# OPTIMIZING HUMAN-COMPUTER INTERACTION FOR THE ELECTRONIC COMMERCE ENVIRONMENT

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**ABSTRACT**

The paper investigates the interaction effects between the search strategy of software agents and the subject's product class knowledge. The experimental study consists of a 2 (product class knowledge: high, low) x 4 (agent search strategy: elimination by aspects (EBA), weighted average method (WAD), profile building (PROFILE) , and simple hypertext (HYPERTEXT)) design with product class knowledge as the between groups variable. Significant differences were found for affective reactions of the subjects toward the agent/application depending on the level of product class knowledge possessed by the subjects. Subjects with high product class knowledge had more positive affective reactions towards agents/applications which used the WAD and EBA strategies as compared to the profile building strategy. Subjects with low product class knowledge had more positive affective reactions to agents/applications which used the profile building strategy as compared to the EBA and WAD strategies. When the systems were modified to increase the amount of information provided and to increase the degree of control provided to the subjects, their affective reactions to the agents/applications were found to be different from the original study. Subjects responded more positively to the previously "less preferred" strategy, thus weakening the interaction effect. This research is done in the context of consumers searching for information on the World Wide Web prior to the purchase of cars.

**Keywords**: electronic commerce, search engines, software agents, decision making, satisfaction, confidence

## 1. Introduction

Marketing managers in the consumer goods industry face a new frontier of electronic information and commerce. Understanding buyer behavior in this new marketing channel is crucial. Projections about the diffusion of electronic commerce have been breathtaking. It is estimated that by the year 2000, business-to-consumer electronic commerce will account for a sales volume of 80 billion dollars a year and business-to-business electronic commerce will account for a sales volume of 300 billion dollars a year (Al Gore, USA Vice President in his report to Congress, 1998). The past few years have seen a rapid growth in the variety of products carried by the electronic shopping malls on the World Wide Web. Simultaneously, technological advances have resulted in increasingly complex products. Consumers, who are becoming more mature, sophisticated, and intelligent, are demanding higher levels of product information before making purchasing decisions. Rapid advancements in web technology have offered a solution to this dilemma in the form of computerized decision aids which use software smart agents to provide an intelligent interface to the consumer. These computerized decision aids improve transactional efficiency by providing merchandising and sales information to consumers, offering sales support, and facilitating sales promotions, while at the same time, enhancing the consistency, availability, and quality of support to consumers. These computerized decision aids have the potential to empower consumers by enabling them to make informed decisions about the marketplace. The providers of these computerized decision aids inherently assume that these computerized decision aids are useful and desirable. To be useful as alternative sources of product information, consumers must choose to incorporate these computerized decision aids in their decision making process, and to rely upon the information and recommendations presented. Consumers will be more likely to develop new patterns of information search and decision making strategies involving new information technologies if the time and energy expended in these activities is perceived to be judicious and beneficial.

One of the main objectives of marketing managers is to present consumers with information on which to base their decisions. The information presented has to be such that it allows consumers to make decisions and select products that best match their tastes and needs [Bettman, Johnson & Payne, 1991]. Otherwise consumers' incentive to seek out information will be minimal [Alba, Lynch, Weitz, Janiszewski, Lutz, Sawyer, & Wood, 1997]. Presenting such information is not simple. On the one hand, a vast amount of information could be relevant, even

very relevant to some consumers. On the other hand, presenting superfluous information might impede consumers' ability to make good decisions [Bettman, Johnson & Payne, 1991]. If consumers were predictable and all alike, presenting information would present no problem – marketing managers could provide only the information that is deemed most relevant by all the consumers. However, because of the heterogeneity between and within consumers, almost none of the potentially available information is universally perceived as relevant. What is a key datum for a certain consumer at a certain point in time may be perceived as superfluous information by other consumers and even by the same consumer at a different point in time. The task facing marketing managers is not simply to present consumers with every piece of information, but rather to present consumers with information that is appropriate for their current needs. The objective is to help consumers be appropriately selective in their information acquisitions [Hoffman & Novak, 1996a, 1996b; Alba, Lynch, Weitz, Janiszewski, Lutz, Sawyer, & Wood, 1997]. Since there is an abundance of potentially relevant information and since consumers have limited cognitive resources available to process this information, there is a need for marketing managers to choose wisely what information to present, and how to present it. The issue of information overload has occupied marketing managers for some time now, as it relates to all forms of marketing communications. The relevance and scope of this problem has increased tremendously with the prevalence of electronic information, computers, and computer networks [Alba, Lynch, Weitz, Janiszewski, Lutz, Sawyer, & Wood, 1997; Hoffman & Novak, 1996a; Gupta, 1995; Hoffman, Novak & Chatterjee, 1995]. The central goal of this research is to examine how the design of communication systems for electronic commerce impacts consumers' ability to use the information provided and consumers' affective reactions towards the agent/application. The objective is to understand how query-based decision aids (QBDA) influence consumer decision making, to examine their advantages and disadvantages, to relate these to different aspects of information systems, and to shed some light on the relationship between the availability of these decision aids and consumers' use of information systems. The term "query-based decision aids" (QBDA) is used to refer to the search and decision making tools available on the Internet such as those provided by Personal Logic (http://www.personalogic.com), Microsoft Carpoint (http://carpoint.msn.com), and Auto-by-Tel (http://www.autobytel.com). These tools support the decision making process of consumers who are shopping on the world wide web. Some of them support common multi-attribute heuristics such as elimination by aspects and the conjunctive rule.

For the purposes of this research, agents are defined as performing two basic tasks:

1. they collect information from the user, and
2. they use that information to generate a reduced set of options by matching the various alternatives to the preferences expressed by the user

Agents use various strategies to perform these tasks.

The major objective of this research is to understand why consumers react the way they do to different forms of agent technology and how to optimize the cognitive fit between an individual's knowledge and expertise and the decision strategy used by the agent. This set of experiments aims to examine how the individual's prior knowledge of the product influences his affective and behavioral reactions to agent strategies, as well as to provide implications of this finding for marketing managers and the designers of the web sites for the shopping malls. It is likely that attributes of these strategies that are under the web retailer's control may help to explain an individual's varying reactions to the agent/application based on their prior knowledge of the product being evaluated for purchase. To achieve this objective, four different decision environments were created which varied the process used for filtering the information. A simulated web site is used which supports various agent strategies. The strategies used by the agent for information filtering are discussed below:

1. The Weighted Average (WAD) strategy uses all the information about the subject's preferences and computes a weighted preference matching score for each alternative based on the degree to which the attribute values of that alternative match the attribute values entered by the subject as his preferred values and the preference weights allocated to each of the attributes by the subject. A linear additive multi-attribute utility model is used to compute the preference matching score for each alternative. The alternatives are then sorted by the computed preference matching scores and this sorted list is presented to the subject in descending order of the preference matching score. The subject can browse this list and narrow his choice set by first selecting the subset of alternatives which he would like to consider further in his decision process and then systematically eliminating alternatives from the choice set until he arrives at his final choice. An example of the WAD strategy is available on the Personal Logic web site (http://www.personalogic.com).
2. The Elimination By Aspects (EBA) strategy [Payne, Bettman, & Johnson 1993] obtains cutoff values from the decision maker on a set of product attributes. Alternatives that do not meet these specified criteria

are eliminated from the choice set and the remaining alternatives make up the reduced choice set. An example of the EBA strategy is available on the Personal Logic web site (http://www.personalogic.com).

3. The "Profile Building" (PROFILE) strategy assigns the user to a particular group based on the demographic profile of the user (that is, his age, household income, gender, educational level). The individual decision maker is asked for ratings on a series of related products and is grouped with "similar others" based on their previous ratings of the same products. Choices made by these similar others in the product category under consideration are then used to form the recommended reduced choice set for the decision maker. In this decision making strategy, a preference structure is deduced based on the subject's demographic profile and ratings of related products. An example of the profile building strategy is available on the Firefly web site (http://www.firefly.com) and the Amazon.com web site (http://www.Amazon.com).

4. The "Simple Hypertext" (HYPERTEXT) strategy does not provide any information filtering support to the user. The user is presented with a set of hypertext links to all the alternatives and is allowed to narrow the choice set at his own pace by sequentially eliminating alternatives from the initial choice set.

