Association for Information Systems
AIS Electronic Library (AISeL)

PACIS 2001 Proceedings

Pacific Asia Conference on Information Systems (PACIS)

December 2001

A Study of Web Searching Behaviors - Comparing the Effort-Accuracy Tradeoff Model with the Social Cognitive Theory

Feng-Yang Kuo
National Sun Yat-sen University

Tsai-Hsin Chu
National Sun Yat-sen University

Hong-Ssu Hsieh
National Sun Yat-sen University

A Study of Web Searching Behaviors – Comparing the Effort-Accuracy Tradeoff Model with the Social Cognitive Theory

Feng-yang Kuo bkuo@mis.nsysu.edu.tw
Tsai-hsin Chu thchu@mis.nsysu.edu.tw
Department of Information Management,
National Sun Yat-sen University

Hong-ssu Hsieh
m8442614@mis.nsysu.edu.tw

Abstract

The rapid growth of Web makes Web users or the consumers may waste a lot of time and efforts to search for information. This becomes one of the major barriers to electronic commerce. In this study, we have applied the effort-accuracy tradeoff model (Johnson & Payne, 1985; Payne, Bettman, and Johnson, 1993) and the Social Cognitive Theory (Bandura, 1986) to study WWW search decisions. Specifically, we attempt to understand if there is a tradeoff between effort and accuracy as well as the impact of self-efficacy on the tradeoff model in Web searching behavior. The result shows that self-efficacy is an important factor to Web search accuracy. People with high efficacy yield more accurate result in the search. In addition, the tradeoff between effort-saving and accuracy only exists in the low efficacy individuals. In contrast, for high-efficacy people, there is no significant change in efficacy, effort expended, and accuracy in the trials. Furthermore, the emphasis of accuracy will increase the effort expended in low efficacy group but not in high efficacy group.
Keywords: effort, accuracy, self-efficacy, tradeoff, social cognitive theory.

Introduction

The rapid growth of World Wide Web (WWW) has significantly increased the quantity of data available to WWW users and, at the same time, raised many questions on the information's accessibility (Liang, et al., 1999). First, information explosion causes significant cognitive overload. Next, the non-linearity of the hyper documents may cause disorientation of the user who may easily lose the sense of location and direction. Moreover, the uncontrolled growth of data reduces the quality of the data. Some are incorrect or out of date, while others are incomplete. The lack of quality significantly reduces the value of WWW as a reliable information source. Finally, the information providers have little control of who has access to what data and how the data are used. WWW users may waste a lot of time and effort to search for information. Thus, getting lost in WWW is more frequent than common and, therefore, becomes one of the major barriers to the development of electronic commerce. Research must be directed at understanding users' Web search behavior to provide guidance for the design of WWW applications.

Several previous studies are particularly relevant here. Hoffman & Novak (1996) suggest two kinds of browsing behaviors: goal directed and experiential. Users who adopt goal directed strategy are utilitarianists and have explicit motivation to search for specific information. Similarly, Murphy (1999) suggests that searching and surfing are two major ways to browse the Web sites. Searching refers to specific information finding activity while surfing means that people simply browse Web pages for curiosity and fun. Furthermore, Vendenbosch & Higgins (1996) find that scan- and focus-search are two ways to acquire information through Internet. In scan-search, people simply browse with no specific question to resolve while focus-search occurs when people want specific information for specific

problem (Auguilar, 1967; Huber, 1991). Collectively, these studies suggest that goal is very important. People who have explicit goal will adopt a directed, focused strategy to search. Still, while these studies explore the influence of goal motivation, they have ignored the factor of experience in web browsing decisions. In real world applications, both goals and experience are important factors and, in certain cases, experience could even play a more important role than goals in determining Web search behavior.

To be specific, in the aspect of goal motivation, the effort-accuracy tradeoff model (Johnson and Payne, 1985; Payne, Bettman, and Johnson, 1993) provides a good explanation for the choice of a strategy. In this model, people choose a more sophisticated and, therefore more effort-demanding strategy (which, using the terms reviewed above, could be a goal directed, searching, or focus strategy), when they are seeking for an accurate result that is important to their goal completion. Conversely, a less effort-consuming (i.e., scanning or surfing) strategy will be employed when people do not care much for the result. Thus, people have a reservoir of strategies to choose from and will attempt to minimize the cost and/or maximize the return when making their choice of strategies.

While the effort-accuracy tradeoff model has been shown to be useful to explain subjects' behaviors in laboratory environments, it has failed to consider the effect of experience, which is a critical factor in real world conducts. Several studies have shown that in naturalistic environment, people often stick to the same strategy regardless of situational differences (Klein, 1993). For example, Beach and Mitchell propose the image theory that stresses the intuitive and automatic aspects of decision-making in real-world settings (Beach, 1990; Mitchell & Beach, 1990). This theory suggests that people test the acceptability and compatibility of a single alternative with the decision maker's images. An option is rejected when the weighted violation of the criteria exceeds some critical threshold. Furthermore, making judgment about the compatibility of an option with one's image is a rapid, smooth process that can be characterized as intuitive. An analytical process is evoked only if there are more than one acceptable alternative. Similarly, Hammond, et al. (1987) propose that people will rely on intuition, which is a rapid, low cognitive control strategy to solve their problem if they are experienced and if there are a large number of cues. Finally, in researching computer usage, Olson and Nielsen (1987) find that expert users do not change their access method. These findings collectively suggest that people habitually adopt intuitive ways to solve problems when they are experienced.

We should note that goal motivation and experience are not mutually exclusive. Rather, according to the Social Cognitive Theory (Bandura, 1986), they are reciprocally determined. In this theory, experienced people who are also confident may adopt a goal level that is higher than one adopted by those with little experience. Conversely, people of low experience and self-conviction may deem trivial challenges to be impossible and give up quickly. More importantly, experts may rely on intuitive strategies over analytical ones and can still manage to maintain a high level of performance. The Social cognitive theory therefore provides an appropriate framework for researching the influence of goal motivation and experience on Web searching decisions.

