explain some of the information-seeking process of the bilingual users in this study. According to Holscher and Strube's (2000) model, users have information needs so they decide to directly access a website they know or interact with a search engine. Then they access the resulting documents and examine the contents of them. Furthermore, they browse the website and may or may not successfully find the information they need. Finally, they can obtain the satisfying results or go back to the first step if they don't feel satisfied with the results.

The bilingual users in this study demonstrated a similar process, but they also need to use more tactics when they examined and browsed the contents in different languages. They needed tools such as translation tools or language tools to help them browse the contents in other languages and needed to search for more information in Chinese and English to ensure the validity of the search results.

5.1.4 A conceptual model of bilingual information seekers search behavior

Results from this study have enabled the researcher to develop a conceptual model (see figure 4) of bilingual users' online searching process to illustrate the similarities and differences of bilingual users and general users. Figure 4 below demonstrates that bilingual users' need to select the language they want to use first. They consider about factors such as translation, keyword extraction, task description, to obtain relevant results and search engine selection. Then, they use one or more search strategies to obtain relevant information. If they obtain enough

relevant information, they can complete their search. If they don't obtain enough information, they can use another language to complete their search with other search strategies.

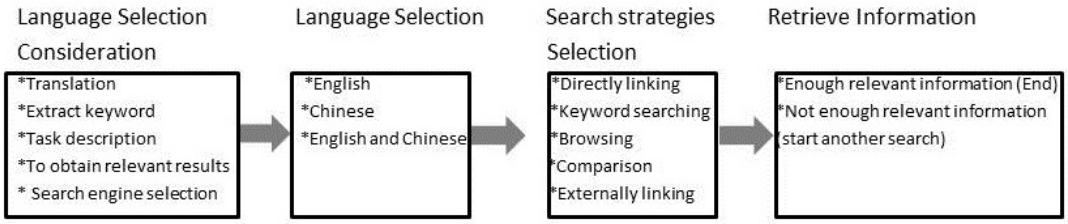

Figure 4. Bilingual users' online searching

The unique features of bilingual users' online search behavior includes: (1) They used the search engine as a translation tool so they can understand and compare the results from two languages. (2) They extracted useful information from the task description and translate them so they can decide to use a language. (3) They chose a language because of the results the participants want to obtain. (4) They chose a language because of the task description. (5) They chose to use a search engine because of the language they use. (6) They compared the results in two languages so they can confirm that they obtained the relevant results. Table 9 shows the evidence of these features.

Table 9. Unique features of bilingual, native-Chinese speakers' information-seeking behavior

Unique feature	Why?	Evidence
Used the search engine as a translation tool	The bilingual users want to make sure the English/Chinese of the word so they can understand it.	Evidence 1: (1) Google "祭拜祖先 節日"[ancestor worship holiday] (2) Google "除夕 英文"[New Year's Eve English] (3) Google "端午節 英文"[Dragon Boat Festival English](n05)(Chinese holiday) Evidence 2: (1)google.tw "ancestor worship Chinese holidays" (2)yahoo.tw=>dictonary=>ancestor worship (3)google.tw "Chinese ancestor worship"=>google.tw "Chinese ancestor worship holiday" (4)google.tw" 需要祭祖的節日"[a festival which need to worship ancestor] (5) google.tw"祭祖日"[ancestor worship day] (6) google.tw"祭祖"[ancestor worship](n15)(Chinese holiday task)
Extracted useful information from the task description and translate them	The bilingual users need to translate the task description so they can decide to use a language.	(1)google.tw "ancestor worship Chinese holidays" (2)yahoo.tw=>dictonary=>ancestor worship (3)google.tw "Chinese ancestor worship"=>google.tw "Chinese ancestor worship holiday" (4)google.tw" 需要祭祖的節日"[a festival which need to worship ancestor] (5) google.tw"祭祖日"[ancestor worship day] (6) google.tw"祭祖"[ancestor worship](n15)(Chinese holiday task)
Chose a language because of the results the participant want to obtain	The bilingual users want to obtain relevant information.	"For U.S. holiday again, since it's for U.S. holiday, I thought that English information should be complete."(n01)
Chose a language because of the task description	It's easier to extract keywords from the task description.	"your question is also in English so it's easier to get the keywords in English and just use it as a search term."(n02)

Chose to use a search engine because of the language they use	Sometimes the bilingual users prefer to use a search engine to search for information in a language.	Evidence 1: "I switch Google into Google Taiwan search engine what's…um somehow I feel it's very terrible and if I…I mean if I am searching in Chinese then I think I am more familiar with the interface of Google Taiwan so I will just switch the interface and see the function"(n10) Evidence 2: "if related to United States, I'll use Google or Wikipedia but if related to Chinese I'll use Chinese…"(n13) Evidence 3: "But my second preference will be yahoo(he meant Yahoo Taiwan), I were use these two sites, and for yahoo, I always search for some Chinese data because I think they have more data in Chinese."(n16)
Compared the results in two languages	The bilingual users compare the results to make sure they obtain relevant results.	"And then, I type the keyword in English. But only for the Chinese holiday, I try to find the Chinese holiday in English and try to match."(n04)

5.2 RESEARCH QUESTION (2): WHAT ARE BILINGUAL USERS' EXPECTATIONS OF THE BILINGUAL ONLINE SEARCHING AND OTHER SEARCH TOOLS IN THE FUTURE?

Most of the participants indicated that the translation feature is helpful when they are searching for Chinese and English information. They described examples of an ideal bilingual online searching interface during the interview. Some said that it would be helpful if the search engine could have automatic translation and others used Wikipedia as an example for developing a helpful translation feature. In Wikipedia, there is information about the same topic in several languages and the page has links to the information in other languages on the left side of the page. Some of them mentioned the helpfulness of the keyword suggestion function. The keyword suggestion function provides a list of related keywords under the query the user uses and the user can choose to use the suggestion keyword to do next searching. They mentioned that it is helpful when the search engine corrects spelling mistakes and suggest keywords for them. Two of the participants mentioned the importance of the layout of the bilingual interface. They said it would be good to put Chinese and English results side by side so they can find the relevant results easily.

The relationship between search engine and search tools is discussed in this study. Some of the participants used one search engine to do all of searching; others used different search engines when they were searching in different languages. Several participants chose to use the local version of an international search engine such as Yahoo® Taiwan or Google® Taiwan. Others used a Chinese search engine such as Baidu®. The participants noted that there are different kinds of translation or language tools in the search engines they chose but they weren't accustomed to use them. When they used a search engine, they just keyed in the query terms and

browsed the search results they obtained. The fact that they weren't accustomed to current translation or language tools implies that they might use the translation or language tool within the search engine if it has some improvements. First, the search engine can integrate the translation/language tools in their interface by having a link to the translation function so the users can approach the tools easily. The search engine hides the language setting function in the advanced search interface now and the users can't find it. Second, dictionary, spelling correction and keyword suggestions functions are useful for bilingual users. They can help bilingual users to form the query term and then retrieve satisfying results; these functions should be emphasized in the online searching websites for bilingual users.

Most of the participants were satisfied or somewhat satisfied with the results they obtained in this study. However, they also had some suggestions about the improvement of translation or language tools from the bilingual user perspective. They reported that the translation provides by translation tools is needed even if it is not completely correct when they need to clarify the meaning of the search results they obtain. Some of them care about the reliability of the translation provided from the translation tool. Some of them mentioned that it would be good to have a translation button to link to the translation tool in the searching interface. Therefore, users can access the translation tool easily. To sum up, the participants suggested these improvements for bilingual online searching system interface: (1) The search results should have a good list so users can find relevant information easily. (2) The Chinese and English search results can be listed side by side so users can decide to use an appropriate language to obtain relevant results. (3) Users can control over language selection by having language selection feature in the searching interface so they can switch language during their searching process. (4) The search engine can combine translation/dictionary tools with search

function so users can use it during their searching process. (5) The search engine can emphasize keyword suggestion feature so the bilingual users can choose best keywords from the suggestion list instead of thinking about appropriate words by themselves. (6) The search engine can provide automatic translation help users to understand the search results not in their native language. (7) Users can control over search results to restrict the search results by different factors so they can obtain relevant results.