In providing agent services to consumers, intelligent agent tools depend on the accuracy of preference prediction to provide benefits to the consumer [Gershoff & West 1998]. The majority of the literature examining intelligent agent-assisted electronic commerce assumes that consumers possess and are able to convey established preferences in the product category. As [Gershoff and West 1998] point out, their research on intelligent agents assumes "well-defined" and "stable" preferences.[ Pazgal and Vulkan 1998] claim that search agents provide users with several useful advantages including increased productivity if the user "can specify precisely what he or she is looking for … the knowledge of the exact preferences of their owners allows agents to serve an important role in alleviating the time consuming problem of having to evaluate alternative products and compare different product attributes". Product class knowledge has a significant influence on people's general likelihood of purchasing products via the Internet. Individuals are significantly more likely to purchase via the Internet if they know exactly what they want than if they have only a general idea of what they want. As noted by Bettman, [Luce and Payne 1998], an important property of the constructive viewpoint is that preferences will often be extremely context-dependent. As such, an agent's goal in a choice situation characterized by constructive preferences is not just to inform, provide alternatives and uncover existing preferences, but to help the consumer build preferences with the ultimate goal of aiding in choice. Certain characteristics of the agent may have a significant impact on the preferences formed and the choices made, not only through variations in what information is presented, but also in how that information is presented.

## 2. Theoretical Development of Hypotheses

Between Group Hypotheses

One fundamental way in which electronic commerce agents differ is the strategy they use to filter information in order to present the user with a reduced set of recommended alternatives. This process, called information filtering, is the mechanism agents use to filter the vast number of product alternatives available to the user, leaving only those that are thought to be relevant to the individual given his or her specified (or deduced) preferences. Three information filtering methods, briefly mentioned earlier, are increasing in popularity and use by "smart agents" to match consumers' preferences with available product alternatives. These are referred to as the elimination by aspects (EBA) strategy, the weighted average (WAD) strategy, and the profile building (PROFILE) strategy.

In the EBA strategy, the user is queried on specific product attribute values and must respond with a minimum or cutoff value for each attribute. Alternatives that do not meet the attribute criteria are eliminated from the choice set and a reduced set of remaining alternatives is presented to the user. Because there is no free response or user generation of attributes or attribute levels, it is possible for users with low product class knowledge to complete the task. Users are presented with attributes and their possible levels and they select their preferred level of each. However, as this process requires consideration of each product attribute and expression of preference with regard to each, it seems reasonable to expect that it will be easier for individuals with high product class knowledge and thus will be preferred by them. Research by Payne, Bettman, and Johnson [1992] finds that experts prefer to use non-compensatory strategies like elimination by aspects and tend to process relevant information more efficiently than novices [Fiske 1993]. Brucks [1985] finds that experienced consumers know which attributes are useful for distinguishing between options and may search only on those.

While experienced consumers are well equipped to process attribute information, individuals with low product class knowledge will likely find such a task more difficult. Attribute-oriented messages are found to be less informative to novices [Maheswaran & Sternthal 1990; Alba & Hutchinson 1987] as they do not process attribute information as efficiently as experts. Given the added effort for individuals with low product class knowledge to

process attribute information, it is expected that they will show negative affective reactions to the agent/application when the agent is using the EBA strategy.

Hypothesis 1a: *Subjects who have high product class knowledge will have higher satisfaction in the decision process, higher confidence in the decision, higher trust in the agents' recommendations, greater propensity to purchase, higher perceived cost savings, and lower perceived cognitive effort than subjects who have low product class knowledge for applications in which the search engines use the elimination by aspect filtering strategy.*

The Weighted Average (WAD) strategy uses all the information about the subject's preferences and computes a weighted preference matching score for each alternative based on the degree to which the attribute values of that alternative match the attribute values entered by the subject as his preferred values and the preference weights allocated to each of the attributes by the subject. A linear additive multi-attribute utility model is used to compute the preference matching score for each alternative. The alternatives are then sorted by the computed preference matching scores and this sorted list is presented to the subject in descending order of the preference matching score. The subject can browse this list and narrow his choice set by first selecting the subset of alternatives which he would like to consider further in his decision process and then systematically eliminating alternatives from the choice set until he arrives at his final choice. As this process requires consideration of each product attribute and expression of preference with regard to each, it seems reasonable to expect that it will be easier for individuals with high product class knowledge and thus will be preferred by them.

Hypothesis 1b: *Subjects who have high product class knowledge will have higher satisfaction in the decision process, higher confidence in the decision, higher trust in the agents' recommendations, greater propensity to purchase, higher perceived cost savings, and lower perceived cognitive effort than subjects who have low product class knowledge for applications in which the search engines use the weighted average filtering strategy.*

The profile building (PROFILE) strategy matches the user with "similar others" based on his demographic profile (age, education, gender, household income), and based on his ratings of related products. The agent deduces the user's preferences by matching him with a group of similar individuals based on his demographic profile and expressed preferences and predicts that their preferences in the product category under consideration will also be similar to the user's. For example, when a user logs onto the Amazon.com web site, he is presented with a list of recommended books based on the books which he has purchased previously. Given their inability to process attribute information as efficiently as individuals with higher levels of product knowledge, consumers with low product class knowledge have been found to seek more summary information [Brucks 1985]. Because of the lower level of effort required, individuals with low product class knowledge are predicted to prefer the profile building strategy as compared to the EBA or WAD strategies. Conversely, individuals with high product class knowledge may base their search only on product attributes [Brucks 1985]. The absence of attribute information in the profile building strategy prevents experts from using their knowledge to evaluate alternatives. Without this opportunity experts may reject the communication as uninformative [Maheswarana & Sternthal 1990] and will have negative affective reactions towards agents/applications which use the profile building strategy.

Hypothesis 1c**:** *Subjects who have low product class knowledge in a product category will have higher satisfaction in the decision process, higher confidence in the decision, higher trust in the agents' recommendations, greater propensity to purchase, higher perceived cost savings, and lower perceived cognitive effort than subjects who have high product class knowledge for applications in which the search engines use the profile building strategy.*

The "simple hypertext" (HYPERTEXT) strategy presents the user with a set of hypertext links to the alternatives and the user can then click on any hypertext link to view the details of any of the alternatives. The user can then decide whether to consider that alternative further in his decision process or to eliminate it from further consideration. No information filtering support is provided to the user in narrowing his choice to arrive at his final choice. Since subjects with high product class knowledge have a greater ability to discriminate among alternatives and to eliminate undesirable alternatives from the choice set, it is expected that they will experience more positive affective reactions to the "simple hypertext" strategy than subjects who have low product class knowledge. However, because of the lack of agent support in filtering the information, it is expected that subjects in both the

groups will experience significantly negative affective reactions to the "simple hypertext" strategy as compared to the EBA, WAD, and PROFILE strategies.

Hypothesis 1d: *Subjects who have high product class knowledge in a product category will have higher satisfaction in the decision process, higher confidence in the decision, higher trust in the agents' recommendations, greater propensity to purchase, higher perceived cost savings, and lower perceived cognitive effort than subjects who have low product class knowledge for applications in which the search engines use the"* ***simple hypertext" strategy. Subjects in both groups (high and low product class knowledge) are expected to have more negative reactions to the "simple hypertext" strategy as compared to the EBA, WAD, or PROFILE strategies.***

Within Group Hypotheses

Hypothesis 2a: ***Subjects who have high product class knowledge will have the following affective reactions to the decision strategies employed by the agents:***
***Confidence in Decision:***
***WAD > EBA > PROFILE > HYPERTEXT***
***Satisfaction with Decision Process:***
***WAD > EBA > PROFILE > HYPERTEXT***
***Propensity to Purchase:***
***WAD > EBA > PROFILE > HYPERTEXT***
***Perceived Cost Savings:***
***WAD > EBA > PROFILE > HYPERTEXT***
***Trust in the Agent:***
***WAD > EBA > PROFILE > HYPERTEXT***
***Perceived Cognitive Effort:***
***HYPERTEXT > PROFILE > WAD > EBA***