In this study, we have applied the effort-accuracy tradeoff model and the Social Cognitive Theory to study WWW search behaviors. This paper is organized as follows. Section 2 reviews the effort-accuracy tradeoff model and The Social Cognitive Theory. Section 3 describes the research design. In section 4 data analysis is presented. Finally, discussion and conclusion are presented in section 5.

Effort-accuracy tradeoff

Much past research concerning peoples' strategy for processing information suggests that the number of alternatives be a critical factor in their decision. When faced with decision

problems involving few alternatives, people often use normative decision strategies that process all relevant information. On the other hand, when they are faced with more complex choice problems involving many alternatives, people often adopt heuristic strategies that are selective in the use of information; this phenomenon is often attributed to human's bounded rationality (Simon, 1955, Keeney & Raiffa, 1976; Tversky, 1972). Thus, Johnson & Payne (1985) and Payne, et al. (1993) argue that individuals have multiple goals and use multiple strategies in different situation. How people may decide is predictable when both the benefits and costs of specific decision strategies in particular task environments are taken into account. They suggest that choice decision is a process of tradeoff between accuracy-seeking and effort-saving.

Payne, et al. (1993)'s basic premise is that people tend to prefer choices that have a high level of accuracy and that require less effort. But strategies yielding more accuracy often require more effort. Therefore, people's strategy selection is the result of a compromise between the desire to make the most correct decision and the desire to minimize effort. The relation between accuracy and effort saving can be represented in Figure 1 (Payne, et al., 1993). People have a reservoir of heuristic strategies for performing a task. These decision heuristics approximate the accuracy of normative decision rules with substantial savings of effort in a particular decision environment. The selection of a heuristic will be a function of the emphasis placed on maximizing accuracy versus saving effort. When people are committed to an accuracy goal, they choose strategies in the upper left quadrant. These strategies are analytical in nature and requires significant amount of effort in order to yield an accurate result. Conversely, when effort is the constraint, they move toward right to those that are more intuitive although less accurate. The relation governing the selection of strategies therefore can be depicted as an indifference curve (see Figure 1).

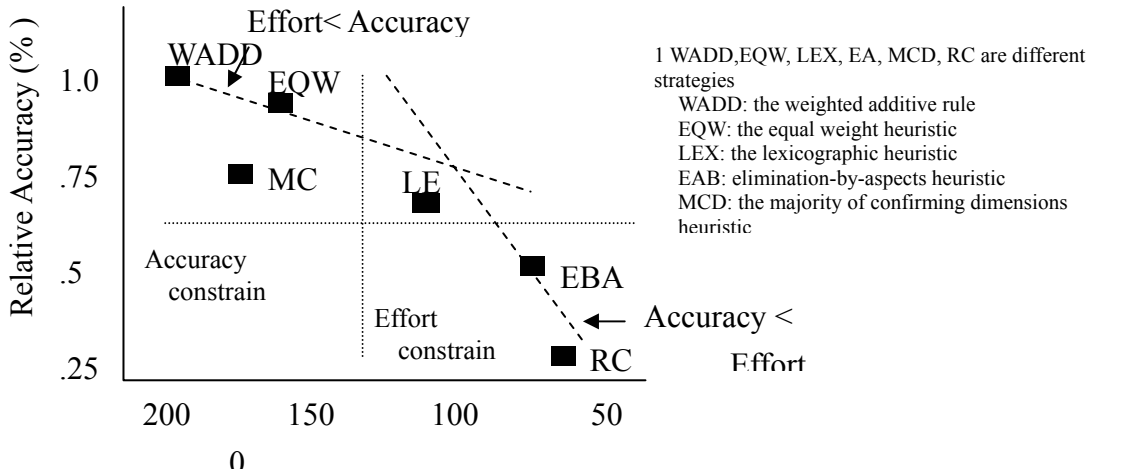

Figure 1 Effort-Accuracy tradeoff [1]
(Source: Payne, 1993)

Thus, according to this effort-accuracy tradeoff model, WWW users will adopt either a focus strategy or a scan one based on their goal. They adopt the focus search strategy when trying to find specific information. However, the information overload and the incomplete, incorrect data require people to visit more and more WWW sites. People will choose to do so only if their goal motivation for a high level of accuracy surpasses their desire to save effort. In other words, people will vary their search behavior depending upon the situation and this behavior will be a result of tradeoff between effort-saving and accuracy-seeking. Accordingly, we can propose a hypothesis as follows.

H1: There exists a tradeoff between effort-saving and accuracy-seeking on WWW search behavior.

In addition, people will adopt more analytical and time-consuming strategies when they are committed to an accuracy goal (see Figure1). That is, when people decide that accuracy is the goal they will expend more effort in exploring or comparing the choices to make sure the correctness of the decision. Thus, we can formulate the following hypothesis.
H2: When people become committed to an accuracy goal, they will expend more effort.

Self-efficacy

The Social cognitive theory (SCT) is concerned about human behavior from the perspective of a continuous reciprocal causation among behavior, cognitive and environment determinants (Figure 2) (Bandura, 1986). It regards human conducts as outcomes of a self-regulation process (Bandura, 1988), in which one of the most important mechanisms governing the decision on effort and strategy is self-efficacy. Perceived self-efficacy refers to beliefs in one's capabilities to organize and execute the courses of action to manage prospective situations (Bandura, 1986; 1997). Bandura (1986) suggests that self-efficacy is a critical factor of motivational and learning processes that govern task performance. The level of self-efficacy determines how much effort people will expend and how long they will persist in the face of obstacles or aversive experiences. When beset with difficulties people who entertain serious doubts about their capabilities slacken their efforts or give up altogether, whereas those who have a strong sense of efficacy exert greater effort to master the challenges (Bandura, 1982). People's judgments of their capabilities additionally influence their thought patterns and emotional reactions during anticipatory and actual transactions with the environment. Self-efficacy reflects not only an individual's perception of his or her ability to perform a particular task based on past performance or experience, but also reflect on the level of anxiety (Glass and Knight, 1988; Meier, 1985).

