

# Exploring Individual User Attitudes Towards Performance with Web Search Engines: An Extension Study

**Allison J. Morgan**

School of Information Sciences and Technology  
Pennsylvania State University  
amorgan@ist.psu.edu

**Bernard J. Jansen**

School of Information Sciences and Technology  
Pennsylvania State University  
[jjansen@ist.psu.edu](mailto:jjansen@ist.psu.edu)

**Eileen M. Trauth**

School of Information Sciences and Technology  
Pennsylvania State University  
etrauth@ist.psu.edu

## ABSTRACT

As the Internet fulfills an increasingly important role in society, study into human behavior and interaction with the technology becomes key to the development of improved systems. As a result, the research agenda of the authors seeks to identify the role of individual differences with users of technology and its subsequent impact on performance. In this initial study, we examine an instance of individual differences with users of the World Wide Web by evaluating user attitudes and performance with Web search engines. Search engine importance is connected to their role as the primary vehicle for locating content on the Internet. Prior research into user attitude has shown a connection with use of technology. In our study we replicate, extend, and critique an investigation conducted by Liaw and Huang (2003) into user attitudes toward search engines as information retrieval tools. Liaw and Huang found that factors such as individual computer experience, quality of search systems, motivation, and perceptions of technology acceptance impact users desire to use search engines as a tool for information retrieval. However, the connection is not drawn to actual individual user performance with a searching task. Based upon the analysis of our data, we were unable to replicate the results achieved in the Liaw and Huang study or draw a connection between these factors and performance. This finding, that our analysis yielded different results, supports the need for further investigation into individual differences and suggests areas for future research.

## Keywords

Search engine, User behavior, Information retrieval, Attitude, User performance, Individual Differences, External Validity, Replication.

## INTRODUCTION

The Web is a powerful collection of resources in terms of educational, entertainment, personal, and professional content. Due to the nature of the benefits and advantages that the Web provides, it is becoming increasingly important for all people to have access to the technology (Hoffman et al., 2004). So, the current unequal access among individuals to this resource, termed the "Digital Divide" has been an important area of interest and concern.

Digital Divide research has articulated the problem of unequal access to the Web in terms of both physical and social access. The early focus in Digital Divide literature on physical access to the Internet articulated the situation in regard to the actual infrastructure and hardware elements necessary to connect to the Web. In addition, social access to the Web refers to the technical skill and the social network necessary to benefit from use of the Internet (Kling, 1998). Although these explanations provide insight into the situation, there does not appear to be a "silver bullet" reason for the unequal participation of people with Internet technology. Therefore it is necessary to explore the factors, influences, and barriers that people have in their use of Web technology.

In relation to understanding how people interact with Internet technology, the research agenda of the investigators seeks to identify the role of individual differences of users of technology and its subsequent impact on performance. This interest is

rooted in the understanding that individual people will exhibit different behaviors based upon influences of and experiences with the environment<sup>1</sup>. In accordance with this agenda, we embarked on this project to investigate an instance of individual differences at a micro level. In order to do so, we examine the nature of attitude in relation to usage of and performance with technology. Attitude can be defined as “positive or negative feeling or mental state of readiness, learned and organized through experience, that exerts specific influences on a person’s response to people, object, and situation” (Gibson et al., 1991 p.70 in Liaw and Huang, 2003). The purpose of evaluating user attitude is to seek evidence that individual differences do indeed result in patterns of difference among users. We have based this investigation upon a study carried out by Liaw and Huang (2003) in which they developed an instrument to gauge user attitudes towards search engines. Additionally, we test their instrument to ensure it is valid in alternative research settings. Importantly, this research represents an initial pilot study that seeks to provide basis for the investigation into whether or not individual differences are a factor in use and performance with technology.