Hypothesis 2b: ***Subjects who have low product class knowledge will have the following affective reactions to the decision strategies employed by the agents:***
***Confidence in Decision:***
***PROFILE > EBA > WAD > HYPERTEXT***
***Satisfaction with Decision Process:***
***PROFILE > EBA > WAD > HYPERTEXT***
***Propensity to Purchase:***
***PROFILE > EBA > WAD > HYPERTEXT***
***Perceived Cost Savings:***
***PROFILE > EBA > WAD > HYPERTEXT***
***Trust in the Agent:***
***PROFILE > EBA > WAD > HYPERTEXT***
***Perceived Cognitive Effort:***
***HYPERTEXT >WAD > EBA > PROFILE***

Given these anticipated differing responses to agent search strategies based upon the level of product class knowledge of the user, an interesting next step is to examine more closely the specific characteristics of each strategy that contribute to this interaction, alterations to which could eliminate the interaction effect. In other words, what characteristics of each strategy could be changed to make individuals' negative responses to the strategy more positive? A clearer understanding of individuals' reactions to specific characteristics and functionalities of each of the agent strategies may help to uncover the reasons behind the predicted interaction effects. Once these functionalities are identified, alterations to them may make the previously negative affective reactions to each agent search strategy more positive, thus reducing or eliminating the interaction effect.

Modification of Application Design For The Elimination By Aspects Strategy And The Weighted Average Strategy

The above sections predict that individuals with low product class knowledge will react less positively to agents using the EBA and WAD strategies as compared to individuals with high product class knowledge. However, it is possible that alterations could be made or functionalities included that could change this perception of the agent/application. An understanding of the underlying reasons behind this negative affective response could shed some light on this possibility. Relative novices generally have less attribute knowledge and find the attribute information more challenging to respond to. The weighted average strategy is compensatory in nature and requires the user to specify his preferred values for each attribute and also a set of weights which represent the degree of importance attached to each attribute in the decision. Although the elimination by aspects strategy is non-compensatory (i.e. it does not require direct tradeoffs among attributes), it requires the user to decide on constraint or minimum required levels of each attribute. To the extent that novices do not process attribute information as efficiently as experts, this task may be a difficult one. Luce [1998] hypothesizes that decision environments that are characterized by higher tradeoff difficulty and/or higher conflict will be associated with increased negative emotion as well as increased tendencies for decision makers to choose avoidant options. The ability to choose an avoidant option (skip making the decision) is found to reduce this negative emotion [Luce 1998]. Hence, the ability to avoid specifying preference values for certain attributes or to provide a neutral response ("don't know" or "don't care") may reduce individuals' negative response toward the agent search strategy.

Additionally, if individuals are permitted to provide a measure of their confidence in their preference specifications, they may feel more confident that the recommendation given by the agent reflects a weighting of the attributes in terms of their confidence level. This increased confidence in the overall experience may be conditional upon some limit to the number of attribute constraint responses that receive a low confidence rating by the user. In other words, if the user indicates low confidence in the majority of attributes, the opportunity to express this lack of confidence would not likely increase his/her confidence in the overall task. However, if the user indicates low confidence in a small percentage of the attributes, a heavier weighting of the remaining attributes may make the user feel more confident that the recommendations made are, in fact, more accurate reflections of his knowledge and preferences. In some ways, this functionality gives the user more control over the recommendation process.

Thus, it is expected that by modifying the application in the following two ways, the negative affective reactions of subjects with low product class knowledge towards agents/applications which use the EBA and WAD strategies will be eliminated or significantly reduced.

1. Increasing the amount of information provided

   When the subjects are expressing their preference values for the attributes and when they are browsing the attribute information for the alternatives, instead of just being presented with the attribute names on the screen, they are presented with hypertext links for each attribute. If they click the hypertext link for any attribute, they are presented with a screen of information which provides detailed information about that attribute.

2. Increasing the degree of control the subjects have in expressing their preferences and making their decisions

   This increase in the degree of control is achieved through three mechanisms:

   i. The subjects are given the option to skip attributes when expressing preference or cut-off values for the attributes.

   ii. The subjects are given the option of specifying confidence levels in their preference specifications for each attribute.

   iii. The subjects are given the option of returning to the preference specification stage from any stage in the decision process and changing the preference values specified. Thus after subjects have obtained some information about attributes, they are able to utilize that information in specifying their preferences.

Hypothesis 3: *Changes to the functionality of the application such as (1) increasing the amount of information provided in the description of each attribute and (2) increasing the degree of control the subject has in expressing his preferences and making his decision, will reduce or eliminate the negative affective reactions of subjects with low product class knowledge towards the agents/applications which employ the EBA and WAD strategies.*

**3. Description of Variables and Operationalization of Constructs**

Independent Variables Being Manipulated

***Agent Search Strategy*** (STRATEGY)

This refers to the search and decision strategy employed by the agent in making recommendations to the user. The system was designed to have four treatment conditions, viz. Weighted Average Method (WAD), Elimination By Aspects Method (EBA), Profile Building Method (PROFILE), and Simple Hypertext Method (HYPERTEXT).

***Product Class Knowledge*** (KNOWLEDGE)

Product class knowledge refers to the knowledge about the product and the familiarity with the product which the subject has. The following scale items were used to measure the construct KNOWLEDGE. The respondents were told to mark each of the responses on a 7-point Likert scale ranging from "Strongly Disagree" to "Strongly Agree".

1. I am an expert in cars
2. I am very experienced in purchasing cars
3. I am very knowledgeable about cars
4. I understand the features of cars well enough to evaluate the alternative car models
5. I am not at all familiar with cars **( r )**
6. I have a great interest in cars

The value of Cronbach for the construct KNOWLEDGE was .91.

The above Likert scale measure and responses to the following two questions were used to obtain an approximate indication of the product class knowledge of the subjects prior to the training task so that subjects could be allocated to one of the two groups "high" and "low" product class knowledge.

How many times in the past five years have you purchased or helped another person purchase a car?

How regularly do you read articles on cars appearing in consumer publications, newspapers, and magazines (number of articles read per month)?

The existence of a consumption vocabulary for attributes of the product category [West, Brown, & Hoch 1996] was used as a measure for the construct KNOWLEDGE. Subjects were asked to recall from memory the list of attributes which they would consider if they were to purchase a car. The number of valid, distinct attributes they could recall from memory was used as a measure for KNOWLEDGE.

Dependent Variables

***Trust in the Agent's Recommendations*** (TRUST)

Trust in the agent refers to the degree to which the subject feels that the software agent has recommended options to him which most closely matches his preferences. The following scale items were used to measure the construct TRUST. The respondents were told to mark each of the responses on a 7-point Likert scale ranging from "Strongly Disagree" to "Strongly Agree".

1. I believe that the alternatives which the agent recommended to me were consistent with the preferences I expressed
1. The agent can be trusted to recommend alternatives which closely match the preferences I expressed
2. I am convinced that the agent recommended alternatives which most closely matched my preferences
2. The alternatives recommended by the agent were not credible **( r )**
3. The agent recommended alternatives which were consistent with my preferences
4. The agent has probably used my preference specifications in recommending alternatives to me
1. It is questionable whether the agent used my preference specifications in recommending alternatives to me **( r )**
2. The agent can relied on to use my preference specifications when it recommends alternatives to me
5. The agent can be depended on to recommend alternatives which closely match my preferences

The value of Cronbach for the construct TRUST was .84.

***Propensity to Purchase*** (PURCHASE)

This represents the subject's perception that he would purchase the selected alternative following the experiment if he were going to make a purchase in that particular product class. The following scale items were used to measure the construct PURCHASE. The respondents were told to mark each of the responses on a 7-point Likert scale ranging from "Strongly Disagree" to "Strongly Agree".

1. I would like to purchase this car.
2. If I purchased a car right now I would purchase this car model.
3. I would purchase this car if I had the money available.
4. I feel a strong urge to purchase this car.
5. I am willing to pay the price quoted for this car.
6. It is very likely that I will purchase this car.
7. I would definitely like to purchase this car.
8. It is important that I purchase this car.

The value of Cronbach for the construct PURCHASE was .79.