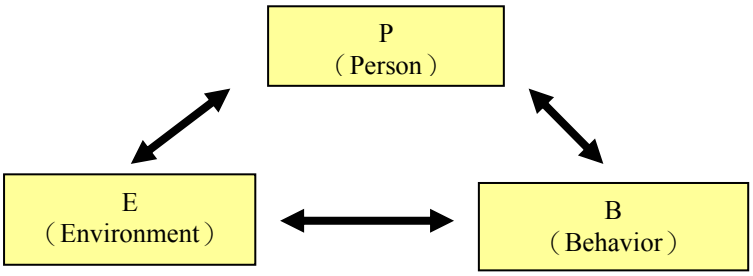

Figure 2 Social cognitive theory

Self-efficacy is not only a reflection of past performance and experience, it has been shown as a strong predictor of subsequent task-specific performance (Bandura, 1982；Wood and Bandura, 1989； Wood et al., 1990；Schunk, 1989；Zimmerman, 1990；Rooney and Osipow, 1992；Pajares and Miller, 1994；Compeau and Higgins, 1995) and all definition of the construct ultimately refer to what a person perceives their capabilities to be with regard to a specific task (Marakas, et al., 1998). Particularly relevant to the present study is that self-efficacy may influence the choice of strategy. In this regard, Wood and Bandura (1989) suggest a core model (Figure 3).

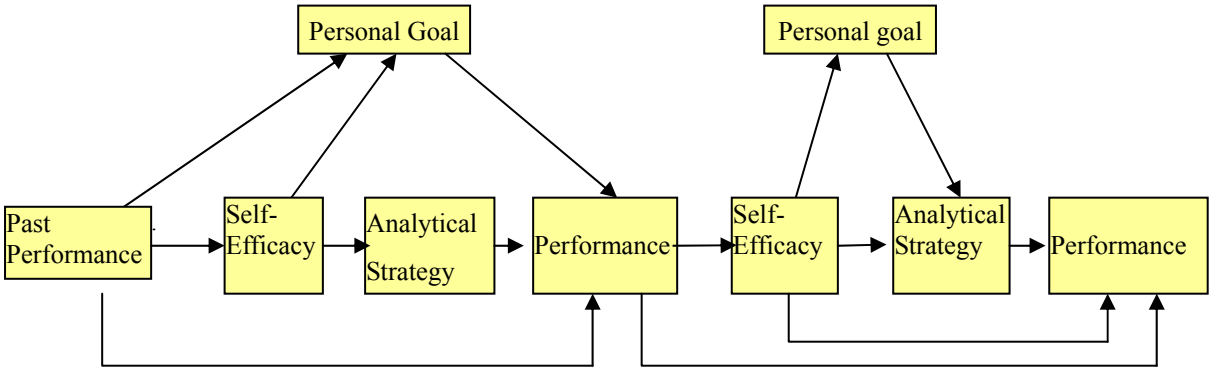

Figure 3 Core model of social cognitive theory
（Source：Wood and Bandura, 1989）

As we can see in this model, higher self-efficacy people who have strong belief in one's problem-solving capability tend to set a challenge goal. Also, people who are committed to a goal are likely to persist when confronted by a difficult task (Locke, 1968; Locke, et al., 1984; Hollenbeck & Klein, 1987) and use more effort in the development of strategies (Earley, Wojnaroski & Prest, 1987). However, this may lead to suboptimal performance unless it is aided by systematic thinking that reflects the experience (Earley, Connolly & Ekegren, 1989). Accordingly, if their effort is organized they can quickly arrive at a solution. On the contrary, less experienced people tend to begin with multiple factors simultaneously. This makes it difficult to determine which factors affected performance, and they make less effective use of feedback (Wood & Bandura, 1989; Wood, et al., 1990). Thus, perceived self-efficacy affects the quality of strategy, which in turn affects the performance.

To sum up, self-efficacy is important predictor to the performance of particular task. In Web search, users with high level of self-efficacy may therefore perform better than those of low level of self-efficacy. Thus, we propose a hypothesis as follows.

H3: People with higher self-efficacy will yield more accurate result in Web search behavior.

In addition, according to the Social Cognitive Theory, such high level of performance is not necessarily at the price of effort. This contrasts the prediction of Payne, et al. (1993) whose theory is concerned about only the tradeoff between cost and benefit. Much research has suggested that experts use intuitive strategies that are less effortful and yet, they still attain accuracy (Beach, 1990; Mitchell & Beach, 1990; Hammond, et al., 1987; Staggers & Norcio, 1993). Experts are able to holistically filter out the ambiguous and uncertain information and make use of the methods with which he or she is most experienced. They can direct their cognitive resources at solving the problem itself, rather than at the choice of strategy. The result is both effective and efficient use of the strategy that leads to quick and accurate result. Applying this concept to Web search, the experienced, high self-efficacy users may expend less effort but still attain better performance. As a consequence, the tradeoff between effort-saving and accuracy-seeking may not occur for people of high self-efficacy. Thus, we propose a hypothesis as follows.

H4: There is no tradeoff between effort and accuracy for people of high self-efficacy.

Research design

Experiment design

This study investigates users' search behavior on the Web based on the Social Cognitive Theory and the effort-accuracy tradeoff model. A longitudinal experiment of three trials is

conducted in order to observe the effect of the change of self-efficacy in research model.

Subjects

Eighty volunteers participated in this experiment (see Table 1 for the demographics). They are college students. Thirty of them major in computer relevant discipline. The average age of the subjects is twenty-six. There are twenty-two female and fifty-eight male.

