

Modeling Traveler Response to Traveler Information Systems:  
Laboratory Simulation of Information Searches  
Using Multimedia Technology

by

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Submitted to the Department of Civil and Environmental Engineering  
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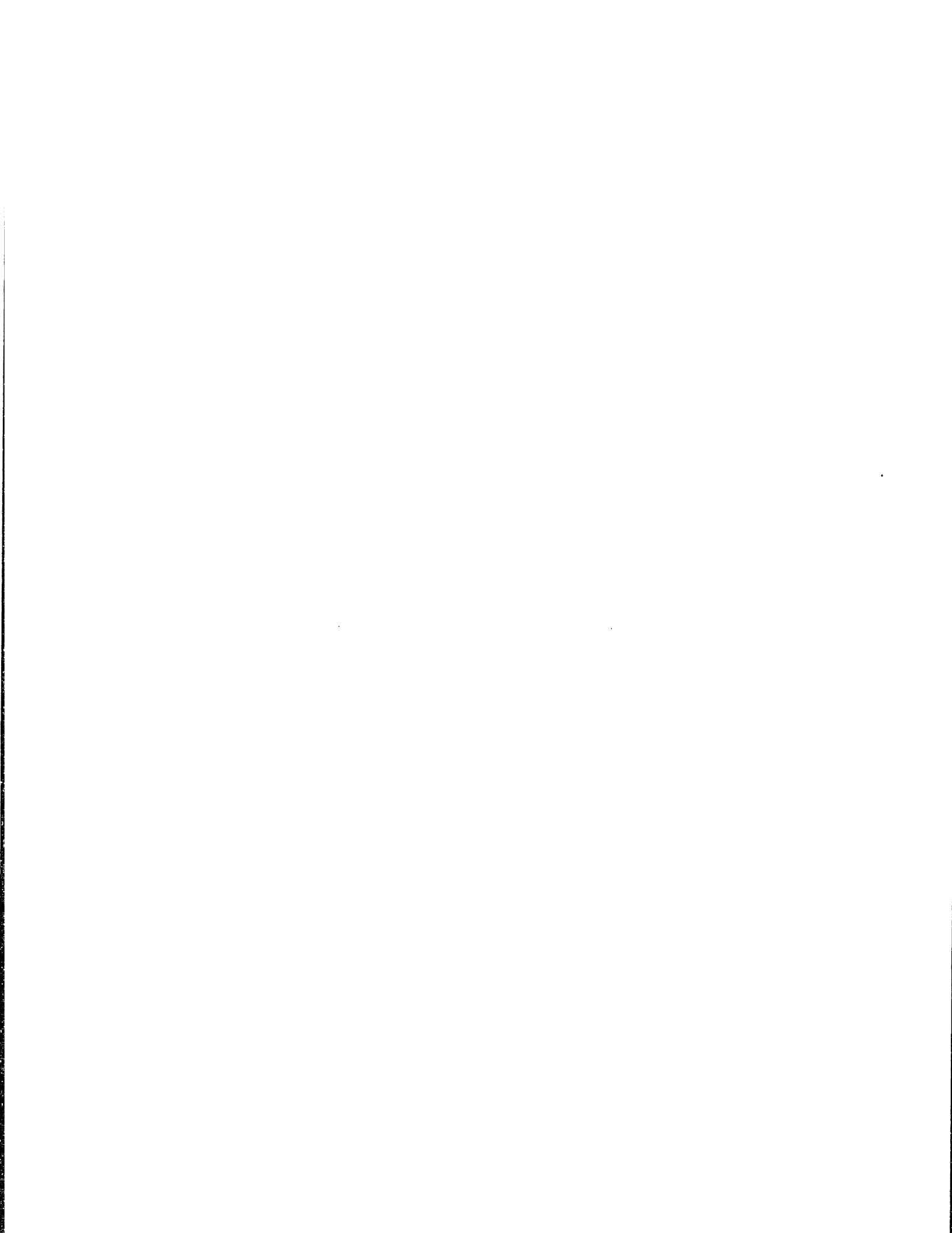
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**ABSTRACT**

Understanding traveler response to potential Advanced Traveler Information Systems (ATIS) is critical for designing such services and evaluating their effectiveness. Much research has been done on how much people will use ATIS if they have free access to it, how the traffic information will impact the users travel decisions, and how learning impacts these two stages. However, very little is known about the market potential of ATIS. Without understanding the market potential, we cannot understand or influence the impact that ATIS will have on the transportation system. This study focuses on both the "willingness to pay" aspect of traveler response, and also on the way in which consumers learn about such products and develop their perceptions. A new data collection procedure is presented, which combines a market simulator (in which subjects can acquire product information about various types of future ATIS) with a travel simulator (in which the subjects can make simulated automobile trips on the computer with the aid of the ATIS of their choice). This simulator provides a flexible and relatively inexpensive method of obtaining data on all stages of traveler response to ATIS, and, in particular, on the early stages of response. A model to predict purchase behavior and the way in which consumers learn about ATIS is also specified, and a summary of the data collected from a trial run on the simulator is presented. The ATIS Market/Travel Simulator provides us with critical data that is not attainable through any of the other data collection methods, and the proposed model is the first to acknowledge the importance of product information search and acquisition on a consumer's ATIS purchase decision.

**Thesis Supervisor: Dr. Moshe Ben-Akiva**

**Title: Professor of Civil and Environmental Engineering**





*To my parents  
Louise and Larry*

*and my siblings,  
Kathy, Jeff, and Sue*

*for always being there when I need them*



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# Chapter 1

## Introduction

This study focuses on the early stages of user response to ATIS, namely how people find out about ATIS and whether or not they will purchase the products or subscribe to the services. It is important to understand these early stages so that the future penetration rate and the impact of ATIS on the transportation network can be analyzed. This study presents a new data collection procedure for these early stages of response, presents a summary of data collected by this method, and specifies a model to predict purchase behavior of ATIS.

### **1.1 Advanced Traveler Information Systems (ATIS)**

The goal of ATIS is to provide travelers with information such as road layout, traffic conditions, weather conditions, route guidance, parking availability, and transit information that will aid them in making travel decisions. ATIS is not one product, but numerous products with widely varying characteristics. Traffic information systems that are commonly available today include variable message signs, highway advisory radio, and television and radio

traffic reports. In some cities, phone-based systems are being tested in which travelers can telephone a service and get the prevailing traffic conditions on the route or area of their choice. In the future, such detailed and person-specific information could be available from interactive television services, computer dial-up services, or from in-vehicle equipment. The primary advantages of future ATIS systems are:

- **Reliability** - Technology is improving the accuracy with which we know the existing traffic conditions and can predict the future traffic conditions. Note that this will also improve the traditional information systems, because they will also have more reliable traffic information.
- **Customization** - The future systems allow the travelers to acquire traffic information that is relevant to their specific trip, and not the entire network in general. TV and radio traffic reports tend to focus on bottlenecks, major commute routes, and commute times.
- **On-Call** - Travelers can acquire information whenever they want, whereas TV and radio traffic reports are available at given time intervals (with frequent reports during rush hours and infrequent reports at other times of the day).
- **New Information** - Future ATIS may also provide information that is not available in the traditional traveler information systems such as your present vehicle location, information on parking locations and

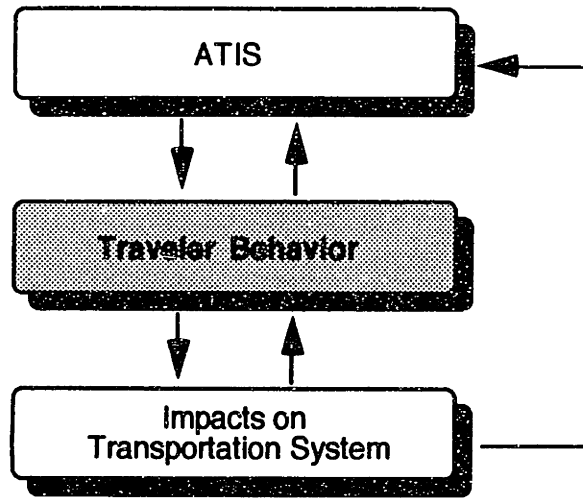
availability, and yellow pages information databases to businesses, attractions, and motorist services.

ATIS involves a wide variety of products such as those mentioned above. However, only a few, simple versions of which are available on the market today. In order to understand the impact of ATIS, the potential future systems must be studied.

## **1.2 Motivation**

Increasing attention has been paid in recent years to the idea of using ATIS as a method to decrease traffic congestion by helping travelers make the most efficient travel decisions. There is great interest in both the marketability of these future systems and the influence that they may have on congestion, the environment, and travel patterns. A better understanding of the influences of ATIS will help guide the design of ATIS products and services, ensure an efficient implementation of ATIS, increase the effectiveness of future ATIS strategies, and define the government role in the implementation of ATIS.

However, as Figure 1 shows, to understand the impacts that ATIS has on the transportation system, it is necessary to understand how travelers will respond to ATIS, e.g. will travelers buy the systems? use the systems? change their travel behavior because of the systems?

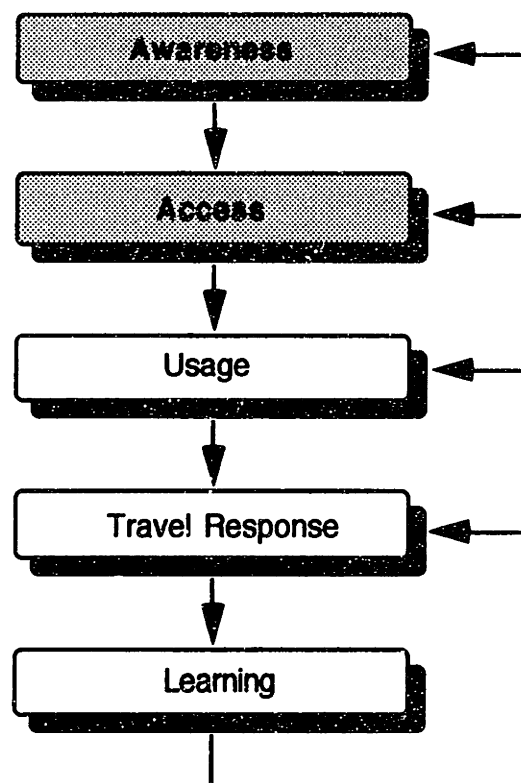


**Figure 1**  
**The Role of Traveler Behavior**

There have been many studies on particular aspects of the implementation and use of ATIS, but none so far have studied traveler response to ATIS in a comprehensive fashion. To reach this end, Ben-Akiva et al (1993) developed a comprehensive modeling framework for ATIS (shown in Figure 2), which consists of 5 stages of traveler response. The first stage is *awareness*, and it deals with how people find out about ATIS -- how they acquire information about available products and services and thus increase their knowledge and develop their perceptions about ATIS. If someone does not know about ATIS then they cannot use it. The second stage is *access*. This stage occurs after travelers have gained enough information about the product to make a decision on whether to purchase equipment or subscribe to a service so that they will have a particular type of ATIS available to them on their trips. This is more of a long term decision in that the decision they make here will impact the availability of ATIS on numerous trips in the future. Some traveler information systems do not require an access decision to be made, such as radio traffic reports. On the other hand, the next stage, *usage*, is a short term



decision and applies to whether the person acquires any traffic information for a specific trip. Travelers will only be able to use ATIS which they have "accessed" in the previous stage, or for which no access decision is required (like radio traffic reports). The *travel response* stage corresponds to how the information gained in the usage stage impacts their travel decisions. Finally, *the learning* stage is how travelers' experiences throughout the stages impact future decisions.



**Figure 2**  
**Modeling Framework for Traveler Response to ATIS**  
**[ Ben-Akiva et al (1993) ]**

For example, a person finds out about an in-vehicle system from seeing a newspaper article, and learns more about it by speaking with friends and visiting a retail outlet (the awareness stage). After learning about the system,

the person decides to purchase the system (access). The person then chooses to use the system to acquire traffic information on the shortest path to the office on a particular day (usage), and follows the suggested route (travel response). If the advice given by the ATIS appeared to the user to be the best route available, then this will probably make the traveler use the system more frequently in the future and more likely to follow the advice (learning impacting the usage and travel response stage). If the system over time appears to save time and give good advice, than the user is more likely to retain and/or purchase the system for other vehicles in the household (learning impacting the access stage).

There has been extensive research in the usage and travel response stages, and how learning impacts usage and traveler response has also been fairly well studied. However, the first two stages, awareness and access, have virtually been untouched by researchers in ATIS. These stages are critical to understand because they determine the market penetration rate of ATIS, and thus, the extent of the system-wide benefits of ATIS (such as impacts on congestion and the environment).

It is important to explicitly model the awareness of ATIS for many reasons. Consumers awareness of ATIS does not come about randomly; there are influences (such as economic factors) that impact the level of awareness that the individuals in the population have about ATIS. We are interested in what these factors are and how they (and thus how we) can influence the penetration rate of ATIS. "We" includes the government and transportation people in general that are interested in both understanding the proper government role in the implementation of these products and interested in

influencing the impact that ATIS will have on the transportation network. Manufacturers and suppliers of such products and services are also interested in how they can better impact the profitability of their ATIS. Since ATIS is a new product -- very different from anything on the market today -- we cannot learn very much about the manner in which ATIS will penetrate the market by studying the penetration of other goods, since the factors impacting ATIS awareness and access are going to be different than those that impact existing products. In addition, ATIS will take many years to penetrate the market, and we want to influence this penetration now so as to lead to the most effective designs of and implementation strategies for ATIS.

It is the goal of this study to develop methods that will allow the data acquisition and model development necessary to research and model the awareness and access stages, and to further develop the comprehensive modeling framework.

### **1.3 Alternative Approaches to Data Collection**

Collecting data is a critical aspect of studying traveler response to ATIS. The data can be used to give general information on traveler behavior and also to calibrate models that explain this behavior. There are four primary methods of collecting data on traveler response to ATIS: operational field tests, test markets, surveys, and simulators. Since this study concentrates on the awareness and access stages and the complete 5 stage framework, the alternative approaches to data collection for these cases will be briefly discussed.

### **1.3.1 Awareness**

Data on the awareness stage of user response to ATIS could be collected through a survey of either consumers in an existing market or consumers in a test market. In such a case, the consumers in either an existing or test market would be asked about their search process in finding out about a product. One problem with this method is that it is extremely difficult for consumers to accurately recall their search process because there are many different factors to remember, and the information acquisition process usually occurs over a long period of time. These reasons also make it difficult to observe the awareness process directly. An additional problem with test markets is that they are extremely expensive and they require a rigid design of the product. Similarly, with existing markets we are restricted to the products that are already on the market, and so the experiment design is inflexible.

An alternative method to study the awareness stage is to collect data through a simulated market environment, in which a future market environment is simulated on a computer. This method offers great flexibility of experimental design at a reasonable price. The Market Simulator will be discussed in detail later.

### **1.3.2 Access**

Data on the access stages can be obtained from various sources. The primary technique that has been used thus far is the traditional stated preference (SP) survey of either the general population or of operational test participants. The limitations of obtaining data from the general population are that very little information about the product can be presented in this survey format, everyone makes their decision based on the same information (i.e. the

awareness stage is not considered), and the decisions are not made in any sort of a market environment. In the operational test case, again there is no market environment in which the decision is made, people have extensive information about and experience with the product, and the perceptions of the product are fixed according to the operational test.

It is also possible to get revealed preference data on access by surveying consumers in either existing markets or test markets. However, we would be restricted to the products now available in the market or available in the designed test-market, and awareness data still are difficult or impossible to observe. In addition, test markets are extremely expensive.

Finally, a simulated market environment can be used to collect stated preference data. Once again, this method is very flexible in terms of the types of future scenarios that can be tested, it is inexpensive, and it enables us to study the awareness and access stages together. More about the simulator will be presented later.

### **1.3.3 Complete 5 Stages of Traveler Response to ATIS**

The 5 stages of traveler response to ATIS occur over a long period of time, and numerous decisions are made by the consumer. Thus, a simulator is the only way of collecting data simultaneously on all five stages. It is necessary to consider all 5 stages simultaneously in order to study the complete learning process. While the Market Simulator, mentioned above, can be used to obtain data on awareness and access, a travel simulator can be used to obtain data on usage and response. In a travel simulator, subjects make simulated automobile trips on the computer with the aid of ATIS. This is a well-established method of

collecting data on usage and travel response. By combining a market with a travel simulator, we can study the complete 5 stages of user response.

#### **1.3.4 Summary of Data Collection Options**

A simulator that includes both a market environment and a traveling environment (ATIS Market/Travel Simulator) has great potential in acquiring data in the traveler response to ATIS research areas that have been neglected. Such stated preference data are necessary because many future ATIS products are not available in any market today and valid RP data on awareness is not possible. With the simulator, a wide variety of data may be collected easily and relatively inexpensively in a controlled environment, and currently non-existing products may be simulated. An ATIS Market/Travel Simulator has been designed and developed in this research and will be described in more detail in the following chapters.

#### **1.4 Research Objectives**

There are two primary objectives of this research. The first is to specify a model of the consumers' ATIS awareness and access decisions, because these areas of travel response to ATIS have been neglected and yet they are critical in understanding the factors that influence ATIS' impact on the transportation network. The second objective is to improve the data collection methods for studying ATIS, so that the data necessary to support the development of this model can be collected.

## **1.5 Outline of the Study**

In the remainder of the study, the results of the primary research tasks leading to the modeling framework and data collection for the awareness and access stages is presented. Chapter 2 is a brief summary of the literature review that was conducted in the areas of ATIS research and marketing research. Chapter 3 presents the specification for a model for the awareness and access stages of traveler response to ATIS. In Chapter 4, a new data collection procedure, the ATIS Market/Travel Simulator, that was developed to support the development of the awareness and access model is described. Chapter 5 summarizes the results from a preliminary data collection effort that was undertaken with the simulator. Finally, a summary of the study and suggestions for further research is presented in the last chapter.





# Chapter 2

## Literature Review

In the literature review, two areas were investigated: ATIS traveler behavior research and pre-market forecasting research for other products.

### 2.1 ATIS Literature

Table 1 is a summary of the data that has thus far been collected by ATIS researchers. It shows, as we mentioned before, that there has been no research on awareness or on how learning impacts the awareness and access stages. There has been minimal research on the access stage. The models that have been developed for the access stage use stated preference surveys. The limitations of such studies were discussed in section 1.3.2.

Existing ATIS travel simulators, which are used extensively for the usage and travel response stage, are not capable of collecting data on awareness and access. [ See Koutsopoulos et al (1993) for an extensive review of the existing ATIS travel simulators.] The travel simulators do not offer the subjects choices

of what technology to use during their trips, but rather a particular technology is automatically given to the subjects and then the research involves studying their response to the technology. Also, all ATIS simulators force particular product information on the subject, i.e. the subject has no say over what type of product information they obtain on ATIS products and services. Since penetration rates cannot be estimated without considering the awareness stage, existing ATIS benefit studies must assume a penetration rate. However, clearly the penetration rate of the products will have a large influence on the level of impact that ATIS will have on the traffic network. Thus better methods to forecast penetration rates must be found.

ATIS STAGE	General Population		Subjects of Operational Tests
	Existing ATIS	ATIS that has not been implemented	Experimental ATIS
Awareness	<i>none</i>	<i>none</i>	<i>none</i>
Access	survey*	survey*	<i>none</i>
Usage	survey	travel simulator*	travel log
Travel Response	survey	travel simulator	travel log
Learning Awareness/Access Usage/Response	<i>none</i> survey*	<i>none</i> travel simulator*	<i>none</i> survey*

\* Existing data only partially covers the cell or is of insufficient quality

**Table 1**  
**Existing Data for User Response to ATIS**  
**[ Ben-Akiva et al, 1993 ]**

## **2.2 Marketing Literature**

Two aspects of the marketing literature was reviewed: modeling approaches and data collection.

### **2.2.1 Modeling Approaches**

Premarket forecasting has been studied extensively in the marketing arena.<sup>1</sup> Premarket models are popular because they provide a relatively inexpensive and fast method of forecasting the potential success of a product. Four different types of approaches will be discussed in these sections: stated preference methods (which are applied to all types of goods), and specific modeling approaches for non-durable goods, durable goods, and services. The specific approaches for different types of goods have been developed because the information search and decision process is different for each of these classes – imagine how a consumer decides what type of cereal to buy, what type of car, and what type of long-distance telephone service to use.

In general, the models are based heavily on managerial judgement, past consumer purchase behavior of similar products, and the producers marketing plan (production rate, advertising, and price). The models assume a well-defined physical product that is ready to be introduced to the market. Most of the models only consider one product at a time, and the interaction with other products in the market is minimal. Since ATIS consists of many different products, it is helpful to investigate these modeling approaches used for non-durable, durable, and service goods and the more general approaches

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<sup>1</sup>Note that the Bass or Logistic Diffusion Modeling methods cannot be used for pre-product forecasts, because they forecast future growth based on past sales history. Thus, six to seven years of sales data are necessary to estimate such models.

that use stated preference techniques. Thus, a summary of the state of the art in each of these areas will be presented in the following paragraphs. For further information, see Urban et al, 1993.

#### **2.2.1.1 Stated Preference Approaches**

Indicators of sales potential can be obtained by asking consumers either their intent to purchase or their probability of purchase. These measures are then translated to sales potential through a number of methods. Often these stated preferences are translated to sales potential using managerial judgement based on prior experience with similar goods. For some industries (such as packaged goods), there are "norms" used for this translation. However these norms vary significantly between categories. Alternatively, discrete choice models such a logit or ordered logit (used when the data are in the form of the probability of purchase) are used.

Since these forecasts assume that everyone in the population is aware of the product and it is available for them to purchase, the forecasts are often conditioned by an estimate of the number of people who are expected to know of the existence of the product and by the availability of the product.

#### **2.2.1.2 Non-durable, Frequently Purchased Goods**

There are several alternative modeling approaches for non-durable goods. An important component of forecasting long-run sales for non-durable goods is estimating the initial trial and repeat dynamics. This is also important for many types of ATIS, particularly low-cost information services. It is necessary to predict the percentage of people who will try the product, and the percentage of those people who will become repeat users. One method to

estimate the initial trial percentage is to estimate regression models based on previous purchasing experience of a similar product; the regression equation is a function of the percentage of households who will buy one item in the product class over the year, money spent on advertising, and the percentage of stores stocking the product. Another method is to simulate the purchase environment in a lab, in which subjects are brought in, given fixed information on the product, and then given the option to purchase the product or others in its product class. Trial repeat is measured in a lab environment by surveying people who have tested the product.

The ASSESSOR model [Silk et al, 1978], is a commonly used model to predict purchases of non-durable goods. It is based on trial and repeat estimates, as described above, and attitude change models, in which preference measures for the new and existing products are obtained after the consumer has experienced a period of trial usage of the new product. The results from these two forecasts are compared and reconciled to obtain the brand share prediction.

#### **2.2.1.3 Durable Goods**

The research in this area is still fairly new. The state of the art is a model developed by Urban et al (1990). Unlike the non-durable goods models, product information acquisitions is considered important, and trial and repeat dynamics are insignificant. The model is a macro-flow model, in which the consumer transitions from one behavioral state to another. For example, a particular consumer may start out being unaware of a new product, then become aware of the product through seeing an advertisement on television, decide to enter the market to which this new product belongs, visit a retail

outlet, and then buy the new product. The model predicts the flow of people between any two behavioral states. The primary inputs are experimental/clinic data, data on similar products, data on the product class, and managerial judgement. The flow rates can depend on time, and thus the model may be dynamic. The subjects are not given a choice of what information to acquire, and are instead presented with set, limited information about the product. However, the product information is provided in the form of a realistic market information source (such as an advertisement or a brochure). Initial validation tests of the models for new car purchases provide promising results.

#### **2.2.1.4 Services**

There has been very little research in this area. The models that have been developed for services are very similar to the durable good models in that information acquisition is considered and flows between behavioral states are estimated. Research in this area should provide great insight into the traveler response to ATIS, since ATIS will most likely rely on payment to the agency that is providing the information. (Chicos, 1993)

#### **2.2.1.5 Applying Marketing Pre-Market Forecast Models to ATIS**

The ATIS market has many qualities that make it different from the traditional products on which marketers use premarket forecasting models. One of the major complications is that there are a wide range of ATIS either available now or to be available in the future. The attributes of the systems vary greatly: some require new equipment at home and/or in the vehicle, some are service oriented, and some are a combination; they provide varying types and quality of information; and they require completely different payment

methods (some require a lot of money up front, others a monthly service charge, others are free). ATIS is not a very clear class of products -- consumers probably will not consider highway advisory radio and in-vehicle navigation systems as products from the same class. Thus, a very heterogeneous group of products falls under the category of ATIS.

ATIS is also not like any other product available today and it is not entering into an existing market; therefore we cannot project market conditions based on the behavior of a similar product (as is often done in marketing forecasts). There is also a lot of uncertainty regarding what the products will be like and how they will be treated by the consumer. For example, it is not clear whether the in-vehicle systems will be considered value-added (adds to the ability to drive better or safer) or luxury items (such as leather seats or a high quality stereo).

Despite the complications with applying these models directly, the ongoing research in these areas should be insightful in developing awareness and access models for ATIS.

### **2.2.2 Data Collection**

The models discussed above focus on the fact that the process of acquiring information ("awareness stage") on a product is a very important step in determining the access decision of durable goods and services. Thus, in order to model the awareness and access decision, we must consider the information search process. It is difficult for consumers to accurately recall their information acquisition process. Thus, a great deal of research has been done attempting to simulate and study the information acquisition stage of a consumers purchase decision.

A literature review of several information simulators was conducted. Most of the studies reviewed use computers to present consumers with a choice of information to acquire, elicit response, and collect data. All of these simulators run on a personal computer. A brief summary of five such simulators is presented here.

#### **2.2.2.1 Information Display Board (IDB) [Painton et al,1985; Hoyer et al, 1982; Lehmann et al, 1980; and Jacoby et al,1978]**

In IDBs, information is structured in a matrix format where each row identifies an attribute and each column identifies a brand (or vice-versa). All of the information is concealed unless requested by the subject, and the subject may only view one piece of information at a time. Most IDBs are 2-dimensional, where the dimensions are attribute and brand, but one study used a 3-dimensional matrix in which the third dimension was the source of information.