***Satisfaction with the Decision Process*** (SATISFACTION)

This represents the subject's subjective state of satisfaction with all aspects of the computerized decision process immediately after the decision has been made. The following scale items were used to measure the construct SATISFACTION. The respondents were told to mark each of the responses on a 7-point Likert scale ranging from "Strongly Disagree" to "Strongly Agree".

1. This system is one of the best ways to select a car
2. If I could do it over again, I'd rather not use this system to select a car **( r )**
3. I am **not** happy that I used this system to select a car **( r )**
4. This system was very useful in helping me to select the best car model to suit my requirements
5. If I had to select a car in future, and a system such as this was available, I would be very likely to use it
6. If my friend was searching for information in order to purchase a car, and I knew that a system such as this was available, I would be very likely to recommend this system to him

The value of Cronbach for the construct SATISFACTION was .86

***Confidence in the Decision*** (CONFIDENCE)

This refers to the confidence expressed by the subject that he has selected the best alternative from the set of feasible alternatives. The following scale items were used to measure the construct CONFIDENCE. The respondents were told to mark each of the responses on a 7-point Likert scale ranging from "Strongly Disagree" to "Strongly Agree".

1. I am confident that I selected the best car model to suit my needs
2. I am confident that I selected the car model which best matches my preferences
3. I am **not** confident that I selected the best car model **( r )**
4. There are probably other car models I should have examined more closely **( r)**
5. I would select this same car model if I had to make the decision again.
6. This is clearly the best car model available for my budget.

The value of Cronbach for the construct CONFIDENCE was .73

***Perceived Cost Savings*** (SAVINGS)

This reflects the degree to which the subject feels that the use of the system has helped him to realize significant cost savings in his purchase decision. The following scale items were used to measure the construct SAVINGS. The respondents were told to mark each of the responses on a 7-point Likert scale ranging from "Strongly Disagree" to "Strongly Agree".

1. By using this system to select a car, I was able to obtain the best value for my money
2. The use of this system has enabled me to save a lot of money in purchasing a car
3. If I had not used this system I would have obtained a better deal for my money **( r )**
4. This car is a real bargain
5. This system enabled me to compare the prices of different car models very efficiently
6. I could have obtained a better deal from a car dealer **( r )**

The value of Cronbach for the construct SAVINGS was .94

***Cognitive Decision Effort*** (EFFORT)

Cognitive decision effort refers to the psychological costs of processing information. This represents the ease with which the subject can perform the task of obtaining and processing the relevant information in order to enable him to arrive at his decision. The following scale items were used to measure the construct EFFORT. The respondents were told to mark each of the responses on a 7-point Likert scale ranging from "Strongly Disagree" to "Strongly Agree".

1. The task of selecting a car model using this system was very frustrating
2. I easily found the information I was looking for **( r )**
3. The task of selecting a car model using this system took too much time
4. The task of selecting a car model using this system was easy **( r )**
5. Selecting a car model using this system required too much effort
6. The task of selecting a car model using this system was too complex

The value of Cronbach for the construct EFFORT was .92

Experiment # 1

Objective

The objective of this research was to isolate the constructs of product class knowledge and agent search strategy and study the interaction between the two. In order to test how people with varying product class knowledge react to each type of agent search strategy, a simulated Internet shopping environment was set up which subjects navigated through, using the help of a "smart agent". For subjects in each group, "high" and "low" product class knowledge, reactions to the different agent strategies was measured.

Subjects

160 MBA students at a major university in the southern United States participated in the study.

Industry Selection

The product category "cars" was selected the maximize the likelihood of a wide variation in product class knowledge for the subject group used in the experiment. There are more than 400 car models currently available in the USA and there exists a large number of attributes which customers typically use in their selection of cars. A specific goal in selecting the product category "cars" for use in the stimuli was to represent search goods. These types of products are commonly represented in Web retail settings. The objective in selecting the product category "cars" is to meet the following criteria:

1. Subjects are likely to possess widely varying prior knowledge in the product category
2. Subjects can be relatively easily trained on the product category
3. Search product type is represented
4. The product category is conducive to all the agent search strategies
5. The product category can be described with attributes and attribute values that are basic enough and/or can be explained well enough that novices can feasibly complete the task.

Experimental Design

The experiment design consisted of a 2 (product class knowledge: high, low) x 4 (agent search strategy: EBA, WAD, PROFILE, HYPERTEXT) design with product class knowledge as the between-groups variable. Subjects in each group (high and low product class knowledge) were randomly assigned to one of the four treatment conditions. Independent samples testing was used. The use of 160 subjects in the experiments resulted in a sample size of 20 subjects for each cell.

The 2 X 4 design resulted in 8 cells as is illustrated in Figure 1 below:

| | Agent Filtering Strategy Employed | | | |
|---|---|---|---|---|
| Subject Groups | Elimination By Aspect Strategy | Weighted Average Strategy | Profile Building Strategy | Simple Hypertext |
| High Product Class Knowledge | | | | |
| Low Product Class Knowledge | | | | |

Figure 1: 2x4 Research Design

Factors Controlled in the Experiment

The results of the pretests point out the need for experimental control. In order to test the hypothesized effects, the following factors were controlled in the experiment:

**1. *Information Presentation Format and Graphics*:** The use of a local web site for each alternative enabled effective control of the information presentation format and graphics on the web sites so that this would not influence the decision making of the subjects.

**2. *Information Content of the Web Sites*:** For each alternative which the subject examined, the information content was the same. That is, the attributes on which information was provided was consistent across all the alternatives. The entire software system was developed by a research assistant using PowerBuilder software. This enabled effective control of the content and format of the information which was presented to the subjects for each alternative.

**3. *Download Time of the Web Pages*:** The download time of the web pages was constant for all the alternatives. This could have been a major influence on the decision making behavior of the subjects because the web sites for many of the car models reside on servers located all over the world (Germany, Japan, Italy, France, U.K., Korea, USA, Canada). The use of web sites and a database query system residing on a single server which was located in the same physical vicinity where the subjects were undertaking the experiments eliminated this factor as a source of variability in the subjects' responses.

**4. *Number of Alternatives in the Feasible Set*:** The subjects were told to make their choice from among the set of alternatives which were presented to them. This set was the same, regardless of the treatment condition, and included all the 400 car models currently available in the USA.

**5. *Choice Task*:** All the respondents were given the same choice task, a setting where they were asked to select a car to purchase from among the cars in the database.

**6. *Number of Attributes for each Alternative*:** When making the query the respondent had a choice of a fixed set of attributes. He could set values and ranges for some or all of these attributes. These attributes are the same set of attributes used in the car selection task by Personal Logic (http://www.personalogic.com). The attributes used included body type, fuel efficiency, safety record, price, maintenance costs, performance (in terms of acceleration, braking distance), car manufacturer, and country of manufacture. The subjects could specify preferences for various subcategories within these broad categories.

**7. *Source of Information*:** This was confined to a search of the web sites which represented the type of design and information content which the car manufacturers provide on their web sites.

**8. *Market Segment*:** The sample is based on a convenience sample of MBA students. This represents a fairly homogeneous market segment for the decision making task.

These controls limit the generalizability of the research, but are necessary to test the effects of interest.

Choice Environment

A laboratory experiment served as the vehicle for testing the stated hypotheses. Eight workstations in a behavioral decision laboratory at a major university in the southern United States provided a controlled environment where subjects participated in the experiment. An interactive software system running on personal computers was used to collect the data. The package was designed to be user friendly, with complete details / instructions being provided on the system. A software program developed in PowerBuilder was the main instrument used in data collection. The database used to store the attribute values of the alternatives was Oracle. The PowerBuilder software enabled the establishment of a connection from the World Wide Web to a database which contained the data for the queries and thus simulated the World Wide Web browser environment. This program used a structured database, and interactively displayed the desired information, recording unobtrusively the data selected by the subject.