Table 1 Demographic Characteristics of the Sample

		N	Percentage (%)
Gender	Female	22	27.5
	Male	58	72.5
Background	Computer relevant	30	37.5
	Non computer relevant	50	62.5
Age	Below 20	41	51.25
	21~30	17	21.25
	31~40	16	20.00
	Above 41	6	7.50

Task

The task is for subjects to search for a particular product in each trial. All of the products are computer related products, such as RAM, scanner, and notebook. They are chosen because that the subjects (who are young) are familiar with these products and are approximately equally available in the Internet. The level of difficulty of each search, therefore, is appropriately equivalent.

Trials and Procedures

Three successive trials are conducted in this study. In each trail the subjects are asked to complete their search in twenty minutes. These trials are constructed according to the micro analytical research strategy outlined by Bandura (1977). According to this strategy, the researcher must follow a particular sequence in each session. Specifically, the researcher must measure subjects' computer self-efficacy first. The short search task was then given. Afterwards, the subjects were informed of the result before the beginning of the next trial. The trials are arranged to reflect the purpose of this research. Trials 1 and 2 represent general situations, i.e. both effort saving and accuracy are equally emphasized. This allows the observation of the self-efficacy's impact on performance as well as the possible effect of subjects' self-learning. Trial 3 represents the situation that emphasizes the accuracy-seeking goal. That is, in Trial 3, the award for finding the lowest price item is increased, allowing us to observe if the subjects conduct the effort-accuracy tradeoff to meet the new goal.

Thus, before the start of the trials, there is a training program to make sure that the subjects can operate the system successfully and finish the task correctly. These subjects are required to answer a questionnaire about network experiences as their past experience of the first trial. In each trial, an instructor gives the subjects a product description (functional specifications) and asks them to find a new product that meets the specifications. Next, the self-efficacy questionnaire is administered to subjects before the actual searching activity. The subjects are asked to find the lowest price of the desired object as soon as possible in each trial. The expended time and the browsing log are recorded automatically. After the subjects complete the search, they enter the resulting URL and price into a database. The performance will be accounted by weighted multiplication of the expended time and that

price. At the end of each trial, we announce the name of the person who has best performance, as well as his/her time spent and price as a feedback. In addition, we provide NT$200~1000(about US$6~30) to the best five subjects as an incentive to motivate subjects. In Trial 3, the new reward formula that emphasized accuracy is announced to the subjects. The design is to see if subjects will expend more time on search.

Measurements

The design of the self-efficacy measurement is based on the guidelines suggested in Bandura (1995). First, The assessment of self-efficacy should be domain specific. Next, perceived self-efficacy should be measured against levels of task demand that represent gradations of challenges and participants are asked to judge their ability to meet the challenges or to surmount the various impediments. Third, the item should be phrased in terms of "can do" rather than "will do" because "can" is a judgment of capability and "will" is a statement of intention. For tasks the individuals judge they can do, they rate the strength of their perceived efficacy on a 100-point scale, ranging in 10-unit intervals from 0 ("cannot do"); through intermediate degrees of assurance 50 ("moderately certain can do"); to complete assurance, 100 ("certain can do"). The efficacy strength scares are summed and divided by the total number of items to indicate the strength of perceived self-efficacy for the activity domain. Finally, a pretest must be conducted to ensure that the measurement items contain sufficient gradations of difficulty. We have done so to come up with the final items in Figure 4. The Cronbach's α of the resulting instrument in Figure 4 has a value of 0.9715 which indicates a sufficient reliability (Nunnally 1978).

In the column of Confidence rate how sure you are that you can find the cheapest monitor at the shortest time in this trail at each of the levels described below. Rate your degree of confidence by recording a number form 0 to 100 using the scale given below.

1.Top 30 (75% better)
Cannot do 0 10 20 30 40 50 60 70 80 90 100 Certainly can do

2.Top 20 (50% better)
Cannot do 0 10 20 30 40 50 60 70 80 90 100 Certainly can do

3.Top 15 (37.5% better)
Cannot do 0 10 20 30 40 50 60 70 80 90 100 Certainly can do

4.Top 10 (25% better)
Cannot do 0 10 20 30 40 50 60 70 80 90 100 Certainly can do

5.Top 5 (12.5% better)
Cannot do 0 10 20 30 40 50 60 70 80 90 100 Certainly can do

6.Top 3 (7.5% better)
Cannot do 0 10 20 30 40 50 60 70 80 90 100 Certainly can do

7.Top 1 (2.5% better)
Cannot do 0 10 20 30 40 50 60 70 80 90 100 Certainly can do

Figure 4 An example of the assessment of self-efficacy

The measurement of network experience is the multiplication of two ordinal scales: how many years they have accessed Web and how many time they expend on Web each week. The scales of how many years are leveled as: 1 indicates less than one year; 2, one to two years; 3, two to three years; and 4, more than three years. The measurement of usage per week is measured as follows: 1 means less than 3 hours; 2, four to twelve hours; 3, thirteen to thirty-six hours; and 4, more than thirty-seven hours.

Accuracy is assessed by standardizing prices that are identified by all the subjects. For example, the accuracy of a particular subject who finds price p will be 1- (p-y)/(x-y) when the highest price found among subjects is x and the lowest one is y. The lower the value, the more accurate because it is closer to the lowest price. On the other hand, effort is also accounted by standardizing the time expended of a particular subject. Because the total time in each trail is twenty minutes (1,200 seconds), the effort of a particular subject who expends time t will be t/1200.

According to the aforementioned formula, a subject with a low level of effort and a high level of accuracy is regarded as a high performer. This confirms to the prediction of the effort-accuracy tradeoff model. Trials 1 and 2 do not particularly emphasize either effort or accuracy, so that the performance on these trials is measured as 1-(standardized time)*(standardized price). However, the reward formula of the third trial is altered to be 1-(standardized time expended)$^{1/4}$ *(standardized price) because accuracy is emphasized at the price of effort.