Table 10. Features of interface design suggestions that were helpful to bilingual, native Chinese speakers

Features of interface design helpful to bilingual, native Chinese speakers	Why?	Evidence
Good list	It helps users to find relevant information.	Evidence 1: It's a clean list of the searching result including title and part of the content, which I think it helps me to know more about that site.(n11) Evidence 2: "I go to Wikipedia because Wikipedia usually does good lists."(n01)
List Chinese and English results side by side	Users can decide which language they want to use after they browse the results list.	Evidence 1: "It might actually be interesting if they can list that Chinese search and English search side by side, like, instead of they all mix up together."(n01) Evidence 2: "the return results for both Chinese and English side by side then I can quickly decide which one is more relevant considering the terms that I am issuing but now they cannot return if I issue the English one they'll return all English, right?"(n06)
User control over language selection	Language selection feature can allow users to switch language during their searching process.	Evidence 1: (1) Google "tomb-sweeping day"=>Qingming Festival in wikipedia=>switch to Chinese description=>link to other Chinese holidays in Chinese(n07)(Chinese holiday) Evidence 2: (1)google "wikipedia" (2)search "ancestor worship holiday" in English in Wikipedia=>religion in China in Wikipedia=>switch to Chinese version(n19)(Chinese holiday)
Combine translation/dictionary tools with search function	Users can use translation/dictionary tools when they are searching for information.	Evidence 1: "In my case, if there would be some translation assistance that would be much better for me. Because I am not quite sure about several vocabularies in the questions, I have to open another website to search what does this mean in Chinese."(n17) Evidence 2: "Then the Chinese holidays, I don't know what's the word mean because we don't use this kind of word so I go to a professional translation website. It is invented by Chinese people in mainland. And so I just search for the translation and the best point for this translation website is variety translation results mainly from the website."(n07)
Keyword suggestion	The bilingual users can choose best keywords from the suggestion list instead of thinking about appropriate words.	Evidence 1: "So I just type in and they have a recommendation keyword feature, so I, sometimes I just key in a word and it might return a whole sentence for me."(n21) Evidence 2: "I use Google because it's very simple and you just key in some terms and most of the results can match the answer and Google provides the relevant recommended terms to you."(n15)
Automatic translation help	Automatic translation can help bilingual users to understand the search results not in their native language.	Evidence 1: "I mean when I search for a certain kind of information, I can get all kind of information in different language and translate into English or Chinese in order to not restrict by the content language use."(n11) Evidence 2: "Translation. Like Wikipedia, if you have question in English, then you can have Chinese right away. But sometimes the translation might not right but it still works."(n19)

User control over search results	It's easier to find relevant information if bilingual users can restrict the search results by different factors.	"So if there are some facets on the side, you can choose with like something you can find on Amazon. You can limit the search part, that would be faster for me to find answer."(n06)

5.2.1 Discussions related to task

Most of the participants used English to search for relevant information for the technology task because they tried to find information related to life in the United States. They directly linked to the relevant website if they are familiar with this topic. They also used *browsing* and *comparison* strategies to collect relevant information so they could make a decision to accomplish the tasks. For any decision task, users need to obtain specific information, so for this task the participants used more keywords and specific terms when they were searching for information for this task than for the others. Furthermore, they not only viewed the information from the manufacturer but also retrieved review websites to help them make a decision.

The researcher found that they tended to search for related information in English because they think this topic is related to English. There are some Chinese review websites for smartphones but most of them didn't use Chinese review websites because there is fewer less related information about buying a smartphone in the United States on them. This task proved that the type and requirement of a task can influence users' language selection and the search strategies they use. Therefore, the researcher can assume that the topic of the search is a crucial factor for the users' language selection.

Participants tended to use English to complete the U.S. holidays task and use English and Chinese to search for Chinese holidays. The results from the study showed that they liked to obtain a list of holidays first and expand their search according to the information they have on the list. Therefore, *keyword searching* and *browsing* strategies were generally used when

participants were completing this task. Those who searched for information in Chinese and English compared the results they obtained. This action indicated that bilingual users have searching behavior distinct from that of users completing monolingual searches when dealing with information in two languages.

When the users are searching for the Chinese and English holidays, they might need to have language control to select an appropriate language to search. Participants mentioned the tools they used or needed when they discussed this task. The tools bilingual users need include translation tools, keyword suggestions, and organized information in different languages like that provided by Wikipedia.

Participants used *directly linking* and *keyword searching* strategies to complete movie task. They went to a review website directly if they were familiar with the movie. Otherwise, they searched for several keywords such as movie, review and Avatar. Although the movie is from the United States, it was released all over the world. Therefore, some of the participants searched for Chinese and English information about the movie.

The reviews of the movie vary for different person using different language, so participants tried to search for reviews from different websites in Chinese and in English to obtain thorough information. This situation indicated that bilingual users need to have a tool to integrate Chinese and English search results for a topic in one interface when they are searching for information about opinions and personal interests.

Movie task is relatively easy comparing to the other tasks. For difficult task, participants used more search strategies and browse through more information to complete the task than movie task. For movie task, the questions are straightforward and participants can complete the

task using fewer search strategies. They also used fewer keywords to search for related information.

5.2.2 Search engine as a multilingual tool

Rieh and Rieh (2005) reported that the users in their study tended to have two favorite search engines, separating use of the foreign search engine from use of the Korean (their native language) search engine, meaning they did not use web search engines as a multilingual tool. In this study, some of the participants had a different favorite online searching website for Chinese and English but some of them also used one search engine to complete the task. My research results showed some other differences from Rieh and Rieh's as well. For example, several participants searched for terms they were not sure of in the search engine to obtain the meaning of the term. They searched for the meaning of the same term in Chinese and in English to compare the results, especially for the Chinese holiday task. For example, they can obtain general information from Wikipedia and other informational webpage such as online dictionary pages on the web. Furthermore, the participants explained that sometimes they couldn't find enough information in one language so they then tried to search for information in the other language. For example, one participant (n04) said, "And then, I type the keyword in English. But only for the Chinese holiday, I try to find the Chinese holiday in English and try to match." One reason for the differences might be that there is more information online now, so the participants have a higher possibility to get satisfying answers in multiple languages from the search engine. To sum up, multilingual function in the search engine can improve users' online searching experience.

5.2.3 Translation support

The participants in this study suggested that translation support in an online searching system is helpful. They used the search engine to search for dictionary and translation services online and to do the translation, and were able to find satisfying information there. Some participants reported that these helped them understand the information they did not totally understand when they read it. The search engine was also used to gather the translation resources online when some users were searching for translation for certain topics. Clearly, translation support within the search engine can improve bilingual users' online searching experience. However, we can infer from participants' answers to interview questions and notes made while completing the tasks that the integration of translation tools and search results can be improved. Wikipedia is a good example for a useful multilingual website. It has good organization of the information in different languages according to the interview responses. The website has links to the information on the same topic in different languages on the left side of the webpage which participants of this study found helpful because they could then have information for the same topic in Chinese and English. Furthermore, they could extend their search in Chinese and English according to the information in this page.

5.2.4 Interactivity

Interactivity means the capability of a search engine interface to interact with users. The interactivity capabilities of an online searching website are essential because it helps users to get the information they need. According to this research, users think that the interactive functions such as keyword suggestions and spell check are helpful when they are doing Chinese and

English online searching. They reported being satisfied with how the online searching system automatically checked the query term they used and gave them suggestions for better query terms. These kinds of functions gave users some ideas about the relevant keywords for the topic they search and helped them to form the search when they didn't know which keywords were appropriate to use. They also helped users to have more accurate search results when they were searching in several languages.

5.2.5 User control

The participants pointed out that they would like to use functions such as comparison and language choice when they are using the searching engine. There are user control functions on the search engines but some of them are hidden in the advanced interface of the search engine. The users can't find these functions if they aren't familiar with the interface. Users have different needs for different kinds of searching tasks so they need to have user controls more obvious to choose the function they need for the task. For example, they need to use the comparison function when they are doing decision task to help them to make a decision and they need to switch languages when they need to figure out the information in different languages when they are doing background task.

5.2.6 Interface design

A clear interface design is essential because it can help bilingual users to understand the functions of the search engine. Most online searching websites have language choice and translation functions but these are not easy to find. Some users gave up on trying to find the

language choice and translation functions when they were difficult to find. Others just used what was on the homepage of the online searching website. The Wikipedia interface is a good example for a useful multilingual information structure. Users can easily find the link for different languages in the navigation system on the left side of the webpage. The integration of clear interface design and user oriented function in the search engine can make the bilingual users' information searching progress easier.

6.0 CONCLUSION

Implications and future directions of this research are explained in this chapter. The implications section concludes the findings and discussions of this research and further research section provides the research direction of this research in the future.

6.1 IMPLICATIONS

This study allowed the researcher to investigate bilingual users' information-seeking behavior and search strategies used by this population. Their information-seeking behavior in some ways matches that predicted by general information-seeking behavior models such as Spink's (1997) interactive search process model. However, bilingual users' ability to make a language selection makes their information-seeking behavior different from other user group. The participants decided on their search strategies according to the related language of the topics, their familiarity with the topics, and the type of information they wanted to obtain. Their search strategies included *directly linking*, *keyword searching*, *browsing*, *comparison*, and *externally linking*. Bilingual participants use Chinese and English differently and they chose to use a language for a purpose. They tended to not mix Chinese and English in one query.