Choice Procedures

Subjects were first administered a pre-experiment questionnaire which was intended to determine initial knowledge in the product category. This included measures of familiarity with the product category and knowledge about the product category. The pre-experiment questionnaire was also used to collect demographic information from the subjects (e.g., their age, household income, education level, gender, etc.). These questions provided a subjective measure of the subjects' product class knowledge. The level of product class knowledge was then manipulated by providing each of the subjects who were identified following the initial questionnaire as belonging to the group "high product class knowledge" with training on product attributes and features. This consisted of a series of screens of terminology used to describe and assess attributes of the product with the opportunity to click on any of the terms and receive additional information. Subjects in the "low product class knowledge" group received no training on the product category but received some screens of unrelated terminology (about music CDs) as a filler task. All subjects were then required them to list from memory the attributes that they would use in their purchase decision for this product. This provided a more objective measure of product class knowledge. Subjects in "high product class knowledge" category were expected to score higher in the objective knowledge section, indicating higher levels of product class knowledge as a result of the training task. In accordance with West, Brown, and Hoch [1996], consumers who have a consumption vocabulary are better able to develop and express preferences in a

product category. Thus, product class knowledge, or at least familiarity with product attributes and descriptive terminology is expected to be an indicator of high product class knowledge. The subjects in each of the two groups "high" and "low" product class knowledge were then allocated at random to one of the four treatment conditions.

Independent variables which were manipulated included the agent recommendation strategy and the product class knowledge of the respondents. After completion of the choice task, subjects were asked to rate the choice task on the following dependent variables: cognitive effort, confidence in their decision, satisfaction with the decision process, propensity to purchase, perceived cost savings, and trust in the product alternatives recommended by the agent. In addition, an open-ended question asked subjects what application qualities or features would have made the task easier.

Stimuli

The stimuli consisted of a simulated Internet shopping application. Each subject conducted one search and selection for the product. Each subject was exposed to one application type. To investigate the relationship between the specific characteristics of the computerized decision aid and the satisfaction which the subject experiences with the decision process, four versions of an interactive, computer-driven decision aid were developed. Each version contained a database of attribute-value information for 400 car models which are currently available in the USA. Beyond the common database, the versions varied by the agent search strategy EBA, WAD, PROFILE, or HYPERTEXT, which enabled subjects to specify their preferences and helped them in the choice task. This resulted in four distinct types of decision environments. Extensive pretesting was conducted to check the effects of the experimental manipulation on the dependent variables.

Manipulation Check

The initial subjective measure of product class knowledge showed some difference in product class knowledge between subjects in the "high product class knowledge" and "low product class knowledge" groups. The initial measure of product class knowledge was done by using the multi-item 7-point Likert scale measure. Means for product class knowledge (high knowledge = 4.12; low knowledge = 2.77; p = .155) were not significantly different. Following the training task, a question was presented to test subjects' objective knowledge about the product category. The responses to the question on choice factors (List the attributes you would consider in your purchase decision for cars?) were analyzed. The number of distinct, correct answers to the question was tallied to come up with an objective knowledge score. An independent scorer familiar with the product category and blind to the hypotheses being tested also graded the subjects' responses. Inter-rater reliability was .93. Disagreements were resolved by discussion. The scores on this objective measure of product class knowledge differed significantly between the "high product class knowledge" and the "low product class knowledge" groups in the direction predicted, with subjects in the "high product class knowledge" group being more knowledgeable about the terminology and choice factors than those in the "low product class knowledge" group ($F_{1,158}$= 12.99; p = .001; mean high knowledge = 6.82; mean low knowledge = 3.15; scores ranged from 0 to 11 for list of car attributes considered). In addition to pre-task measures of product class knowledge, these measures were taken again after task completion. Following the shopping task, subjects were presented with a series of questions assessing product class knowledge, and various affective reactions such as satisfaction with the decision process, confidence in the decision, propensity to purchase, perceived cost savings, cognitive effort, and trust in the agents' recommendations.

Results

The experiment was administered to 160 MBA students. Independent samples testing was used. 20 subjects were assigned to each cell in the 2x4 research design. The allocation of subjects in each of the two groups "high" and "low" product class knowledge to one of the four treatment conditions (EBA, WAD, PROFILE, HYPERTEXT) was done at random. Following extensive pretests and the procedures required for instrument purification, the measures used in the main experiment were found to have values for Cronbach ranging from .73 to .94. From this analysis, it can be concluded that the measures used had high reliability. Factor analysis of the data indicated that the scale items loaded onto the constructs they were apriori expected to load on. There were no cross-loadings. Furthermore, the number of factors which emerged was identical to those expected apriori. Thus, there is statistical evidence to support the claim that the scales have adequate uni-dimensionality, convergent and discriminant validity at the monomethod level of analysis. Hence it can be concluded that the measures used had high validity. The influence of the decision environment on the dependent variables was tested using a single factor ANOVA with the factor being KNOWLEDGE. The measures used for the dependent variables SATISFACTION, CONFIDENCE, TRUST, PURCHASE, SAVINGS and EFFORT were represented as the mean-centered scores of the 7-point Likert scale items which were used to measure these constructs. Correlation analysis shows that product class knowledge is significantly correlated with several dependent variables, including satisfaction with the decision process (r=.23, p=.037), how much they trusted that the agent represented them well in selecting alternatives (r=.27, p=.085) and how effortful they found the task (r=-.21, p=.039).

To rule out any potentially confounding effects, the sample means for computer familiarity were statistically compared across cells. Results of these tests indicated that each cell contained subjects who, on average, had the same level of computer familiarity. In addition, subjects were distributed approximately equally across cells by gender. Hence, effects identified in the experimental data can be assigned with greater certainty to the experimental variables under investigation.

Table 1: Reliability of Measures Used

| **Acronym** | **Measure** | |
|---|---|---|
| **SATISFACTION** | Satisfaction with the Decision Process | **.86** |
| **CONFIDENCE** | Confidence in the Decision / Choice | **.73** |
| **TRUST** | Trust in the Agent's Recommendations | **.84** |
| **PURCHASE** | Propensity to Purchase | **.79** |
| **SAVINGS** | Perceived Cost Savings | **.94** |
| **EFFORT** | Cognitive Decision Effort | **.92** |
| **KNOWLEDGE** | Product Class Knowledge | **.91** |

Table 2: Correlations Between the Constructs

| | EFFOR | SATISF | CONF | SAVIN | TRUST | PURCH | KNOW |
|---|---|---|---|---|---|---|---|
| EFFORT | 1.00 | | | | | | |
| SATISFACTION | -.1546 | 1.00 | | | | | |
| CONFIDENCE | .0947 | .0443 | 1.00 | | | | |
| SAVING | -.2027 | .1973 | .1498 | 1.00 | | | |
| TRUST | .0423 | .0619 | .2497** | .2538** | 1.00 | | |
| PURCHASE | .0316 | .0618 | .2192 | .2519** | .1683 | 1.00 | |
| KNOWLEDGE | -.2142** | .2341** | .2893*** | .1052 | .2716*** | .1865 | 1.00 |

*** Significant LE .01 (2-tailed) ** Significant LE .05 (2-tailed)

Table 3: Results of Single Factor Anova Analysis for the Treatment Condition Elimination By Aspects (EBA)

| Dependent Variable | Mean of Sample with HIGH product class knowledge (n = 20) | Mean of Sample with LOW product class knowledge (n = 20) | $F_{1,38}$ | Significance Level |
|---|---|---|---|---|
| SATISFACTION | 5.11 | 3.01 | 8.143 | .007*** |
| CONFIDENCE | 5.39 | 3.43 | 6.882 | .012** |
| TRUST | 5.26 | 2.92 | 9.089 | .005*** |
| PURCHASE | 4.18 | 1.96 | 8.636 | .006*** |
| SAVINGS | 5.63 | 3.27 | 9.091 | .005*** |
| EFFORT | 2.71 | 4.65 | 6.264 | .017** |

Table 4: Results of Single Factor Anova Analysis for the Treatment Condition Weighted Average Method (WAD)

| Dependent Variable | Mean of Sample with HIGH product class knowledge (n = 20) | Mean of Sample with LOW product class knowledge (n = 20) | $F_{1,38}$ | Significance Level |
|---|---|---|---|---|
| SATISFACTION | 5.32 | 2.91 | 9.325 | .004*** |
| CONFIDENCE | 5.63 | 3.47 | 8.139 | .007*** |
| TRUST | 5.17 | 2.68 | 10.231 | .003*** |
| PURCHASE | 4.25 | 1.92 | 9.087 | .005*** |
| SAVINGS | 5.79 | 3.02 | 11.072 | .002*** |
| EFFORT | 2.96 | 4.75 | 4.990 | .031** |