In an effort to explore the role of individual differences in relation to technology, we investigate user behavior with Web search engines. The decision to evaluate search engines as a subset of technology was based on the essential role that they play in the location of content and the information searching process on the Internet. More specifically, we investigate user attitudes and performance with these Web search engines. According to Yang and Yoo (2004), attitude “deserves more attention in IS (information systems) research for its considerable influence on the individual and organizational usage of IS (p.19)”. In the Liaw and Huang (2003) study, user attitude was explored through the collective inquiry into integrated individual computer experience and perceptions, system quality perspective, technology acceptance model (TAM) perspective, and motivation perspective in order to develop a new aspect of individual attitudes toward search engines’ acceptance and use. By using their study as a baseline, we will adopt the perspective of Liaw and Huang and investigate use attitude through the survey of experience with computing, perceived usefulness, enjoyment and ease of use, all of which effect use and acceptance of technology.

Prior research on user attitude has shown a connection with the amount of usage of technology (Howard and Mendelow, 1991; Hartwick and Barki, 1994), user acceptance of technology (Lee et al., 1995), the amount of successful use of technology (Mitra, 1998) and, the amount of successful performance with the Internet (Moon and Kim, 2001). In addition, Liaw and Huang (2003) conducted a study into user attitudes toward search engines as an information retrieval tool. Liaw and Huang found that factors such as individual computer experience, quality of search systems, motivation, and perceptions of technology acceptance impact users desire to use search engines as a tool for information retrieval (IR). However, the study did not draw the connection to actual individual user performance with a searching task. Additionally, the researchers conducted the study on a convenience sample, raising questions of the transferability of results.

There are three goals that we seek to accomplish through this research. First, we replicate, extend, and critique the investigation conducted by Liaw and Huang (2003) to determine if the findings are applicable to other population samples and to understand better how attitude affects not only usage, but also actual user performance with search engine technology. Importantly, in this area of research, replication studies are necessary to determine how applicable findings are in alternate environments (Hsieh-Yee, 2001). Second, we investigate user attitude as a component of individual differences, to determine if they are a factor in usage or performance with technology. Lastly, we test the validity of an instrument created by Liaw and Huang (2003) that seeks to identify an instance of individual differences with search engine technology through the evaluation of user attitude. Due to the researchers’ goal to expand this study into a more broad evaluation of individual differences, we must ensure that the instrument can be utilized in alternative research settings in order to further make use of the constructs. Thus, this research provides important information about the impact of individual characteristics and perceptions on actual usage and performance with Web technology. This research also provides preliminary data to support the need for further investigation of other types of individual differences

## LITERATURE REVIEW

User online searching behavior and performance may vary among users for different reasons. The attribute we explore is that of user attitude. To investigate the impact of attitude, it is necessary to understand the issues affecting the attitudes of individuals towards search engine technology. To do so, we will consider how experience with computing, quality and usability of search engines, and perceived usefulness influence user attitude. Each of these issues may possibly have bearing on an individual’s use of, attitude towards, and performance with Web technology, and specifically search engines.

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<sup>1</sup> Trauth has applied the Individual Differences Theory to gender and IT (Trauth et al., 2004, 2005; Morgan et al., 2004; Quesenberry et al. 2004).

Research carried out in the area of user attitude in relation to technology has yielded a variety of results. Attitude has been linked to an increase in system usage (Desanctis, 1983). It has also been detailed that user attitude is beneficial in learning to use new technologies (Francis-Pelton and Pelton, 1996). Individuals' attitudes towards computing may also be improved through instructional training (Woodrow, 1992). However, in relation to user Web searching behavior, there is a lack of empirical investigation into the connection between user attitude, usage, and performance.

Experience with computing has been shown to have a strong connection to use of technology. This attribute has been identified to be an influencing factor for use of technology, especially with more experienced individuals (Taylor and Todd, 1995; Ajzen and Fishbein, 1980). Previous experience with related technologies has also been determined to influence behavior with a new technology (Agarwal and Prasad, 1999).

The quality and usability of search engines are also correlated with user behavior with technology. Bar-Ilan (2003) describes Web search engines as "major tools for discovering and locating information on the Web" (p. 231). There are roughly 3,200 search engines in existence, which 71% of Web users visit to locate information on the Web (Eastman and Jansen, 2003). According to a study by Wang et al. (2000) users of Web search engines are not generally successful and that they generally find the syntax used in the system problematic. Research has also shown that use of simple queries generally results in better search performance than the use of advanced operators such as Boolean (Eastman and Jansen, 2003). In addition, as cognitive demand on the user increases search performance suffers (Marchionini, 1995).