Information Display Boards are an improvement over recall surveys, because it allows the researcher to directly observe information acquisition behavior instead of relying on the memory of the consumer. Advantages of IDBs are that they are very easy and inexpensive to use and develop, and they can be used in a wide range of settings. However, there are several disadvantages. IDBs make a difficult and unclear problem very structured and clean for the consumer. They also make searching by attribute and searching by brand just as easy to the consumer. This is not realistic, because normally the layout of information in stores or in other information sources will make one of these search methods more difficult than the other. The presentation of information is also highly restrictive in the information that can be provided. For example, the standard 2D matrix cannot distinguish between different sources, and even in the 3D IDB, all of the information is given in textual format.

#### **2.2.2.2 Mouselab Simulator [Johnson et al, 1989a; 1989b; and 1988; and Payne et al,1988]**

Mouselab provides a procedure for monitoring the information acquisition and processing of the consumer. The simulator has been primarily used to determine the information search and decision strategy used by the subject. Subjects can only see one piece of information (i.e. one value) at a time, although they can select what piece they want to view. Each screen only has a few pieces of information, so the subjects eventually view all information. Thus the Mouselab system can only be used for studying the order in which people process information and how this impacts their decisions. Mouselab cannot be used for research on how people choose how much information to acquire and how the amount of information acquired impacts their decisions.

After viewing the information available on the screen, the subject makes a decision (such as what product to purchase or what on what set of probabilistic circumstances they would prefer to place a bet). Advantages of the Mouselab system are that it appears easy to program, and it is very useful in determining information acquisition strategy or testing behavioral theory of information acquisition. The disadvantages of Mouselab are that cannot be used for studying the amount of information acquired and it does not attempt to represent the market realistically.

#### 2.2.2.3 Search Monitor [Brucks, 1988]

The purpose of the Search Monitor is to facilitate research on consumer information search and decision making by providing for a more complete simulation of a shopping/purchasing experiment. In the Search Monitor, successive menu screens are presented to the subject, depending on the selections from previous screens. Each screen provides a message and options. The successive menus form a tree decision-making structure, in which there is a hierarchy of decision (for example, first the consumer picks a store, then a brand, and finally an attribute for which they want information). The information provided may come from a wide variety of sources, use multimedia technology, and include information such as attribute values and product class information.

The advantages of the Search Monitor are that it has the capability of representing the market in a much more realistic fashion than either the IDB or Mouselab, and it is a much more flexible environment. A disadvantage of the Search Monitor is that the tree format imposes a rigidity on the search process used by the subject, whereas research has shown that different

individuals use different search strategies. For instance, the simple example stated in the previous paragraph was that first a person picks a store to search, then a brand to consider, and finally an attribute. Some people may use this sequential strategy, but others may decide what brand to buy based on advertising, and others may prefer to compare two brands side by side (which is difficult to do in the simulator, but easy to do when looking at a shelf of products in a store). The search strategy used varies based on the individual, the product, and the source. The consumers purchase decision is based on the search strategy used; thus, it is important to carefully consider the specifications of the decision tree presented to the subject.

#### 2.2.2.4 Information Acceleration Simulator [Weinberg, 1993; Hauser et al, 1992].

The purpose of the Information Acceleration (IA) Simulator is to obtain data from the simulator that can eventually be used to estimate pre-production forecasts for goods and services. The simulator is based on the concept of *information acceleration (IA)* -- the acceleration of information availability from a future context to the present. It enables the consumer to experience those activities associated with a consumer decision process (namely information search) for a future durable good. The subjects are presented with sources of information to choose from, and they are able to select the number of sources to search, the order in which to search them, and the time spent on each source. The simulator runs on a personal computer and multimedia platform so that sources may be represented more realistically. They have thus far only simulated a single product in any one experiment. Products that have been simulated are new cars, cameras, medical instruments, electric vehicles, and telephone services.

The initial validation of the IA Simulator is promising. First, the IA simulator was sensitive enough to detect differences among sources of information. Consumers gained more value from some information sources than others and preferred some information sources over others. Second, the computer-simulated retail outlet seems to be a valid surrogate for the real-life simulated retail outlet. They tested two different representations of the retail outlet, one was a graphical representation on the computer screen and another was a mock-showroom set up in a room with a mock-car and an actor-salesperson. The total search time allocated to each of the two outlet representations and the effect on purchase intent of the two representations of the outlet were not significantly different. Third, the IA Simulator is sensitive enough to distinguish between two similar products. The final purchase intents between the two simulated automobiles, the RX-7 and the Reatta, were significantly different and the total showroom search time between automobiles was significantly different.

The Information Acceleration Simulator is the state of the art in information simulators. The simulator is very much like the Search Monitor and has the same advantages and disadvantages. The additional feature that the Information Accelerator has over the Search Monitor is that there is an effort to simulate realistic information sources, instead of offering the specs of the product. The initial experiments and validation tests show excellent results in that the simulator is sensitive enough for a subject to distinguish between different information sources and different products.

#### **2.2.2.5 Battelle ATIS Research [Kantowitz, 1993]**

This is the only simulator described in this review that was designed specifically for ATIS research, because it is the only ATIS simulator that attempts to address the access and awareness stages of ATIS. Battelle is conducting two separate experiments to study driver acceptance of ATIS, both of which use a simulator. In particular, they are trying to evaluate product and consumer characteristics that influence acceptance of ATIS. The description of these two experiments follow. The data analysis methodology and modeling efforts they plan to develop in this research project are unknown.

**Experiment 1:** The stated objectives of the first experiment are to (1) obtain consumer evaluation of the TravTek ATIS, and (2) determine if video presentation is sufficient for observers who have not driven a TravTek vehicle to grasp the fundamentals of ATIS devices. The subjects are shown a split-screen video showing both the view out of a drivers window and the TravTek navigation system. The objective is to make the subject develop a feel for the attributes of the TravTek system without having to actually drive the vehicle. In their experiment there is no interaction between the subjects and the video screen. After viewing the video, the subjects are asked questions related to product characteristics, consumer characteristics, and TravTek capabilities. The subjects who see the video are given the exact same survey that the TravTek researchers gave to the people who actually drove the cars; this was so that the second objective could be achieved. The subject does not have any choice of what information to acquire or what ATIS to access or use; TravTek is automatically provided to the subject.

**Experiment 2:** The objective of the second experiment is to determine the level of reliability necessary for consumers to accept IVHS technology. A computer-based route guidance simulator is used in which drivers use a touch screen to select route links and then a real-time view of traffic on that link is shown. The two types of ATIS available to the subjects are "general traffic reports", which are free to the subject to use, and "specific link info", which is provided to the subject at a cost. The researchers will vary the reliability of the ATIS and observe how trust and driver route selection are influenced.

Battelle stated that these experiments were directly addressing the access and awareness stages of the comprehensive modeling framework. However, they are not providing the subjects with any real market simulation such as allowing them to select the sources of information to acquire and to select whether or not to invest in the ATIS.

#### **2.2.2.6 Summary of Information Simulators and Features**

Five Simulators were reviewed for this study. The Information Acceleration Simulator was found to be the state of the art because of the flexibility with which the subject could search for information, and the use of multimedia technology to provide more realistic sources. The Battelle Simulator is the only ATIS travel response simulator that attempts to deal with information acquisition and processing for ATIS. As a summary of the five simulators,

SIMULATOR

FEATURE	Info Display Board		Mouselab	Search Monitor	Info. Accel.	Battelle ATIS
	2-D	3-D				
<u>Presentation of Information:</u>						
Matrix	✓	✓	✓			
Tree			✓	✓	✓	
A Single Batch (1 source, no search)			✓			✓
<u>Information Search</u>						
Choice of Facts (not presented as a particular source)	✓		✓			
Choice of Source		✓		✓	✓	
Choice of Order	✓	✓	✓	✓	✓	
Choice of Time per Source	✓	✓	✓		✓	
No Choice of any Aspect of Info Search						✓
<u>Sources Provided</u>						
Realistic Source(s) Simulated		✓		✓	✓	✓
More than one Source Simulated		✓		✓	✓	✓
Facts about Product Presented not in Source Format	✓		✓			
<u>Media Used</u>						
Graphics	✓	✓		✓	✓	
Video				✓	✓	✓
Audio				✓	✓	
<u>Information Processing Allowed</u>						
Allows Search by Brand	✓	✓		✓	✓	
Allows Search by Attribute	✓	✓		✓	✓	

Table 2: Features of Existing Information Acquisition Simulators

Table 2 presents a chart of the possible features of an information simulator and shows which simulators incorporate this feature. The features listed are the presentation format of the information, the information search characteristics (how much flexibility is given to the subjects in determining the type of search they conduct), the sources provided (in terms of simulating realistic sources from which a consumer acquires information in real life), the media used to present the information, and the method(s) of information processing (search by brand or search by attribute) allowed by the simulator. The information simulator technology will clearly be useful in meeting the goal of analyzing the access and awareness stages of user response to ATIS.



## Chapter 3

# Proposed Model to Predict Purchase Behavior of ATIS

One of the primary goals of this research is to study the market potential of ATIS products and services. In this chapter, a model of the awareness and access stages is proposed. The distinguishing feature of this model compared with other models that address market penetration of ATIS is the explicit modeling of the awareness stage.

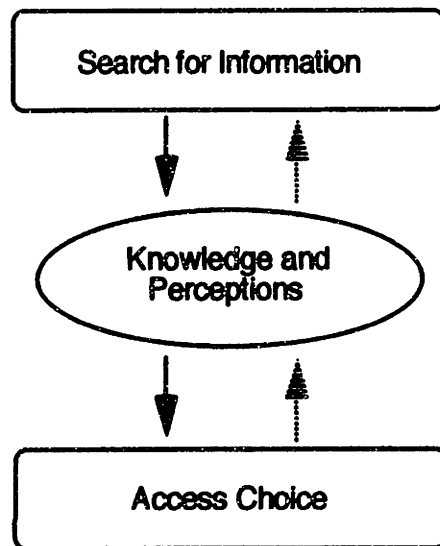
The model presented here draws upon the models that have been developed in the marketing arena for pre-product forecasting, which were discussed in the literature review. The primary insight from these marketing models is the importance that awareness and information search have on the access decision for durable goods and services, and the hypothesis that the consumer moves among different behavioral states throughout the awareness stage. However, unlike the marketing models, which frequently rely on aggregate data for forecasting, this model is based on disaggregate data. Since penetration rates are based on the aggregation of individual behavior, the

model system is based on choice models estimated with individual-level choice data. The proposed model also models competition explicitly, and uses more advanced disaggregate modeling approaches.

The following text presents a discussion of the model. First, an overall framework is presented, then the behavioral process of the consumer is discussed, and finally a model is specified.

### 3.1 Framework

The overall framework for modeling awareness and access is shown in Figure 3 -- people search for information (this is the awareness stage), and as they acquire new information, they update their knowledge and perceptions about the products. Knowledge and perception then influence a person's access decision. Conversely, the access decision impacts one's knowledge and perceptions and this impacts the information search process.

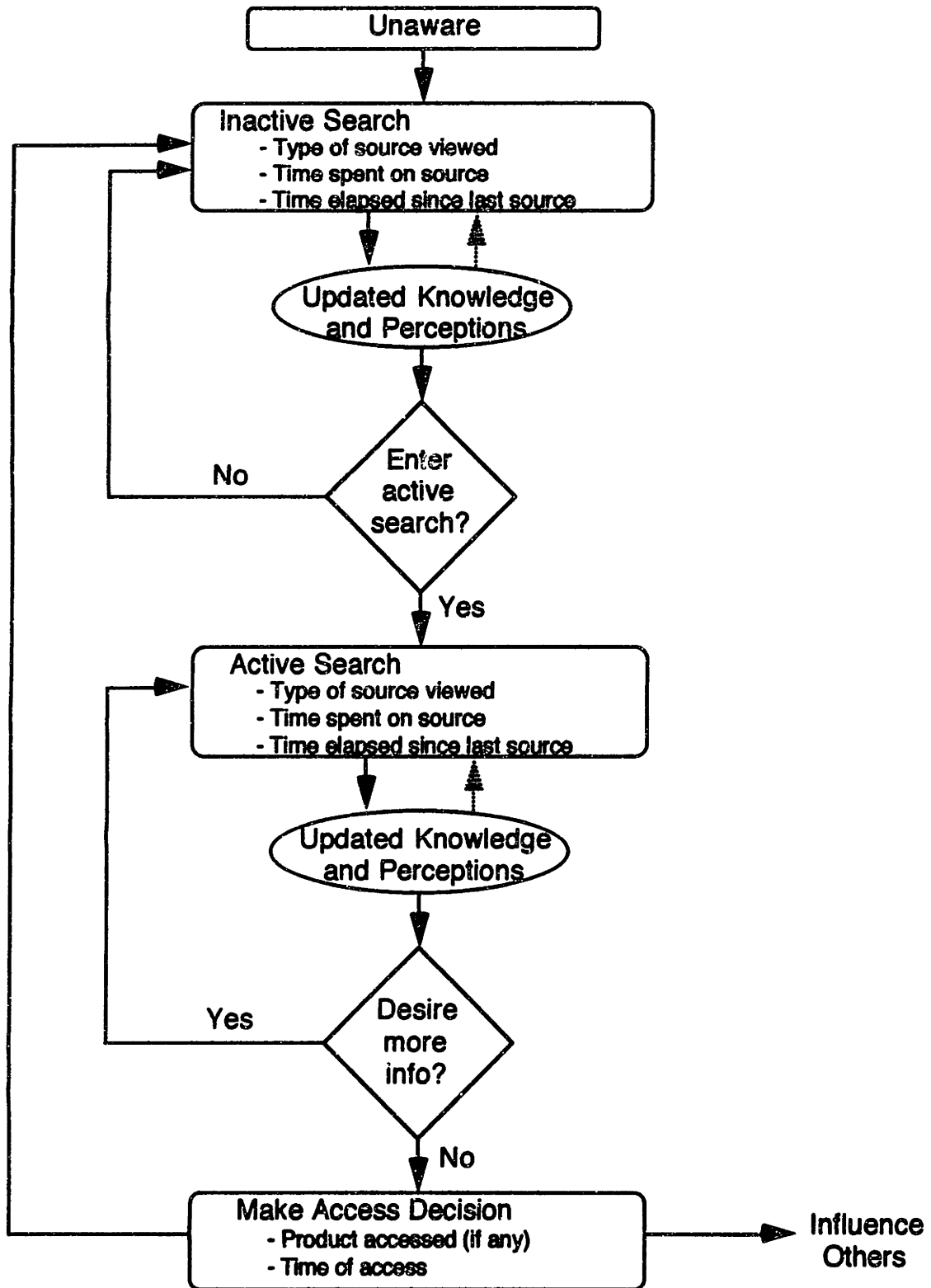


**Figure 3**  
**Overall Framework of Awareness and Access Models**

### **3.2 Behavioral Process**

The behavioral process of consumers' awareness and access decisions is shown in Figure 4. First they are unaware, i.e. they don't know that the product exists. At some point, they become aware via one of the information sources available on the product. [Urban, 1993] For example, they may see a television advertisement on an in-vehicle ATIS. Once aware of the product, consumers can be in one of two product information search modes: inactive search or active search. The inactive search stage corresponds to the state in which consumers are aware of the product's existence, but they are not particularly interested in it, and make no effort to find out more about it. For example, they would not go to a retail outlet, or seek out the opinions of people who have had experience with the product. However, even without actively searching for information, a consumer may still come across information on the product through their daily routine. For example people may notice an article on traveler information systems in the morning paper. On the other hand, active search corresponds to the state of behavior in which the consumer knows of a product's existence, and is interested enough in the product to make a concerted effort to obtain more information.

Thus, once consumers are aware of the product, they may choose at any time whether they want to inactively or actively acquire information. In inactive search, when consumers come across a source of information about ATIS, they decide how long to spend on the source. Whereas, in active search, the consumers initiate the search for information, and thus not only decide how much time to spend on the source, but they also have much more control over the types of sources from which they acquire information and the products they learn about. After each acquisition of information, whether in the



**Figure 4**  
**Behavioral Process**

inactive or active search stage, the consumers' knowledge and perceptions are updated, and these impact their future decisions. These perceptions (along with consumers' personal and travel characteristics) will determine whether a consumer chooses to be in inactive search or active search.

At some point, consumers who have been conducting inactive search may decide that they have enough information to make an access decision. Thus, they leave the active search loop and enter the access decision stage, in which they decide what product to access. Depending on the products that are available on the market, the access decision could be to buy a product, subscribe to a service, or decide not to access any type of ATIS. Following their access decision they revert back to the inactive search stage, because even though they feel they no longer need/want information, they will still be exposed to information sources on the products.

This process occurs over time, and so also included in the behavioral process is the time at which the consumer becomes aware of the product, the time between the acquisition of each piece of information in both the inactive and active search, and the time at which the access decision is made.

### **3.2.1 Limitations**

This behavioral process assumes a linear decision process and it also assumes a clear division between the inactive search and active search stages. In reality, the search process is probably not this neat; consumers may go back and forth between inactive search and active search, and they may even return to the unaware stage if they forget that the product exists. [Urban, 1993] Thus, this model is more realistic for short term intervals (say one year),

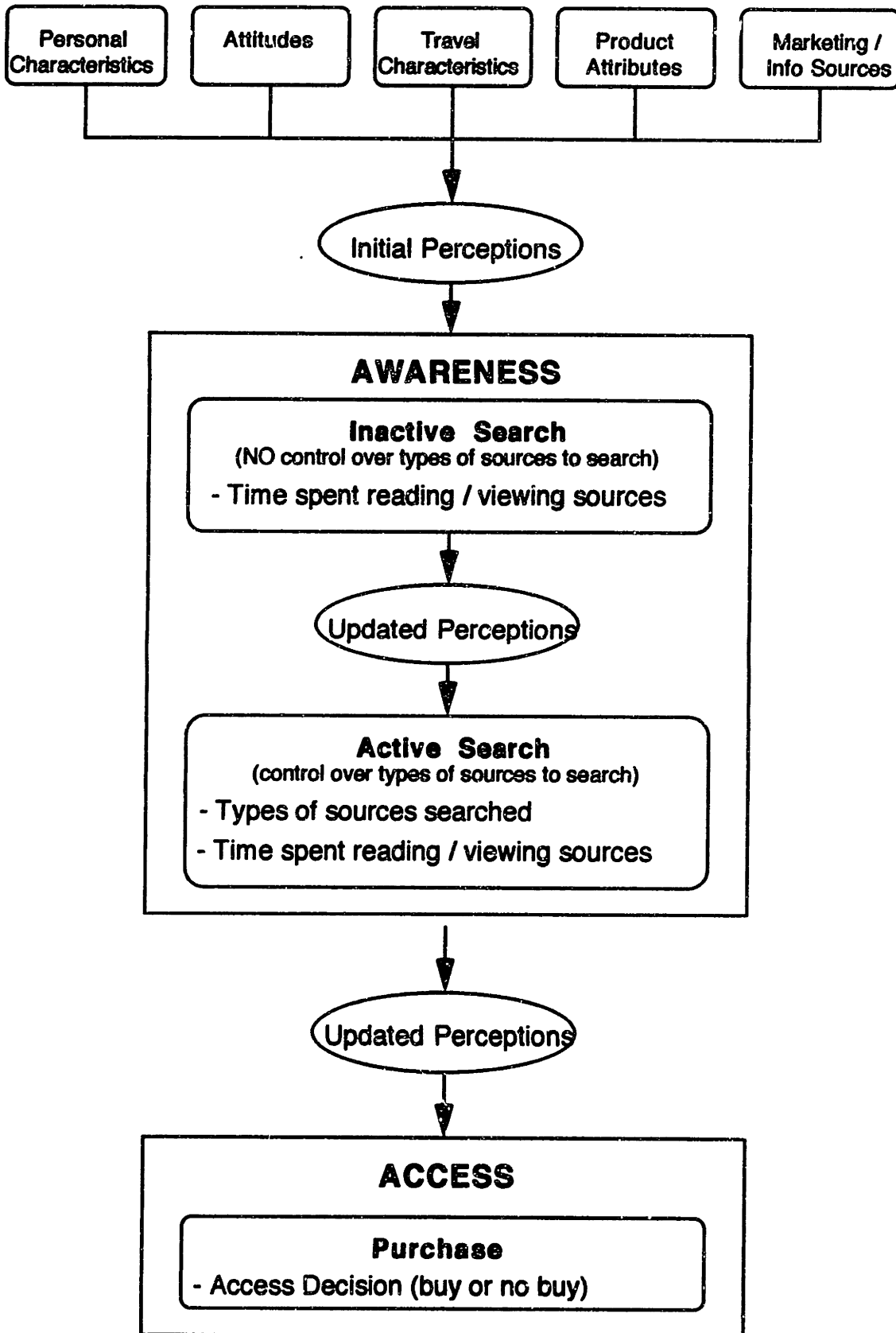
and may have to be used recursively over time to get long term predictions. In addition, the line between active and inactive search is not very well defined in real-life, and in fact consumers are probably often in a state that has characteristics of both inactive and active search.

Despite these deviations from reality, this behavioral process does incorporate the most important factors in the search process -- it recognizes that information is often passively acquired and it recognizes that people have some control over the type and amount of information they acquire. Thus this behavioral hypothesis will provide a good basis for developing a model specification.

### **3.3 Model Specification**

Given the behavioral process, the next question is how to model real-life behavior. The overall structure of the proposed model system is depicted in Figure 5. The model specified in this section attempts to abstract the actual behavior of acquiring information about a product and making an access decision. It is a hierarchical model in that decisions that appear lower in the hierarchy are conditional on the decisions of higher levels. The model includes four primary parts: the explanatory variables (shown at the top of Figure 5), the awareness (or information search) decisions, the updating of perceptions throughout the search, and the access decision. Each of these categories will be discussed in more detail in the following sections.

There are two primary differences with the model specified in this section and the behavioral process just presented. The first is that it combines numerous



**Figure 5**  
**Model Specification**

smaller decisions into a few larger decisions. For example, instead of modeling separately the decision of how much time to spend on each information source in inactive search, the total time that a consumer spends consulting sources in inactive search is modeled. This was done to make the model more tractable by reducing dozens of decisions to a few. Also the time span over which the information search takes place and the time of the access decision is not modeled. This resulted from the foreseen difficulty of collecting data and estimating the timing of these decisions. The issue of incorporating time into the model is discussed further in the final chapter.

### **3.3.1 Explanatory Variables**

There are numerous explanatory variables that we can use in the model. The basic categories are shown at the top of Figure 5. These are:

**Personal Characteristics** - such as income, number of cars, and experience with electronic machines.

**Travel Characteristics** - such as the amount of time per week spent traveling by car, current use of traveler information systems, and flexibility of travel patterns.

**Attitudes** - on issues such as whether the consumers think travel information can save them time, and whether they like to try new products.

**Product Attributes** - such as what products are available in the market and each products cost, reliability, and customization.



**Marketing and Information Sources** - such as what information sources are available in the market, the information contained in these sources, and the marketing plans of the manufacturers and suppliers.

### **3.3.2 Information Search**

The real-life information search process includes numerous decisions that are made by the consumer. Instead of modeling each acquisition of information (for example each time someone reads a newspaper article) as shown in the behavioral process, a few variables that represent a summary of the information search decisions are modeled. One summary variable is selected to represent inactive search, and two are chosen for active search, all of which are discussed in the following paragraphs.

In reality, for the inactive search stage, consumers decide how much time to spend on each product information source that they come across. In the model, these multiple decisions are modeled as one decision -- the total time spent consulting sources in the inactive search mode. Consumers may stop spending time on sources in the inactive stage either by choosing to enter active search, or by deciding they do not want any further information on the product (i.e. they will not spend any more time on sources that they come across in their daily routine). After each acquisition of information in the inactive search stage, the consumers update their perceptions and this influences the amount of time they choose to spend consulting sources in inactive search. Thus, the dependent variable for the inactive search stage of the model is the total time spent consulting sources in inactive search. This

behavior will be predicted by a linear regression model or by a censored Tobit model, if necessary.

Once the consumer decides to enter the active search, then the consumer has substantial control over what type of sources to search and the type of ATIS on which to acquire information. As with the inactive search, the total time spent consulting product information sources in active search will be modeled. However, the types of information sources that the consumer searches also must be modeled for the active search stage since the consumer decides what sources to search. The total time spent consulting sources in the active phase is highly correlated with the total number of sources consulted, thus we only model whether or not a particular type of source is chosen and not the exact number of newspaper articles, commercials, etc. consulted within each source. Thus, the choice that is modeled is the combination of types of information sources that the consumer selects. Any combination can be selected by the consumer, from consulting no sources to consulting all possible types of sources. For example, if a consumer reads two newspaper articles and sees one advertisement while in active search, then the model considers only that at least one newspaper article and at least one advertisement was consulted, and the number of items consulted within each source is not modeled. These two decisions for inactive search (sources searched and time spent searching) will be modeled using a joint discrete/continuous model.

### **3.3.3 Access Decision**

Once consumers have enough information, then they make their access decision. Competition is modeled explicitly by assuming consumers have a choice of accessing any of the available ATIS on the market. The access

decision will be modeled as either a logit or nested logit, which predict the consumer's purchase probability of each type of ATIS.

#### **3.3.4 Updated Perceptions**

Consumers' perceptions are constantly being updated throughout their information search process. Instead of modeling the constant progression of these perceptions, the perceptions are modeled at three discrete times during the information search: before they enter the market, after the inactive search stage, and after the active search stage. Perceptions are latent variables, and thus a latent variable model will be used for this stage.

### **3.4 Estimation**

To estimate this model we need to collect data on awareness and access. The next chapter will discuss the data collection method that was created to support the development of this model. Time did not permit collection of enough data to estimate the model for this phase of the research. However a test sample was conducted, and a summary of the data will be presented in Chapter 5.



# Chapter 4

## ATIS Market/Travel Simulator

This chapter describes the design of the ATIS Market/Travel Simulator in detail, and it also discusses some of the issues that arise in developing the simulator. This data collection method was created to support the development of the awareness and access model presented in Chapter 3.

The simulator has three main components: the Market Simulator, the Travel Simulator, and the surveys. This chapter first presents a general discussion of the simulator, and then discusses each component separately, including a description of the component and a discussion of issues that arise in design. The last section of this chapter brings all of the components of the simulator together by giving a description of the sequence of activities that a subject goes through while on the Simulator.

Note that the Appendices contain many of the details about the prototype simulator that was developed. Appendix A has screens from the simulator,

Appendix B contains the product information sources available in the Market Simulator, and Appendix C contains the surveys.