Table 5: Results of Single Factor Anova Analysis for the Treatment Condition Profile Building Method (PROFILE)

| Dependent Variable | Mean of Sample with HIGH product class knowledge (n = 20) | Mean of Sample with LOW product class knowledge (n = 20) | $F_{1,38}$ | Significance Level |
|---|---|---|---|---|
| SATISFACTION | 2.91 | 5.25 | 9.090 | .005*** |
| CONFIDENCE | 2.52 | 4.49 | 7.219 | .011** |
| TRUST | 2.19 | 4.24 | 7.812 | .008*** |
| PURCHASE | 1.53 | 3.92 | 4.013 | .052* |
| SAVINGS | 2.05 | 4.41 | 9.326 | .004*** |
| EFFORT | 4.82 | 2.79 | 7.220 | .011** |

Table 6: Results of Single Factor Anova Analysis for the Treatment Condition Simple Hypertext (HYPERTEXT)

| Dependent Variable | Mean of Sample with HIGH product class knowledge (n = 20) | Mean of Sample with LOW product class knowledge (n = 20) | $F_{1,38}$ | Significance Level |
|---|---|---|---|---|
| SATISFACTION | 2.82 | 2.49 | 1.950 | .171 |
| CONFIDENCE | 2.78 | 2.48 | 1.413 | .242 |
| PURCHASE | 2.42 | 1.96 | 2.261 | .141 |
| SAVINGS | 2.53 | 2.23 | 1.419 | .241 |
| EFFORT | 5.51 | 5.81 | 1.457 | .235 |

Table 7: Comparison of Sample Means for the Group HIGH Product Class Knowledge

| Dependent Variable | Mean of Sample for treatment condition WAD (n = 20) | Mean of Sample for treatment condition EBA (n = 20) | Mean of Sample for treatment condition PROFILE (n = 20) | Mean of Sample for treatment condition HYPERTEXT (n = 20) |
|---|---|---|---|---|
| SATISFACTION | 5.32 | 5.11 | 2.91 | 2.82 |
| CONFIDENCE | 5.63 | 5.39 | 2.52 | 2.78 |
| TRUST | 5.17 | 5.26 | 2.19 | |
| PURCHASE | 4.25 | 4.18 | 1.53 | 2.42 |
| SAVINGS | 5.79 | 5.63 | 2.05 | 2.53 |
| EFFORT | 2.96 | 2.71 | 4.82 | 5.51 |

Table 8: Results of Single Factor Anova Analysis for the Group HIGH Product Class Knowledge

| Dependent Variable | WAD preferred to EBA $F_{1,38}$ Signif. level | WAD preferred to PROFILE $F_{1,38}$ Signif. level | WAD preferred to HYPER-TEXT $F_{1,38}$ Signif. level | EBA preferred to PROFILE $F_{1,38}$ Signif. level | EBA preferred to HYPER-TEXT $F_{1,38}$ Signif. level | PROFILE preferred to HYPER-TEXT $F_{1,38}$ Signif. level |
|---|---|---|---|---|---|---|
| SATISFACTION | 1.434<br>.239 | 9.325<br>.004*** | 10.231<br>.003*** | 8.636<br>.006*** | 9.089<br>.005*** | .666<br>.420 |
| CONFIDENCE | 1.621<br>.211 | 12.667<br>.001*** | 11.069<br>.002*** | 13.009<br>.001*** | 11.071<br>.002*** | 1.630<br>.209 |
| TRUST | .675<br>.416 | 13.011<br>.001*** | | 12.675<br>.001*** | | |
| PURCHASE | .580<br>.451 | 11.072<br>.002*** | 5.122<br>.029** | 10.997<br>.002*** | 12.663<br>.001*** | 3.209<br>.081* |
| SAVINGS | 1.097<br>.302 | 12.671<br>.001*** | 12.664<br>.001*** | 12.661<br>.001*** | 12.669<br>.001*** | 2.368<br>.132 |
| EFFORT | 1.625<br>.210 | 5.725<br>.022** | 10.229<br>.003*** | 8.143<br>.007*** | 11.067<br>.002*** | 2.818<br>.101 |

Table 9: Comparison of Sample Means for the Group LOW Product Class Knowledge

| Dependent Variable | Mean of Sample for treatment condition WAD (n = 20) | Mean of Sample for treatment condition EBA (n = 20) | Mean of Sample for treatment condition PROFILE (n = 20) | Mean of Sample for treatment condition HYPERTEXT (n = 20) |
|---|---|---|---|---|
| SATISFACTION | 2.91 | 3.01 | 5.25 | 2.49 |
| CONFIDENCE | 3.47 | 3.43 | 4.49 | 2.48 |
| TRUST | 2.68 | 2.92 | 4.24 | |
| PURCHASE | 1.92 | 1.96 | 3.92 | 1.96 |
| SAVINGS | 3.02 | 3.27 | 4.41 | 2.23 |
| EFFORT | 4.75 | 4.65 | 2.79 | 5.81 |

Table 10: Results of Single Factor Anova Analysis for the Group LOW Product Class Knowledge

| Dependent Variable | WAD preferred to EBA $F_{1,38}$ Signif. level | WAD preferred to PROFILE $F_{1,38}$ Signif. level | WAD preferred to HYPER-TEXT $F_{1,38}$ Signif. level | EBA preferred to PROFILE $F_{1,38}$ Signif. level | EBA preferred to HYPER-TEXT $F_{1,38}$ Signif. level | PROFILE preferred to HYPER-TEXT $F_{1,38}$ Signif. level |
|---|---|---|---|---|---|---|
| SATISFACTION | .666<br>.420 | 9.093<br>.005*** | 2.149<br>.151 | 8.638<br>.006*** | 2.427<br>.128 | 11.077<br>.002*** |
| CONFIDENCE | .426<br>.518 | 7.220<br>.011** | 3.281<br>.078* | 3.717<br>.061* | 3.233<br>.080* | 13.119<br>.001*** |
| TRUST | 1.625<br>.210 | 4.470<br>.041** | | 3.972<br>.053* | | |
| PURCHASE | .416<br>.523 | 7.218<br>.011** | .411<br>.525 | 6.881<br>.012** | .169<br>.683 | 6.879<br>.012** |
| SAVINGS | 1.621<br>.211 | 3.973<br>.053* | 3.016<br>.091* | 3.895<br>.056* | 3.556<br>.067* | 8.635<br>.006*** |
| EFFORT | .660<br>.422 | 6.882<br>.012** | 3.716<br>.061* | 5.725<br>.022** | 3.895<br>.056* | 12.666<br>.001*** |

There were interesting suggestions of an interaction between product class knowledge and agent search strategy. Subjects with high product class knowledge had more positive affective reactions to the agent/application in the WAD and EBA conditions than in the profile building condition while subjects with low product class knowledge showed the reverse reactions. Subjects with low product class knowledge had more positive affective reactions to the agent/application in the profile building condition than in the EBA and WAD conditions. A potential explanation could be that in the EBA and WAD conditions, the agent utilizes the product class knowledge possessed by the subject to a much greater extent than in the profile building condition. Subjects with low product class knowledge have less knowledge of the product attributes, and they may have not felt comfortable with providing this type of information to the agent as was requested in the WAD and EBA strategies. They would feel more comfortable when the agent used the profile building strategy.

Experiment # 2

Objective

The objective of this study was to identify how particular features of each agent strategy may be modified to appeal to individuals with both product class knowledge states, thus weakening or eliminating the product class knowledge x agent search strategy interaction effect.

Methodology

The software application for the EBA and WAD search strategies was modified to increase the degree of control provided to the user and to increase the amount of information provided to the user. The degree of control provided to the user was increased by giving the user the capability to return to the preference specification stage at any time and restate his preferences, by providing the user the ability to skip responses to certain attribute specifications requested, and by giving the user the capability to express his degree of confidence in his preference specifications for each attribute. The amount of information provided to the user was increased by converting the attribute names on the screen into hypertext links which if clicked would bring up a screen of detailed information about that attribute.