Results of this study indicated that bilingual users use search engines as a multilingual tool. This result is different from the finding in Rieh and Rieh's (2005) study. Future research

should investigate the usage of search engine as a multilingual tool and develop multilingual function in search engine for multilingual users in the future. Bilingual online searching is an emerging searching style in online information retrieval. According to the results of this study, an efficient bilingual online searching system needs to have the following features:

(1) *Translation support*: The participants pointed out that translation functions would be helpful when they are doing Chinese and English searching. The translation support in a search engine can improve bilingual users' online searching experience.

(2) *Interactivity and user control*: The participants pointed out that they would like to use functions such as comparison and language choice when they are using the searching engine. The search engine needs to give users the ability to easily refine the search results and filter out uninteresting information.

(3) *Interface design*: the participants pointed out that they prefer to use a clear and simple interface when they are doing online searching. A clear and simple interface doesn't have distracting design in the interface and is easy to use. The language function in the online searching interface needs to be easy to find and the information in the search results page need to be organized according to language.

This research revealed information-seeking behavior that differs from Rieh and Rieh's (2005) study. The participants in this study used search engine as multilingual tool. However, this research also pointed out similar information-seeking behavior with Rieh and Rieh's (2005) study. The participants used different search engines when they used different language to do online searching. This research explored Chinese speaking bilingual users' information-seeking behavior when conducting specific tasks and this topic has been little explored by other researchers. Future study in this area should explore the information-seeking behavior of

different bilingual user group to make the bilingual information-seeking behavior research complete.

6.2 FUTURE RESEARCH

There are two possible directions for the future research on bilingual online searching. First, explore how to integrate translation tools with the searching interface so the users can find the features easily, and second, investigate how the translation tools' functions can be improved to match users' preferences. Furthermore, the interface design and the search engine preference of users can be considered in the design of the future bilingual online searching system. In addition, user studies of the bilingual and multilingual users' information-seeking behavior can be conducted on diverse user groups such as larger user group or users with other characteristics by replicating the research design in this study. This will help to build a complete picture of bilingual online searching among different user groups, and in different contexts, in order to understand the specific needs for different user groups. This information is helpful for the development and improvement of the multilingual online searching interface in the future.

The relationships among different factors of bilingual users' information-seeking behavior can be discussed in the future. Different types of online searching tasks can be conducted to see the relationship between task type and bilingual users' language selection. The relationship between familiarity of the task and bilingual users' language selection can be further discussed in the future. The relationships among search engine selection, language selection and task type can be observed in the future.

Researchers can also do user studies to distinguish the different needs of users using different languages such as Spanish, Korean and other languages. To observe the influence of language ability on users' information-seeking behavior would be another crucial issue to explore in the language and information-seeking behavior field. Researchers can try to relate the

users' language ability to the online searching support they need. It might be helpful for the bilingual or multilingual users.

APPENDIX A

TASK DOCUMENT

For research use:
Subject#:_____
Place: _____
Date: _____

QUESTIONNAIRE

Part 1. General Information

1. How long have you been searching on the web?

☐Never ☐less than 1 year ☐1-2 years ☐3-4 years ☐more than 4 years

2. What is your age?

☐20 or under ☐21-25 ☐26-30 ☐31-40 ☐over 40

3. What is your academic status?

☐graduate (master's) ☐graduate (doctoral)

☐post-doctorate ☐other_____

4. What is your field of study? In which university?

_____ _____

5. How often do you search on the web?

☐Never ☐Rarely ☐Monthly ☐Weekly ☐Daily

6. How long ago did you begin learning English?

☐1-2 year ☐3-4 years ☐more than 4 years

7. Rate your English proficiency.

☐Not proficient at all ☐Somewhat proficient ☐Proficient ☐Very proficient

8. What is your TOEFL score?_____ out of_____

9. Which online searching website do you usually use? (choose all that apply)

☐ Google ☐Yahoo ☐Bing ☐Other_____

10. Which kind of language setting do you usually use when you search online? (choose all that apply)

☐ English ☐Traditional Chinese ☐Simplified Chinese ☐Other_____

11. Which kind of website do you usually use? (choose all the apply)

☐ Search engine ☐Social network website ☐Blog ☐Online forum ☐Bookmark website ☐Other_____

Part 2. Task Results

1. How familiar were you with the <technology> task?

☐Not familiar at all ☐Somewhat familiar ☐Familiar ☐Very familiar

2. How difficult was the <technology> task?

☐Not difficult at all ☐Somewhat difficult ☐Difficult ☐Very difficult

Why?_____

3. What is your overall satisfaction with the task results of the <technology> task?

☐Not satisfied at all ☐Somewhat satisfied ☐Satisfied ☐Very satisfied

Why?_____

4. How familiar were you with the <holiday> task?

☐Not familiar at all ☐Somewhat familiar ☐Familiar ☐Very familiar

5. How difficult was the <holiday> task?

☐Not difficult at all ☐Somewhat difficult ☐Difficult ☐Very difficult

Why?_____

6. What is your overall satisfaction with the task results of the <holiday> task?

☐Not satisfied at all ☐Somewhat satisfied ☐Satisfied ☐Very satisfied

Why?_____

7. How familiar were you with the <movie> task?

☐Not familiar at all ☐Somewhat familiar ☐Familiar ☐Very familiar

8. How difficult was the <movie> task?

☐Not difficult at all ☐Somewhat difficult ☐Difficult ☐Very difficult

Why?_____

9. What is your overall satisfaction with the task results of the <movie> task?

☐Not satisfied at all ☐Somewhat satisfied ☐Satisfied ☐Very satisfied

Why?_____

Part 3. Language and Visual Influence

1. How many **relevant** English results did you get?

☐None (0 out of 9) ☐Some (1-3 out of 9)

☐About half (4-6 out of 9) ☐Most of them were relevant (7-9 out of 9)

2. How many **relevant** Chinese results did you get?

☐None (0 out of 9) ☐Some (1-3 out of 9)

☐About half (4-6 out of 9) ☐Most of them were relevant (7-9 out of 9)

3. Describe the page layout of the online searching interface you chose. What made the page layout helpful/not helpful?

_____

_____

_____

INTERVIEW QUESTIONS

1. Describe your search process. What kind of difficulty/ease of searching for the technology/holiday/movie task did you have?

2. Tell me about the language selection in your search process. Why did you search in Chinese or English for a certain task?

3. Tell me about your preference for certain online searching websites. Why did you use that particular searching website?

4. Tell me about the satisfaction level of your searching process. What kind of support would be most beneficial when doing a Chinese/English search (e.g., Visualization; Translation; Instructions…)?

INSTRUCTIONS for TASKS

Please use one or more searching websites of your choice to finish each task.

1. The whole task can be finished in about 40 minutes, but there is no time restriction.
2. You can relax and do the search as you would do your normal online searching.
3. You need to obtain 3 or more **Chinese and English** websites to finish each task.
4. The tasks are randomly ordered.
5. You can search in Chinese, English or both, to find appropriate answers for each task.
6. There is no restriction on the number of query terms you use.
7. The researcher will use recording software to record your searching process.

SEARCHING TASKS

Task 1: Technology topic:

Technology: You want to buy a new smart phone so you need to find reviews and other related information about it. The functions you need include build-in GPS, high quality camera, and good looking appearance. Furthermore, it would be better if the cell phone is up to date (released after June, 2010) and available from a reliable seller. Your budget for this smart phone is $200 U.S. dollar. Which smart phone will you choose?

_____

Please list the searching steps concisely.

Query term 1:_____
Searching website name1:_____
Result website name 1:_____
(in_____language)

Query term 2:_____
Searching website name 2:_____
Result website name 2:_____
(in_____language)

Query term 3:_____
Searching website name 3:_____
Result website name 3:_____
(in_____language)

Task 2: U.S. Holiday Topic:

U.S. Holiday: you want to find out information about the traditions, and special events related to U.S. holidays. You are especially interested in the holidays and celebrations which have ethnic and religious origin.

What are the ethnic and religious holidays and celebrations in the United States? (list four of them) _____

_____

_____

Please list the searching steps concisely.