Current Web search engines are built upon the principles of traditional IR systems and generally utilize techniques and algorithms from those systems, along with some specific hypermedia techniques such as link analysis and anchor text. Much of the functionality of these IR systems is based on a notion that users are able to represent their information need in the form of textual query (Belkin et al., 1982). Web search engines follow in this tradition by allowing users to enter queries in order to search for the information they seek on the Web.

Perceived usefulness is an additionally important factor in influencing individual use of technology. The construct of perceived usefulness deals with an individual's perception of the value of the system. Research suggests that perceived usefulness is a valid way of measuring satisfaction of users with IS (Davis, 1989). Those people who exhibited a high degree of perceived usefulness were more likely to be better performers with technology than those with low perceived usefulness. According to Lees (1987), the perceived usefulness of software has a correlation in with an increase in a users experience level. According to Davis (1993), perceived usefulness is an important measure in determining usage level of an information technology.

## RESEARCH QUESTION

Utilization of Web technology and more specifically search engines may be affected by a number of factors. This study seeks to identify some of those factors in an effort to better understand individual differences and human information behavior with Web search engines. Therefore, we seek to investigate:

*RQ1: How does individual user attitude affect user performance with Web search engines?*

## Hypotheses

In researching this question, we have posed the following hypotheses, which we adapted from the Liaw and Huang (2003) study with the addition of a hypothesis that integrated the notion of perceived usefulness. Based on the documented importance of an individuals experience with technology, it appears that there is a strong connection to use. Therefore, we hypothesize that level of experience with computing will correlate with enjoyment and use of search engines:

*H1. The more general computing experience an individual has, the more he or she will enjoy search engines.*

*H2. The more general computer experience an individual has, the easier he or she will perceive the use of search engines.*

Research points to the quality and ease of use of search engines to be a positive influence on use. In this study, quality is being measured based on the user's perception of the utility of search engines. Therefore, we believe that the higher/better the quality of the search engine leads to more usage and enjoyment of search engines:

*H3. The higher the quality of the search systems, the more the individual will enjoy using search engines.*

*H4. The higher the quality of search systems is, the easier the individual will perceive the use search engines.*

If a user is able to work effectively with a search engine, there may likely be enjoyment from use of the technology. Therefore, we hypothesize that enjoyment will lead to an increase in usage of search engines.

H5. The more the individual enjoys using search engines, the more he or she will use search engines.

H6. The easier the use of search engines is, the more he or she will use search engines.

Use of search engine technology may allow for greater participation and ease of use of the technology. Therefore, a users' intention to use search engines will be increased based on their actual use of the technology.

H7. The more the individual uses search engines, the higher his or her intention to use search engines will be.

Due to perceived usefulness being a strong predictor of usage with technology, we believe that it will also have a strong correlation with performance.

H8. Perceived usefulness will lead to performance increase.

Based upon our hypotheses, the following graphical representation (Figure 1.) illustrates the process by which usage of web search engines is realized. Users first have an opportunity for exposure and experience with Web search engines. The more experience that an individual has with search engines will then increase their level of enjoyment with the technology. Enjoyment with the technology may then positively affect perceived ease of use of the technology and subsequently increase the frequency with which an individual uses the search engines. The increase in the frequency of use of search engines will then result in a higher intention for continued use of the technology as well as effect performance.