## **4.1 General**

### **4.1.1 Introduction**

The purpose of the ATIS Market/Travel Simulator is to collect disaggregate level data on traveler response to ATIS to both gain a general understanding of traveler response to ATIS and to support the development of models of traveler response to ATIS. In particular, the simulator will be used to obtain data for estimation of the awareness and access model presented in Chapter 3

The ATIS Market/Travel Simulator provides an environment on the computer in which a consumer can learn about traveler information systems, develop their opinions and perceptions about such systems, purchase or subscribe to ATIS, and use the accessed ATIS on their automobile trips. Figure 6 shows how the market and travel simulators are combined to allow the collection of data on all 5 stages of the comprehensive modeling framework. The top box in Figure 6 is the Market Simulator. On the Market Simulator subjects acquire product information on ATIS from available information sources (e.g. newspaper articles or brochures), and they have the opportunity to purchase such systems. The inputs to the Market Simulator are the sources that provide information on ATIS and the ATIS products themselves. Thus, in the Market Simulator we can observe how people learn about the products (awareness stage), and we can observe their access decisions.

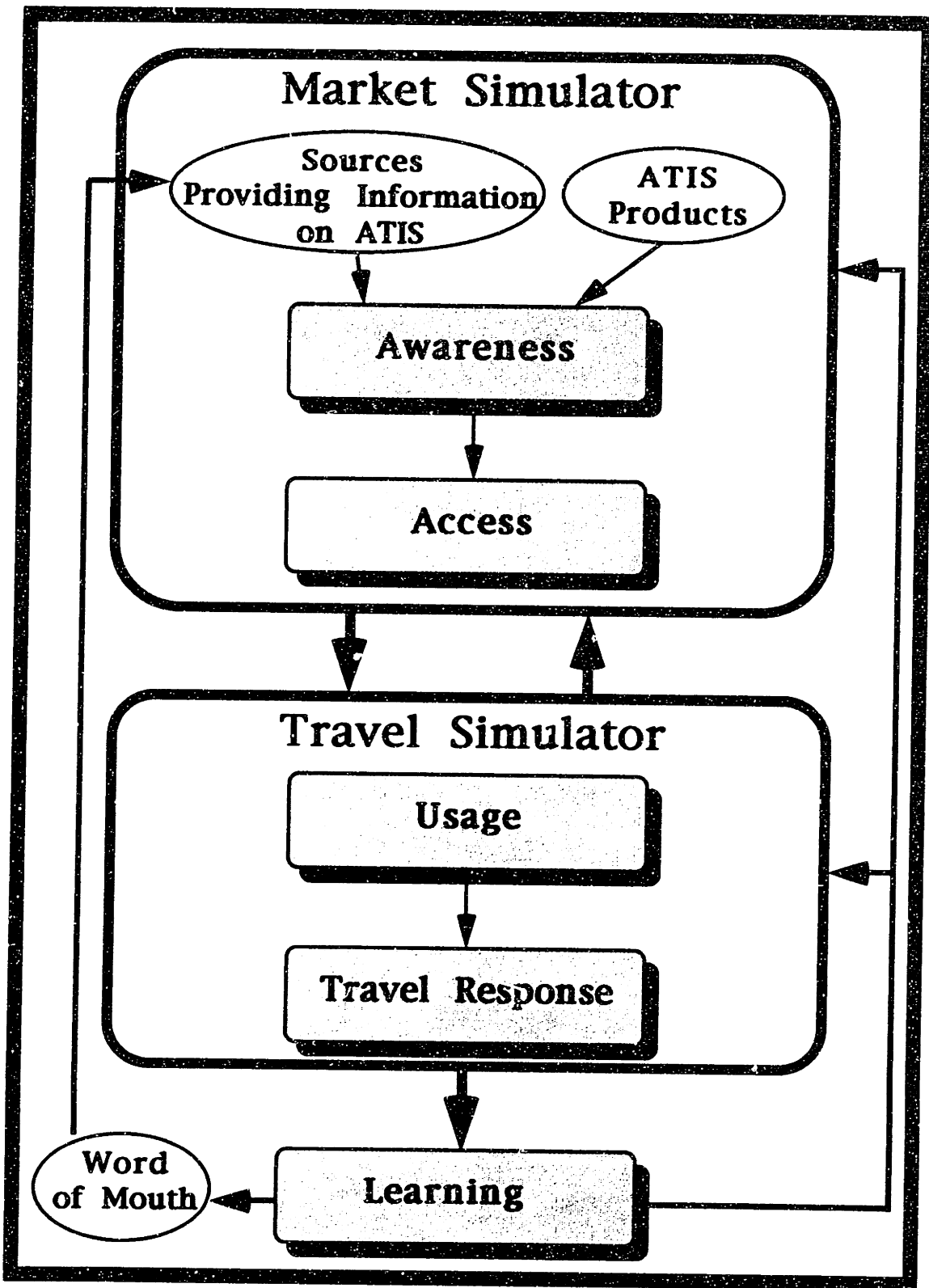


Figure 6  
 ATIS Market/Travel Simulator

The lower box in Figure 6 is the Travel Simulator. In the Travel Simulator, subjects simulate trips in their automobile. On each trip, they may select whether or not to use an ATIS, and what type to use. Thus, we observe travelers' usage of ATIS, and also their travel response to the travel information. In addition, we can obtain data on learning because the subjects decisions over time in both the Market Simulator and the Travel Simulator can be observed.

Word-of-mouth is also shown in Figure 6 because the experiences of an individual user also impact other users through word-of-mouth (one of the types of sources available in the Market Simulator).<sup>1</sup>

The idea of the ATIS Market/Travel Simulator is extremely flexible, in that numerous specifications of the market environment (including sources of product information and types of ATIS) and the travel environment (including the types of trips and ATIS available) may be simulated. Thus, numerous alternative future market scenarios can be simulated and tested. The prototype simulator that has been developed in this research has four types of product information sources and three types of ATIS. The following sections will describe how these design decisions were made, and discuss some of the issues involved. While the specifics of the prototype simulator will frequently be discussed in this chapter, it should be remembered that the nature of the simulated environment is that of flexibility.

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<sup>1</sup>In the prototype simulator this feedback effect is not incorporated, but methods of incorporating word-of-mouth feedback are discussed in the final chapter.



#### **4.1.2 Fidelity Versus Validity**

Two criteria are frequently used to describe a simulated environment: fidelity and validity. Fidelity refers to the accuracy of the correspondence between the simulator and the operating environment. Fidelity includes both the level of realism (accuracy in the physical representation) and comprehensiveness (degree of completeness of representation of all functions, environmental characteristics, etc.) in the simulator. Validity refers to the correspondence between the results acquired by using the simulator and a set of outcomes that are desired to meet the objectives of its use. [Koutsopoulos et al, 1994] In specifying the simulated environment, one has to consider both validity and fidelity issues. However, it has been found that psychological fidelity is much more necessary than physical fidelity, which often is not necessary or cost effective. For example, it was found that the incredibly expensive, high fidelity air force simulator produced the same behavioral results with and without all of its "bells and whistles" (e.g. vibrating seat and engine noise).<sup>1</sup>

Thus, in designing the simulator, the aim is to reach the level of realism and comprehensiveness that is required to meet the objective of obtaining valid traveler response data.

#### **4.1.3 Computer Equipment, Software Environment, and Programming Time**

The simulator runs on a personal computer with multimedia capability. The multimedia equipment includes speakers, a microphone, a sound card, a graphics card, a video card, a CD Rom, and the corresponding software for each

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<sup>1</sup>Barry Kantowitz, Workshop on User Response to ATIS, October 1, 1993, MIT, Cambridge, MA.

device. In addition, a scanner was used to scan pictures into the computer. Multimedia is used to more accurately portray a market environment; it allows various product information sources to be distinguishable from one another and more realistically presented.

Computers and software packages are rapidly improving the ease with which multi-media programs can be developed. Both Macintoshes and Personal Computers (PCs) were considered. Currently, Macintoshes provide a more user-friendly programming environment for multimedia applications. However a PC was selected because the Travel Simulator that was updated for the Market/Travel Simulator was already on a PC environment and PCs are the prevalent computers used with transportation planning software.

The simulator was programmed using C++.<sup>1</sup> The goal was to make the simulated environment user friendly, therefore it is programmed in a windows environment, and the subjects input their choices by clicking on squares on the computer screen with a mouse. Microsoft Word was used to display the text information sources because of the ease with which pictures and graphics could be incorporated into the environment and with which the articles, brochures, etc. could be formatted and edited. The disadvantages of this method is that once a text file with graphics and pictures is called from the simulator, it takes time to load MS Word and additional time to load the pictures. This could be improved by either re-scanning the pictures using a lower resolution, or using a different software package to display the documents.

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<sup>1</sup> Borland C++ for Windows Version 4.0 was used as the compiler.

The current prototype simulator was programmed in about 500 hours, which includes the time required for completely programming the Market Simulator and updating the pre-existing Travel Simulator to be run in a windows environment and to include the ATIS access decision.<sup>1</sup> Now that the program includes examples of all necessary window and multimedia programming, editing the existing simulator or making another simulator will take significantly less time. However, modifying the simulator requires a high level of programming skills, including knowledge of C++, windows programming, and multi-media programming.

#### **4.1.4 Types of ATIS Simulated:**

One of the primary decisions to be made in designing the ATIS Market/Travel Simulator is to determine the ATIS products and services to include on the simulator. It is important to simulate the range of alternative ATIS that are likely to be available in the market, so that the consumer is not faced with the choice, for example, of either having an expensive in-vehicle system or *no* traffic information. In addition, we want to understand the impact that various ATIS attributes have on traveler response. Thus, we are interested in simulating many different types of ATIS so that choices among various ATIS products can be studied.

The three most important attributes of ATIS to the consumers are cost, customization, and reliability. The cost refers to both one-time costs involved (such as the purchase of equipment) and ongoing costs (such as the cost of a phone call to a phone-based ATIS or the cost of a monthly subscription).

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<sup>1</sup> This time does not include the time to design the characteristics of the simulated environment or the creation of the information sources.

Customization refers to the degree with which travelers have control over what traffic information they receive (including the level of detail and the geographic location of the information) and when they receive it. Reliability refers to both the accuracy of the information and the timeliness of the information (i.e. how up-to-date it is).

In order to represent an ATIS market and to study the impact of various product attributes on traveler behavior, it is desirable to simulate ATIS with varying costs, customization, and reliability. To meet this goal of having a market with a wide variety of ATIS while controlling the level of programming and simulation of product information sources, three types of ATIS are simulated in the prototype simulator: radio traffic reports, a phone-based traffic information system, and an in-vehicle dynamic route guidance system.

Radio traffic reports are broadcast at given time intervals. They tend to focus on major bottlenecks and commute routes in the Metropolitan area during peak periods. Radio traffic reports are free, and they are accessible to anyone who has a radio.

The phone-based ATIS is a service in which people can telephone a center and access recorded information on current traffic conditions on the routes and areas of their choice (chosen from a list of options). Information such as congestion levels, backups, and location and duration of accidents can be obtained on all major highways and major arterials in a metropolitan area. Information on major events or construction that may disrupt the regular pattern of traffic is also provided. This information may be obtained either

pre-trip or en-route (if one has a cellular phone). The cost of using such a system is a certain amount per call.

The third ATIS that is simulated is an in-vehicle route guidance system. This is comprised of a micro-computer in the vehicle that shows the driver a detailed electronic map of the area, on which each segment of road is color coded to represent the amount of traffic congestion on the segment. The map also shows the current location of the vehicle and the location of accidents on the network. In addition, this system will calculate the shortest route to a selected destination based on prevailing traffic conditions and provide the driver with step by step driving instructions to the destination. The cost of this system includes both the purchase of the equipment and the cost of acquiring the real-time traffic information (a monthly subscription).

Table 3 shows how these three products give the consumers a range of price, customization, and reliability. (A road map is also offered to the subjects since a hypothetical network is used.)

Traveler Information System	Cost		Traffic Information	
	Access	Usage	Customization	Reliability
Road Map	low	none	n/a	n/a
Radio Traffic Report	none (radio)	none	n/a	set by design of experiment
Phone-based	free or subscription (telephone)	free to moderate	moderate	set by design of experiment
In-Vehicle - traffic information - route guidance	high	free to moderate	high	set by design of experiment

**Table 3**  
**Parameters of ATIS Provided on the Simulator**

## **4.2 Market Simulator**

### **4.2.1 Introduction**

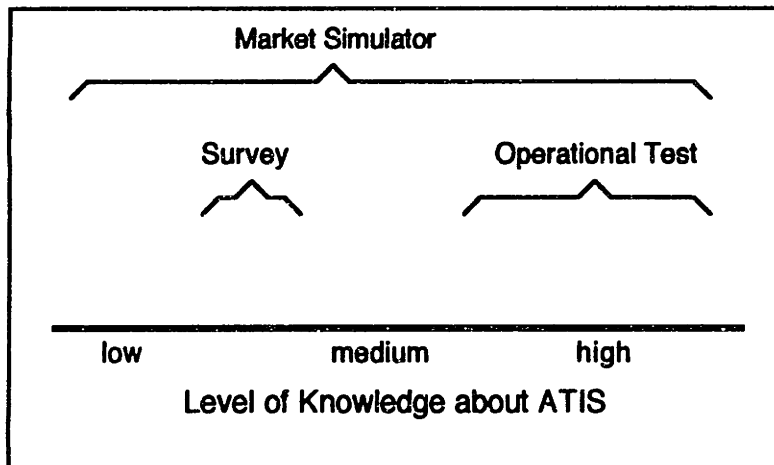
The purpose of the Market Simulator is to allow the collection of data on the awareness and access stages of user response to ATIS. Since ATIS is a future product, it is necessary to project people into a future market environment, and the simulator provides an inexpensive and flexible way of doing so.

To simulate a future market environment, we must simulate the existence of the future ATIS. Thus, the products assumed to be available in the future must be specified, and the information sources that will provide product information to consumers in the future market must be simulated. This will enable today's consumers to search for information on and interact with future products. For example, on the simulator the consumer can learn about the product by reading a couple of newspaper articles and talking to people who have had some experience with the product, just as they would in a real market environment.

The intent of the simulator is to simulate the future environment with enough realism such that the subjects get the feeling of being in a real market environment, learn as much about ATIS products and services as they would in a real market environment, and make their access decisions according to their experiences in the market environment.

The key to the Market Simulator is that people have realistic product information sources available to them, and they have control over what sources they search and how long they search each source. In fact, they do

not have to acquire any product information if they do not desire it. How much they search will depend on their interest and their availability of time. In real-life, the freedom with which consumers pursue their information search leads to a large variance of levels of knowledge among consumers, and we are trying to simulate this effect. As Figure 7 shows, traditional surveys, which only give a one or two paragraph description of the ATIS, provide all respondents with the same level of information about a new product. Likewise, by conducting a willingness to pay survey on those people from an operational test, the observation set will only contain those people with a high degree of knowledge about the ATIS (since they have used the ATIS extensively). Whereas the Market Simulator will result in a group of subjects with widely varying degrees of knowledge.



**Figure 7**

**Resulting Variance of Knowledge from Different Data Sources**

It is important to allow flexibility of information acquisition before conducting a willingness to pay survey, because consumers information search patterns will vary tremendously based on their interest and needs, and these awareness decisions will impact their access decision. Test markets will



allow wide ranges of knowledge in the population, but they are extremely expensive, and do not allow for any flexibility in the product or for testing of alternative scenarios. Existing markets would also have a wide range of knowledge among the consumers, but many types of ATIS that we expect to have in the future have not yet been implemented.

The remainder of this section will discuss specifics of the design of the Market Simulator, including the reaction of the product information sources, the simulation of the information search process, and data collection.

#### **4.2.2 Simulation of Product Information Sources**

This section discusses how the future product information sources are simulated. It includes a discussion of how decisions on the types of information sources to provide, the content of each information item, and the amount of information to provide were made for the prototype simulator.

##### **4.2.2.1 Information Sources to Provide**

In deciding what information sources to provide, there are several issues to consider. The first is the desire to represent the market as realistically as possible by providing numerous types of sources and by providing the consumer with the specific types of sources they like to access. The intent is to provide the subjects with the various product information sources that they may reference when researching a product in a real market environment. Another issue is the amount of time it takes to create the actual information sources and the time to program the necessary windows. In balancing these two issues, four different information sources are available to the user on the prototype simulator:

### **Advertisements**

The advertisements source consists of both print and television advertisements.

### **Conversations With People**

The conversations with people source consists of fifteen second to two minute long video clips of people talking about their experiences (both positive and negative) with various ATIS products. This is an important source since many people make their purchase decision by gathering recommendations from people.

### **Newspaper Articles**

The newspaper articles source consists of articles that are likely to be found in newspapers when such future ATIS products are on the market. These articles are from one to two pages long, tend to be non-technical, and of the type that would likely be found in the local newspaper.

### **Retail Outlet**

The retail outlet is only for the in-vehicle system, since consumers will not find out about the phone-based system or radio traffic reports from a retail outlet. It contains a detailed brochure that describes the product, and it also contains an option for a "test drive" in which the user is transferred to the Travel Simulator for a trip using the in-vehicle system at no cost.

More detail will be provided on the simulation of these sources in later sections.

Although there are many other sources from which a consumer may acquire product information, these four were chosen because they are believed to be the primary sources that consumers would access in searching for information on ATIS. While these sources include most of the types of sources that people would choose to access, in future versions of the simulator, it would be helpful to have more specific information sources. For example, with the "newspaper source" subjects could have a choice of reading articles from specific magazines or newspapers, and even particular sections within the newspaper. Thus, a subject could choose between an article in the business section of the *New York Times*, a *Consumer Reports* story featuring ATIS, or an editorial in the local newspaper. This would allow consumers to better mimic their real-life information searches, since they would be attracted to the types of articles they would be likely to come across in real-life. The problem with this is that it becomes much more difficult to design the information sources.

Also, the retail outlet source and conversations with people source need to be expanded to include an interactive question and answer session between the subject and either a salesperson or a user. In the current simulator, the subject has no method to directly ask questions about the product. A question and answer platform could be simulated by having pre-video taped answers to questions that consumer's might ask. The subject can either select questions that they would like answered from a list of possible questions or input questions to ask (and have a "smart" computer decipher the question by

looking for key words). [Ozanne, 1988] The latter method is more realistic, but much more difficult and time consuming to program.

The following sections will describe the information sources in more detail, including how they were created, how many are provided, and how the subject selects what type of information source to view.

#### **4.2.2.2 Creating Simulated Information Sources**

To make the simulated product information sources as realistic as possible, they were based on sources that have been written or made for existing or operational test ATIS.

Newspaper articles, brochures, and advertisements were all based on existing sources for prototype or operational test systems. For the phone-based system, the marketing literature and newspaper articles for the *SmarTraveler* operational test, which is being conducted in Boston, were used as a basis for the product information sources. A lot of information was available from SmarTraveler because they had an extensive marketing campaign, and received a lot of press in the local papers. For the in-vehicle system, several newspaper clippings and advertisements for prototype and operational test in-vehicle systems were used. These sources were much more scarce than the SmarTraveler sources, because the operational tests did not involve extensive marketing campaigns, and there are almost no in-vehicle systems on the market. The articles that were available for in-vehicle systems tended to be either a very brief description of the product, or a very technical article in a trade journal. Most of the literature sources provided in the Market Simulator for the in-vehicle information system were based on literature from the

TravTek operational test in Florida. A thirty-second commercial for the in-vehicle system was developed using video clippings of the TravTek system and of the Japanese Amtics system.

Unlike the other product information sources, there was not a lot of pre-existing material on which to base the "conversations with people" source. The problem is that it is necessary to simulate users of future products. There are very few people who have used an in-vehicle system, and we did not have access such people. We did obtain some user quotes from the TravTek operational test, but they were all extremely positive towards the TravTek system. On the other hand, for the phone-based and radio traffic reports, there are users in the Boston area, and a few of these people are used in the simulator. However, in the end, most of the people used for the conversations with people source were primarily graduate students in transportation.

The conversations with people source was simulated by using videotapes of real people describing their opinions about the products. To obtain the video clips, a group of students were briefed on the products that are simulated in the Market/Travel Simulator. (The handout from this session is shown in Appendix D.) The advantage of using students who are studying transportation is that it was easier for them to visualize transportation at a future date, what ATIS systems may be like, and the issues involved. After the briefing, they were asked to pretend that they were a user of ATIS and talk in front of the video camera about their travel patterns, what they think of ATIS, how they have used it, and how they have found it helpful or not. The students were not scripted, but, if necessary, they were given suggestions of the types of things they could say, and an attempt was made to get a wide range of responses that

covered many issues about the systems. A summary of the conversations with people comments is in Appendix B.

Multimedia provided the use of graphics, video, and audio to replicate sources accurately. Thus, newspaper articles and print advertisements often included photographs and graphics, and television commercials and conversations with people are videos that are shown on the computer screen

#### **4.2.2.3 Positive and Negative Information**

To realistically simulate an environment, it is necessary to have both positive and negative information on the products. Of the four sources that were simulated, the word-of-mouth sources are most suitable for including negative information. In the real-world, advertisements and retail outlets rarely have negative information. The newspaper articles on which the simulated articles were based tended to be positive, and only went so far as to mention some of the issues regarding the cost and benefits of such systems. However, with word-of-mouth information sources, a consumer may talk to a person who had a very negative experience with an ATIS. Thus, it is important to include both positive and negative information in this source. The most difficult question to answer is that of how much of the information provided to the subjects should be negative and how much should be positive. For the prototype simulator, it was decided that the majority of the comments should be positive, because negative information has a much larger impact on a person's opinions about a product. One way of determining how much negative information to provide on the simulator (although this has currently not been implemented) is to base the amount of negative information on comments about the simulated ATIS product and services from the subjects who have

already been on the simulator. Since negative information can have such a large impact on consumer behavior, this should be carefully considered.

#### **4.2.2.4 Amount of Information Provided**

Each of the four information sources on the Market Simulator has several different items in it (e.g. there are several newspaper articles programmed in the newspaper source), and each item may contain information on one or more types of ATIS.

It is desirable to have many information items on the simulator to realistically represent a market environment. For example, the SmarTraveler Operational Test had dozens of newspaper articles in the local papers and throughout the United States. However, there are limitations to the amount of time spent designing the sources. Also the amount of information available on the future products limits the number of unique information items that can be created. The goal for the prototype simulator was to provide at least a couple of items of information within each information source and for each product. Table 4 shows the information sources that are available to the subjects in the prototype simulator. Less information was provided for road maps and radio traffic reports because these products are fairly well-known by consumers today. There is also not very much marketing or media attention on these traditional products in today's market, nor will there be in the year 2000. The one exception is advertisements for radio traffic reports; however, this source was not included in the prototype simulator due to time constraints. Even though there is little specific information on radio and map information sources provided on the simulator, they are mentioned repeatedly throughout the information sources for comparison purposes.

ATIS Available in Travel Simulator		Advertisement		Newspaper Article	Word-of Mouth			Retail Outlet	
		Television	Print		Positive	Negative	Neutral	Brochure	Test Drive

**FREE TRAVELER INFORMATION SYSTEMS**

Map	None	None	None	None	0	0	0	None	Available
Radio	None	None	None	None	3	2	1	None	Available

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**PAY TRAVELER INFORMATION SYSTEMS**

Phone-based System	1	2	2	2	5	1	0	None	Available
In-Vehicle System	1	2	2	2	7	2	2	1	Available

**INFORMATION ABOUT ATIS IN GENERAL**

	None	None	None	1	Total: 17 videos			None	N/A
--	------	------	------	---	------------------	--	--	------	-----

**Table 4  
Information Sources Available on ATIS Market Simulator**



Since there are only a few items within each type of information source, the simulator was designed so that subjects would not view a source twice unless they had already viewed all other items within the information source category.

### **4.2.3 Simulation of Information Search**

Another important issue in the design of the simulator is how to provide the subjects with access to the various product information sources available on the simulator. In designing the simulator, we want people to be able to search for information about the products in the same manner that they would search for information in real life. The behavioral hypothesis that is presented in Chapter 3 is based on a two-stage information search: inactive search and active search. Thus, on the simulator, we want to simulate these two types of searches. The following sections will describe how each of these search stages is simulated and how the subject transfers between the two stages. In addition, comments will be made on how to deal with time and cost of search in a simulated environment.

#### **4.2.3.1 Inactive Search**

In a real-world inactive search, a consumer may come across information on a certain product without making any effort to do so. On the simulator, this is simulated by having product information sources appear on the screen without any prompting by the subject. The subjects do not have any choice of what sources to view, but they have control over how long they view each source. On the prototype simulator, the subject is equally likely to view an advertisement, a newspaper article, or a conversation with people video. For each source shown in inactive search, the computer first randomly picks

either advertisement, newspaper article, or conversations with people, and then randomly picks one of the items within the chosen source to show on the screen. Because the prototype simulator contains about the same number of information sources on the phone-based system and the in-vehicle system, the consumers are equally likely to obtain information on either of the systems. The retail outlet is not included in inactive search, because this is usually an active form of search.

In reality, each individual is likely to come across different information sources depending on their characteristics. For example a person who watches no television and reads the Wall Street Journal every day would have a very small chance of seeing a television advertisement, and a high chance of coming across an article on ATIS from the Wall Street Journal. Thus, in the future, the types of sources that a user comes across in the inactive search stage should be based on the characteristics of the subject. The type of ATIS on which people obtain information is also dependent on the manufacturers marketing plan and the amount of press that a product gets. These are both functions of the stage of deployment that the product is in. Currently on the simulator, these issues are not considered, but they may be in the future.

#### **4.2.3.2 Active Search**

In the active search stage, since consumers are actively pursuing information on a product, they have more control over both the types of information sources they access and the types of ATIS on which they acquire information. Thus, while in the active search stage on the simulator, the subject has greater control over their search than they do in inactive search. In the simulated active search, subjects first select what information source they want to use,

and then, for most sources, they may select the type of ATIS for which they would like to acquire information. The subject has complete control over the type of information source they view, but the amount of control over the type of ATIS on which they acquire information varies depending on the information source. This is to simulate the real-life occurrence of looking for information on one topic and coming across another. Thus, there is still some element of passive acquisition of information in the active stage.