Query term 1:_____

Searching website name 1:_____
Result website name 1:_____
(in_____language)

Query term 2:_____
Searching website name 2:_____
Result website name 2:_____

(in_____language)

Query term 3:_____
Searching website name 3:_____
Result website name 3: _____
(in_____language)

Task 3: Chinese holiday topic:

Chinese holiday: you want to find out information about the traditions, and special events related to Chinese holidays. You are especially interested in the holidays which have "ancestor worship" tradition.
What are the holidays which have "ancestor worship" tradition?
(list four of them)
_____
What should one prepare for ancestor worship?
_____
Please list the searching steps concisely.
Query term 1:_____
Searching website name 1:_____
Result website name 1:_____
(in_____language)

Query term 2:_____
Searching website name 2:_____
Result website name 2:_____
(in_____language)

Query term 3:_____
Searching website name 3:_____
Result website name 3:_____
(in_____language)

Task 4: Movie topic:

Movie: You just saw the movie "Avatar" and you want to find out more information about this movie. You want to search for reviews from three different sources, the interview of the director, and the news about the movie. Please list the searching steps concisely.
Query term 1:_____
Searching website name 1:_____
Result website name 1:_____
(in_____language)

Query term 2:_____
Searching website name 2:_____
Result website name 3:_____

(in_____language)

Query term 3:_____
Searching website name 3:_____
Result website name 3:_____
(in_____language)

APPENDIX B

QUERY TERM CODING SAMPLE LIST FOR MAIN RESEARCH RESULTS(TRANSLATION IN[])

Subject	Technology task	U.S. Holiday task	Chinese Holiday task	Movie task
No1	(1) cell phone gps camera (2) (the name of the cell phone) (3) "(the name of the cell phone) review (4) "(the name of the cell phone) comparison	(1) american holidays (2) American holidays religious (3) US ethnic holidays (4) religious holiday US	(1) 祭拜祖先 節日[ancestor worship holiday] (2) ancestor worship chinese	None
No2	(1)iphone 1 tech specs (2)iphone, price (3)iphone 1 price (4)htc desire hd price (5)smartphone under 200 (6)smartphone under 200 2010 (7)smartphone under 200 2010 gps (8)htc phone under 200 (9)htc phone (10)iphone at&t (11)htc hd2 tech specs	(1)Christmas (2)U.S. holiday ethnic religious	(1)Chinese holidays ancestor worship (2)chinese holidays ancestor (3)ancestor worship preparation	(1)avatar rotten tomatos (2)avatar imdb (3)avatar new york times review
N03	(1)smart phone (2)smartphone 200 us dollar (3)smartphone 200 us dollar released after June (4)smartphone 200 us dollar released after June 2010 (5)smartphone 200 us dollar released in	(1)traditional us holidays (2)traditional us holidays ethnics (3)traditional us holidays religious	(1)Chinese holiday ancestor worship (2)傳統節日 祖先祭拜 [traditional holiday ancestor worship]	(1)avatar review (2)avatar interview director (3)avatar news

	2010 (6)amazon (7)smartphone released 2010 (8)smartphone released in 2010 200 us dollar (9)smartphone 200 us dollar (10)smartphone under $200 (11)smartphone under $200 2010			
N04	(1) iphone	(1) U.S. holiday (2) ”US holidays” celebrations (3) us holidays celebrations	(1) ”Chinese” “ancestor worship” (2) 中國[Chinese] holiday “ancestor” (3) 清明節 [Qingming] (4) 端午節[Dragon Boat Festival] (5) 中秋節[Mid-Autumn Festival] (6) 新年[New Year]	(1) Review avatar (2) review of the movie avatar (3) avatar director interview (4) avatar news
N05	(1) 手機比價[cell phone comparison] (2) gps cell phone (3) cell phone reviews (4) gps 手機[cell phone] (5) 手機比價[cell phone comparison] (6) Google nexus price	(1) ethnic holiday usa (2) st. Patrick’s Day 2011 (3) religious holiday (4) religious holiday usa	(1) 祭拜祖先 節日 [ancestor worship holiday] (2) 除夕 英文 [New Year’s Eve English] (3) 端午節 英文 [Dragon Boat Festival English]	(1) avatar wiki (2) avatar interview of director (3) avatar review (4) Avatar film review (5) avatar movie ranking
N06	(1) smart phone gps camera less than 200 (2) smartphone gps camera less	(1) American religious holidays (2) American religious holidays wiki	(1) Chinese ancestor worship (2) Chinese ancestry worship (3) Chinese	(1) rotten tomatos

	than 200 HTC (3) smartphone gps camera HTC (4) built-in gps smart phone (5) built-in gps smartphone less than 200 dollars (6) built-in gps blackberry		ancestry worship holidays (4) 中國 祭祖 節日[Chinese ancestor worship holiday] (5) 中國 拜拜 節日[Chinese worship holiday] (6) 中國 傳統拜拜 節日[Chinese traditional worship holiday]	
N07		(1)wiki (2) ethnic and religious holidays (3) ethnic and religious holiday U.S. (4) .de? (5) ethnic and religious holidays	(1) tomb-sweeping day	(1) douban (2) imdb (3) 卡梅隆 [Cameron]
N08	(1) t-mobile (2) smartphone reviews (3) iphone	(1) thanksgiving (2) US holiday (3) US holiday information (4) US holiday tradition (5) 美國傳統節日 [American traditional holiday]	(1) 傳統節日 祭祀 [traditional holiday worship] (2) 祭祀祖先 準備 [ancestor worship preparation] (3) 春節祭祀祖先 [Chinese New Year's ancestor Worship]	(1) Avatar (2) avatar (3) avatar reviews
N09	(1) smart phone with GPS camera	(1) special events us holidays (2) special events us holidays ethnic religious (3) 美國宗教節日 [American religious holiday]	(1) 中國節日 祭祖 [Chinese holiday ancestor worship] (2) 中國節日 祭祖 [Chinese holiday Ancestor Worship] (3) 中國節日 祭祖 祭祀物品[Chinese holiday Ancestor Worship]	(1) avatar interview director (2) avatar reviews (3) 阿凡達[Avatar] (4) 阿凡達 豆瓣 [Avatar Douban]
N10	(1) "smartphone" build in GPS (2) "smartphone"	(1) US holiday calendar (2) "us holidays"	(1) google tw (2) ancestor workship	(1) Avatar (2) avatar review

	build in GPS camera (3) BlackBerry Storm 9530 smartphone	ethnic and religious (3) us religious holidays ethnic and religious	(3) google 字典 [dictionary] (4) 祖先崇拜 [ancestor worship] (5) ancestor worship in chinese (6) Chinese ancestor worship holiday (7) google tw (8) 全球華文網路教育中心，台灣節慶[Global Chinese Network Education Center, Taiwan Festivals] (9) 台灣節慶 祭祖 [Taiwanese Festival Ancestor Worship] (10) Chinese ancestor worship holidays (11) 台灣節慶 祭祖[Taiwanese Festival Ancestor Worship]	
N11	(1) att (2) smartphone reviews (3) mobile01 (4) at	(1) US holdays (typo) (2) thanksgiving day (3)聖誕節的由來 [Origin of Christmas]	(1) Chinese holiday ancestor worship (2) Chinese holiday (3) traditional Chinese holiday (4) 端午節[Dragon Boat Festival]	(1) avatar movie (2) avatar news (3) avatar
N12	(1) atnt (2) youtube htc aria review	(1) US holiday calendar (2) us holiday religious	(1) Chinese holiday ancestor worship (2) 節日 祭祖 [holiday ancestor worship] (3) 端午[Dragon Boat Festival]	(1) avatar review (2) avatar imdb
N13	(1) smart phone, 200 dollars, latest (2) shouji 1600 元	(1) ethnic and religious holidays in US	(1) 祭奠祖先的節日[ancestor worship festival]	(1) avatar (2) avatar review (3) avatar,

	[dollar] (3) smart phone, GPS, Camera, 200 dollars	(2) American ethnic and religious cultural holidays	(2) chinese ancestor worship (3) chinese ancestor worship holidays	interview of the director (4) avatar, 新聞 [news]
N14	(1) comparsion iphone4 camera gps	(1) martin luther (2) religious holidays united states	(1) ancestor worship in China (2) ancestor worship in China holiday (3) ancestor worship in China holiday calendar (4) ancestor worship (5) 祭祖 放假 [ancestor worship holiday]	(1) imdb avatar (2) James Cameron avatar interview
N15	(1) smart phone gps camera (2) smartphone (3) smartphone gps camera price (4) 手機王[sogi]	(1) USA holiday ethnic (2) USA holiday religiou (3) USA celebration ethnic religion	(1) Chinese holiday ancestor worship (2) Chinese holiday ancestor worship (3) 傳統節日 [traditional holiday] (4) 中國傳統節日 [Chinese traditional holiday] (5) 中國傳統節日習俗[Chinese traditional holiday] (6) 傳統節日習俗 [traditional holiday customs]	(1) avatar review (2) avatar director interview (3) avatar news
N16	(1) 手機王[sogi] (2) 手機[cell phone] (3) 買手機[buy cell phone] (4) 選購手機 [choose and buy a cell phone]	(1) ethnic religious holiday (2) ethnic religious holidays us (3) american holidays (4) ethnic religious holidays	(1) ancestor worship Chinese holidays (2) Chinese ancestor worship (3) Chinese ancestor worship holiday	(1) 阿凡達 影評 [Avatar review] (2) avatar interview (3) avatar reviews imdb