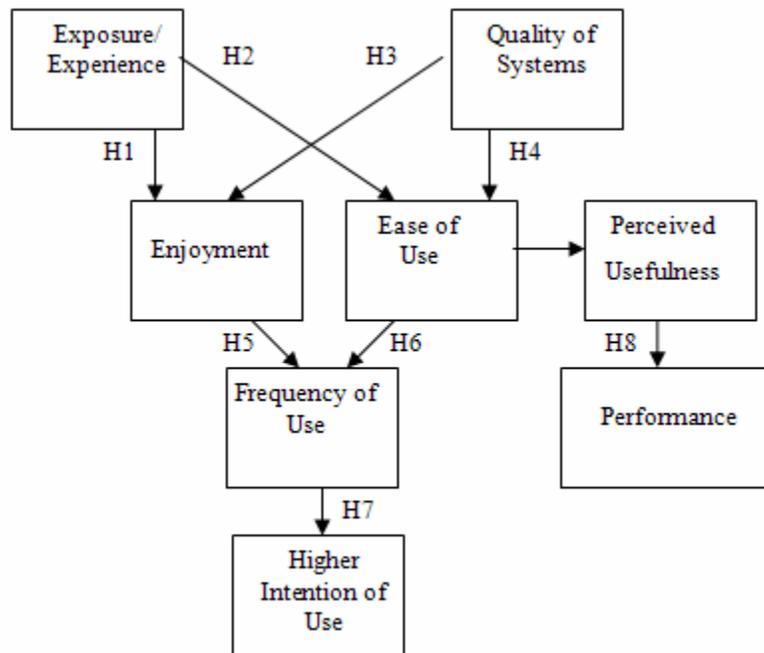


Figure 1. View of User Behavior with Web Search Engines

## RESEARCH DESIGN

To evaluate our hypotheses, we conduct a user study with searchers interacting with a real Web searching system. The system utilized in this evaluation that was similar to standard Web search engines, except that this system offers personalized automated assistance. The backend searching system is Microsoft's Web Information Service (IIS). The IIS system is running on an IBM-compatible platform using the Windows XP operating system and Microsoft Web Explorer as the systems' interface. For the personalized searching assistance, the automated assistance application was integrated via a wrapper to the Web Explorer browser. The interface was very similar to that experienced in the standard Web browser, as shown in Figure 2.

## Pre-Study Measures

The study participants were 43 college students attending a major U.S. university. A pre-evaluation demographic survey was administered based upon previous research of one of the investigators. (Jansen and McNeese, Forthcoming). All were

familiar with the use of Web search engines. Thirty (63%) of the participants reported having over 5 years of experience using Web search engines. Most of the students were studying information science and technology or other aspects of engineering. So, our sample has an understanding of computers and information technology.

We also collected demographic data on the subjects, along with data concerning their searching perceptions and behaviors. The mean age was 21 (sd=2). The subjects also self-rated their searching skills. Of the forty-three subjects, thirty rated themselves as expert or near expert. None of the subjects rated themselves as a novice. The most commonly used search engine was Google (78% of participants). The average number of searches per day was about 3-5. So, generally, the study sample represents a young population that is comfortable with using the Web to locate information.

### Document Collection and Topics

The study used the W2G Text Retrieval Conference (TREC) document collection with six topics. The TREC collection is a standard content collection for use in searching studies. The documents come in aggregate files. We parsed the aggregate files into their individual component documents. The test collection after parsing contained approximately 200,000 documents. Each TREC collection comes with a set of topics for which there are relevant documents in the collection. The six topics we used for this study were: *Behavioral genetics*, *Tropical Storms*, *Quilts being used to generate income*, *Robotic technology*, *Estonia economic issues*, and *Super critical fluids*.

In the results reported here, we were interested in the documents that the users selected as relevant, so we did not utilize the TREC relevant judgments.