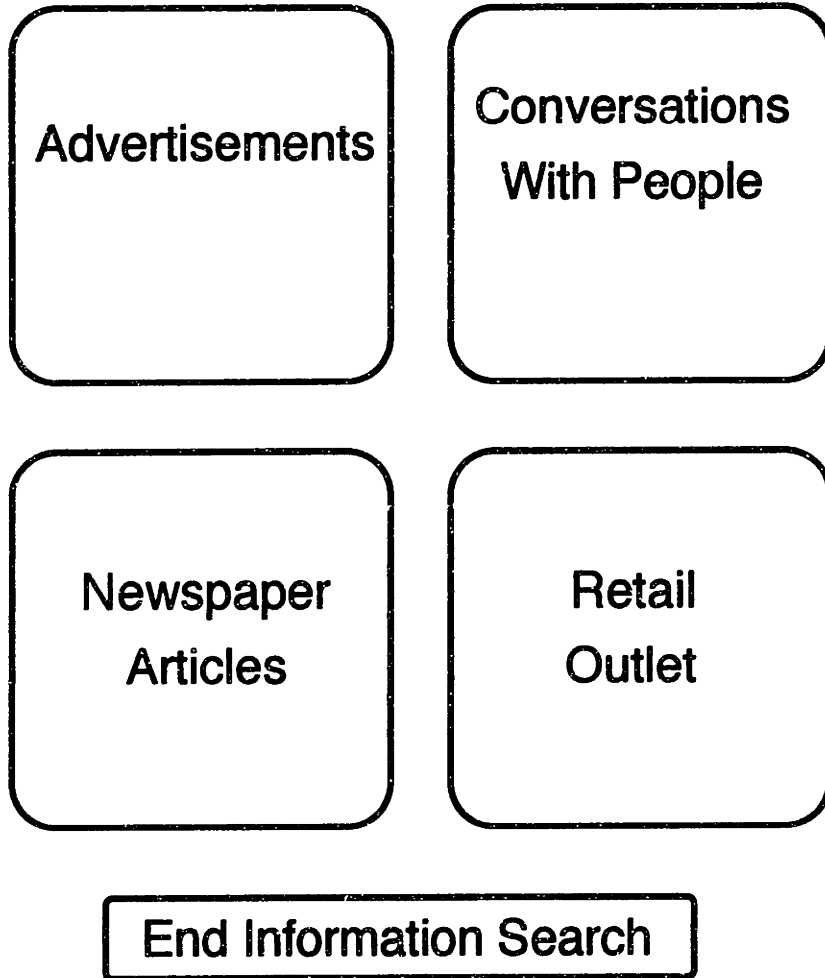
Figure 8 shows the "main menu" screen of the active search stage on the Market Simulator. In the active search stage, the subject makes a series of selections that will eventually lead to a presentation to the subject of a particular item (e.g. an advertisement) containing information on one or more ATIS. After viewing each item of information, the subject is returned to the main menu. Figure 9 shows the window hierarchy of the active stage of the Market Simulator.

If a subject selects the advertisements box from the active search main menu, then one of the advertisements programmed into the simulator will randomly be shown on the screen -- it may be print ad, a television ad, or, potentially, a radio ad (although no radio ads were included in the prototype simulator) and it may be on any one of the products in the environment. With advertisements, the subjects do not get a choice of which particular product's advertisement they see, because the consumer cannot seek out this advertisement in a real market environment.

If subjects select newspaper articles, then they are asked if they would like an article on a specific type of ATIS, all types of ATIS, or any type of ATIS. Even

# Main Menu

The following are the sources of information available to you.  
Please either (1) click on the source you would like to use, or  
(2) click on the box to leave the information search.



**Figure 8**  
**Main Menu of Active Search Stage**

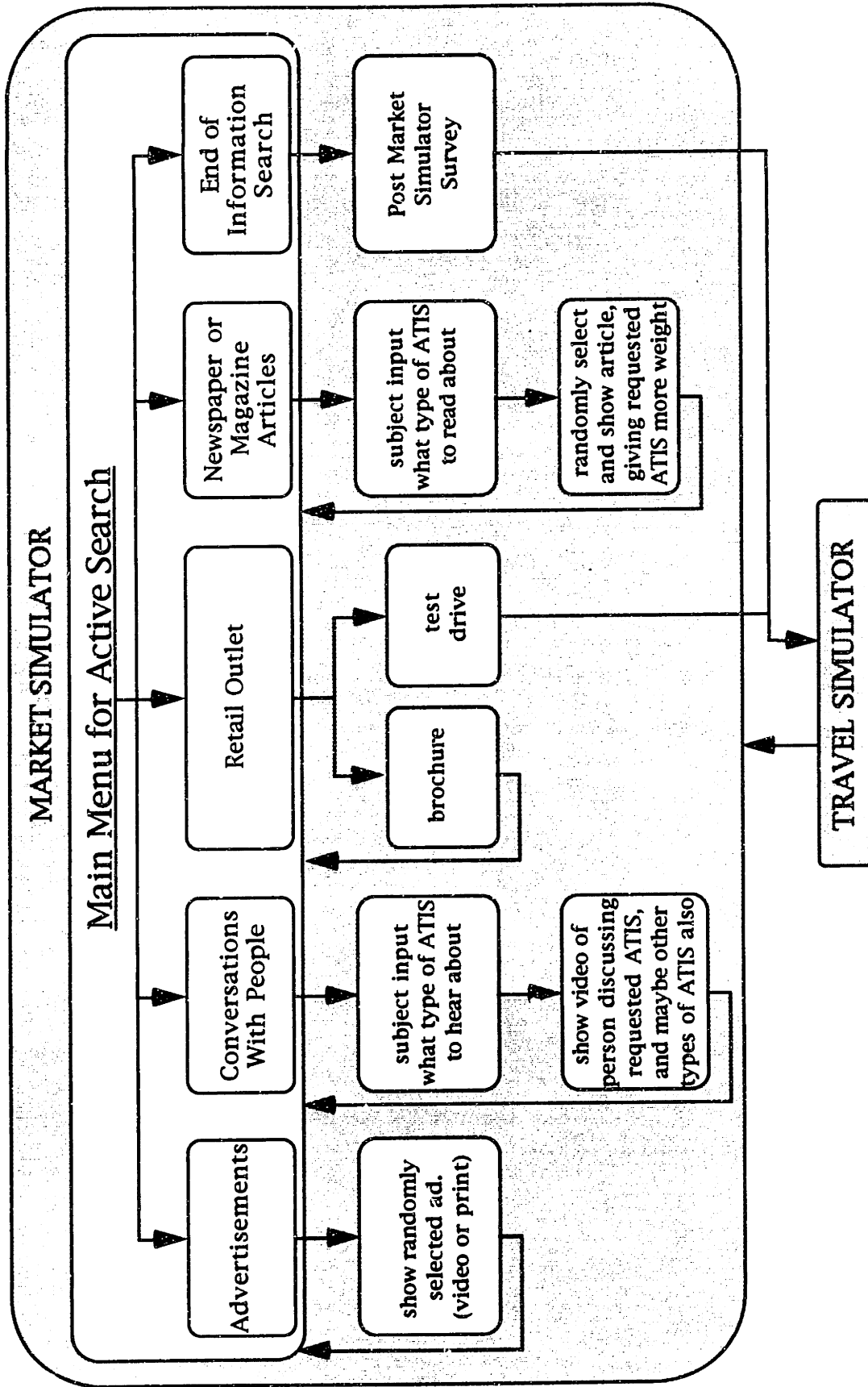


Figure 9: Window Hierarchy of Active Search

though they select one of these choices, they are not guaranteed an article on that topic (because while looking for one article, a consumer may come across another). The simulator currently gives subjects a 75% chance (which was chosen arbitrarily, and may easily be changed) of acquiring the article that they requested. If subjects do not get what they selected, then they are told so before being shown the article.

For the conversations with people videos, subjects are asked what type of ATIS they would like to hear about. They are guaranteed to receive some information on the ATIS that they requested, but it may be positive or negative, and the person may also discuss other types of ATIS (positively or negatively). This selection criteria was designed to add randomness. It assumes that the consumers know who to approach to find out information about a certain product.

If subjects select the retail outlet, they can only acquire information on the in-vehicle ATIS since the radio and phone-based ATIS would not be sold in retail outlets. In the retail outlet, they may either look at the brochure for the in-vehicle ATIS or take a test drive. If they choose to take a test drive, then they are transferred to the Travel Simulator for a trip in a vehicle that is equipped with the in-vehicle system. On the test drive, the vehicle is also equipped with a phone and a radio. They were included to allow the consumer a chance to test the other ATIS services. It is more likely that these other products will be tested in either the consumer's own vehicle or an acquaintance's vehicle, but the test drive was included here instead of adding another information source.

#### **4.2.3.3 Transition From Inactive Search to Active Search**

Now that the simulation of the two search stages is specified, the question becomes what determines the phase that a subject is in, and how does the subject transition between the two while in the simulator. Before the subjects enter the information acquisition process in the simulator, the inactive and active search stages are defined in real-world terms (not in terms of how the search occurs on the simulator), and the subject is asked whether they are interested enough in any of the products to pursue active search. If subjects say yes, then they are shown the main menu of the active search stage, and they must remain in the active search stage for the rest of their information search. If the subject says no, then they enter inactive search on the simulator, and a randomly selected information source is shown on the screen. The subject has complete control over how much time to spend viewing the source. After the first information source is viewed in inactive search, subjects are again asked whether they want to be in inactive search or active search, and they are also given the option of not acquiring any more information on ATIS. Thus, in the simulator, the subjects are forced to view at least one<sup>1</sup> information source on ATIS, but the time the subjects spend on the source is up to them. This is to force at least minimal exposure to ATIS, because over the lifetime of the products, consumers will probably come across a small amount of information on ATIS (such as see a headline or talk to someone who has used ATIS). However, minimal information is forced on the subject, and, in fact, the amount of forced information depends highly on what information source is randomly selected for the subject. Note that the subject never is required to enter active search.

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<sup>1</sup> This number was arbitrarily chosen, and it can be chosen to be any small number.

#### 4.2.3.4 Time and Cost of Search

The amount of effort required to gather information is normally much less in a simulated environment than in a real market environment. Thus if search costs or time limits are not imposed on the subject, then people will tend to acquire more information in a simulated environment than they would in real life. Several different methods were discussed in the literature to simulate search costs. One study presented physical costs of acquiring information in the description of the sources, and then asked subjects to consider this as they would in real life. [Meyer, 1985] The problem with this is that there is no real penalty associated with it. Another paper suggested represented time costs as a blank screen; this clearly seems more aggravating than the time costs imposed in real life. [Ozanne, 1988]

In the application of the Information Acceleration automobile purchase experiment, real-life search time was translated into IA Simulator search time. [Weinberg, 1993] Prior to starting the IA stage of the experiment, the subjects were surveyed on their information acquisition behavior from their last automobile purchase. The subjects then were assigned different levels of IA search time reflecting their past search behavior. The IA time simply equalled the amount of time that it would have taken the subject to make their real-life search on the IA simulator. The subjects spent about the same amount of time searching each of the information sources in the simulator, as they reported they had on their last search for an automobile. However, this is likely to be due to response bias since the subjects were asked about their prior search for an automobile, then asked to behave in the Market Simulator as they would in real-life, and then they were allowed to search for information



on the simulator. Another issue is that there were not enough options of information sources to truly test their algorithm. For example, many of the subjects stated that they read many more articles than the number of articles that were available on the simulator.

It is not clear that this method would work with ATIS, because it requires the subjects to have had past search efforts of similar products. The simulator time allocated to subjects would instead have to be based more on general search habits (like if someone tends to search a lot or search very little), or on search habits of more similar products. The time allocated also needs to be based on the interest that the subject has about ATIS (assuming that someone who is more interested will search more than someone who is not), and on the inquisitive nature of the individual.

Despite this discussion on how to properly limit search time, there are no limits to search time on the prototype simulator. This is because we want a person's interests to drive the amount of information that is acquired, and also all of the options of limiting search times involve their own biases. Although no artificial time constraints are imposed on the subjects in the ATIS simulator (such as limiting subject's information search to 10 minutes), the subjects still experience real-life time-constraints, because the more they search on the simulator, the more time they will spend in the experiment, and thus the less time they will have to do other things. In addition, although it is probably easier to obtain product information from the simulator than in real-life, it is still not terribly easy to acquire information on the Market Simulator. For example, the subject does not have total control over what information they acquire, some of the sources are very slow in loading onto the computer

screen, and some of the information sources are not very informative or interesting.

#### **4.2.4 Altering Parameters of Simulated ATIS on Market Simulator**

As mentioned earlier, price, customization, and relevancy are all important characteristics of ATIS products and services. For the modeling, it is necessary to offer a range of these characteristics so that we may observe how the attribute impacts traveler behavior. Thus, the ease with which the parameters can be adjusted on the simulator is important. In the prototype simulator, all of these characteristics are fixed. This is because we applied the simulator to a small test group of subjects and widely varying parameters would make the data more difficult to interpret. In addition, the data was not used for modeling purposes, which is the primary reason that ranges of attributes are necessary. However, it is fairly simple to adjust such parameters on the simulator. The main issue is that the opinions expressed in the newspaper articles and word-of-mouth are based on the product characteristics. Thus, depending on the desired range of parameters, separate information sources (or partially rewritten information sources) may have to be created if the range of parameters is large. Once these separate information sources are created, it is trivial to first assign the subject with a set of products with specific characteristics for their information search, and then select the set of information sources that go with these product characteristics that will be shown to the subject on request. This may get complicated quickly if there are many different combinations of possible product characteristics. Within a small range for each attribute, a fill in the blank method could be used in which, for example, the price of the product could vary slightly without having to change the rest of the text.

#### **4.2.5 Data Collection**

An advantage of a simulated environment is the ease with which data can be collected and manipulated. Every decision that the subject makes on the simulated environment is recorded by the computer, including what sources are viewed and when, how much time is spent viewing each source, the information contained in each source viewed, and the time spent in active and inactive search. This data can be automatically entered into summary tables or into a database from which models can be estimated. Thus, if the specific uses of the data are known in advance of the data collection, the data manipulation becomes very easy.

### **4.3 Travel Simulator**

#### **4.3.1 Introduction**

The Travel Simulator is used as a tool for the collection of data on traveler behavior in the presence of traffic and route-guidance information. Such data can then be used to refine and calibrate models.

On the Travel Simulator, subjects make simulated trips in their automobile. On each of these trips, travelers can choose whether or not to use an ATIS (and which ATIS to use) to help them make their travel decisions. The interface of the Travel Simulator is shown in Figure 10, and the following sections will describe the Travel Simulator in more detail.

# ATIS

- (Road Map)
- Radio
- Phone-based
- ✓ In-Vehicle

## Driving/Observation Window

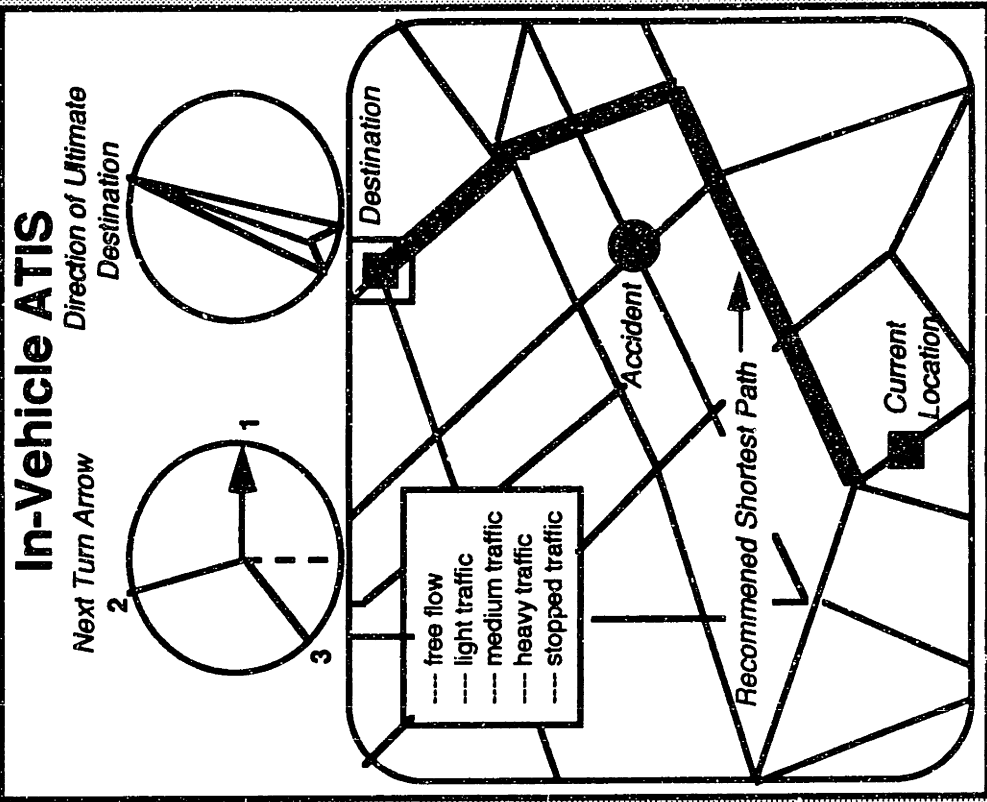
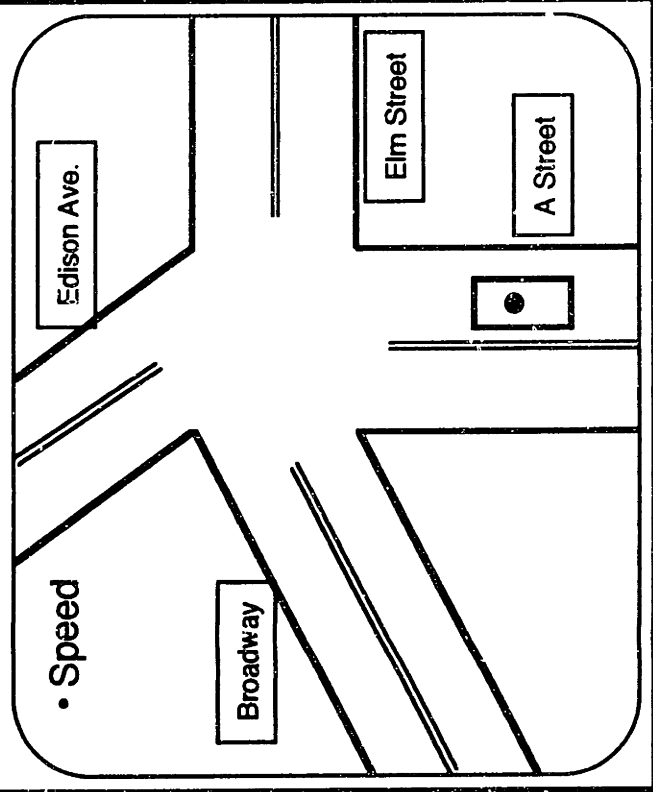


Figure 10: Travel Simulator

The simulator used for this study is an updated version of the Travel Simulator described in Koutsopoulos et al (1992). The primary adjustments made to the Travel Simulator for this research were to make the program window-based, to simulate several types of ATIS, and to give the subject total control over what types of ATIS to use. Multimedia was also incorporated so that some of the ATIS (e.g. radio traffic reports) uses audio to convey traveler information.

#### 4.3.2 Simulation of Driving Task

The bottom left box on the simulator interface (Figure 10) is the driving/observation window, which represents the view that a driver sees out of the car windows while traveling. Even though this is not exactly what a driver would see (it is instead a bird's eye view of the car), information is given to try to more clearly represent the traffic conditions. The streets in the driving/observation window are shown in different colors that represent the traffic conditions on each street. For example, the following categories are used:

no traffic	->	grey
minimal traffic	->	yellow
light traffic	->	green
medium traffic	->	light blue
heavy traffic	->	dark blue
bumper-to-bumper	-->	magenta
stopped traffic	->	red

In addition to the color-coding, photographs are provided that show what each traffic condition (and corresponding color-code) may look like. In future versions of the simulator, the speed of the subjects vehicle will be given.

For each trip on the Travel Simulator, the subject is given an origin and a destination and has to make a decision of which way to turn at each intersection on the way to the destination. During the trip, the driving/observation window shows the car moving along the chosen street and it also shows the part of the network that includes streets adjacent to the current location of the car.

#### **4.3.3 Network Representation**

The network on which the subjects drive is shown in the bottom right box of Figure 10. A hypothetical network was used for the prototype ATIS Market/Travel Simulator, however any network may be programmed into the simulator. Whether to use a hypothetical network or one based on a real network, and how complicated to make the network are all dependent on the goals of the experiment.

Currently, the travel times (i.e. travel conditions) on each link (i.e. a segment of road connected by two adjacent intersections) are generated from travel time distributions based on the mean travel time and the variance of the travel time on that link. The travel times on each of the links are calculated independently from all other links in the network. This leads to anti-intuitive traffic conditions on the travel network. For example, a major accident only impacts the link on which it occurred, and it doesn't impact any of the surrounding road segments. Thus, a better traffic assignment model should be

implemented. The incidents are generated by sampling from pre-defined frequency distributions, and the type of incident (minor or major) and its duration are sampled as well.

#### **4.3.4 Simulation of ATIS Products and Services**

The three types of ATIS that were simulated in the Market Environment need to be simulated in the Travel Simulator.

The simulation of the in-vehicle system is shown on the right-hand side of the interface in Figure 10. It is represented as an electronic map with traffic conditions represented by different link colors. The location of the car, the destination of the trip, accidents on the network, and the suggested route is all shown on the in-vehicle electronic map. In addition, the recommended next link to follow is shown above the electronic map. The other arrow above the electronic map shows the direction of the ultimate destination. If the subject has not chosen to purchase the in-vehicle system, then the electronic map remains on the screen, but without any of the real time traffic information (no color codes, shortest-path, etc.). This represents a standard road map and is offered to the subject because a hypothetical network is used.

Due to time constraints, the phone-based and radio traveler information systems were not simulated very well in the prototype Travel Simulator, and they do not realistically represent the products. It is necessary to improve this before any data from the Travel Simulator is used. In the prototype simulator, if subjects turn on the radio, then they will periodically hear information via audio about the accidents on the network. As the vehicle arrives at each intersection, the computer randomly selects one of the existing incidents on

the network to report. The report includes the location of the incident and the expected duration. For the phone-based system, subjects select the link on the electronic map for which they want traffic information, and the traffic condition on the link is told to them via audio.

#### **4.3.4.1 Altering Parameters of Simulated ATIS on Travel Simulator**

Since it is necessary to simulate a range of the characteristics of price, customization, and reliability, these characteristics must be variable on the Travel Simulator. The price is very easy to adjust, since it has nothing to do with the Travel Simulator itself. In future versions of the simulator, when the subject chooses to access an ATIS on the Travel Simulator, they may be warned of the price of the product. However, it would be quite easy to program the correct price to appear.

The reliability of the travel information is controlled by the analyst by setting a variable from 0 (totally random traffic information) to 1 (perfect traffic information). However, this variable corresponds to the traffic information throughout the whole network. In reality, the reliability of the traffic information may vary throughout the network. For example, traffic information might be good on a high-tech freeway with numerous sensor devices, and poor on an old part of the city with old and often broken loop detectors and no other source of information. This aspect should be programmed in a future version of the Travel Simulator. It would require dividing the network into several groups of links depending on the accuracy with which the travel conditions are known on each link, and then a separate reliability variable would be defined for each group of links. In addition, the reliability across traveler information systems may vary, and thus it is



necessary to specify reliability variables for each ATIS. At this time, the simulator only has one reliability variable for all links and for all type of ATIS.

The customization characteristic varies mostly from system to system. More choice of features could be given to the subjects to get a better feel of their response to different features and levels of customization.

#### **4.3.5 Simulating ATIS Access and Usage**

##### **4.3.5.1 Availability of ATIS Products for the Subject to Access**

The upper left-hand box on the Travel Simulator screen (Figure 10) allows the subjects to select different types of ATIS to help them with their travel decisions. The in-vehicle system can only be accessed at the beginning of a trip, and once it is accessed, it can be used at any time during the trip. Since we assume that each subject has a car radio and a cellular phone, the radio can be turned on or off at any time before or during a trip, and also a call can be made to the phone-based system at any time before or during a trip. Currently, the subject clicks on an item in the menu and it is 'purchased.' In future versions of the simulator, it would be good to show more of a purchasing environment (i.e. show a picture of a store and the product, if applicable) and to remind the subject of the cost of the system. Also, only the usage choices should be able to be made easily from the Travel Simulator, and the access decisions (for example purchasing an in-vehicle ATIS) should only be allowed from the active search stage of the Market Simulator.

In the prototype simulator, it is assumed that everyone has a car radio and a cellular phone, and thus everyone has access to radio traffic reports and the phone-based ATIS. This was done because it is not realistic to tie the purchase of a phone or a radio to the desire to acquire traffic information. A model could be estimated to predict whether someone will have a car phone or a radio, but this was not done for this stage of the research.

#### **4.3.5.2 Simulated Cost of Purchasing ATIS**

In real life, there is clearly a cost to the consumer for purchasing an ATIS, especially an in-vehicle system. It is important to translate this cost to the consumer in the simulated environment. Some of the studies in the literature review paid the subjects a given amount for participating in the study, and then the consumer could use this real money to purchase a real non-durable good. [Lehmann, 1980] Due to the high cost of some ATIS systems, and the fact that they are not currently available for the subject to take home, this method will not work for ATIS.

Most of the studies simply provided information on the cost of the goods, and asked the subjects to consider this factor as they would have in real life. This is the approach that is taken in the prototype simulator. However, as mentioned in the previous section, a more realistic purchase environment could be simulated to stress the fact that the product or service does cost.

#### **4.3.6 Data Recording Capabilities**

Throughout the simulated trips, data are collected on the prevailing traffic conditions, the ATIS accessed, the traffic information provided, and the route choice decisions made. Again, as in the Market Simulator, the electronic data

collection and manipulation can be used and can save time if large samples are used.

#### **4.4 Surveys**

Three different survey are given throughout the simulator. (Due to lack of time, the surveys were not entered as an electronic questionnaire on the prototype simulator.) A brief description of the purposes of each of the surveys follows. The surveys that were administered to the sample set of subjects are given in Appendix C.

##### **4.4.1 Pre-Simulator Survey (Survey A in Appendix C)**

As the name implies, the pre-simulator survey is given before the subject enters the Market Simulator. This survey serves two purposes. One is to obtain information on the subjects personal characteristics, travel characteristics, and attitudes. The other is to help set the stage for the Market Simulator by making the subjects think about their travel patterns and the transportation system.