Data analysis

Is there an accuracy-effort tradeoff effect?

A total of 80 subjects participate in three trials. The Pearson correlation in each trial is represented in Table 2. In both Trials 1 and 2, there are no significant correlations between effort and accuracy. In Trial 3, there is a significant negative correlation between effort and accuracy (r= -.226, p=.044<0.05). That is, the subjects who find more accurate price expend shorter time than the others. Therefore, there is not a tradeoff between effort and accuracy. Hypothesis 1 is therefore rejected.

Table 2 Pearson Correlations

Trial 1			
	Efficacy	Effort	Accuracy
Efficacy	1.000	.058	.119
Effort	.058	1.000	.154
Accuracy	.119	.154	1.000
Trial 2			
	Efficacy	Effort	Accuracy
Efficacy	1.000	.070	.254**
Effort	.070	1.000	.094
Accuracy	.254**	.094	1.000
Trial 3			
	Efficacy	Effort	Accuracy
Efficacy	1.000	-.047	.326***
Effort	-.047	1.000	-.226**
Accuracy	.326***	-.226**	1.000

** p<0.05 *** p<0.001

The effect of commitment to an accuracy goal

Both the Social Cognitive Theory and Payne, et al. (1993) suggest that people will expend more effort when they are committed to an accuracy goal. In this experiment, this means subjects should expend more effort in Trial 3 than that in Trial 2 because in Trial 3, the subjects are asked to search for the lowest price of the specified product as much as possible.

We use paired samples T test to examine the difference of variables in Trial 2 and Trial 3. As it shows in Table 3, effort in Trial 2 is significant different from Trial 3 (t=-2.042,

p=.044<0.05). The subjects do expend more effort in Trial 3 (mean=.6739) than that in Trial 2 (mean=.5886)(see Table 4). Therefore, the users indeed devote more effort to find the most accurate price when an accuracy goal is emphasized. Thus, H2 is supported.

Table 3 Paired Samples T Test of three experiences

	t	Sig. (2-tailed)
Efficacy 1 – Efficacy 2	1.901*	.061
Effort 1 – Effort 2	.235	.815
Accuracy 1 – Accuracy 2	-2.778**	.007
Efficacy 2 – Efficacy 3	-.406	.686
Effort 2 – Effort 3	-2.042**	.044
Accuracy 2 – Accuracy 3	.318	.752

* p<0.1 ** p <0.05

Table 4 Mean of each variable in each trials

	EFFICACY	EFFORT	ACCURACY
Trial 1	4.0875	.6007	.2981
Trial 2	3.7437	.5886	.4373
Trial 3	3.8200	.6739	.4196

Does self-efficacy influence accuracy?

As network experience is significant correlated to self-efficacy (r=.299, p=.007<0.05), self-efficacy does reflect the subjects' network experience. Furthermore, while self-efficacy is not significantly correlated to accuracy in Trial 1, its correlation with accuracy is significant in both Trials 2 and 3 (r_2=.254, p=.023<0.05; r_3=.326, p=.003<0.01). Thus, self-efficacy becomes more and more important as the trials continue. In addition, we test the regression models and find that self-efficacy is the most important predictor of accuracy in both Trials 2 and 3 ($\beta_{2efficacy}$= .248, p=.027<0.05; $\beta_{3efficacy}$=.316, p=.004<0.01) (see Table 5). In other words, people with higher efficacy beliefs will have more accurate result; this effect of self-efficacy increases with the repeated trials. H3 is thus supported.

Table 5 Prediction of accuracy

	Standardized β	P value
Trail 1		
Effort	.148	.191
Efficacy	.110	.328
Adjust R^2	.011	.244
Trial 2		
Effort	.123	.490
Efficacy	.017 **	.027
Adjust R^2	.046 *	.061
Trial 3		
Effort	-.211 **	.048
Efficacy	.316 ***	.004
Adjust R^2	.129 **	.002

* p<0.1 ** p<0.05 *** p<0.01

The difference between high and low self-efficacy group

In the previous analysis, we find that the efficacy is the most important predictor of accuracy. In order to explore the relationship between effort and accuracy in some depth, we classify the subjects into two groups based on their average self-efficacy. There are twenty-eight subjects in high efficacy group (the average network experience is 6.57) and fifty-two in low efficacy group (the average network experience is 4.25) (Table 6). In table 7, we can find that users with high efficacy also have better accuracy.

Table 6 The result of cluster analysis

	N	Cluster Center
High Efficacy	28	6.20
Low Efficacy	52	2.64

Table 7 Mean of each variable in two groups

	High efficacy group			Low efficacy group		
	Efficacy	Effort	Accuracy	Efficacy	Effort	Accuracy
Trial 1	6.1571	.6482	0.3729	2.9731	.5752	0.2579
Trial 2	6.1821	.5904	0.4911	2.4308	.5877	0.4083
Trial 3	6.2679	.6489	0.5057	2.5109	.6873	0.3733

The Pearson correlations in both groups are presented in Table 8. Note that neither Trial 1 nor Trial 2 emphasizes effort or accuracy, while Trial 3 increases the weight on accuracy. The relation between effort and accuracy in each trail on both groups is represented in Figure 5. To the high efficacy group, there is a tradeoff at the beginning but the direction has reversed in both Trials 2 and 3. It means that there is not only no tradeoff anymore in following trials, but the one expend less time can get higher accuracy. This could be the result of increasing influence of self-efficacy, which becomes the dominant factor that impacts accuracy in the latter trials. In the mean time, effort becomes less and less relevant to accuracy in these trials. This effect is especially strong in Trial 3. In contrast, there are tradeoffs in all three trials in the low efficacy group. This observation shows that the tradeoff between effort-saving and accuracy-seeking exist only in the low efficacy group. To explore this effect further, let us consider the situation of emphasizing accuracy. Table 9 presents the result of pair-samples T test.