80 MBA students participated in the study. Measures of subjective knowledge for the product category were taken. Subjects identified as belonging to the group "high product class knowledge" received further training in the product class. Subjects identified as belonging to the group "low product class knowledge" received further training in an unrelated product class which served as a filler task. This was done to manipulate product class knowledge. Subjects in each of the groups "high" and "low" product class knowledge were then randomly assigned to one of two treatment conditions – WAD or EBA. Measures of affective response to each agent search strategy such as satisfaction with the decision process, confidence in the decision, propensity to purchase, perceived cost savings, cognitive effort, and trust in the agent's recommended alternatives were taken. In addition, open-ended questions were asked to assess particular features of each agent search strategy that were liked or disliked.

Results

Table 11: Results of Single Factor Anova Analysis for the Treatment Condition Elimination By Aspects (EBA)

| Dependent Variable | Mean of Sample with HIGH product class knowledge (n = 20) | Mean of Sample with LOW product class knowledge (n = 20) | $F_{1,38}$ | Significance Level |
|---|---|---|---|---|
| SATISFACTION | 5.27 | 4.29 | 3.257 | .079* |
| CONFIDENCE | 5.48 | 4.71 | 2.996 | .092* |
| TRUST | 5.26 | 4.21 | 3.683 | .063* |
| PURCHASE | 4.31 | 3.17 | 3.895 | .056* |
| SAVINGS | 5.68 | 4.29 | 4.139 | .049** |
| EFFORT | 2.57 | 3.21 | 2.654 | .112 |

Table 12: Results of Single Factor Anova Analysis for the Treatment Condition Weighted Average Method (WAD)

| Dependent Variable | Mean of Sample with HIGH product class knowledge (n = 20) | Mean of Sample with LOW product class knowledge (n = 20) | $F_{1,38}$ | Significance Level |
|---|---|---|---|---|
| SATISFACTION | 5.41 | 4.57 | 3.077 | .087* |
| CONFIDENCE | 5.59 | 4.78 | 3.056 | .089* |
| TRUST | 5.29 | 4.26 | 3.439 | .071* |
| PURCHASE | 4.27 | 3.19 | 3.821 | .058* |
| SAVINGS | 5.76 | 4.25 | 4.139 | .049** |
| EFFORT | 2.94 | 3.32 | 2.072 | .158 |

Subjects' affective reactions to systems that had been modified to increase the amount of information provided and to increase the degree of control provided were found to be different from the original interaction effect found in the original study. While the basic approach of each agent search strategy remained the same, particular aspects of each agent search strategy was modified. Based on these modifications to characteristics of each particular strategy, subjects responded more positively to the previously "less preferred" strategy, thus weakening the interaction effect.

**4. Discussion**

The environment in which consumers encounter information has a substantial impact on the way this information is evaluated and integrated. Specifically, user interfaces which provide consumers control over the content, order, and duration of product-relevant information cause information to have higher value and to become increasingly usable over time. The experimental results presented here demonstrate that the cognitive fit of agent search strategy and subjects' product class knowledge has a significant impact on consumers' ability to integrate information, to understand inputs to their judgments, and to be confident about their judgments. In addition, consumer satisfaction with the decision process was significantly increased when the cognitive fit was high. Proper design of these decision aids allows for a better match between evaluative judgments and underlying utilities.

This research has implications for a number of settings within the realm of marketing and consumer behavior, especially in the electronic commerce environment. Understanding how consumers' preferences vary based on the level of their product class knowledge will help marketers design web sites more effectively to cater to a large segment of peoples' needs. Understanding the reasons behind individuals' reactions to agent strategies based on the level of their product class knowledge allows web retailers to modify their web sites and include functionality in their agents/applications to make the agent's search strategy more appealing to both those with high as well as low product class knowledge. Specific recommendations to managers would include making at least two agent search strategies (WAD or EBA, and PROFILE) available to users and allowing the users to use the one they prefer. Alternatively, managers could include the functionalities demonstrated in experiment # 2 which reduce negative reactions by individuals with differing states of product class knowledge. As product category learning occurs and product class knowledge develops, both through experience with the agent/application and through experience with the product, individuals may change in terms of the type of agent search strategy they prefer.

By acknowledging the constructive nature of product class knowledge and the differences it brings about in consumers' expectations from and reactions to various selling techniques, marketers can more effectively tailor their messages to suit more people. By taking on the task of helping consumers acquire product class knowledge, Internet marketers help their cause by:

1. providing consumers the necessary vocabulary and product information needed to lessen the likelihood of choices being based purely on price, which is a current fear of Internet marketers
2. increasing positive affective reactions to the shopping experience, thus increasing satisfaction with the shopping experience and encouraging choice, which should serve to promote repeat and long-term patronage as opposed to a one-shot purchase that the consumer would rather not repeat
3. encouraging people who would normally just browse the web sites looking for information to actually make their purchases online.

This research has demonstrated that optimizing the cognitive fit between agent search strategy and consumers' product class knowledge significantly increases consumer satisfaction with the decision process. However, it has been noted that although some decision aids may improve decision making, abuse is possible [Todd & Benbasat, 1994]. In particular, Widing and Talarzyk [1993] have shown that the decision aid most likely to be a part of an electronic commerce environment (i.e. a cutoff rule that allows the formation of a consideration set containing only those alternatives that pass consumer-specified attribute cutoffs) can lead to sub-optimal decisions in efficient choice sets. A separate stream of research has shown that a second likely characteristic of an electronic commerce environment, i.e. a visually rich presentation, can distort the decision process by diverting attention away from information that is most important for the task at hand [Jarvenpaa, 1989, 1990].

Academic Contributions

The phenomenon of consumers purchasing products on the World Wide Web is relatively new. In this business model, consumers select items to purchase from electronic shopping malls by making queries to databases using software tools such as software smart agents. A large proportion of the purchase transaction is conducted via computers without the consumer ever having face-to-face contact with the sales personnel. This has raised a host of interesting research issues which need to be investigated. Research that should shed light on such issues is already underway (e.g. Degeratu, Rangaswamy, and Wu's [1998] study of electronic commerce for grocery items, Lynch and Ariely's [1998] study of electronic commerce for wines, and Shankar and Rangaswamy's [1998] study of electronic commerce in the travel industry). The influence of QBDA on satisfaction with the decision process, confidence in the decision, and the propensity to purchase has not been examined previously and is of crucial importance.

Managerial Implications

This research has significant managerial implications in terms of providing guidelines for the design of web sites in order to optimize the interface between the consumer and the system.

***Design of User Interfaces for Electronic Commerce***

The design of the user interface with a view to optimizing the satisfaction of consumers who are making their purchases via the World Wide Web is a critical issue. The electronic commerce channel is likely to emerge as a significant channel for conducting sales transactions and will significantly alter the structure of most industries. It is imperative that a research agenda be immediately established to understand how this will influence consumer behavior and market structures. Designers of web sites need to understand the cognitive and perceptual rules that prompt consumers to make electronic detours in their search for goods and services. Ultimately, this research should help designers of web sites to make accurate generalizations about the effects of computerized decision aids on strategy selection so that they can then design their web sites to provide the optimal interface for a given task environment.

***Impact on Industry***

The World Wide Web is increasingly being used by consumers to search for information prior to the purchase of major consumer durables such as cars. In, 1997, 2 % of the car sales in the US originated from a single web site Auto-by-Tel (http://www.autobytel.com/). Bud Mathaissel, Chief Information Officer of Ford Motor Corporation expressed the opinion that he expects a significant proportion of new car sales to be transacted via the World Wide Web by December, 1999 and this would increase dramatically over the next two years. General Motors launched its nationwide Internet car-selling service on March 10, 1999, the latest move by an automaker to tap the growth in consumers using the Web to buy cars. Called GM BuyPower (http://www.gmbuypower.com), the Web site lets consumers view the inventory of nearby GM dealers, find up-to-the minute rebate deals and get price quotes. GM says about 75% of its dealers, almost 6000, will participate. "If you look at the growth of the Internet and the number of people using it to shop, it is absolutely critical that we be a part of it," says Roy Roberts, GM's vice president for North American sales. "Those automakers that aren't on the bandwagon early on will lose out", says Doug Dohring of automotive market researcher Dohring Co. "Well over half the customers we surveyed intend to use the Internet for their next vehicle purchase." Most automakers have Web sites offering services similar to GM's. Ford Motor has BuyConnection where consumers can "design" a vehicle and get a price quote from a dealer [Earle 1999]. Thus this research has very significant managerial implications.