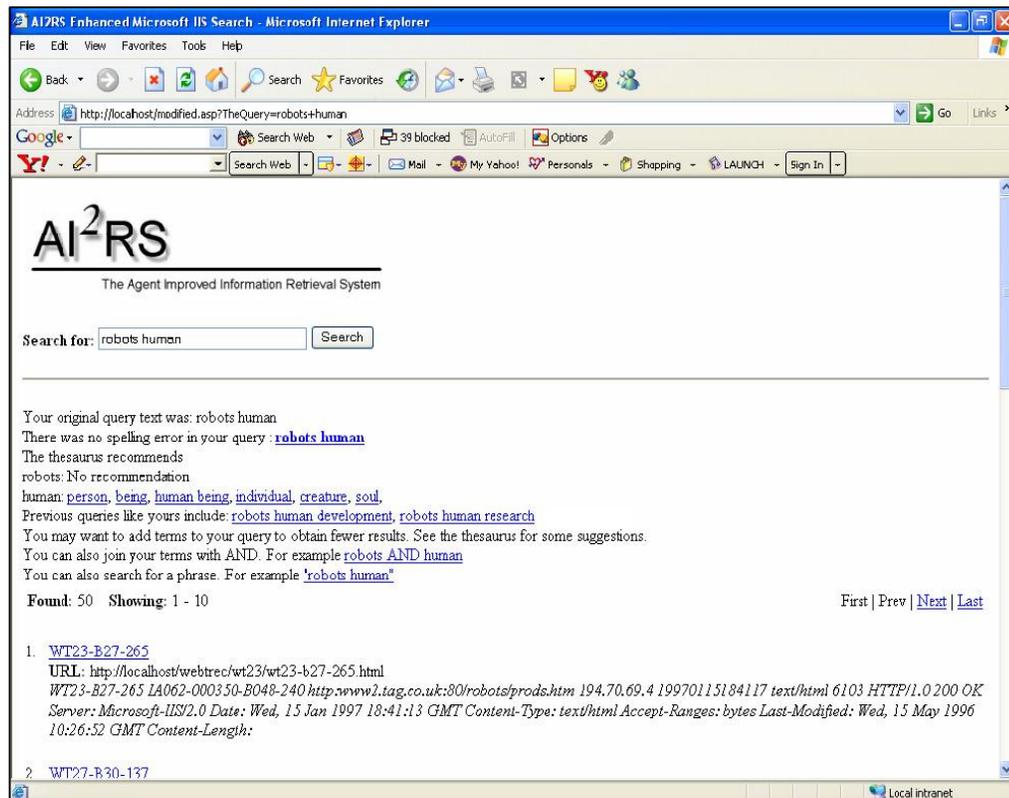


Figure 2. The System With Automated Assistance Displayed

### Experimental Set-Up

At the beginning of the study, each of the subjects was provided with a short statement instructing them to search on a given topic in order to prepare a report, which is in line with the definition of relevance judgments for the TREC documents. The subjects had fifteen minutes on the system to find as many relevant documents as possible. We determined the length of the search session based on reported measures of the typical Web search session (Jansen and Spink, 2003). We notified the subjects that the system contained an automatic feature to assist them while they were searching. We showed them a screen

capture of an example of the displayed assistance. Again, we instructed the subjects that they could view the assistance or ignore the assistance with no detrimental effect on the system.

For the searching sessions, we then gave each of the subjects one of the six search topics, read the one paragraph explanation provided with the TREC collection, and then afforded the written explanation to them. We asked the subjects to search as when they normally conduct online research, taking whatever actions they usually take when locating documents of interest online. In this respect, we adhere to recommendations to place the searching need within a scenario (Rosson and Carroll, 2002).

### Instrument

The data collected in this study was conducted using a survey instrument adapted from a study by conducted by Liaw and Huang (2003) into user attitudes toward search engines as an information retrieval tool. There were two parts to the questionnaire that included computer and Internet experience and perceptions of search engines. The computer and Internet experience portion of the questionnaire surveyed participants experience with use of operating systems, word processors, the Internet, web search engines, World Wide Web programming languages. The perceptions of search engines portion surveyed the participants' opinions of the capability of search engines to help them locate desired online content. The six themes surveyed in this portion of the instrument included quality of search engines, Internet response time, perceived enjoyment of search engines, perceived ease of use of search engines, perceived usefulness of search engines, and intention to use search engines.

### DATA ANALYSIS

The analysis of the data collected in this study was performed using linear regression analysis. We ran the regression using SPSS version 12.0. Linear regression was the chosen method in the Liaw and Huang study, and it approximates the coefficients of a linear equation that contain one or more independent variables to calculate the predicted value of the dependent variable.

In the Liaw and Huang (2003) study, the authors reported that all relationships held true for the proposed hypotheses. However, we were not able to replicate those results in this study. Actually, based on our analysis, we found that significant relationships exist for only two of the proposed hypotheses.