##### **4.4.2 Perceptions Survey (Survey B in Appendix C)**

The perceptions survey is given every time the subject exits either inactive or active search. The survey inquires about the subjects knowledge of ATIS, perceptions about ATIS , and purchase intent. The purpose of the survey is to obtain information on how the subjects knowledge, perceptions, and purchase intent change throughout their information search. For this reason, most of these questions are also asked in the pre-simulator and post-simulator survey.

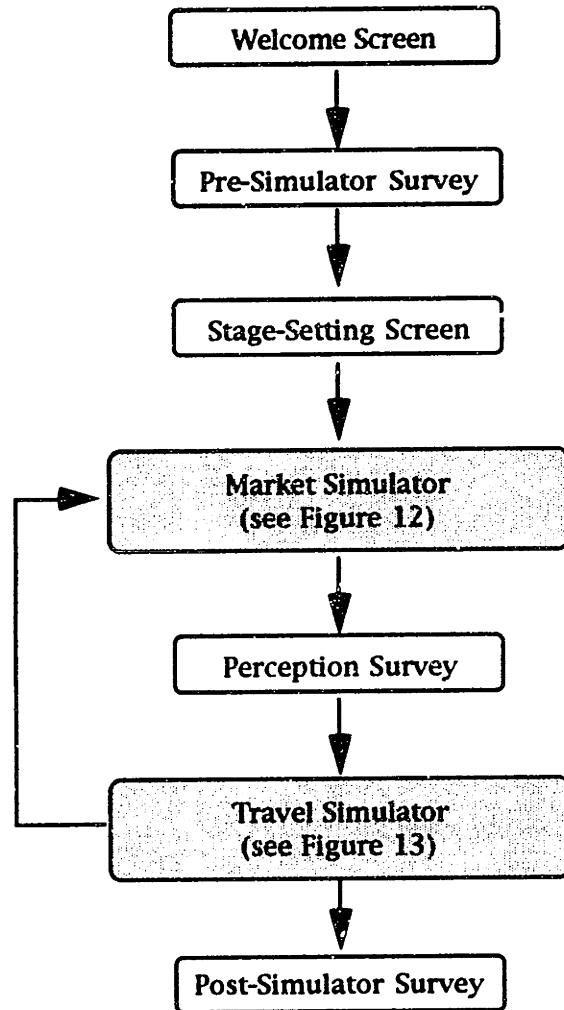
#### **4.4.3 Post-Simulator Survey (Survey C in Appendix C)**

After subjects have completed the required number of trips on the Travel Simulator, they are given a post-simulator survey. The purpose of this survey is to obtain updated data on the subjects' perceptions and purchase probabilities, to ask for comments about the ATIS to be used for the word-of-mouth source (although at this point these are not used in the prototype simulator), and to obtain feedback about the simulator and the experiment.

#### **4.5 Sequence of Activities on ATIS Market/Travel Simulator**

Up until now, the simulator has been described in broad summary terms or in disjoint details. To provide a better picture of the simulator, this section will describe the entire process that the subjects go through during an ATIS Market/Travel Simulator experiment. Figures 11 through 13 show the sequence of tasks that subjects perform on the prototype simulator, and this sequence will be described in more detail here. See Appendices A, B, and C for further information on the simulator screens, information sources, and surveys respectively.

First the subjects view a "welcome screen", which briefly describes what they will be doing, and thanks them for their participation. Then, they are presented numerous questions in the pre-simulator survey, which is described in section 4.4.1. After the survey, another text screen is shown which briefly sets the stage of the future date in which the simulator is set, the year 2000, and it also further introduces the simulator.



**Figure 11**  
**Sequence of Activities on ATIS Market/Travel Simulator**

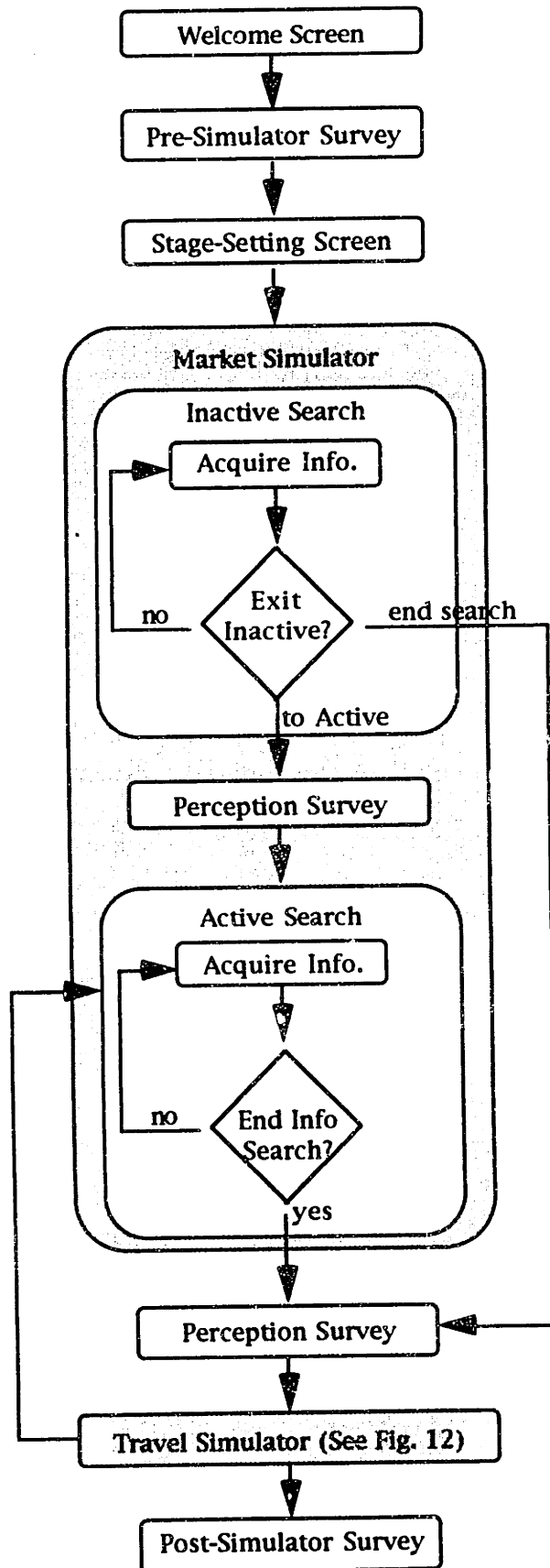


Figure 12: Sequence of Activities on Market Simulator

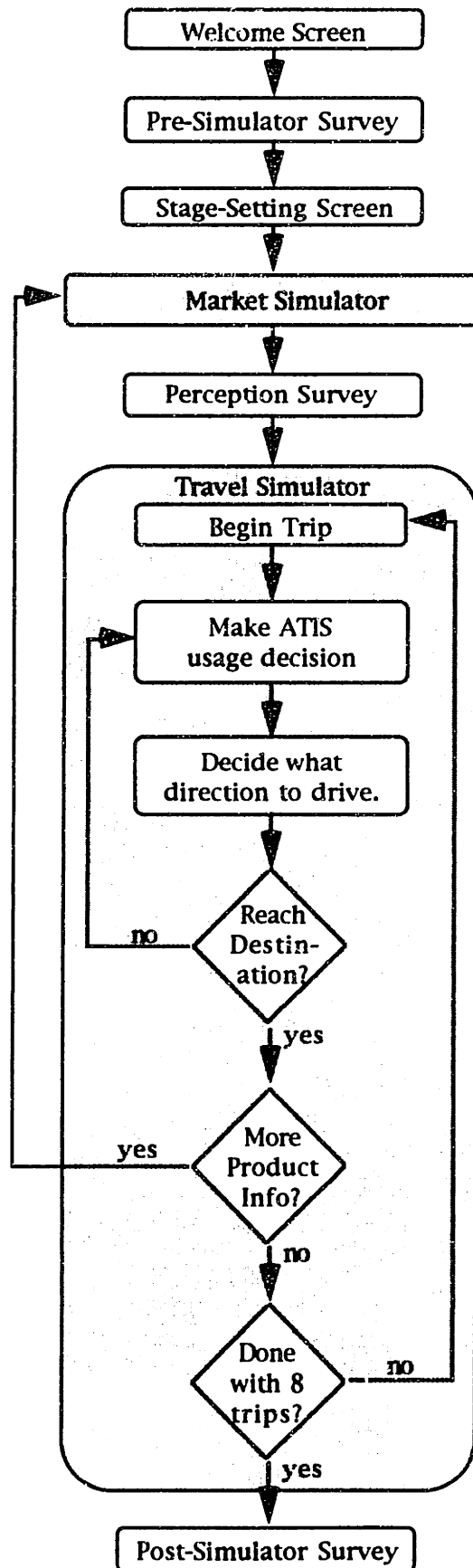


Figure 13: Sequence of Activities on Travel Simulator

The subjects then enter the Market Simulator, in which they acquire information on ATIS from various information sources. As described earlier, there are two stages of product information acquisition: inactive search and active search. Subjects must decide whether they want to enter active search. In the inactive search stage on the simulator, the subjects have no control over what types of sources they view or the types of ATIS on which they receive information. In this stage, sources appear on the screen, and the user only decides how much time to spend on the source. Following each acquisition of information in the inactive search, the subject decides whether to remain in inactive search, enter active search, or end their information search. They may stay in the inactive search for any length of time, and they are not required to enter the active search stage. Once they decide to leave the inactive search, they are given the "Perceptions Survey" (described in section 4.4.2), which inquires about their knowledge of ATIS, perceptions about ATIS, and purchase intent.

In the active search phase, the subjects are presented with the active search main menu (Figure 8) and each subject determines which sources to search, the amount of time to allocate to searching each source, and the order in which each source is searched. While they have considerable control over the type of ATIS on which they obtain information, there is a certain amount of randomness that has been programmed into the simulator (see section 4.2.3.2). After each acquisition of product information, they are returned to the active search main menu. They may search for information in active search for as long as they desire. When they do not wish to acquire additional product



information, then they are again given the perceptions survey before they enter the Travel Simulator.

In the Travel Simulator, they make 8 trips with identical origins and destinations. The number of trips and types of trips (e.g. commute or non-commute) are selected depending on the goals of the experiment and are easily changed on the simulator. Eight trips were arbitrarily chosen for the prototype simulator, but it is not terribly significant since the specified awareness and access model does not use the information from these trips. On each of these trips, the subjects choose their route to the specified destination by selecting the direction in which to proceed as they arrive at each intersection. To aid in their route-choice decisions, they may access and use any of the ATIS available on the Simulator. At the end of each trip, subjects have a choice of continuing on their next trip or returning to the active search phase of the Market Simulator. Should they decide to return to get more product information, they must take the perceptions survey again when they return to the Travel Simulator. After they have made the required number of trips, then they are given a post-simulator survey (described in section 4.4.3).

The next chapter will summarize the data that was collected from a small sample of test subjects who were put through the prototype simulator.



# Chapter 5

## Data Collection: A Pretest

As an initial test, the ATIS Market/Travel Simulator was used to collect data on awareness and access from ten subjects. The purpose of the initial sample was to get a general idea of how subjects react to the simulator, to receive feedback on the simulator, and to obtain qualitative indicators of traveler response to ATIS. Although the data collected from each subject included all that is required to estimate the awareness and access model proposed in Chapter 3, a sufficient number of subjects was not obtained to estimate the model. However, this small sample is the necessary pilot test that allows the simulator be fine-tuned before data from a large sample are collected.

in this chapter, general impressions and statistics regarding the data will be discussed. Summary data on search characteristics, the subjects' level of knowledge about ATIS, and purchase intent will be presented and analyzed. In addition, the subjects' reaction to the simulator is discussed. Appendix E contains more detailed data than is presented in this Chapter.

The experiment was conducted as described in section 4.5. The surveys that were administered appear in Appendix C, and the information sources provided to the subjects are included in Appendix B. The subjects were required to answer 3 different surveys and make 8 identical trips on the Travel Simulator, and they were allowed to search for as much (or as little) product information as they desired. For this experiment, all subjects were provided with the same ATIS price structure: \$0.50 per call to the phone-based service, \$600 for the in-vehicle system equipment, and a \$20/month subscription free to dynamic traffic information for the in-vehicle system. When data are collected to estimate the model, it becomes necessary to provide different subjects with different prices so that the influence of price on behavior can be studied. However, so few subjects were used in this test run and the data are not to be used for modeling, so the same prices were given to all subjects.

A convenient sample of students was used for this test, so the subjects tended to be young, computer literate, and well-educated. The test sample subjects also had a greater initial knowledge of ATIS products and services than today's average consumer. In addition, the subjects do not drive extensively, and have minimal experience with use of existing ATIS services.

## **5.1 Average Search Characteristics**

This section will discuss the average characteristics of the information acquisition process that the subjects pursued on the Market Simulator. A summary of each subject's activities on the simulator is included in Appendix E.

Table 5 shows the average number of sources that each subject viewed. For example, the average subject viewed 0.7 advertisements while in active search. Note that very few sources were viewed in the Inactive Search mode. In fact, only one of the ten respondents chose to be in the inactive search mode at any time during the information search. In reality, this would probably not be the case, and it is probably due to biases in the market simulator (for example due to the way in which active and inactive search are defined on the simulator). In addition, although an effort was made to not

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**Inactive Search**

<u>Source type</u>	<u>Avg number of info. items viewed per source type</u>
Advertisements	0.1
Conversations	0.2
Newspaper	0.2
(Retail Outlet was not an option in inactive search)	

**Active Search**

<u>Source type</u>	<u>Avg number of info. items viewed per source type</u>
Advertisements	0.7
Conversations	3.8
Newspaper	1.8
Retail Outlet - Brochure	0.7
Retail Outlet - Test Drive	0.6
Average total number of info items viewed by each subject (of any source type, in either inactive or active search):	8.1

**Table 5**  
**Average Number of Sources Searched By Each Subject**

---

offer any information about the products before the subject entered the Market Simulator, the subjects did acquire a one or two sentence description (effectively, passive information) of the products during the pre-simulator survey. For all but one subject, these brief descriptions, along with prior knowledge, was enough to lead the subjects to pursue active search. This indicates that the subjects were interested in the concept of ATIS, and in finding out more about it. However, the transition to active search on the simulator compared with real-life behavior needs to be studied more carefully. In the active search stage, conversations with people was the most frequently selected source of information, followed by newspaper articles, retail outlet, and, lastly, advertisements. On average, each subject consulted eight different items of product information throughout their search on the simulator (both inactive and active).

Table 6 displays the percentage of subjects who viewed each type of information source. For example, 70% of the subjects viewed at least one advertisement while on the simulator. Once again, conversations were the most popular. The popularity of the conversations source is probably because many of the subjects knew some of the people who had been video taped for the conversations source. Also, the videos tended to be entertaining and took little effort on the part of the subject to gather useful information, unlike some of the other sources such as newspaper articles and the brochure. The retail outlet was the next most popular, followed by advertisements and newspaper articles. Table 6 also displays the average time that the subjects spent on each item of information. For example, the average person spent 1 min. and 11 sec. on each advertisement that he or she viewed. The times spent indicate that the subjects did make an effort to acquire information on the product once

entering the information source, and were not just playing with the simulator. For example, the newspaper articles were from 1-2 pages long, and thus two minutes is enough time to skim the article. Notice that the simulated drive time was very short. The travel simulator time elapsed can be sped up to any degree. For both the test drive and the required 8 trips, the subjects were to travel from the bottom most node to almost the top most node on the simple hypothetical network, which is about an hour and twenty minute drive. For this experiment, the time was sped up immensely to make the experiment shorter.

---

<u>Source</u>	<u>Percentage of Subjects Who Viewed at Least One Item From Source</u>	<u>Average Time Per Individual Item Viewed</u>
Advertisements	70%	1 min., 11 sec.
Conversations	90%	0 min., 52 sec.
Newspaper	60%	2 min., 12 sec.
Retail Outlet	80%	2 min., 44 sec.
- Brochure	70%	2 min., 51 sec.
- Test Drive	50%	2 min., 35 sec.

**Table 6**  
**Types of Sources Viewed and Time Spent Viewing**

---

Table 7 demonstrates how subjects allocated their time on the simulator. No restrictions were placed on the subjects concerning their time allocation or time available. The only required activities were to view at least one product information source on the simulator, answer all of the surveys (see Appendix

C), and make 8 identical trips on the Travel Simulator. The subjects spent about 1 hour on the simulator, and about 2/3 of that time was spent on the required tasks of answering surveys and making simulated automobile trips. On average, subjects spent about 13 minutes acquiring product information. A test should be conducted on the simulator to see how the time that subjects spend acquiring product information varies according to the extent of the other required tasks.

---

Average Time in Inactive Search:	1 min., 28 sec.
Average Time in Active Search:	12 min., 18 sec.
Total Average Search Time:	13 min., 46 sec.
Average Time Spent in Surveys:	19 min., 21 sec.
Average Time Spent in Travel Simulator:	21 min., 3 sec.
Average Total Time in Experiment:	57 min., 39 sec.

**Table 7**  
**Allocation of Time By Subjects**

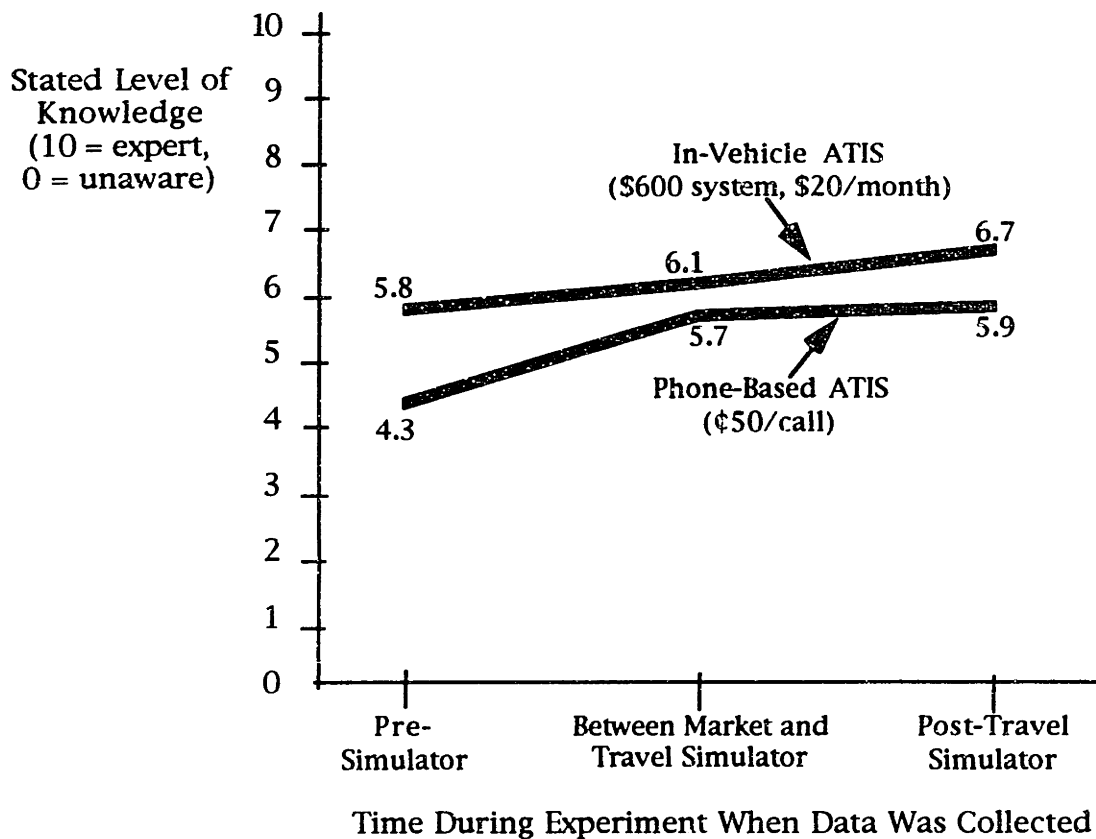
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While this section only discussed the average characteristics of the subjects, the search patterns varied greatly between the subjects. For example, the extremes on the time spent acquiring information was 2 minutes, 24 seconds versus 47 minutes, 29 seconds. Also the number and types of sources viewed by each subject varied greatly. This is similar to behavior of consumers in a real market -- consumers search for product information based on their interest in the product and their needs. This leads to widely varying search behavior and thus to widely varying degrees of knowledge.



## 5.2 Progression of Knowledge Throughout Experiment

Throughout the simulator, the subjects are acquiring additional information about ATIS and thus increasing their knowledge. The subjects were asked to state the level of knowledge they believed to have about the in-vehicle and phone-based system at various times during the experiment, including before entering the Market Simulator, just prior to entering the Travel Simulator, and at the end of the experiment. Figure 14 shows the average stated level of knowledge at different stages of the experiment. The convenient sample of subjects that was used tended to have higher initial knowledge about ATIS than today's average consumer. This caused some problems because of the conflict between the pre-conceived notions that the subject had on what these products would be like, and the particular ATIS product as simulated for the experiment. However the subjects were still able to increase their knowledge on the simulator. This graph shows that both viewing product information sources (i.e. acquiring information in the Market Simulator) and having direct experience with the product (i.e. taking trips on the Travel Simulator) increases knowledge. The subjects barely increased their knowledge about the phone-based system from their experience on the Travel Simulator. This is most likely because of the large discrepancy between the way the phone-based service was simulated on the Travel Simulator and the way it was described in the Market Simulator led to confusion about the specifications of the phone-based system.

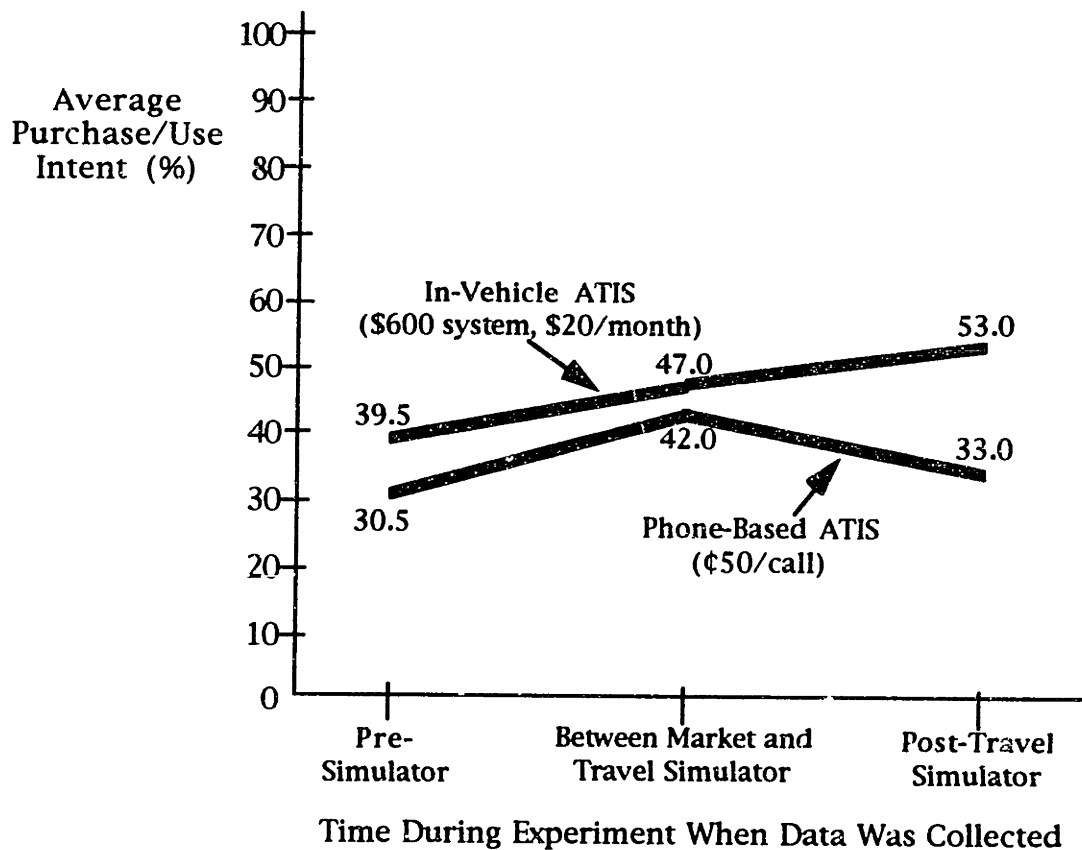


**Figure 14**  
**Progression of Knowledge Through Experiment**

### 5.3 Indicators of Purchase Behavior

Several different questions were asked throughout the experiment to obtain indicators of the subject's potential purchase behavior. First, the subjects were asked to state their purchase intent (i.e. probability with which the subject will purchase/use an ATIS product/service) for the phone-based and in-vehicle systems. This question was asked at three times during the experiment: before entering the Market Simulator, just before entering the

Travel Simulator, and at the end of the experiment.<sup>1</sup> Figure 15 shows how the average subject's purchase intent varied throughout the experiment for both the phone-based system and the in-vehicle system, and Table 8 shows that on average the subjects changed their purchase intent more than 10% between responses.



**Figure 15**  
**Progression of Purchase Intent Through Experiment**

<sup>1</sup> If the subjects returned to the Market Simulator after entering the Travel Simulator, then they were again asked for their purchase intent prior to re-entering the Travel Simulator. However since few subjects did this, the data is not included in this summary. See Appendix E for the data.

From Figure 15, we can see that after the subjects acquired additional information about both products in the Market Simulator, the subjects were more likely to purchase/use the systems. However, after the travel simulator, while the purchase intent for the in-vehicle system increased, the purchase intent for the phone-based decreased. This is primarily due to the fact that the phone-based ATIS was simulated poorly on the simulator, and was in fact different than the product described in the Market Simulator. This data shows that both information acquisition and experience using a product influence purchase behavior. In addition, those subjects who returned to the Market Simulator after making one or more trips on the Travel Simulator, were again asked their purchase intent prior to re-entering the Travel Simulator. Four of the subjects selected this option, and two of them changed their purchase intent after acquiring additional information on the Market Simulator. Thus, the amount and type of information acquired influences purchase behavior.