***Impact on Consumer Satisfaction and Confidence***

Given the large number and variety of decision aids currently emerging on the Internet, it is imperative that we investigate how these decision aid formats impact consumer satisfaction and confidence in the decision. The fact that the cognitive fit of agent search strategy with consumers' product class knowledge has a significant impact on consumer satisfaction and confidence is worth noting. Cognitive effort is an important determinant of how the search aids (QBDA) are used. While designers of web sites can use this knowledge to their advantage, ignoring it may lead to the tools being used in unanticipated and undesirable ways. Designers of web sites who take a non-directive approach to the design of their web sites risk foregoing the improved decision quality benefits and are instead more likely to see efficiency benefits. Only by designing web sites efficiently, using the reduction of cognitive effort as a key lever, will the use of the decision aids for the purpose of electronic commerce result in increased decision making effectiveness. Documenting the performance of these computerized decision aids in varied environments should help identify the conditions under which they can be used to a decision maker's advantage and when they might create system-induced errors. Understanding when problematic interactions are likely to occur should focus research attention on corrective mechanisms to mitigate the potential for error. It is of interest to investigate the users' viewpoints with regard to the computerized decision aids to discern a computerized decision aid's likelihood of acceptance. The future challenge in developing consumer oriented computerized decision aids does not reside in technological advances, but rather in developing systems that are useful and appealing to the intended consumer. This is necessary to avoid consumer perceptions of non-utility, and ultimately non-use of the computerized decision aids.

***Marketing Strategy of Online Vendors***

Many merchants who have set up electronic shopping malls on the World Wide Web fear that the reduced cognitive search effort associated with this environment will lead to increased price competition and lower profit margins. This is consistent with arguments proposed by Bakos [1997], Lynch and Ariely [1998], and Alba, Lynch, Weitz, Janiszewski, Lutz, Sawyer, and Wood [1997]. This may lead to merchants adopting a strategy of providing a less than optimal web site so as to make it difficult for consumers to use this medium to obtain price comparisons, quality comparisons and comparisons across web sites. This research has demonstrated that optimizing the cognitive fit of agent search strategy with consumers' product class knowledge results in an increased perception of cost savings among consumers. This leads to consumers experiencing greater satisfaction with the decision process. This will lead to the consumers using this channel more extensively to search for pre-purchase information and ultimately even making their purchases through this channel. Merchants who adopt the strategy of not providing the optimal interface to consumers on their web sites will risk losing a substantial portion of the business which will be transacted via this channel.

***Providing a Consolidated Source of Information***

The fact that many web sites such as Auto-by-Tel (http://www.autobytel.com), Microsoft Carpoint (http://carpoint.msn.com), and Personal Logic (http://www.personalogic.com) provide a consolidated source of information about products from many manufacturers significantly increases the benefits that consumers obtain from using these web sites to search for information. This has resulted in the rapid adoption of these web sites by consumers in their search for pre-purchase information on various products.

***Implications for Consumer Policy***

Widespread availability of electronically provided product information has the potential to significantly enhance consumers' ability to cope with complex product environments, thereby facilitating the decision process. However, because of their ability to influence consumers' choice processes, such systems should be subjected to careful scrutiny. Electronically provided information is not currently regulated with respect to its veracity or objectivity. Since the majority of these systems are sponsored by parties with a vested interest in selling products, it is plausible that the information presented is likely to be biased in favor of the sponsor. If the integrity of the information is compromised, the strategic position of the consumer is likely to be weakened, rather than improved, through interaction with the system. Because of their dual power to both empower as well as abuse the consumer, these issues must be addressed by consumer advocates and policy makers alike in the near future.

## 5. Limitations of the Research

As with any experimental investigation, there are a number of limitations present in this research. This research was restricted to the selection of cars on the World Wide Web. Clearly, a variety of choice situations as well as products must be investigated before generalizable comments can be made to guide the development of computerized decision aids. Another limitation of this research is the composition of the group which participated in the study. The sample is homogeneous, and presumably has greater than average cognitive capabilities. A more diverse sample would have facilitated investigation of several intriguing results and would have offered greater

opportunity for generalization of the findings. The respondents were placed in a choice task that implicitly demanded and facilitated search, and an analytical approach. However, since the hypotheses which were developed dealt with the specific effects of the manipulations, these factors only point to the difficulty in the generalization of these results to different segments of the market and to different choice situations.

## 6. Directions for Future Research

This research has examined the influence of QBDA on decision making and their impact on different aspects of performance and satisfaction with the decision process. Much more work needs to be done on examining the influence of these QBDA on consumer preferences. Some of the potential research areas are discussed below.

### *Influence of the Query-Based Decision Aids on Decision Strategies*

A potential area for further research is to examine how the use of computerized decision aids such as software smart agents and database query engines impacts the decision strategies which consumers adopt when they are shopping on the World Wide Web [Alba, Lynch, Weitz, Janiszewski, Lutz, Sawyer, and Wood, 1997].

### *Preference for Various Decision Aids in User Interfaces*

The experiments presented in this paper forced subjects to use computerized interfaces for some time and measured the outcomes of this experience. In the real world, consumers are not randomly assigned to treatment conditions, and it is an open question whether they will demand a greater availability of QBDA in conditions where the current research shows they are beneficial. In order to understand the influence of QBDA on consumer decision making, we need to study preferences and not just performance. The goal of information providers is not only to provide consumers with useful information that could facilitate good decisions but also to get consumers to adopt their services and continue to subscribe and use them in the long term.

### *Motivation and Search Effort*

There is a question with regard to whether the use of QBDA would increase consumers' motivation to search for information. Pleasurable activities are likely to result in a higher tendency to engage in these activities. Therefore, much as consumers who enjoy shopping spend more time at it than those who do not, one can ask whether the use of QBDA will enhance the pleasure of information search and thus increase search time. Some evidence in this direction has come from work on optimal stopping rules [Saad & Russo, 1996], who demonstrated that under conditions that allow more free search, people examine more information before they reach a point where they feel they have sufficient information to make a decision. While electronic communication channels have the potential to significantly decrease search costs, increased motivation can ultimately result in increased overall search effort and search time.

### *The Use of Query-Based Decision Aids in Different Information Environments*

Ample evidence exists that information is not simply acquired in reaction to pre-defined preferences, but that it also helps decision makers define their own values and preferences as they engage in the process of acquiring information [Tversky, Sattath & Slovic, 1988; Payne, Bettman & Johnson, 1993]. In other words, the information itself changes the way preferences are constructed, and therefore one cannot define the decision space in advance. There exist potential liabilities for QBDA in dynamic environments in which innovation can change the correlation structure of alternatives in the environment. As long as the information environment is stable and does not change much, the structure of preferences can be expected to have some stability. Hence in such environments QBDA can be beneficial. However, in situations in which information changes over time, consumers served by QBDA alone would be unlikely to notice the changing correlational structure of the environment. In these environments, additional mechanisms would need to be built into the system to continuously update the knowledge base. Expert systems could play a vital role in these decision environments.

### *Planning Upgrade Paths*

Under some circumstances, it might be better to have a simple user interface that does not require much effort to learn and use. The advantages of such interfaces are primarily at the initial stages of usage, when experience is low. Over time, as experience accumulates, the advantages of more powerful and flexible interfaces become more apparent. Therefore, electronic merchants have the problem of providing either a good solution for the short term in the form of simple user interfaces, or for the long term in the form of complex user interfaces. The challenge for marketing managers is to provide consumers with information systems that change over time such that they fulfill the consumers' short term needs without sacrificing the consumers' long term interests.

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