Table 8 Pearson correlations in two groups in each trial

Trial 1						
	High efficacy group			Low efficacy group		
	Efficacy	Effort	Accuracy	Efficacy	Effort	Accuracy
Efficacy	1.000	-.131	-.165	1.000	.063	.144
Effort	-.131	1.000	.341*	.063	1.000	.028
Accuracy	-.165	.341*	1.000	.144	.028	1.000
Trial 2						
	High efficacy group			Low efficacy group		
	Efficacy	Effort	Accuracy	Efficacy	Effort	Accuracy
Efficacy	1.000	.169	.190	1.000	.060	.319**
Effort	.169	1.000	-.218	.060	1.000	.295**
Accuracy	.190	-.218	1.000	.319**	.295**	1.000

Trial 3						
	High efficacy group			Low efficacy group		
	Efficacy	Effort	Accuracy	Efficacy	Effort	Accuracy
Efficacy	1.000	-.409**	.334*	1.000	.244*	.326**
Effort	-.409**	1.000	-.623***	.244*	1.000	.001
Accuracy	.334*	-.623***	1.000	.326**	.001	1.000

* p<0.1 ** p<0.05 *** p<0.01

Table 9 pair-samples T test of both groups

	High efficacy group		Low efficacy group	
	t	p	t	p
Efficacy 1 – Efficacy 2	-.078	.939	2.525**	.015
Effort 1 – Effort 2	.761	.453	-.183	.855
Accuracy 1 – Accuracy 2	-1.283	.210	-2.525**	.015
Efficacy 2 – Efficacy 3	-.225	.824	-.345	.731
Effort 2 – Effort 3	-.895	.379	-1.843*	.071
Accuracy 2 – Accuracy 3	-.140	.889	.539	.592

* p<0.1 ** p<0.05 *** p<0.01

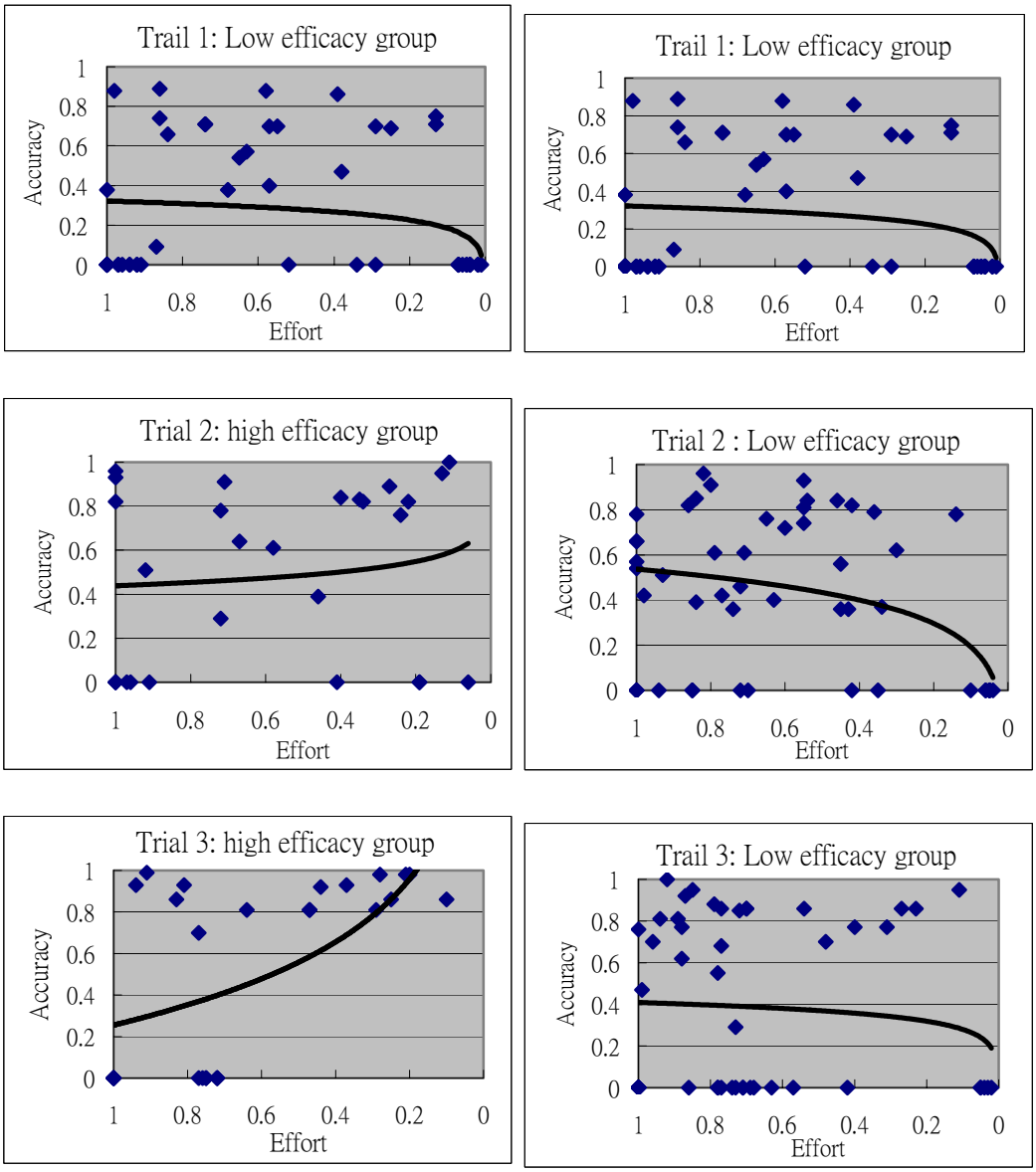

Figure 5 The relationship between effort and accuracy in each group

As we can see in Tables 7 and 9, people with low efficacy significantly increase their effort, thus reflecting the effect of accuracy requirement ($t=-1.843$, $p=.071<0.1$). Yet, the accuracy is not increased ($t=.539$, $p=.592>0.1$). In addition, for the high efficacy group, while there are no significant changes in their self-efficacy and expended effort, they attain a constant level of accuracy. Thus, the present analysis further clarifies how self-efficacy may influence the accuracy-effort tradeoff issue.