	(5) 手機網站[cell phone website] (6) buy smart phone	celebration usa	(4) 需要祭祖的節日[a festival which need to worship ancestor] (5) 祭祖日[ancestor worship day] (6) 祭祖[ancestor worship]	
N17	(1) smart phone price comparison (2) smartphone price comparison (3) iphone 3Gs specs	(1) us holidays religious (2) us holidays wiki	(1) Chinese holiday wiki	(1) movie review avatar (2) avatar interview director youtube
N18	(1) smartphone reviews (2) 手機 導購[cell phone shopping guide] (3) unlocked cell phones	(1) us holidays ethnic religious (2) US holidays ethnic religious list (3) us holidays ethnic religious list	(1) 中國傳統節日祭祖[Chinese tranditional holiday ancestor worship]	(1) avatar reviews (2) 阿凡達 影評[Avatar review] (3) 阿凡達 影評 迅雷[Avatar review Xunlei] (4) avatar 影評[review] (5) avatar 影評[review] (6) 阿凡達 影評[Avatar review] (7) 阿凡達 影評 迅雷[Avatar review Xunlei]
N19	(1) at & t	(1) religious holidays (2) religious US holidays	(1) ancestor worship holiday China (2) ancestor worship holiday (3) Wikipedia (4) 孔子誕辰 準備[Confucius' Birthday preparation] (5) 媽祖誕辰 準備[Matsu's birthday preparation]	(1) avatar director (2) rotten tomatoes (3) avatar
N20	(1) smartphone (2) Samsung Black Jack II-black(AT &	(1) U.S. Holiday (2) U.S. holiday ethnic religious	(1) Chinese holiday ancestor worship	(1) avatar review (2) avatar review imdb

	T) release (3) htc hd7 review	(3) U.S. holiday ethnic religious celebration	(2) Chinese holiday ancestor worship prepare	(3) avatar interview director (4) avatar news
N21	(1) android smartphone (2) radioshack (3) ebates wireless	(1) traditional us holidays (2) religious holidays (3) holiday in usa	(1) “ancestor worship” in China (2) ancestor worship in China (3) ancestor worship in China (4) ancestor worship in China holidays (5) preparation of qingming (6) preparation of qing ming	(1) avatar (2) interview avatar james (3) avatar 電影 [movie]

APPENDIX C

CODING AND ACCOMPANYING EVIDENCE

Appendix C Coding and Accompanying Evidence from the Data					
Categories			**Evidence**		
A priori codes	**Open coding: Sub-category**	**Open coding: Attributes of sub-category**	**Data Source: Questionnaire**	**Data Source: Interview**	**Data Source: Observation (Camtasia)**
1 Search strategy					
	1.1 directly linking				
		knowing how to obtain information (familiarity)		"And then finally with movie like I say, I know the websites I usually go to. I just go directly. "(n01)	"directly link to rotten tomatoes and IMDB"(n01)(movie task)
		knowing how to obtain information (familiarity)	<movie>: not difficult at all Why? I already know lots of review websites; <movie>: very satisfied Why? I did it fast.(n02)	"I just type in Avatar and some of their review websites I know so I type in avatar rotten tomatoes, and avatar imdb, and avatar new york times review."(n02)	Google "avatar rotten tomatos"; Google "avatar imdb"(n02)(movie task)
		knowing how to obtain information (familiarity)	<movie>: not difficult at all Why? I know where to get the answers even I haven't watched the movie at all.(n06)	"for the movie task, it's pretty straight forward because I kind of know where I can find the answer, so I just type in the website …three of them."(n06)	directly link to IMDB, directly link to wikipedia; Google "rotten tomatoes"(n06)(movie task)
		clearly search strategy plan		"for the first one, I usually buy things a lot online. Normally everyday find the deals so I just directly go to the Amazon's to see what's the categories need to be like: what's the price limitations try to find, and then I go to buy.com to compare prices and review some user reviews because normally there are different people from buy.com and Amazon."(n07)	directly link to buy.com and search within the website; directly link to Amazon and search within the website(n07)(technology task)

	1.2 keyword searching				
		extract useful information from the task description		“I type in something like U.S. holiday, religion, some keyword in the statement, in the question.”(n02)	(1) Google "Christmas" (2) Google "U.S. holiday ethnic religious" (n02)(U.S. Holiday task)
		clearly search strategy plan		“At the beginning of my search process, I use general keyword. And to find some other website, and then I use the more specific one, and I find the results I want.”(n03)	Google “smart phone”=>Google “smartphone 200 us dollar”=>Google“smartphone 200 us dollar released after June”(n03)(technology task)
		extract useful information from the task description		“And I just type the keywords from the question, and click enter and to check the results.”(n09)	Google “avatar interview director”(n09)(movie task)
		extract useful information from the task description		“Actually, for most of the task, I just…when I read the text, I sort of searching for some keywords. Then I just put the keywords as a query when I search it.”(n12)	(1)Google “Chinese holiday ancestor worship” (2) Google "節日 祭祖 "[holiday ancestor worship](n12)(Chinese holiday task)
		extract useful information from the task description; translate them		“first I will choose maybe the relevant terms in the requirements and most of the tasks I can use the terms in the requirements to get the result I want.”(n15)	(1)google.tw “ancestor worship Chinese holidays” (2)yahoo.tw=>dictonary=>ancestor worship (3)google.tw “Chinese ancestor worship”=>google.tw “Chinese ancestor worship holiday” (4)google.tw" 需要祭祖的節日"[a festival which need to worship ancestor] (5) google.tw"祭祖日 "[ancestor worship day] (6) google.tw"祭祖"[ancestor worship](n15)(Chinese holiday task)

	1.3 browse				
		didn't have a search strategy plan		“I kinda need to browse through especially those technology one. Given the limited budget, I really have to search for the specific answer.”(n06)	(1) go to Amazon=>search for “smartphone GPS hiquality camera”=>search for “smart phone high quality camera” in electronics=>search for “smart phone high quality camera” in any department=>search for “smart phone htc gps camera”=>HTC A8181 Desire Unlocked=>browse=>Sony Ericsson XPERIA x10 mini E10i (2) Google “smart phone gps camera less than 200”=>find the best, best smartphones, compare, reviews & ratings=>HTC EVO 4G=>go back=>Droid Pro=>go back=>browse and compare=>go back to google(n06)(technology task)
		didn't have a search strategy plan		“So I think the most function that I use to find the smartphone is browse. I don’t search it.”(n08)	(1)Google “t-mobile”=>shop 4G phones=>browse (2)Google “smartphone reviews”=>smartphones at cnet Reviews=>t-mobile=>price range $150-$200=>RIM Blackberry Curve 8320-titanium=>play review video=>go back=>T-Mobile Dash 3G=>play review video=>go back (n08)(technology task)

		clearly search strategy plan		"Though at last I put the appearance on the first priority of my search so I use Google shopping and browse all of the pictures, and decide like which appearance of the cell phone most interest me."(n10)	(1)Google ""smartphone" build in GPS"=>Google ""smartphone" build in GPS camera"=>Google shopping=>HTC HD2 T8585@amazon (2)search "smartphone gps camera" in Amazon=>in cell phone & accessories department=>browse (3)go back to Google shopping (randomly browse)=>BlackBerry Storm 9530 (n10)(technology task)
	1.4 comparison				
		clearly search strategy plan		"I have to look for websites that allow for taking variables, for combination of variables"(n01)	(1) directly link to cnet.com=>browse=>compare tools (2) Google product search "cell phone gps camera"=>price and other limitation tools=>browse=>link to amazon.com (n01)(technology task)
		clearly search strategy plan		" finally, the final procedure is going to the Google shopping then compare the prices."(n07)	(5) go to Google shopping=>search for "Noika C6"=>browse(n07)(technology task)
		didn't have a search strategy plan		"And I will …maybe just compare the search results to find some relevant information on the title and then just open the website."(n08)	
	1.5 externally linking				