---

Average absolute changes of purchase intent between successive responses:

	Phone-based	In-vehicle
Pre-sim to post-market sim	14.5%	11.5%
Post-market to post-travel sim	11.5%	10.0%

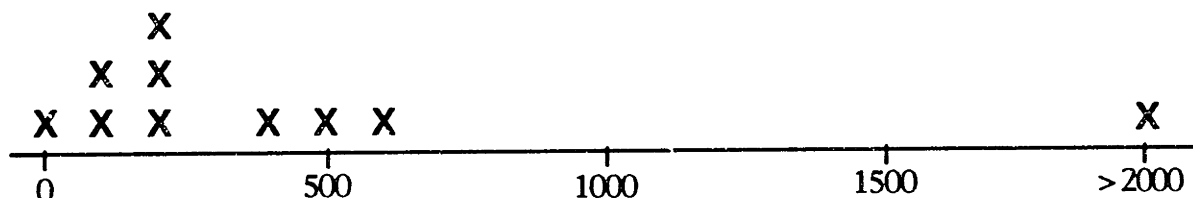
**Table 8**  
**Average Absolute Change of Purchase Intent Between Responses**

---

Another indicator of purchase intent was the answer to a "willingness to pay" question, in which subjects were asked how much they were willing to pay for the in-vehicle and phone based systems. The results are presented in Figure 16. Most of the subjects were willing to pay between \$100-\$600 for the in-vehicle system, and \$0-0.50 per call or \$0-\$5 for a one month subscription for the phone-based system. The extreme answer for the In-Vehicle system is probably an outlier, because the subject stated that there was a less than 10 percent chance that she would purchase the system if it cost \$600. Similarly, the extreme values for the phone-based system (which were from a different subject than the in-vehicle outlier) are also probably outliers because the subject stated a less than 40% chance of using the phone-based system at \$.50/call.

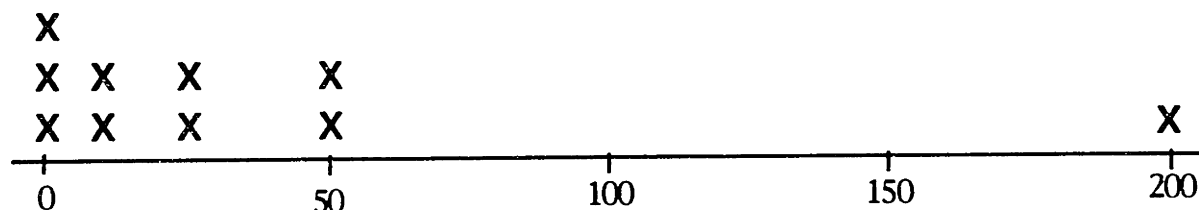
## Willingness to Pay Data

Each 'x' represents an answer from one subject.  
 No scale was given to the respondents.  
 The question as asked at the end of the experiment only.

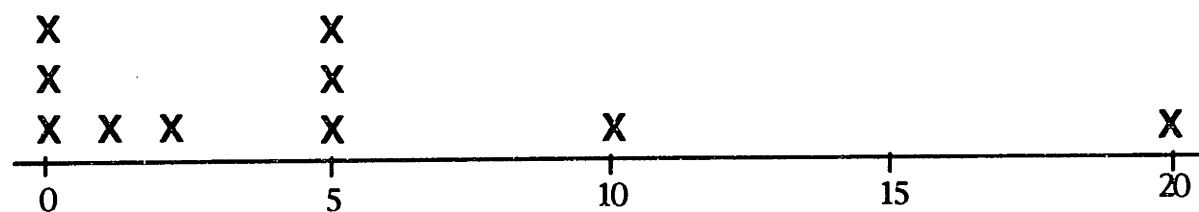


**Willingness to Pay for In-Vehicle Dynamic Route Guidance System**  
 (\$/in-vehicle equipment)

The response assumes free dynamic traffic information.



**Willingness to Pay for Phone-Based ATIS (cents per call)**



**Willingness to Pay for Phone-Based ATIS**  
 (subscription fee in \$/month for unlimited use of service)

**Figure 16**

**Willingness to Pay**

The final indication of purchase behavior is the frequency of use of ATIS during the 8 required trips on the Travel Simulator. Table 9 shows the average percent of trips on which each type of ATIS was used. The in-vehicle system was the most popular, followed by the radio, and then the phone. However, the manner in which the radio traffic reports and the phone-based system are simulated on the Travel Simulator needs to be improved before we can draw conclusions from the data shown in Table 9.

---

Average percentage of trips for which the subjects used the following ATIS:

Radio	20.0%
Phone-Based	17.5%
In-Vehicle	45.0%

**Table 9**  
**ATIS Usage in Travel Simulator**

---

#### **5.4 Subject's Feedback on Simulator**

For the most part, the feedback from the subjects was very positive. Table 10 shows the response to questions asked specifically about their experience on the simulator. The subjects did not think that the simulator was overly difficult to use, or that the experiment was extremely long. They also did not think that the information search experience or the information provided on the products was overly unrealistic. Improvements can still be

made on most of these aspects to improve the results, including improving the quality of the information sources, and the user-friendliness of the simulator. An hour appears to be a reasonable amount of time for the experiment, but any longer would not be recommended. In addition, incentives probably need to be used in the future to be able to obtain a large enough sample of subjects.

---

Average response to the following question:

On a scale of 1 (strongly disagree) to 5 (strongly agree), indicate your level of agreement with the following statements:

The computer search system was easy to use.	3.5
The travel simulator was easy to use.	3.9
The overall search experience was realistic.	3.1
The information provided was realistic.	3.3
The experiment was too long.	2.8

**Table 10**  
**Feedback From Subjects on Simulator Experience**

---

## **5.5 Conclusion**

The initial data collection results are promising. The subjects had widely varying search characteristics depending on their interests and needs. This leads to a sample that obtains a wide range of knowledge about the products and services available in the market by using the simulator. The search patterns and direct experience (acquired in the Travel Simulator) were shown to impact the indicators of purchase behavior. Thus, the awareness stage is important in understanding market potential, and the ATIS Market/Travel Simulator appears to be a useful tool for studying the awareness and access stages of traveler response to ATIS.



# Chapter 6

## Summary and Further Research

### 6.1 Summary

The goal of this research is to improve the methods for studying traveler response to ATIS, and in particular to study the awareness and access stages of the comprehensive modeling framework. It is important to explicitly model these stages because ATIS is a new product that will take many years to achieve its market potential, and thus little is currently known about how consumers will react to such products and services. By modeling these decisions, we can better understand the influences that lead to consumers' awareness and access decisions; thus we will be able to influence the penetration of ATIS and lead to an effective implementation of ATIS products and services.

To meet the goal of this research several tasks were completed. First, an extensive literature review was conducted. By looking at the research in traveler response to ATIS, it was found that little research has been done on the awareness and access stages. There are no existing models on awareness,

and the few existing models on the access decision are inadequate because they do not explicitly model awareness.

By reviewing marketing literature on pre-market forecasts for other types of products and services, it was found that these models are based heavily on past consumer purchase behavior of similar products. This makes it difficult to apply these models to ATIS. The marketing models also stress the importance of the information acquisition stage (awareness) in forecasting penetration of durable goods and services. Thus, another part of the literature review included a review of five information search simulators, which are used to obtain data on consumers' information acquisition. The state of the art was found to be a simulator of the market environment of the particular product under study, in which the subject may acquire product information from realistic information sources in a multi-media environment.

The second task undertaken in this research was to specify a model of awareness and access. Since penetration rates are based on the aggregation of individual behavior, the model system is based on choice models estimated with individual-level choice data. The overall framework of the model is that people acquire information on ATIS, and this information influences their knowledge and perceptions about such products and services. The consumers' perceptions then influence their purchase decision. The search behavior process is hypothesized to occur in two separate stages: inactive search (in which the consumer passively acquires information on the product) and active search (in which the consumer makes an effort to access product information). The model is based on the hypothesis that consumers in the active search stage have choices over the type and amount of product

information that they acquire, and the access decision is dependent on the choices made in the information acquisition phase. Competition in the market is considered explicitly in the model by assuming that the consumer makes a choice among all of the ATIS in the consumers awareness set. The awareness and access model specified is the first to acknowledge the importance of product information search and acquisition on consumers' ATIS purchase decision.

To obtain data for estimating the awareness and access model, a new data collection procedure, the ATIS Market/Travel Simulator, was designed and developed. There are three main parts to the Simulator: the Market Simulator, the Travel Simulator, and the surveys. The Market Simulator simulates a future market environment, in which a variety of ATIS products and services are available to the consumer. The subject may acquire product information from a number of sources, and thus develop their perceptions of the products and services. On the travel simulator, subjects can simulate trips in their automobile, and they may use traveler information systems to help them make their travel decisions. A multi-media environment is used to more accurately portray the market environment and the ATIS products and services.

Since ATIS is a future product, revealed preference data are not available, and thus stated preference data are necessary. The ATIS Market/Travel Simulator is superior to other available methods of collecting data on awareness and access because it gives subjects control over their information acquisition process and places the subject in a realistic market environment in which to make their access decision. The ATIS Market/Travel Simulator also provides us with an inexpensive and flexible method of obtaining data on all 5 stages of

traveler response to ATIS. Thus, the simulator opens the opportunity for comprehensive modeling of traveler response to ATIS and for greater understanding of such issues.

A prototype simulator that includes three types of ATIS (radio traffic reports, a phone-based system, and an in-vehicle system), four product information sources (retail outlet, conversations with people, newspaper articles, and advertisements), and the inactive and active search phases was developed. Data was collected from this simulator using a convenient test sample of 10 people. The results showed the wide variety of searches that consumers conduct, and how the characteristics of the search impact knowledge, perception, and purchase intent.

## **6.2 Future Research**

The work presented here represents only the first stage of this research. This section will highlight some of the most pressing areas of further research, and present some of the ways in which these extensions can be made.

### **6.2.1 Simulator Validity**

One important issue is that of the validity of the simulator, since the simulator provides stated intentions and not actual behavior, and. There is evidence that "real-world" behavior is related to behavior in computer-simulated environments (Clark et al, 1985). In addition, the initial validation tests of the Information Acceleration Simulator (see Chapter 2) were very positive in that the simulator is sensitive enough for a subject to distinguish between

different information sources and different products and also subjects reacted similarly to a simulated retail outlet and a real-world retail outlet.

Despite these promising results, the validity of the market simulator must be tested. In this case, the only way to test the validity is to use revealed preference (RP) data. One way to test the validity is to simulate an existing ATIS market on the ATIS Market/Travel Simulator. The results derived from the simulator can be compared with what occurs in the real market to test how well the market simulator can predict real behavior. While awareness data for actual choices is not reliable because it is difficult for people to recall their information acquisition process, RP data on consumers' access decisions for products in existing market environments is theoretically easy to collect. Thus, the penetration forecasts derived from the models estimated with data from the simulator can be compared with the actual penetration.

However, RP access data can only be collected for products that exist in current markets. This presents a problem since most of the ATIS available today only require a usage decision and not an access decision, and those that do require an access decision are in the very early stages of implementation. For example, radio and television traffic reports and phone-based systems that charge for each call are accessible to anyone with a television, radio, or phone, respectively, and thus only involve a usage decision. Thus, the best validity test is probably to use a test market, in which a product is designed, manufactured, and released on the market in one or several representative cities. This is different than an operational test, because operational tests focus on testing the performance of the product, and they do not directly address sales issues.

## **6.2.2 Improvements to the Simulator**

Another area of further research is to improve the simulator itself. The nature of a simulated environment is that there are numerous improvements that could be made to make it more realistic. However, as discussed in chapter 4, fidelity (or realism) is only necessary to the extent that it is needed to produce valid results. None-the-less, there are many improvements that should be made to the simulator. The most critical improvements are discussed in this section.

### **6.2.2.1 Market Simulator**

Minor changes in the presentation of the information on the Market Simulator need to be made. One change is that the instructions should be given via audio to reduce the amount of text that the subjects must read, and to increase the probability with which the instructions are processed by the subject. Another problem is that many of the information sources take a very long time to load onto the computer screen (because first the application software is loaded first, and then the graphics are loaded), and this causes frustration for the subjects. Thus, these files should be called up to the screen using a faster procedure.

Improvements can be made to the product information sources to tailor them to a more specific audience. This can be done in two ways. First, instead of having generic newspaper articles, the articles could be from a particular newspaper or magazine, such as *Consumers Reports*, the *New York Times*, *Time* magazine, or the local newspaper. These sources all cover issues in different ways. The subjects would be drawn to those sources that they read in real-life,

and thus they would be more likely to obtain the type of product information from the simulator that they would obtain in real-life. Similarly, for the 'conversations with people' source, a short bio of each individual could be provided and then the subjects can choose to listen to the opinion of a particular type of person. By giving the subjects more specific information on the source of the information, they will better be able to select those sources that they would be likely to access in real life.

Another way that the sources should be improved is to provide a question and answer platform. This should be included in both the retail outlet (in which the subject can ask the salesperson specific questions) and the conversations source (in which the subject can ask people specific questions about their experiences). This platform can be made by either providing the subject with a list of questions to choose from, or by using artificial intelligence to decipher subject's questions by recognizing keywords. [Ozanne, 1988] This would involve substantial more programming to be done to the simulator, but would greatly improve the reality of the simulation.

Another problem with the market simulator is that the market environment is static, whereas a real market environment varies over time. Fully introducing dynamics into the market simulator is a difficult problem because it requires translating the time that the subject spends sitting in front of the computer into a real-life time-span, which may occur over days, months, or even years. There has been no work done in this area, and it is extremely difficult due to the number and sensitivity of influences. There are two possible methods of trying to get at this information, and both rely on comparing the information acquisition process that the subjects have experienced for products similar to

ATIS (such as cellular phones, faxes, microwaves, VCRs, etc.) with the search process that they are likely to undergo for ATIS. The first method is to simply ask the subject to think about similar information searches that they have made and make a guess at the time span over which their search on the market simulator would have taken place. The second method would be to model this time span using data from information searches for similar products. The model could assume poisson arrivals of information, and the parameter to estimate would be the average arrival rate of each source of information. This arrival rate would vary from inactive search to active search and from person to person.

Fully introducing dynamics is very difficult, and in fact is probably not necessary. However, there are two fairly simple ways in which the environment could be made more dynamic. The first is to vary the availability of advertisements of the different ATIS products based on a simple marketing plan. For example, earlier in information search on the simulator, when the product is relatively new, the consumer could be more likely to come across advertisements and newspaper articles in the inactive search phase. And perhaps these sources will not always be available later in the active search process. In addition, the probability with which the subject comes across advertisements and newspaper articles on each type of ATIS could be based on assumptions based on the size of the marketing campaign compared with other ATIS products.

The second way to introduce dynamics is to non-randomly select the conversations with people videos to reflect the comments that prior subjects make about the ATIS simulated on the environment. For example, if a survey



of the ten subjects that were a part of the pretest data collection phase (Chapter 5) resulted in 75% of these subjects having primarily positive things to say about the in-vehicle system, then subjects on the next simulator experiment should have a 75% chance of receiving positive information about the in vehicle system when they request a conversation video about the in-vehicle system. Similarly, if 15% of the prior subjects have the same complaint about one of the products, then there should be a similar chance that the future subjects hear this complaint. The more subjects that are used to base the content of future conversations sources, the more realistic the conversations source will be.

Another problem with the market simulator is that the subjects are given an option of learning about ATIS, or leaving the simulator. Thus, it would be valuable to simulate one or more non-ATIS products so that, as in real life, people can be exposed to a market of goods. This would particularly make the decision of whether to enter active search more realistic, since the consumer will have to choose the product on which to actively search for information. As the programming of the simulator becomes easier, this will mostly become a matter of creating the product information sources for the other product(s).

#### **6.2.2.2 Travel Simulator**

In the prototype simulator, the radio traffic reports and phone-based system are not simulated very realistically. The radio traffic reports simply state the location and expected duration of a randomly chosen accident that is currently on the network as the vehicle approaches each intersection. The phone-based system only reports on the traffic flow of one link (a segment of road connecting two adjacent intersections) at a time, and a new call must be made

to get information for each desired link. This traffic information is not as useful as the traffic information that the real sources provide, and thus biases the subjects away from such traveler information systems.

Besides ATIS, another source of information that people use to make their travel decisions is based on their knowledge of how certain observed or stated incidents impact traffic flow on the network. For example, if regular commuters see that the road that they are currently traveling on is more backed up than usual or they are told that one lane is blocked on a certain freeway, then they make deductions as to the conditions of traffic on the rest of the network. On the simulator, the subject cannot draw upon this intuition for two reasons. The first is that on the simulator, the traffic conditions on each link are calculated independently from the traffic conditions on all other links. Thus, a better traffic assignment model needs to be implemented. This would also have the advantage of requiring an origin-destination matrix as an input, which can be varied depending on the time of day at which the simulated trip is assumed to take place.

The second reason why the subject cannot use their intuition is because a hypothetical network is used. While this is useful to study how consumers will behave in areas of which they are unfamiliar, it is not reasonable to abstract this behavior to apply to trips on familiar networks. Thus, it is necessary to also code a real traffic network, or at least a simplification of one. In addition, no information is given as to the time of day at which each simulated trip takes place.

Another issue with the travel simulator is that currently only en-route travel decisions are made by the subject. However, traveler information systems have the potential to impact all travel decisions from destination choice, departure time choice, mode choice, and route-choice. Thus, these travel decisions should be incorporated into the travel simulator.

### **6.2.3 Improvements and Extensions to the Model**

The next step in the modeling phase of the research is to use the simulator to collect data to estimate the awareness and access model proposed in Chapter 3. While data may be obtained from the existing simulator to estimate the model, if the improvements to the simulator proposed in the last section are implemented then the accuracy with which the model predicts real behavior will improve. The forecasting ability of the model can also be improved by making adjustments to the structure of the model. These types of improvements will be discussed in the rest of this section.

The first issue is that the model architecture should be extended to incorporate the real-time over which the information acquisition spans. This can be done using the methods discussed in section 6.2.2.1. It is important to consider the time dimension so that the penetration curve, which tracks the percent of consumers who are using the product at any time in the life-cycle of the product, can be better understood. The rate of penetration and absolute penetration at any time impacts many different aspects of the market such as the marketing plan of the manufacturers and suppliers or the probability with which a consumer will hear about a user's experiences. Also, penetration forecasts need to take into account the probability with which consumers will become aware of the products existence. Models will have to be made based on

assumptions about the marketing plan and the penetration. These models can be estimated using data obtained from products similar to ATIS.

A problem with the model that was mentioned in Chapter 3 is that the model assumes that the information search comes to a definite end at which point an access decision is made. In reality, the consumer makes an access decision after acquiring each new piece of product information. A way of incorporating this is to use a dynamic choice model, in which the consumer makes an access decision after each acquisition of information and future decisions are dependent on past decisions. Each access decision would be based on the consumers' perceptions developed from acquiring information in their prior information search. A compromise would be to assume the model described in Chapter 3 is only applicable for the short term (say 1 year), and then it can be applied recursively to obtain long term forecasts.

One of the major advantages of the ATIS Market/Travel simulator is that it provides a wealth of data on all 5 stages of traveler response to ATIS. Thus, models that incorporate the travelers decisions beyond the awareness and access stages should be developed.

### **6.3 Conclusion**

In conclusion, the awareness and access model specified in this paper addresses the crucial product information search stage, which directly impacts the travelers' ATIS access decision. The simulator that was created to develop this model, the ATIS Market/Travel Simulator, provides us with data that is not attainable through any other data collection method. This will help us better understand the impact that ATIS will have on the traveler and on the transportation network. It will also help us understand the factors that influence traveler response to ATIS and the ways in which government, manufacturers, and other interest groups can influence the ATIS market. This will hopefully lead to the most efficient design and implementation of ATIS products and services.



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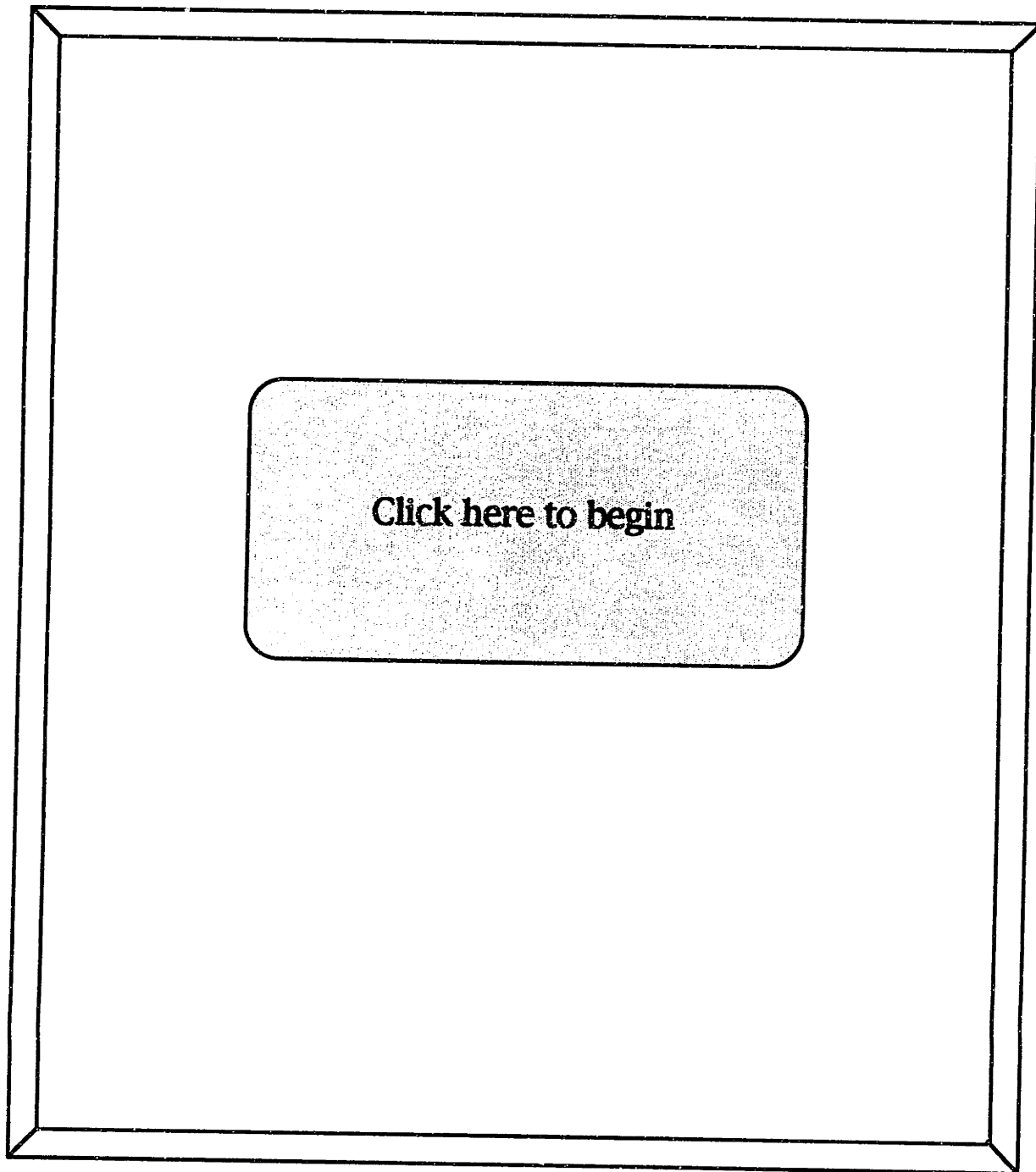
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# **Appendix A**

## **Screens From the Simulator**

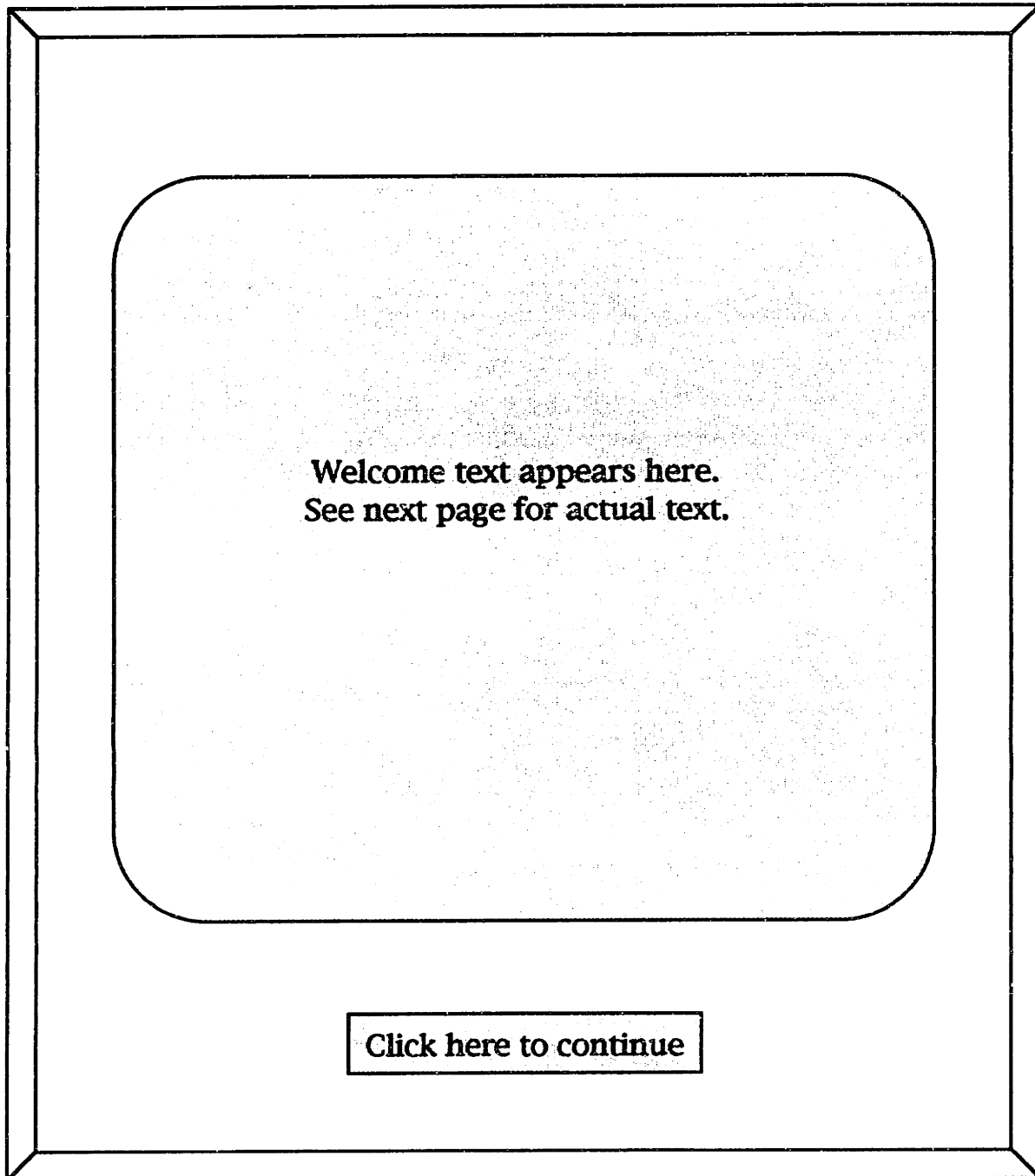




**Explanation of Screen:**

This is the first screen of the simulator. After a brief introduction by the attendant, the participant begins the simulator by clicking on the box.