Discussion and Conclusion

According to the previous analysis, we can conclude that in the high efficacy group, tradeoff only exists at the beginning trial but not in the subsequent trials. In contrast, we can find the tradeoff in each trial for the low efficacy group. Thus, users with higher self-efficacy can find the accurate information without exerting additional effort. This effect is intensified as subjects continue. In order to understand the strategies used, we roughly classify three strategies based on their Web browsing log. The frequencies of the three strategies used in

both groups are listed in Table 10. Most of users use search engine to find the information they want. However, in the high-efficacy group, users become relying more and more on particular sites. That is, they frequently visit such sites which collect price information of computer products. This is not seen in the low efficacy group. High efficacy subjects have a strong image of helpfulness toward the particular sites. Generally speaking, they visit fewer sites to find the information and yet are able to attain higher accurate result. More importantly and somewhat surprising, when they are bad, they are really bad – high-efficacy subjects also are the ones who make the worst search.

Table 10 Strategy used in each group

Group	Trial	Strategies and percentages					
		Search engine and simple keyword	%	Search engine and composite keywords	%	Particular sites	%
High efficacy group	Trial 1	18	64.29	10	35.71	0	0
	Trail 2	17	60.71	8	28.57	3	10.71
	Trial 3	16	57.14	7	25	5	17.86
Low efficacy group	Trial 1	38	73.08	12	23.08	2	3.85
	Trial 2	36	69.23	11	21.15	5	9.62
	Trial 3	37	71.15	11	21.15	4	7.69

Table 11 Average accuracy in each strategy used

		Mean of Accuracy		
		Search engine and simple keywords	Search engine and mix keywords	Particular cites
High efficacy group	Trail 1	0.23	0.63	0
	Trail 2	0.41	0.54	0.84
	Trail 3	0.34	0.61	0.91
Low efficacy group	Trial 1	0.20	0.48	0
	Trail 2	0.35	0.49	0.67
	Trail 3	0.36	0.35	0.58

To conclude, this study attempts to understand if there is a tradeoff between effort-saving and accuracy-seeking as well as the impact of self-efficacy on the tradeoff model in Web searching behavior. The result shows that self-efficacy is an important factor to Web search accuracy. People with high efficacy yield more accurate result in the search. In addition, the tradeoff between effort-saving and accuracy only exist in the low efficacy individuals. In contrast, for high self-efficacy people, there is no significant change in the level of self-efficacy, effort expended, and accuracy in the trials. Furthermore, the emphasis of accuracy will increase the effort expended in the low efficacy group but not in the high efficacy group.

This study has several limitations. First, the twenty-five minutes in each trial may not be enough for non-experiential users to find the result. Second, we only announce the time and price of the top five subjects, so that the others should justify their performance subjectively by comparing their answers with the announced ones. This indirect feedback may make these users misjudge their performance and affect the self-efficacy in the next trial.

The contributions of this study are several. To research, we examine how self-efficacy

may affect the tradeoff between effort-saving and accuracy-seeking in Web search behavior. The results suggest that this kind of tradeoff may only exist in the low self-efficacy group. For researchers who are to base research on the tradeoff model proposed by Panye, et al. (1993), it is important to consider the effect of self-efficacy. To practice, we find that experienced users who have a high level of self-efficacy will not change their effort expended in different goal. This kind of users may have developed a strong image of helpfulness for particular sites. This intuition is both powerful and dangerous. The can be quick and accurate and, yet, when they are wrong, they are really wrong. The Web site designer should be aware of this tendency of Web users and try to enhance their image in the users' mind.

The future research can compare the different effects of self-efficacy between direct and indirect feedback. Much research has suggested that feedback is an important factor influencing the level of self-efficacy. Thus, it is interesting to study the impact of the format and the content of feedback toward self-efficacy. In addition, while this study roughly classifies the strategies used in Web search, future work may consider a micro level analysis of user's mental model of strategies used. This will help to build a cognitive model of Web search behavior and aids in explaining the forming of image toward particular sites.

Reference

Aguilar, F. J., *Scanning the Business Environment*, MacMillan, New York, 1967.

Bandura, A. "Self-Efficacy Mechanism in Human Agency," *American Psychologist* (37:2), February 1982, pp.122-147.

Bandura, A. and Dweck, C. S. The Relationship of Conceptions of Intelligence and Achievement Goals to Achievement-Related Cognition, Affect, and Behavior, Manuscript Submitted for Publication, 1988.

Bandura, A. and Jourden, F.J. "Self-Regulatory Mechanisms Governing the Impact of Social Comparison on Complex Decision Making," Journal of Personality and Social Psychology (60:6), 1991, pp. 941-951.

Bandura, A. Social Foundations of Thought and Action, Prentice Hall, Englewood Cliffs, NJ, 1986.

Bandura, A. Social Learning Theory, Prentice Hall, Englewood Cliffs, NJ, 1977.

Bandura, A., and Schunk, D. "Cultivating Competence, Self-Efficacy, and Intrinsic Interest through Proximal Self-Motivation," Journal of Personality and Social Psychology (41), 1981, p. 586-598.

Bandura, A., and Simon, K. M. "The Role of Proximal Intentions in Self-Regulation of Refractory Behavior." Cognitive Therapy and Research (1), 1977, p. 177-193

Bandura, A. "Manual for The Construction of Self-Efficacy Scales," Available form Albert Bandura, Department of Psychology, Stanford University, Stanford, CA 94305-2130.

Bandura, A. Self-Efficacy: The Excise of Control, W.H. Freeman and Company, NY, 1997.

Beach, L. R., & Mitchell,T. R., "A Contingency Model for The Selection of Decision Strategies," Academy of Management Review (3), 1978, pp.439-449.