				"I think I go for Wikipedia and get some external link information all from there."(n10)	
2 Language	2.1 English				
		Chose a language because of the relevant results the participant wanted to obtain		"For U.S. holiday again, since it's for U.S. holiday, I thought that English information should be complete."(n01)	(1) Google "american holidays" "American holidays religious" (2) browse Wikipedia, find "USA" in the webpage, find "america" (3) Google "US ethnic holidays" , browse USA.gov (4) Google "religious holiday US"=>infoplease (n01)(U.S. Holiday)
		chose a language because of the task description		"your question is also in English so it's easier to get the keywords in English and just use it as a search term."(n02)	Used English to search(n02)
		chose a language because of the task description		"because the questions are English so if I saw the questions are English, normally I use English to find the answer."(n04)	Used English to search for technology, U.S. holiday and movie task (n04)
				"when I am searching in English, if I don't really get the meaning of the word, it will be really hard and it would be a little bit…um…frustrated to started."(n10)	Used Google dictionary when she needs to know the meaning of a word (n10)
		chose a language because of the task description		"Cause this tasks are all in English, so I will first use English keyword."(n14)	Used English to search for technology, U.S. holiday and movie task (n14)

		chose a language because of the task description		"Most of the task I choose English to search because the requirements such as movie, technology and USA holidays is about the English information so I …the task I use English to search."(n15)	Used English to search for U.S. holiday and movie task(n15)
		chose a language because of the task description		"I use English to search of the results and the main reason is that your questions are all in English so it's much easier for me to search in English."(n17)	Used English to search(n17)
				"and only one is to search Chinese holiday. Because I only use English for searching so it's hard to recognized the name of the festival."(n21)	Used English to search for U.S. holiday and Chinese holiday task and Used Chinese and English to search for movie task(n21)
	2.2 Chinese				
		Chose a language because of the relevant results the participant wanted to obtain		"For Chinese holiday, it's obvious that in Chinese there might be more in depth material than English so I look at that in Chinese"(n01)	(1) Google "祭拜祖先 節日"[ancestor worship holiday](n01)(Chinese holiday)
		chose a language because of the task description		"if your question is in Chinese I will use Chinese cause that's the easier way you got the keywords"(n02)	
		Chose a language because of the relevant results the participant wanted to obtain		"I figure it might be more efficient but issue the Chinese query term.(for Chines holiday task)"(n06)	(1) Google "中國 祭祖 節日 "[Chinese ancestor worship holiday] (2) Google "中國 拜拜 節日 "[Chinese worship holiday] (3) Google "中國 傳統拜拜 節日"[Chinese traditional worship holiday](n06)(Chinese holiday)

		chose a language because of the relevant results the participant wanted to obtain		"if I want to find the Chinese holiday, the information about Chinese holiday I think is searching in Chinese because I think there is more Chinese information about Chinese holiday. And the English information about English holidays so I choose, mostly I choose Chinese to search Chinese holiday. But you know, I am a Chinese so I also use Chinese language to search US holiday because it will save me time if I just read Chinese."(n08)	Used English and Chinese to search for U.S. holiday task and used Chinese to search for Chinese holiday task (n08)
		Chose a language because of the relevant results the participant wanted to obtain		"But sometimes for some Chinese related issue about…such as Chinese holidays, I would like to use Chinese search engines.""Usually I would like to choose English, just for some especially Chinese related issue I would like to use Chinese search engine."(n09)	(1)Baidu "中國節日 祭祖"=>(百度知道)中國傳統的祭祖聚族的結日有哪些? (2)Google"中國節日 祭祖"=>Google"中國節日 祭祖祭祀物品"=>祭祀(wikipedia)=>go back=>祭祀(百度百科) (3)go to Wikipedia directly (4)search "祭祖節日" in Wikipedia=>search "祭祖節日" in wikipedia (n09)(Chinese holiday)
		the relationship between search engine and language	Language setting:traditional Chinese(n10)	"I switch Google into Google Taiwan search engine what's…um somehow I feel it's very terrible and if I…I mean if I am searching in Chinese then I think I am more familiar with the interface of Google Taiwan so I will just switch the interface and see the function"(n10)	Google "google tw"=>go to www.google.com.tw (n10)(Chinese Holiday)
		Chose a language because of the relevant results the participant wanted to obtain		"I only use Chinese query in Chinese holidays but…it's because when I try to use English to search the Chinese holiday, somehow it didn't provide me satisfied results so that's why I search in Chinese."(n12)	(1)Google "節日 祭祖 "[holiday ancestor worship] (2) Google "端午"[Dragon Boat Festival] (n12)(Chinese holiday task)

		chose a language because of the participant's language preference		"I use Chinese to search for information. I thought it's much more convenient than use English because I don't need to translating Chinese into…understand and to know more information."(n13)	Used Chinese and English to search for the tasks(n13)
		Chose a language because of the relevant results the participant wanted to have		"But for the Chinese holiday, I think there are more Chinese information in the website so I will choose the Chinese language."(n15)	(1) google.tw "傳統節日 "[traditional holiday] (2) google.tw "中國傳統節日 "[Chinese traditional holiday] (3) google.tw "中國傳統節日習俗"[Chinese traditional holiday] (4) google.tw "傳統節日習俗 "[traditional holiday customs](n15)(Chinese holiday task)
	2.3 dictionary/translation(tools)				
		to understand the meaning of a word		"Then the Chinese holidays, I don't know what's the word mean because we don't use this kind of word so I go to a professional translation website. It is invented by Chinese people in mainland. And so I just search for the translation and the best point for this translation website is variety translation results mainly from the website."(n07)	go to www.iciba.com directly=>search for ancestor worship (search for definition and translation)(n07)(Chinese holiday)
		to obtain relevant results		"translation website like google, google will do translation for search although it's not very precisely but I think it will do a little help."(n16)	
	2.6 Chinese and English				
		to make sure the relevant results		"And then, I type the keyword in English. But only for the Chinese holiday, I try to find the Chinese holiday in English and try to match."(n04)	Used English to search for technology task, U.S. holiday task, and movie task; used Chinese to search for Chinese holiday task(n04)

				“if I am not familiar for this topic, for example, in Chinese holiday, if I don’t know this Chinese holiday’s English name, I have to find the Chinese name first and then to translate into English, and then to find the answer.”(n04)	(1) Google" ”Chinese” “ancestor worship”" (2) Google "中國[Chinese] holiday “ancestor”" (3) Google "清明節 "[Qingming] (4) Google "端午節"[Dragon Boat Festival] (5) Google "中秋節"[Mid-Autumn Festival] (6) Google "新年"[New Year](n04)(Chinese holiday task)
		chose a language because of the task description		“questions are in English so I search directly from English if I understand it. Otherwise, I will choose Chinese and first translate the question to Chinese and in this case, normally, I search by Chinese first then turn to English and otherwise I will stick on English.”(n07)	Used English to search first(n07)
		didn't have a search strategy plan		“as I know, both Chinese and English have certain information so it’s really doesn’t matter for me to use which language so I just randomly use them.”(n11)	Used Chinese and English to search for the tasks(n11)
		try to mix the language to get information in Chinese and English		“Although it’s American movie, but it’s also publish in China so I use a combination of Chinese and English together to get the results and to the…now I found the information from Google, Wikipedia, and Baidu…um…in bilingual, Chinese and English.”(n13)	Baidu"avatar, 新聞 "[news](n13)(movie task)
		chose to use a search engine because of the language they use		“if related to United States, I’ll use Google or Wikipedia but if related to Chinese I’ll use Chinese…”(n13)	Used Google to search for U.S. holiday(n13)

		chose a language because of the participant's language preference		first of all, I will choose to type in Chinese because my mother language is Chinese so if I can find some Chinese data, I can understand it more quickly. And in English, if I can't find any data in Chinese, I will use English."(n16)	Used Chinese first to search for technology and movie task(n16)
3 Search engine	3.1 Google				
	3.1.1 keyword help by Google				
		to obtain relevant results	online searching website: Google(n02)	"nice things about Google is that when I type in some, like when I type in avatar new york and then it will like automatically show the like the best match so that's what I done…yeah."(n02)	Google "avatar new york"=>Google keyword suggestion "avatar new york times review" (n02)
				"yeah, google instant, I think it's very helpful."(n14)	
		to obtain relevant results		"So I just type in and they have a recommendation keyword feature, so I, sometimes I just key in a word and it might return a whole sentence for me."(n21)	Google "tradition"=>google keyowrd suggestion "traditional us holidays"(n21)(Chinese holiday task)
	3.1.2 precision/precise of Google				
		to obtain relevant results	Google: Hits rather relevant, within the first 3 pages(n01)	"it consistently produce relevant results for me."(n01)	
		to obtain relevant results	online searching website: Google(n06)	"Google is somehow reliable that use pop up the first one two three is relevant to, usually my daily search terms so I will assume that's reliable."(n06)	
		to obtain relevant results	online searching website: Google(n15)	"I use Google because it's very simple and you just key in some terms and most of the results can match the answer and Google provides the relevant recommended terms to you."(n15)	