**Screen 1  
Begin**



**Explanation of Screen:**

This screen briefly describes the project and what the participants will be doing.

**Screen 2  
Welcome Screen**

## **WELCOME TO THE MIT ADVANCED TRAVELER INFORMATION SYSTEM (ATIS) MARKET AND TRAVEL SIMULATOR**

The purpose of this simulator is to help us understand how consumers will respond to a new product (ATIS) so that we may better understand the impacts that such systems will have on overall traffic levels. (Throughout your time on the simulator, you will learn more about ATIS, so such descriptions will be saved until later.)

Your session on the simulator will proceed as follows:

1. You will be asked a series of questions about yourself, your travel characteristics, your experience with traffic information systems, and your attitudes and perceptions about travel information services.
2. You will then enter a market simulator that simulates a market environment for future traveler information products. In this simulator, you will be able to acquire information on these future products from various types of sources (Newspapers, Retail Outlets, etc.).
3. You will periodically be asked to fill out surveys about your perceptions and level of knowledge about the products on which you have obtained information.
4. Finally, you will enter a travel simulator, in which you will make a number of simulated automobile trips. On these trips, you will be able to decide which, if any, travel information systems you would like to use.

The simulator is mouse driven, except where otherwise specified. You will receive directions on how to proceed throughout the experiment. However, should you have problems or questions, please do not hesitate to call the attendant.

Welcome Text

Please answer the questions on "Survey A".  
The survey is in the manilla folder that was  
left with you by the attendant.

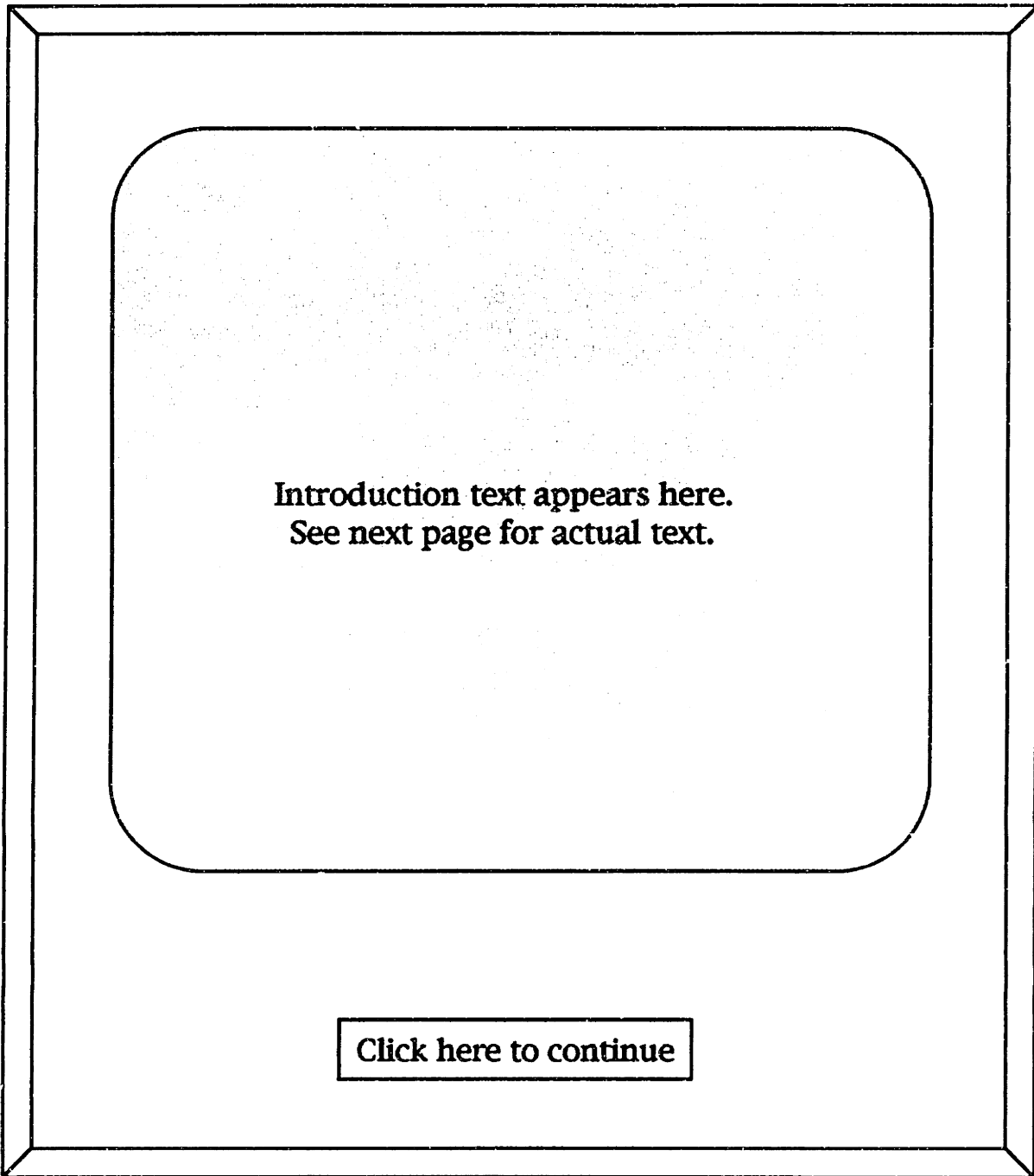
When you have answered all of the  
questions, please click on this box to  
continue.

**Explanation of Screen:**

The participant is presented with numerous questions in this "Pre-Simulator" survey. The purposes of the survey are to obtain information on the subjects personal characteristics, travel characteristics, and attitudes and to make the subjects think about their travel patterns and the transportation system. (See Appendix C for the actual survey that was administered.)

**Screen 3  
Pre-Simulator Survey**





**Explanation of Screen:**

The purposes of this text screen are to set the stage of the future date in which the simulator is set (the year 2000), and to explain what the subjects are expected to do on the market and travel simulator.

**Screen 4  
Introduction**

## **INTRODUCTION: TRANSPORTATION IN THE YEAR 2000**

Imagine the year 2000. What will transportation be like in Boston? At this time, the Central Artery/Third Harbor Tunnel project will be under construction. This is the largest public works project in the nation, and it will have an immense impact on the transportation system. Temporary mitigation measures will be implemented, but much of the current capacity in the downtown area will be temporarily lost. Thus, as you can probably imagine, congestion will be considerably worse than today.

However, new products and methods may be available to help ease the worsening congestion. What kind of technology do you think will be available to aid you in your travel? One product that is currently being developed and will be available in the year 2000 is called Advanced Traveler Information Systems (ATIS). These are systems that report both network and traffic conditions to you, the driver, in an effort to make your travel more efficient.

During your time on this computer, you will have the option of acquiring additional information about ATIS in a simulated market environment. You have as much time as you want to seek information about these products. Search for information about ATIS to the extent you would search for information about a product you are trying to evaluate. Keep in mind your travel patterns and needs, the benefits such a system would provide, and try to act as much as possible as if you are finding out about ATIS in a real market environment. As in a real market environment, you do not have to look at all of the sources, or, any of the sources. You should leave the computer search system when you feel you have searched enough about ATIS. You will also take several simulated automobile trips on the computer. For these trips, you will be allowed to use any of the ATIS that you have selected to purchase. However, only purchase an ATIS on the simulator if you believe you would purchase one in real life. You will have time to play with the simulator and try out the different ATIS after the data collection phase is completed.

Introduction Text

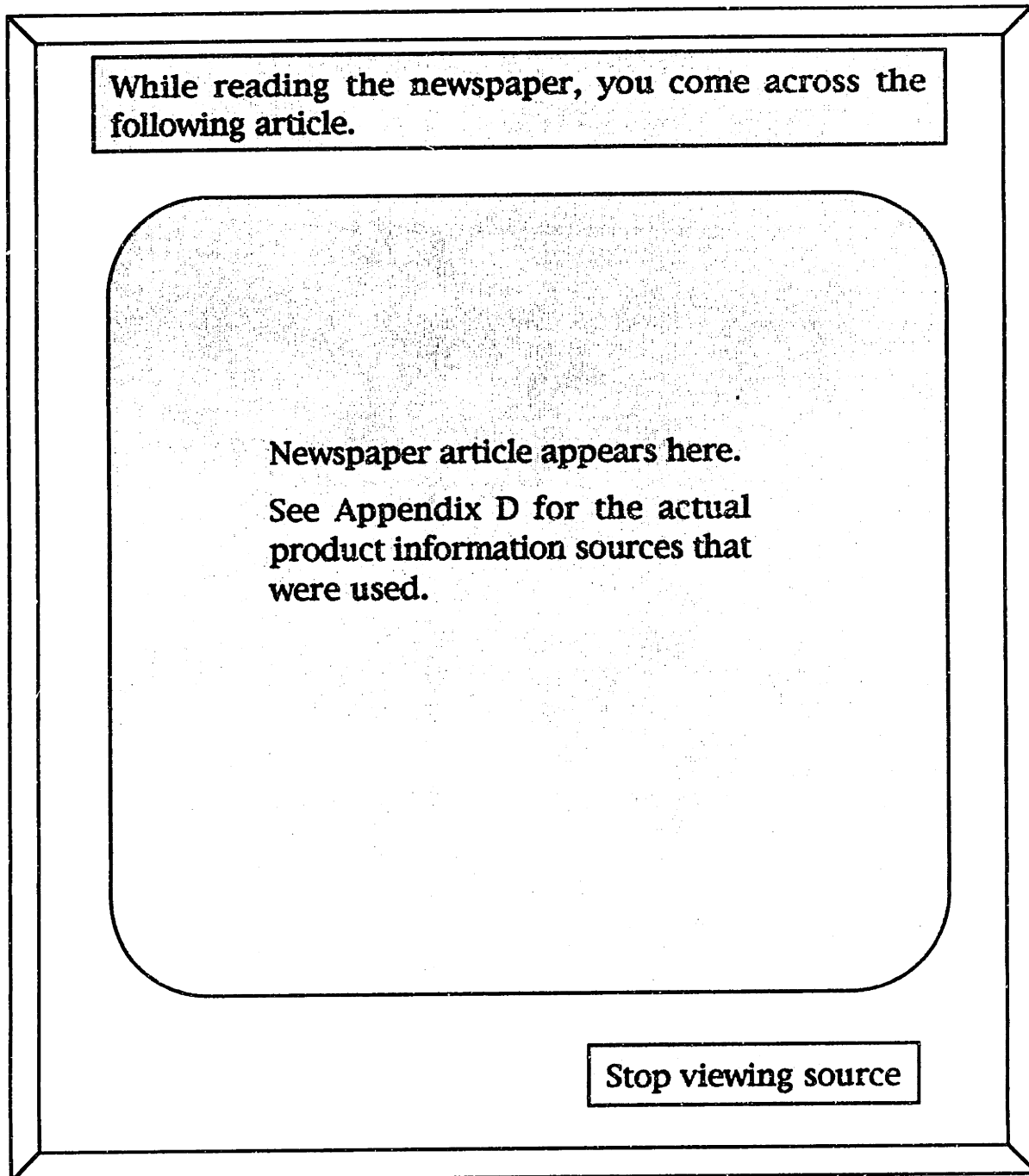
Are you interested enough in either the phone-based or the in-vehicle traveler information systems to actively pursue information on the products and services? That is, if you were in a market environment in which these products exist, do you think you would begin actively shopping for the product. For example, would you go to a retail outlet or seek out people who have had experience with such systems?

yes       no

**Explanation of Screen:**

This screen explains the inactive and active search stages, and inquires as to whether the participant wants to be in inactive search mode or active search mode. Their answer determines whether they start in the inactive mode or active mode of the market simulator.

**Screen 5  
Inactive Search or Active Search Question**



**Explanation of Screen:**

This is an example of an inactive search mode screen, which simulates a consumer passively acquiring information on a product. An information source is selected randomly by the computer (it is equally likely to be a newspaper article, a conversation with a person, or an advertisement), and shown to the participant on the computer screen. The participant decides how long to spend viewing the source.

**Screen 6  
Inactive Search Mode**

Are you interested in either the phone-based or the in-vehicle traveler information systems to actively pursue information on the products and services? That is, if you were in a market environment in which these products exist, do you think you would begin actively shopping for the product. For example, would you go to a retail outlet or seek out people who have had experience with such systems?

yes

no

**Explanation of Screen:**

After viewing the first source presented in the inactive search, participants are asked whether they would like to continue inactive search or enter active search. Thus, participants are forced to view at least two sources of information on ATIS, but they determine how much time to spend on each source. As long as they select to continue inactive search, information sources are selected by the computer by random and shown to the participant.

**Screen 7**

**Exit Inactive Search Mode: Question 1**

Are you interested in either the phone-based or the in-vehicle traveler information systems to actively pursue information on them? Or, are you disinterested in the products enough to stop obtaining product information?

- remain in inactive search
- enter active search
- stop obtaining information on ATIS

**Explanation of Screen:**

After viewing each inactively acquired information source beyond the second one, participants are asked whether they would like to continue inactive search, enter active search, or stop their information search all together. As long as they select to continue inactive search, information sources are selected by the computer by random and shown to the participant (as in Screen 6). If they select to end their information search, they will enter the travel simulator. If they select active search, they will enter active search (see Screen 10).

**Screen 8**

**Exit Inactive Search Mode: Question 2**

Please answer the questions on "Survey B". The survey is in the manilla folder that was left with you by the attendant. You may be asked to take this survey more than once, so do not be surprised if you have already taken it. Please begin with a new survey form each time you take the survey.

When you have answered all of the questions, please click here to continue.

**Explanation of Screen:**

Once the participant leaves the inactive search stage, they answer a survey about their perceived knowledge of ATIS products and services, their perceptions of ATIS, and their probability of purchase of such systems. (See Appendix C for the actual survey that was administered.)

**Screen 9  
Knowledge/Perceptions/Purchase Intent Survey 1**

## Main Menu of Active Search

The following are the sources of information available to you.  
Please either (1) click on the source you would like to use, or  
(2) click on the box end your information search.

Advertisements

Conversations  
With People

Newspaper  
Articles

Retail  
Outlet

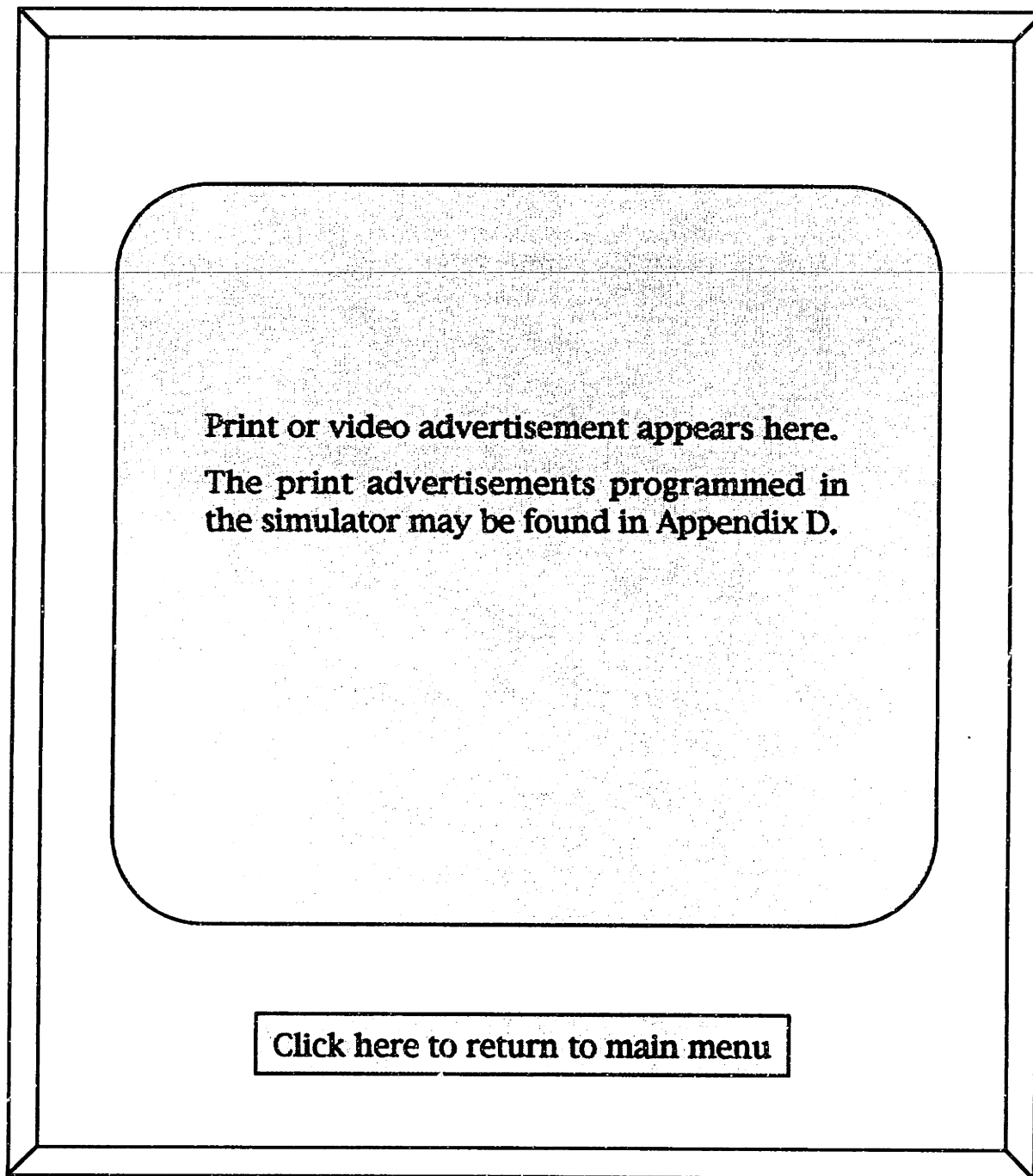
End Information Search

### Explanation of Screen:

Once participants enter the active search stage, they have more control over the types of sources they search, and the products on which they acquire information. On this screen, they may either choose an information source that they would like to search, or end their search and enter the travel simulator. After viewing each information source in active search, they are returned to this main menu.

Screen 10  
Active Search: Main Menu





**Explanation of Screen:**

If the participant selects "advertisement" from the Main Menu (screen 10), then the computer will randomly select either a print or television advertisement on one of the ATIS products to show on the screen. The participant can interrupt the television commercial at any time and return to the main menu.

**Screen 11  
Advertisement Screen**

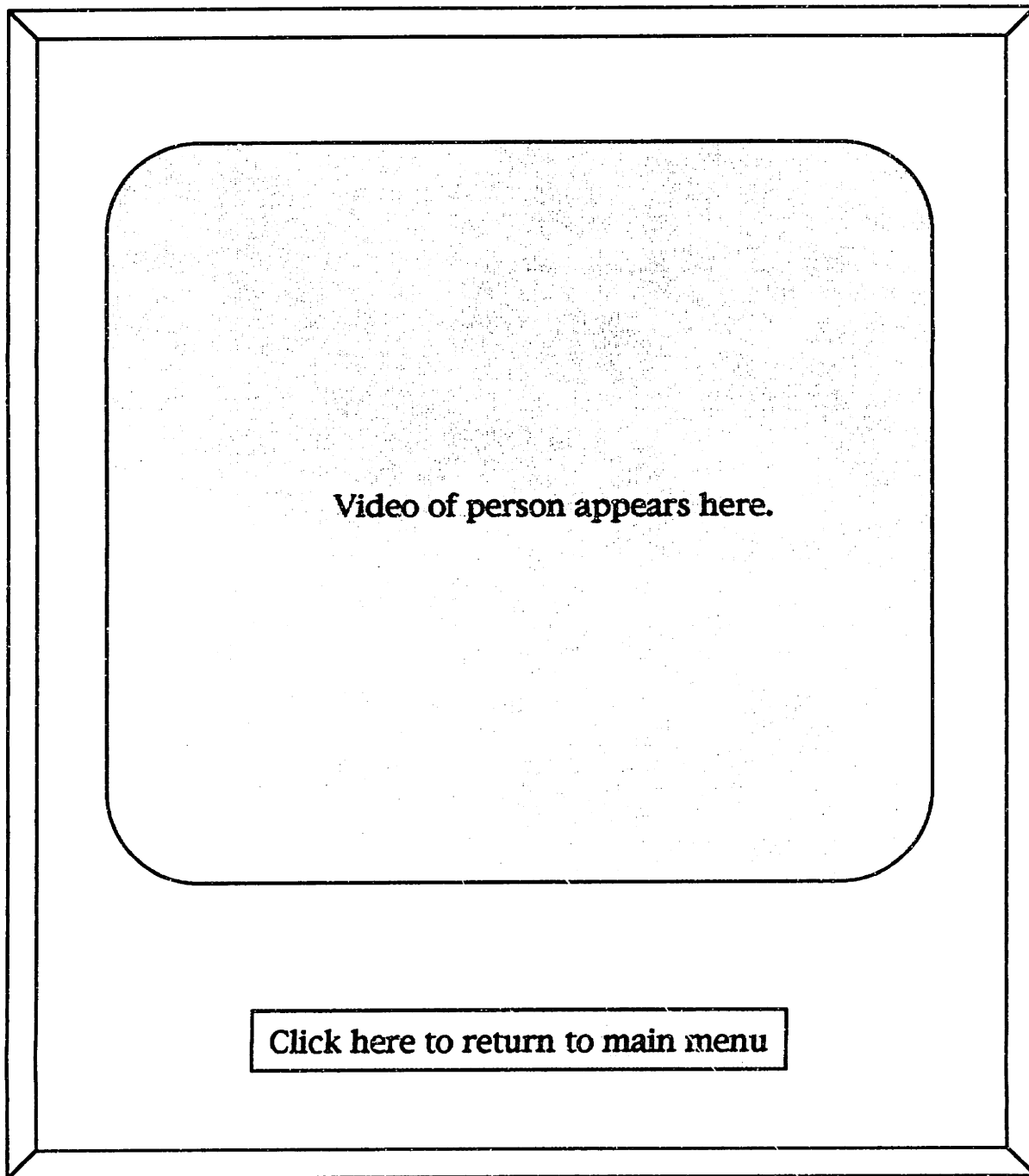
Please select the type of ATIS on which you would like to hear someone speak about:

<p>Phone-Based ATIS</p>	<p>In-Vehicle ATIS</p>
<p>Radio Traffic Reports</p>	<p>Any type of ATIS</p>

**Explanation of Screen:**

If the participant selects "conversations with people" from the Main Menu (Screen 10), then they are asked what system they would like to hear about. They are guaranteed to see a video of person speaking about the ATIS that they selected, but the information may be positive or negative, and the person on the video tape may also discuss other types of ATIS (positively or negatively).

**Screen 12  
Selecting Type of ATIS for "Conversations" Source**



**Explanation of Screen:**

After selecting "conversations with people" from the Main Menu (screen 10) and the type of ATIS (screen 12), a video of a person speaking about the selected ATIS (and perhaps others) appears on the screen. The participants may interrupt the video at any point and return to the Main Menu.

**Screen 13  
Conversations With People Screen**

Please select the type of ATIS on which you would like to read about:

**Phone-Based  
ATIS**

**In-Vehicle  
ATIS**

**All Types  
of ATIS**

**Any Type  
of ATIS**

**Explanation of Screen:**

If participants select "Newspaper Articles" from the Main Menu (screen 10), then they are asked what type of ATIS they would like to read about. They have a 75% chance of obtaining an article on their selected topic (since while looking for an article on one item, they may come across another item).

**Screen 14  
Selecting Type of ATIS for "Newspapers" Source**

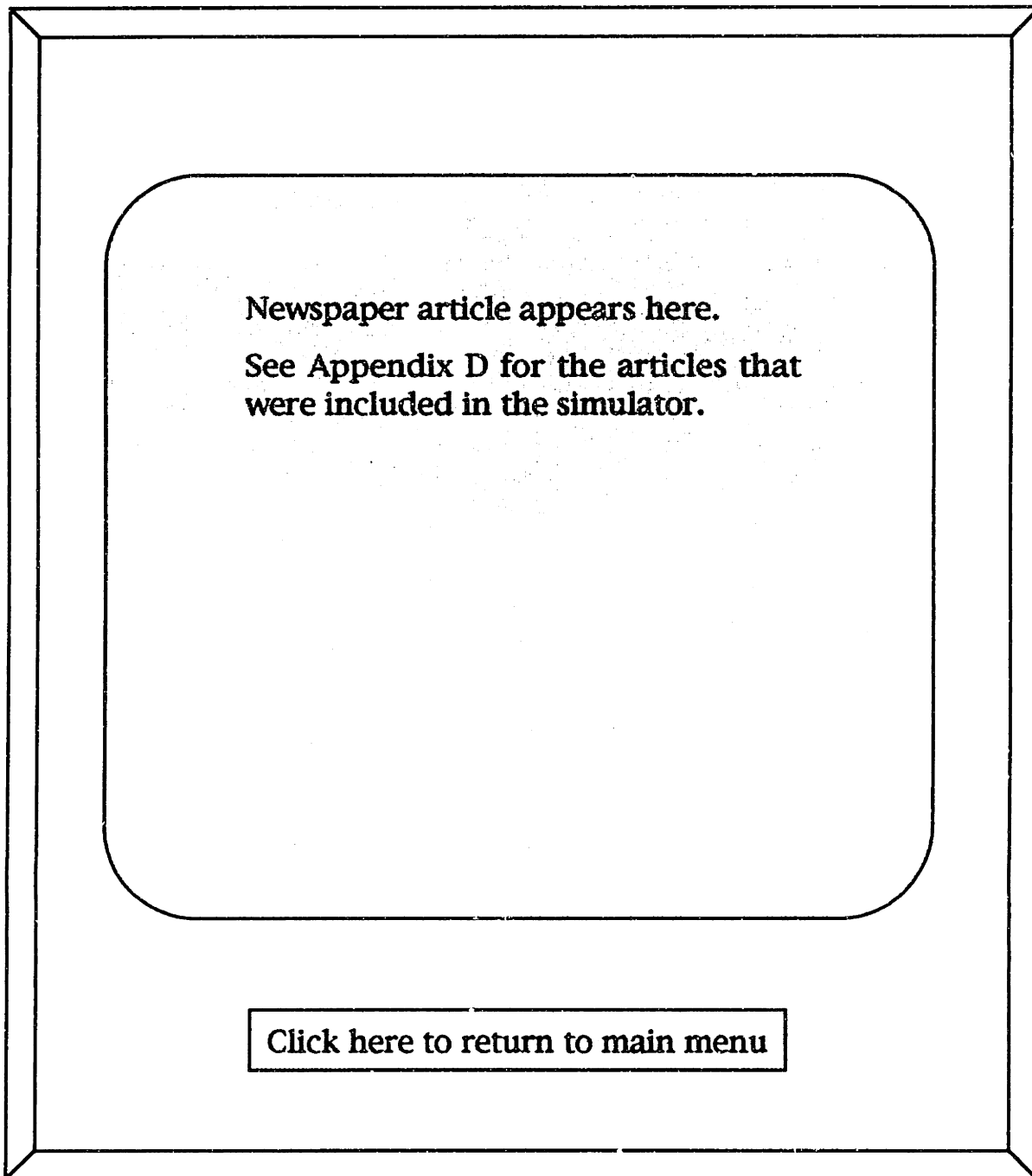
The exact article that you requested could not be found, but the following similar article was discovered.