Our analysis shows supports for *H4. The higher the quality of search systems is, the easier the individual will perceive the use of search engines*, as shown in Figure 3. Support for H4 shows that quality of a search engine as determined by an individual user is predictive of the ease of use an individual has with that technology. The regression was a relatively poor fit ( $R^2_{adj} = 24.0\%$ ), but the overall relationship was significant ( $F_{3,36} = 5.12, p < 0.01$ ).

In addition our analysis results shows support for *H7. The more the individual uses search engines, the higher his or her intention to use search engines will be*, as shown in Figure 4. The relationship identified here illustrates that the individual's perceived ease of use of a search engine predicts their perceived usefulness of the technology. The regression was again a very poor fit ( $R^2_{adj} = 19.8\%$ ), but the overall relationship was significant ( $F_{3,36} = 2.97, p < 0.05$ ).

The findings of this study imply that an individual's perception of quality and experience with search engines are important factors in their usage level. Additionally, none of the items that we analyzed were found to have any significant effect on performance. We were undoubtedly surprised at the results of the analysis. However this finding along with the six other unsupported hypotheses raised some important and interesting questions related to individual differences. Mainly, what factors caused the difference in the results gathered in the Liaw and Huang study versus our own study.

### DISCUSSION AND FUTURE RESEARCH

This research study was conducted in order to understand more about the individual differences of users of Internet technology and the effect upon performance. The fact that we were not able to replicate the results of the original raises some important questions about the factors motivating that unexpected outcome. A variety of explanations can be used to illustrate why this outcome was achieved. We subsequently examine some of these explanations.

First, the population of the Liaw and Huang study was composed of Taiwanese medical students versus the population for our study, composed of American undergraduate university students within an information technology program. So, the diversity of the two population samples exhibit evidence that, at a group level, differences exist with users of technology in different cultural settings and academic programs. This factor may have contributed to the difference in results.

Next, the instrument that we tested in this study may not be valid. It may possibly be too specific to the original situation for which it was developed and not able to be utilized in other settings. The testing of this instrument was extremely important given the exploratory nature of the research question, and the investigators' desire to explore individual differences in a larger population sample in future research. External validity is critical to being able to replicate the study in larger populations. According to Hsieh-Yee (2001), many studies of Web behavior lack external validity, which is problematic when attempting to generalize findings.

Lastly, the reason that we may have not been able to replicate the results of the Liaw and Huang study is likely due to the notion that there are other factors that cause impact on usage and performance that are not being measured with this instrument. Based on that idea, we identify the likelihood that a range of individual differences may indeed have an effect on the performance and usage of Web search engines and the Internet. This understanding provides the researchers' motivation to embark on further research into other characteristics of individuals that may be important regarding use and performance with Web search engines. There may be a variety of other factors and individual differences that influence this situation, and deserve the attention of researchers in this area to better understand the situation and its impact on an individuals' interaction with technology.

Based on the results of this study we will seek to understand the reason that we were not able to replicate the initial results, and the role additional individual differences. Since we were not able to definitively answer why the results were not the same, we seek to better understand what the actual factors are that make individual searchers better, different, or more effective than others. Future research into this area will include evaluating data already collected involving comparing the conceptual models of the system designers and user mental models of search engines. Including this data into our analysis may help us to better understand how designers conceived of users and how users viewed themselves in relation to the system. This data may help us better explain how we arrived at our results.

## CONCLUSION

This research set out to evaluate the nature of the relationship of individual differences to Internet use through the lens of user attitude to usage and performance of search engines. In the process, we also sought to validate an instrument that measured this interaction. We were unable to replicate the findings of the initial study, but we were provided with motivation to further investigate individual differences and how they impact user behavior and performance. It is very important to understand the factors that influence user behavior with Web search engines in order to inform the development of better systems. In addition, the continued study of individual differences with regard to Web searching behavior is critical for defining the differences among online searchers to encourage continued participation with the technology. This may also help to address the situation of the Digital Divide.

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