	3.1.3 Google's simple/clear/easy interface				
			I use google, It's simple & clean & fast. The main reason I use Google is not because of the interface design though…I use it cause it's fast & the results are articulate.(n02)	" I think Google is fast, and the interface is very clean and simple and it's gmail and lots of stuff."(n02)	
		good list	It's a clean list of the searching result including title and part of the content, which I think it helps me to know more about that site.(n11)	"my primary use is Google and it's just because it's fast and it's clean also clean list and most of time I will find my desire website in the first page or second page so that's why I always use Google."(n11)	
		to obtain relevant results	I used Google to search the answer. The layout is terse and clean, and it provides relevant information, such as videos, as well, which could help me get the answer easier and faster.(n12)	"I always use google to search and because the layout is kind of clean. The results provide are kind of satisfied."(n12)	
			(1) clear layout (2) speed of result searching(n14)	"because Google is much clear. I mean the layout and the website is much clear than others and it's fast."(n14)	
		to obtain relevant results	For search pages I prefer a simple and clear interface to input search keyword. It shouldn't contain other redundant elements (contents) on that page. For result pages, it should place the most relevant search result on the top. Besides, I think the "recommended search keywords" is very useful for a user who enters any wrong search cretiria.(n21)	"well, I will prefer to search in google.com. yeah, they provide a very simple and clear interface. There is no other redundant element, for example, advertisement or other words on the webpage."(n21)	

	3.1.4 other functions of google				
				“I prefer Google. Cause I use such as yahoo, bing and Google. I think Google is quite more , better and international.”(n03)	
		easy to browse		“And I use Google shopping, and I think this function is quite handful and I browse…I think I am not really sure.”(n10)	(1)Google ““smartphone” build in GPS”=>Google ““smartphone” build in GPS camera”=>Google shopping=>HTC HD2 T8585@amazon (2)search “smartphone gps camera” in Amazon=>in cell phone & accessories department=>browse (3)go back to Google shopping (randomly browse)=>BlackBerry Storm 9530 (n10)(technology task)
	3.2 Yahoo				
	3.2.1 Yahoo Taiwan/Yahoo Chinese				
		popular		“because yahoo is quite…like…popular in my country so I just use it (for Chinese search).”(n03)	(1) Google “Chinese holiday ancestor worship”=>wikipedia’s Qingming festival page=>browse=>back (2) Search Yahoo Taiwan”傳統節日 祖先祭拜”=>祭拜祖先節日與方式=browse (n03)(Chinese holiday task)
		to obtain relevant results	online searching website: google; yahoo (n16)	“But my second preference will be yahoo(he meant Yahoo Taiwan), I were use these two sites, and for yahoo, I always search for some Chinese data because I think they have more data in Chinese.”(n16)	yahoo.tw=>yahoo shopping center=>browse (n16)(technology task)

	3.2.5 comparison of Yahoo and Google				
		to obtain relevant results	online searching website: google; yahoo (n16)	"I think it's such a culture difference because in U.S. everybody use google so google will have biggest data amount but I think in Taiwan, I think there is still larger part of people using Yahoo Taiwan so I can get a lot of data from Yahoo than Google."(n16)	
	3.3 Bing				
				"And I think that bing might be good but I just never get used to it."(n01)	
		try different search engines		"So after that I went to bing.com and I input "ancestor worship in China holiday" and it returned Wikipedia so basically there is a list of Chinese holidays on Wikipedia so I can check the holiday names and a little bit information about Chinese holiday."(n21)	(1)google "traditional us holidays"=>American holidays: USA.gov (2)bing "religious holidays"=>Holiday in Wikipedia=>religious holidays in Wikipedia=>go back=>list of holidays by country in Wikipedia=>public holidays in the United States in Wikipedia=>federal holidays un Wikipedia (3)yahoo "holiday in usa"(keyword suggestion)=>US Holidays 2011=>Columbus day(n21)(U.S. holiday task)
	3.4.1 comparison of Baidu and Google				
		to obtain relevant results	online searching website: Google; Baidu(n09)	"It(Baidu) did better than I mean searching the Chinese word in Google."(n09)	Used Baidu (and Google) to search for movie task, U.S. holiday task, and Chinese holiday task(n09)

	3.4.2 Baidu's Chinese resource				
		to obtain relevant results		"Baidu is not just a Chinese search engine, so I use Baidu. Because you can find more Chinese information in Baidu."(n08)	Used Baidu (and Google)to search for movie task, U.S. holiday task, and Chinese holiday task(n08)
4 Searching support	4.1 translation				
		automatic translation help		"if there is something like automatically translate Chinese into English, or English into Chinese, perhaps if I type like Chinese holiday ancestor and they can translate to 中國傳統節日, support like that."(n02)	
				"they can show like both results. Perhaps they can detect like, ok, there is a book in Chinese so I should translate this English to Chinese."(n02)	
		automatic translation help		"If we have…like…immediate translation engine or something like that will be more helpful for us. We don't have to try to type the Chinese or to use English first and then go for Chinese. No, we don't have to translate by ourselves. If they have translation directly on the webpage, it will be more helpful."(n04)	(1) Google" "Chinese" "ancestor worship"" (2) Google "中國[Chinese] holiday "ancestor"" (3) Google "清明節 "[Qingming] (4) Google "端午節"[Dragon Boat Festival] (5) Google "中秋節"[Mid-Autumn Festival] (6) Google "新年"[New Year](n04)(Chinese holiday task)
		user control over language selection		"same webpages have bilingual search results especially like Wikipedia. Although the content may be different, but you can stick on the same topic, at exactly same page, just click English or Chinese. And that's why I like the English dictionary with bilingual explanations like Chinese explanations and English explanations."(n07)	(1) Google "tomb-sweeping day"=>Qingming Festival in wikipedia=>switch to Chinese description=>link to other Chinese holidays in Chinese(n07)(Chinese holiday)

		combine translation/dictionary with search function		"for the Chinese holiday, I also start with the English terms. Yeah…and, but, I can translate it into Chinese corresponding ones, holidays and using my acquiring knowledge to find more information."(n11)	(1)Google "Chinese holiday ancestor worship"(keyword suggestion)=>Qingming Festival in Wikipedia=>go back=>go back to Qingming Festival in Wikipedia (2)Google "Chinese holiday"=>Google "traditional Chinese holiday"=>traditional Chinese holidays in Wikipedia (3)google.tw "端午節"[dragon boat festival]=>端午節[dragon boat festival](www2.ctps.tp.edu.tw)=>go back=>端午節[dragon boat festival](park.org)=>go back=>端午節習俗[dragon boat festival custom](lanyangnet) (n11)(Chinese holiday)
		automatic translation help		"I mean when I search for a certain kind of information, I can get all kind of information in different language and translate into English or Chinese in order to not restrict by the content language use."(n11)	
		good quality translation		"basically, if you can provide translation, it would be great but somehow you need to make sure the translation process is good enough."(n12)	
		combine translation/dictionary with search function		"In my case, if there would be some translation assistance that would be much better for me. Because I am not quite sure about several vocabularies in the questions, I have to open another website to search what does this mean in Chinese."(n17)	(1)go to dictionary.yahoo.com.tw directly (2)search "ethnic" in Yahoo dictionary (n17)(U.S. holiday)

		automatic translation help		"Translation. Like Wikipedia, if you have question in English, then you can have Chinese right away. But sometimes the translation might not right but it still works."(n19)	(1)google "wikipedia" (2)search "ancestor worship holiday" in English in Wikipedia=>religion in China in Wikipedia=>switch to Chinese version(n19)(Chinese holiday)
		automatic translation help		"yeah, if I search Chinese holiday in English on Google, I would hope they will return some data in Chinese. Yeah. Because sometimes the translation might be different, and I find a problem, For example, I didn't know what was "qingming" in English but actually I do know that in Chinese. So if they can provide the translate feature on it, it would be good."(n21)	
	4.2 visualization				
				"in some website, it can highlight the word I type. Maybe the visualization"(n05)	
	4.3 layout				
		list Chinese and English results side by side		"It might actually be interesting if they can list that Chinese search and English search side by side, like, instead of they all mix up together."(n01)	
		list Chinese and English results side by side		"the return results for both Chinese and English side by side then I can quickly decide which one is more relevant considering the terms that I am issuing but now they cannot return if I issue the English one they'll return all English, right?"(n06)	
	4.4 other				
		user control over search results		"So if there are some facets on the side, you can choose with like something you can find on Amazon. You can limit the search part, that would be faster for me to find answer."(n06)	
				"link the pictures with a text would be more helpful."(n09)	

6 Satisfaction	6.1 very satisfied				
		to obtain relevant results	Movie: somewhat satisfied(n01)	"And the last one(movie), I am probably happy with it because they have ratings from different users and it usually fits my taste."(n01)	
		familiarity and satisfaction	Technology: satisfied; Movie: very satisfied (n10)	"I think my best satisfaction will be the movie and second will be technology cause they are more daily activity involves"(n10)	
	6.2 kind of satisfied				
			Technology: satisfied; Movie: very satisfied; Holiday: very satisfied (n16)	"yeah…satisfied…I feel satisfied except the technical one because you need to find out the mobile phone and I think that takes a lot of time because I think they are not very well-designed cell phone websites for searching different products."(n16)	
	6.3 not satisfied				
7 Specific Website	7.1 Wikipedia				
		good list		"I go to Wikipedia because Wikipedia usually does good lists."(n01)	(1) Google "american holidays" "American holidays religious" (2) browse Wikipedia, find "USA" in the webpage, find "america"(n01)(U.S. holiday)
		user control over language selection		"Then I go to the Wikipedia to search it by Chinese word. Then I click the English link to see what happens there."(n07)	(1) Google "tomb-sweeping day"=>Qingming Festival in wikipedia=>switch to Chinese description=>link to other Chinese holidays in Chinese(n07)(Chinese holiday)