Beach, L. R., Image Theory: Decision Making in Personal and Organizational Contexts, Chichester: Wiley, 1990.

Campbell, D.J. "Task Complexity: A Review and Analysis," Academy Management Review (13), 1988, pp. 40-52.

Compeau, D. R., and Higgins, C. A. "Application of Social Cognitive Theory to Training for Computer Skills," Information Systems Research (6:2), 1995, pp. 118-143.

Earley, P.C., Wojnaroski, P., and Prest, W., "Task Planning and Energy Expended: Exploration of How Goals Affect Performance," Journal of Applied Psychology, (72), 1987, pp.107-114.

Earley, P.C., Connelly, T., and Ekegren,G. "Goals, Strategy Development, and Task

Performance: Some Limits on the Efficacy of Goal Setting," Journal of Applied Psychology (74), 1989, pp.24-33.
Glass, C.G. and Knight, L. A., " Cognitive Factors in Computer Anxiety," Cognitive Therapy and Res. (12), 1988, pp.351-366.
Hammond, K. R., Hamm, R. M., Grassia, J., & Pearson, T., "Direct Comparison of the Efficacy of Intuitive and Analytical Cognition in Expert Judgment," IEEE Transactions on Systems, Man, and Cybernetics (17), 1987, pp.753-770.
Henderson, R.D., Deane, F.P., and Ward, M.J. "Occupational Differences in Computer-Related Anxiety: Implications for the Implementation of a Computerized Patient Management Information System," Behavior and Information Technology (14:1), 1995, pp. 23-31.
Hoffman, Donna L. and Thomas P. Novak, "Marketing in Hypermedia Computer-Mediated Environments: Conceptual Foundations," Journal of Marketing, July 1996, pp.50-68.
Hollenbeck, J.R. and Klein, H.J. "Goal Commitment and the Goal-Setting Process: Problems, Prospects, and Proposals for Future Research," Journal of Applied Psychology (72:2), 1987, pp. 212-220.
Huber, G. P., "Organizational Learning: The Contributing Processes and the Literatures," Organization Science (2:1), 1991, pp.81-115.
Johnson, E.J., and Payne, J.W. "Effort and Accuracy in Choice," Management Science (31) 1985, pp. 394-414.
Klein, G.A. "A Recognition-Primed Decision (RPD) Model of Rapid Decision Making," in Klein, G.A., Orasanu, J., Calderwood, R. and Zsambok, C.E. (Eds), Decision Making in Action: Models and Methods, Norwood, New Jersey: Ablex Publishing, 1993, pp. 138-147.
Liang, T.P., Shaw, J.P. & Wei, C.P., " A Framework for Managing Web Information: Current Research and Future Direction," Proceeding of the 32th Hawaii International Conference on System Sciences, 1999.
Locke, E. A., "Toward A Theory of Task Motivation and Incentives," Organizational Behavior and Human Performance, (3), 1968, pp.157-189.
Locke, E.A., Frederick, E., Lee, C., and Bobko, P. "Effect of Self-Efficacy, Goals, and Task Strategies on Task Performance," Journal of Applied Psychology (69:2), 1984, pp. 241-251.
Marakas, M.M., Yi, M.Y., and Johnson, R.D. "The Multilevel and Multifaceted Character of Computer Self-Efficacy: Toward Clarification of the Construct and an Integrative Framework of Research," Information Systems Research (9:2), June 1998, pp. 126-163.
Meier, S. T., "Computer Aversion," Computers in Human Behavior, (1), 1985, pp.171-179.
Mitchell,T. R.& Beach, L. R., "…Do I love Thee? Let Me Count…" Toward an Understanding of Intuitive and Automatic Decision Making," Organizational Behavior and Human Decision Processes (47), 1990, pp.1-20.
Murphy, J., "Surfers and searchers: An examination of web-site visitors' clicking behavior," Cornell Hotel and Restaurant Administration Quarterly (40:2), Apr 1999, pp.84-94.
Olson, J. R. and Nilsen, E. "Analysis of the Cognition Involved in Spreadsheet Software Interaction," Human-Computer Interaction, (3:4), 1987, pp.309-349.
Pajares, F. and Miller, M.D. "Role of Self-Efficacy and Self-Concept Beliefs in Mathematical Problem Solving: A Path Analysis," Journal of Educational Psychology (86), 1994, pp. 193-203.
Payne, J, W., Bettman, J. R. & Johnson, E. J., The Adaptive Decision Maker, Cambridge University Press, 1993.
Rooney, R. and Osipow, S.H. "Task-Specific Occupational Self-Efficacy Scale: The Development and Validation of a Prototype," Journal of Vocational Behavior (40), 1992,

pp. 14-32.
Schunk, D.H. “Self-Efficacy and Achievement Behaviors,” Educational Psychology Review (1), 1989, pp. 173-208.
Simon, H. A. “A Behavioral Model of Rational Choice,” Quarterly Journal of Economics (63), 1955, pp. 99-118.
Staffers, N., & Norcio, A. F., “ Mental Models: Concept for Human-Computer Interaction Research,” International Journal of Man-Machine Studies, (38), 1993, pp.587-605.
Vandenbosch, B. and Higgins, C., “Information Acquisition and mental Models - An Investigation into the Relationship Between Behavior and Learning,” Information Systems Research (7:2), June 1996, pp. 198-214.
Wood, R. and Bandura, A. “Social Cognitive Theory of Organizational Management,” Academy of Management Review (14:3), 1989, pp. 361-384.
Wood, R. and Bandura, A. and Bailey, “Mechanism Governing Organizational Performance in Complex Decision-Making Environments,” Organizational Behavior and Human Decision Processes (46), 1990, pp.181-201.
Zimmerman, B.J. “Self-Regulating Academic Learning and Achievement: An Overview,” Educational Psychology Review (2), 1990, pp. 173-201.