				"I got the English results from the web, then I search wiki with English words. Then I turn English word to Chinese to see, to read that and there are more hyperlinks for Chinese."(n07)	
				"I look at the…I think Wikipedia is always helpful."(n10)	(4)google.tw "祖先崇拜"[ancestor worship]=><1>祖先崇拜[ancestor worship] in Wikipedia=><2>祖先崇拜[ancestor worship]-TSCpedia=>中國傳統節[Chinese traditional holiday]日 in Wikipedia=>Ancestor Worship(n10)(Chinese holiday)
		user control over language selection		"I just search at the second time in Wikipedia website and I got the information I want and then I translate it in Chinese and keep looking at Chinese website, I found the holiday I want."(n19)	(1)google "wikipedia" (2)search "ancestor worship holiday" in English in Wikipedia=>religion in China in Wikipedia=>switch to Chinese version(n19)(Chinese holiday)
8 familiarity	8.1 very familiar				
		familiarity and language		"If I am familiar with that topic, I will use Chinese. If I am not familiar with that topic, I choose English. "(n05)	
		familiarity and directly linking		"Then it's the movie task. I found that was the easiest cause I know all these review websites."(n02)	Google "avatar rotten tomatos"; Google "avatar imdb"(n02)(movie task)

		used the search engine as a translation tool		"Because I am familiar with these holidays so I generally…so I just need to make sure the holidays that I think it's the right holiday so I just type their English name to confirm them."(n05)	(1) Google "祭拜祖先 節日 "[ancestor worship holiday] (2) Google "除夕 英文"[New Year's Eve English] (3) Google "端午節 英文 "[Dragon Boat Festival English](n05)(Chinese holiday)
			Technology: very familiar; Movie: very familiar(n18)	"It depends on what kind of task because for the movie task and technology task, I am kind of very familiar with the topics so actually I don't need any searching engine."(n18)	
	8.2 kind of familiar				
				"I am kind of familiar with those topics so, for me, it's not hard to find the answer."(n04)	
	8.3 not familiar				
		familiarity and directly linking		"Otherwise, if you are not familiar with the topic, Google will be the only interest door for you, to me actually. And I think, for some parts, language is still a problem."(n07)	
		familiarity and language		"I think if you want to (search for) some topics you are not familiar with and I think maybe your mother tongue is the best choice."(n13)	
			Technology: not familiar; difficult(n15)	"I think the difficulty for me is to search for the task I am not familiar with like the technology because I am not familiar with the mobile phone market. So it's difficult."(n15)	

				“I think the most difficult part is I am not very familiar with the U.S. holiday task and I spent several times looking at the webpages to find out what I actually want for this task.”(n17)	(1)google “us holidays religious”=>About the USA>holidays>ethnics & Religious Observances (2)google “us holidays wiki”=>public holidays in the United States in Wikipedia (3)go to dictionary.yahoo.com.tw directly (4)search “ethnic” in Yahoo dictionary (n17)(U.S. holiday)
9 credibility				“I’m pretty familiar with everything and when I choose the website, I will definitely concern about the authority and actually I think the ranking is kind of important, too.”(n10)	
				“Actually, I think the content on examiner.com is someone ask a question and someone reply for it so I am not sure is this result is true or not because it’s just someone’s answer, just some feedback.”(n21)	

APPENDIX D

IRB DOCUMENT

Memorandum

To: Wan-Yin Hong

From: Christopher Ryan PhD, Vice Chair

Date: 11/15/2010

IRB#: PRO10060053

Subject: information behavior study

The University of Pittsburgh Institutional Review Board reviewed and approved the above referenced study by the expedited review procedure authorized under 45 CFR 46.110. Your research study was approved under:

45 CFR 46.110.(6)

45 CFR 46.110.(7)

The IRB has approved the advertisement that was submitted for review as written. As a reminder, any changes to the wording of the approved advertisement would require IRB approval prior to distribution.

Approval Date: 11/14/2010

Expiration Date: 11/13/2011

For studies being conducted in UPMC facilities, no clinical activities can be undertaken by investigators until they have received approval from the UPMC Fiscal Review Office.

Please note that it is the investigator's responsibility to report to the IRB any unanticipated problems involving risks to subjects or others [see 45 CFR 46.103(b)(5) and 21 CFR 56.108(b)]. The IRB Reference Manual (Chapter 3, Section 3.3) describes the reporting requirements for unanticipated problems which include, but are not limited to, adverse events. If you have any questions about this process, please contact the Adverse Events Coordinator at 412-383-1480.

The protocol and consent forms, along with a brief progress report must be resubmitted at least one month prior to the renewal date noted above as required by FWA00006790 (University of Pittsburgh), FWA00006735 (University of Pittsburgh Medical Center), FWA00000600 (Children's Hospital of

Pittsburgh), FWA00003567 (Magee-Womens Health Corporation), FWA00003338 (University of Pittsburgh Medical Center Cancer Institute).

Please be advised that your research study may be audited periodically by the University of Pittsburgh Research Conduct and Compliance Office.

To: Wan-Yin Hong

From: Christopher Ryan, PhD, Vice Chair

Date: 10/6/2011

IRB#: REN11080220 / PRO10060053

Subject: information behavior study

Your renewal for the above referenced research study has received expedited review and approval from the Institutional Review Board under: **This approval is for analysis of data only.**
45 CFR 46.110.(6) data/research
45 CFR 46.110.(7) characteristics/behaviors
Please note the following information:

Approval Date: 10/6/2011

Expiration Date: 10/5/2012

Please note that it is the investigator's responsibility to report to the IRB any unanticipated problems involving risks to subjects or others [see 45 CFR 46.103(b)(5) and 21 CFR 56.108(b)]. The IRB Reference Manual (Chapter 3, Section 3.3) describes the reporting requirements for unanticipated problems which include, but are not limited to, adverse events. If you have any questions about this process, please contact the Adverse Events Coordinator at 412-383-1480.

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Letter of Consent for participants

FWA00003338 (University of Pittsburgh Medical Center Cancer Institute).

Please be advised that your research study may be audited periodically by the University of Pittsburgh Research Conduct and Compliance Office.

Title of research: Information Behavior of bilingual online searching

Investigator: Wan-Yin Hong

Before agreeing to participate in this research study, it is important that you read the following explanation of this study. This statement describes the purpose, procedures, benefits, risks, discomforts, and precautions of the program. Also described are the alternative procedures available to you, as well as your right to withdraw from the study at any time. No guarantees or assurances can be made as to the results of the study.

Explanation of procedures:

This research study is designed to discover the information behavior of bilingual online searching and the possibility of information support during the searching process. Wan-Yin Hong, a student at School of Information Sciences, University of Pittsburgh, Pennsylvania, is conducting this study to learn more about the searching process of bilingual online searching. Participation in this study involves completion of questionnaire, searching task and short interview which will be last approximately one hour for whole process. The searching task will be screen recording and will be used for the purpose of data analysis. The interviews will be audiotaped by the researcher and later transcribed for the purpose of data analysis. The interviews will be conducted at a setting that is mutually agreeable to the participant and the researcher.

Risks and Discomforts

The breach of confidentiality is a potential risk of participation. The researcher will keep the data in a secure cabinet during the research period and all of the data will be destroyed after the study finished for six month.

Benefits

Participation offers no direct benefit but that society may benefit through a better understanding of bilingual internet searches.

Confidentiality

The information gathered during this study will remain confidential. There will not be any identifying names on any data. The results of the research will be published in the form of dissertation and may be published in a professional journal or presented at professional meetings. The information will help website designer and system developer to improve their design.

Withdrawal without Prejudice

Participation in this study is voluntary; refusal to participate will involve no penalty. Each participant is free to withdraw consent and discontinue participation in this project at any time without prejudice from this institution.

Cost and/or Payment to Subject for Participation in Research

There will be no cost for participation in the research. Participants will get $5 dollar gift card to participate in this research project.

Questions

Please contact Wan-Yin Hong (wah3@pitt.edu) if you have any questions about the research study.

Agreement

Your signature below indicates that you agree to participate in this study.

_____ _____

Signature of Subject Date

_____

Subject name(printed)

_____ _____

Signature of Researcher Date

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