[click here to continue](#)

**Explanation of Screen:**

The participant is not necessarily shown a newspaper article on the topic that they requested. If they are going to be shown something other than what they requested, then this screen appears.

**Screen 15  
Warning That Requested Topic Was Not Found**



**Explanation of Screen:**

After selecting "newspaper article" from the Main Menu (Screen 10) and selecting the type of ATIS (screen 14), then a newspaper article is shown on the screen.

**Screen 16  
Newspaper Screen**

In the retail outlet, you have the following sources available to you. Please select one by clicking on the box.

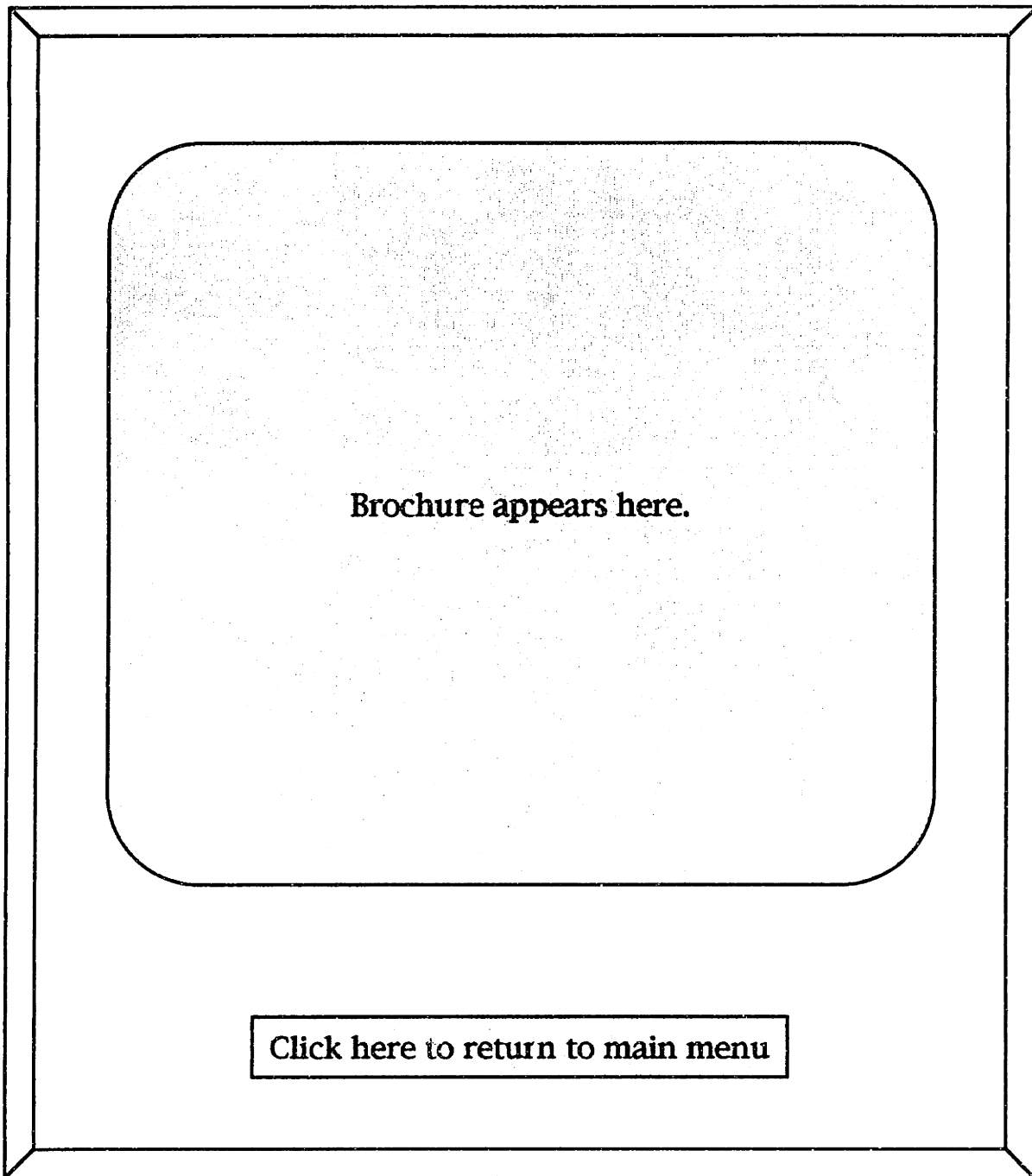
Brochure

Test Drive

**Explanation of Screen:**

If the participant selects the retail outlet from the main menu (screen 10), then they are given the option to either view a brochure or take a test drive. The retail outlet is only for the in-vehicle system, since the other systems (phone-based and radio) would not be sold in a retail outlet setting.

**Screen 17  
Retail Outlet Screen**



**Explanation of Screen:**

If the participant selects "brochure" from the retail outlet screen (screen 17), then a brochure on the in-vehicle system appears on the screen.

**Screen 18  
Brochure Screen**



In this test drive, you are able to take one automobile trip with the aid of the in-vehicle system. This trip will be simulated on the travel simulator.

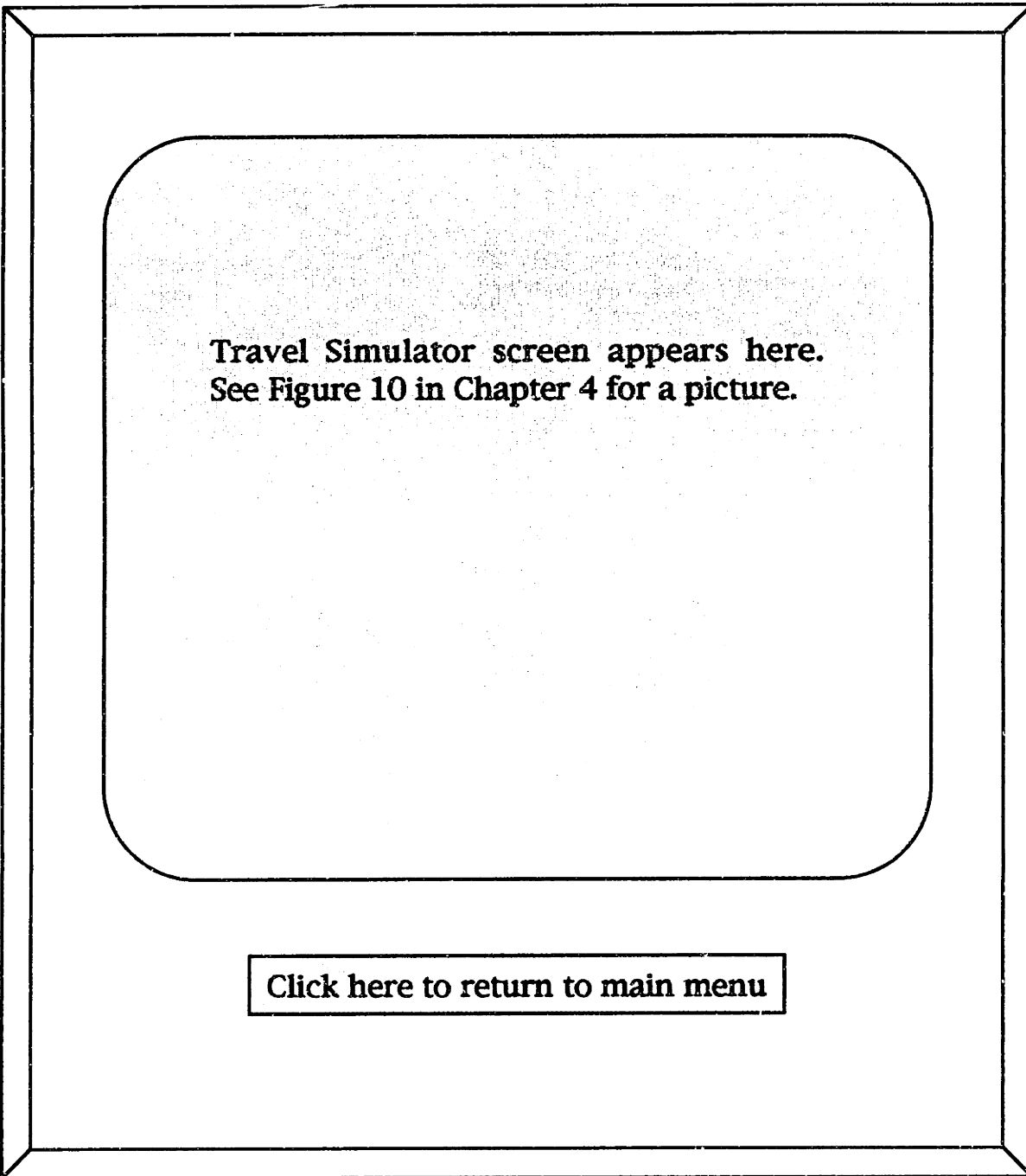
The administrator of the experiment should have already described the travel simulator to you in the introduction to the experiment. Briefly, at every junction you must press the number of the desired direction. The left graphic is a birds-eye view of your automobile traveling through the streets. The right graphic is an electronic map which shows your current location and your desired destination. You may select any desired ATIS from the menu (however, in this case, the in-vehicle system has already been selected for you). In the test drive, all ATIS are provided to you for free.

Should you have questions or problems, please don't hesitate to ask.

**Explanation of Screen:**

If participants select "test drive" from the retail outlet (screen 17), then they are transferred to the travel simulator. This screen explains the test drive to the participants.

**Screen 19  
Test Drive Screen 1**



**Explanation of Screen:**

The travel simulator interface appears on the computer once "test drive" is selected from the retail outlet. For the test drive, the in-vehicle system has already been "turned-on", and is available to the participant for free for one trip.

**Screen 20  
Test Drive Screen 2**

Your test drive is now complete. Reselect "test drive" from the Retail Outlet screen if you would like to take another test drive.

[Click here to return to Main Menu.](#)

**Explanation of Screen:**

The test drive consists of only one trip. Once the trip is completed, then this screen appears.

**Screen 21  
Test Drive Screen 3**

Please answer the questions on "Survey B". The survey is in the manilla folder that was left with you by the attendant. You may be asked to take this survey more than once, so do not be surprised if you have already taken it. Please begin with a new survey form each time you take the survey.

When you have answered all of the questions, please click here to continue.

**Explanation of Screen:**

Once the participant elects to end the information search, then they are again asked to fill out the perceptions, knowledge, and purchase intent questionnaire before entering the travel simulator. (See Appendix C for the actual survey that was administered.)

**Screen 22**  
**Knowledge/Perceptions/Purchase Intent Survey 2**

You are now going to enter the Travel Simulator. On the travel simulator, you are requested to make 8 trips with pre-assigned origins and destinations. Please try to imagine that you are making these trips in real life. The ATIS that were described in the market simulator are available for your use as you make these trips. However, remember that in real life, these systems may cost you, so please try to behave as you would in a real travel situation.

The administrator of the experiment should have already described the travel simulator to you in the introduction to the experiment. Briefly, at every junction you must press the number of the desired direction. The left graphic is a birds-eye view of your automobile traveling through the streets. The right graphic is an electronic map which shows your current location and your desired destination. You may select to purchase or use ATIS from the menu.

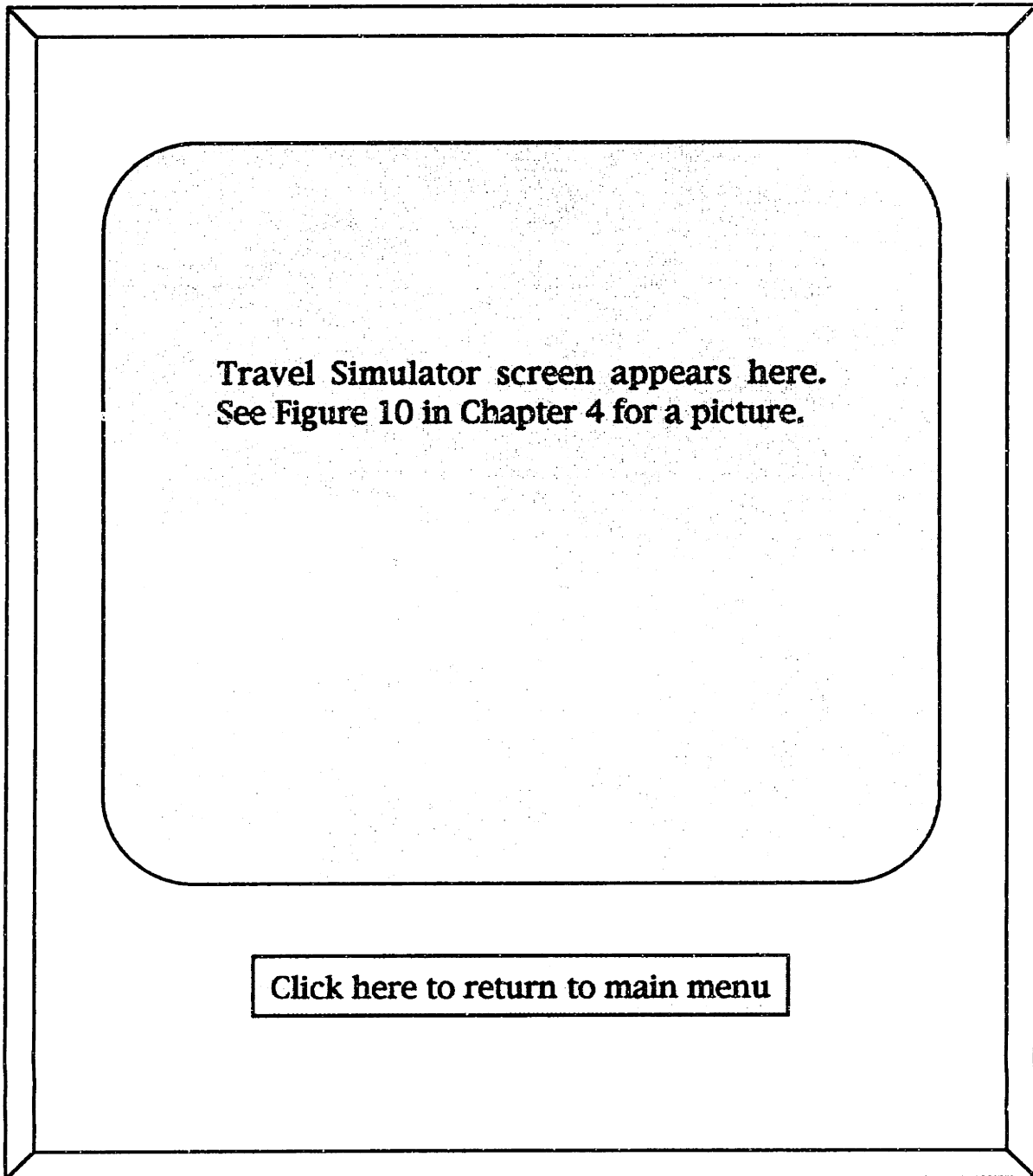
Should you have questions or problems, please don't hesitate to ask.

[Click here to begin your first trip.](#)

#### **Explanation of Screen:**

There is a brief written introduction to the travel simulator before the participant begins the trip. However, most of the explanation is done by the administrator of the experiment before the experiment begins.

### **Screen 23 Introduction to the Travel Simulator**



**Explanation of Screen:**

This is the interface of the travel simulator on which the participant will make several simulated automobile trips.

**Screen 24  
Travel Simulator**

You have just completed \_\_\_ of 8 trips. Do you want to:

continue with the next trip on the travel simulator,

or

return to the market simulator to obtain more information on ATIS products and services.

**Explanation of Screen:**

This screen appears after each trip (except the final trip) on the travel simulator is completed. After each trip, the participant has the option of continuing on to the next trip, or returning to the market simulator to obtain more information on ATIS. Should they return to the market simulator, they will return to the search mode (either active or inactive) that they were most recently in, and they will have to answer the Survey B again when they exit inactive or active search.

**Screen 25  
Post-Trip Question**

**You have completed all of the required trips on the travel simulator. As your last task, please fill out "Survey C".**

**Click here when you are finished, and call the administrator.**

**Thanks for your participation!**

**Explanation of Screen:**

When the participant has completed all trips on the travel simulator, this screen appears. They are asked to fill out the final survey, in which the perceptions, knowledge, and purchase intent questions are asked again, comments about ATIS (to be used for future Conversations With People sources) are requested, and comments about the simulator and the experiment are also requested.

**Screen 26  
Final Survey**



# Appendix B

## Information Items Provided to Participants

<b>Information Item</b>	<b>Page Number</b>
Phone-Based ATIS Print Advertisement 1 .....	167
Phone-Based ATIS Print Advertisement 2 .....	169
In-Vehicle ATIS Print Advertisement 1 .....	171
In-Vehicle ATIS Print Advertisement 2 .....	173
Phone-Based ATIS Newspaper Article 1 .....	175
Phone-Based ATIS Newspaper Article 2 .....	177
In-Vehicle ATIS Newspaper Article 1 .....	179
In-Vehicle ATIS Newspaper Article 2 .....	181
General ATIS Newspaper Article .....	183
In-Vehicle ATIS Retail Outlet Brochure .....	187
Content of Conversations With People Information Source .....	191





**Real time commuter information.  
Any route. Any time.**

**GET THE EDGE IN NEW ENGLAND TRAFFIC,  
WITH SMARTRAVELER TRAFFIC SERVICE.**

**Dial 374-1234 for up-to-the-minute traffic information  
(on ONLY the routes YOU'RE interested in)  
to help you around traffic jams.**

**NOW GET THE EDGE OVER TRAFFIC,  
24 HOURS A DAY, 7 DAYS A WEEK,  
ONLY 50 CENTS PER CALL.**





**IF YOU DON'T USE SMARTRAVELER NOW,  
DON'T WORRY,  
YOU'LL HAVE PLENTY OF TIME TO THINK IT OVER.**

"Boston traffic." With the possible exception of "root canal," is there a more horrifying pair of words? Well, to help ease your pain, we're pleased to introduce a new traffic hotline from SmarTraveler Systems. Using television cameras, traffic sensors, computers, and other sophisticated technological stuff, SmarTraveler Systems provides you with continuously updated information on traffic in and around Boston.

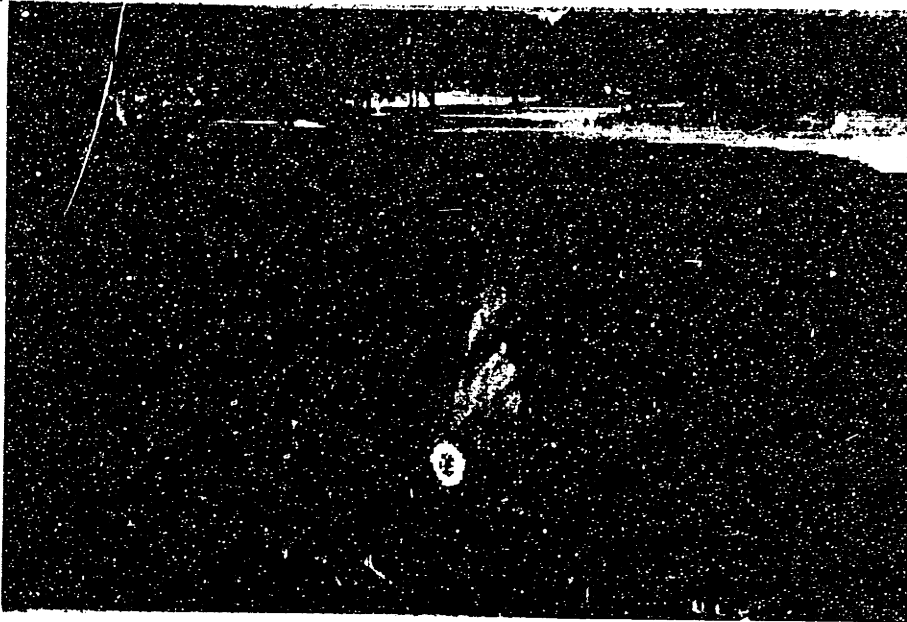
Access to the system is easy: you just dial 374-1234. Then YOU pick the routes on which you want to receive traffic information. Access is also cheap - only 50 cents per call.

***SmarTraveler***  
**SMARTRAVELER SYSTEMS**

**Real time commuter information.  
Any route. Any time.**



## **TravTek: In-Vehicle Navigation System**



**With  
TravTek,  
Wherever  
You Are,  
You Know  
Where  
You're  
Going,  
and What  
Obstacles  
are In Your  
Way.**

Traveling today can be a challenge. There is traffic congestion everywhere. Whether you are out on the town with friends, or conducting business as usual, there are times when having detailed information on the current traffic conditions would help you save time and aggravation. That's why you need TravTek, the word's most exciting electronic traveler information system. It will take the aggravating guesswork out of your travel decisions by giving you the information you need, when and where you need it.

Don't waste any more unnecessary time sitting in congestion or getting lost. Get TravTek.

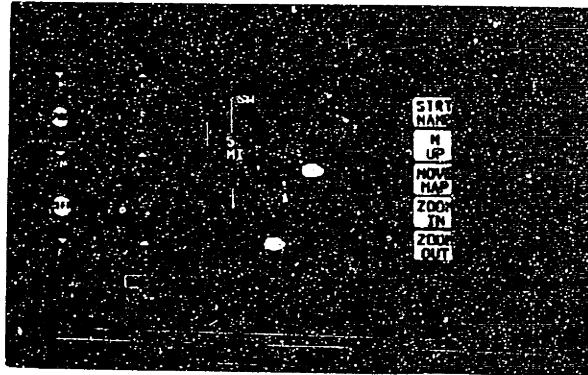
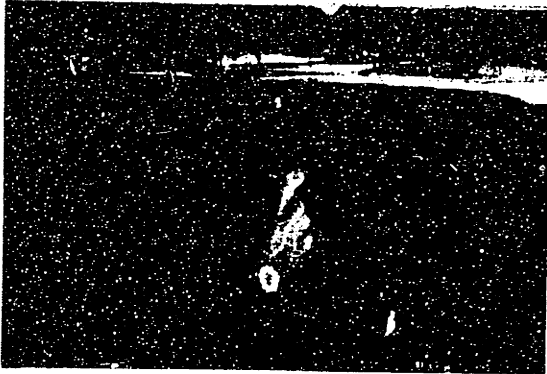






# TravTek

**Up-to-the-minute traffic information and more at your fingertips!**



## **Avoid Traffic Jams!**

You can't afford to waste time sitting in heavy traffic. With TravTek fitted to the dashboard of your car, you can see what's happening up ahead -- as it happens. And you are informed minute by minute of any changes.

A network of specially developed sensors relay signals back to the TravTek control center. These prevailing traffic conditions are then transmitted to your TravTek unit, giving you a bird's eye view of congestion on the area you are interested in, at the scale that you select. The unit can also suggest the shortest travel path to your destination, and guide you there with step by step instructions.

With up-to-the-minute personalized information, 24 hours a day, 365 days a year, TravTek gives you the opportunity to select an alternate route, departure time, mode, or destination to avoid congestion, saving valuable time and fuel.

**Call 1-800-TRAVTEK to find the TravTek Dealer nearest you.**





## SmarTraveler, Technology to Aid traffic Woes



*MISSION CONTROL - SmartRoutes Traffic Managers, Peter Sturgis, left, and David McPherson, seated, monitor Boston's traffic from their Cambridge office.*

It is a rather unassuming looking building in Cambridge, Massachusetts, and indeed looks like many of the other buildings in the city. But this one is special, for inside on the eighth floor some of the world's most advanced technology is being put to use everyday to help make life a little easier for all of us. The office is the headquarters for SmarTraveler, part of a project to increase commuter awareness.

One of the first things that one notices as you enter the office are the TV monitors. An entire wall full, showing all the

major access routes into and out of Boston, and approaches to the bridges over the Cape Cod Canal. SmarTraveler Systems uses live and slow-scan video cameras strategically located to provide an immense overview of traffic conditions. The next thing that catches your eye is the computers. Each data gathering station is equipped with a Macintosh PC. As incidents and traffic updates are reported, a huge data base is generated and updated many times throughout the day. Each traffic manager can then share the information or disseminate it to the proper source. Also all the video that comes in from the

cameras is processed through the computers. Another source of data collection are traffic sensors imbedded in the roadway throughout the Boston Metropolitan Area. Next, but certainly no less important, are the scanners and monitor radios. Bearcats, Motorola two-ways and some Radio Shack units round out the collection with more than 300 channels being scanned at any one time. All of the local public service agencies including police, fire departments and DPW frequencies, are monitored for significant activity.

---

"Basically, we are trying to get people to plan ahead, and not get on the road only to get stuck in traffic they didn't know about."

---

SmarTraveler is a local access, real time, on demand, location specific way for the general public to receive information about commuting in and around Boston. Commuters who would like to know for example if the commuter train out of Beverly is running on time or, if Route 128 in Woburn is jammed up, need only make a phone call which costs 50 cents and by using the touch tone pad on their phone can access information about almost any route they want. For example, if you call and punch 93\*1, you will hear up-to-date information for the stretch of Interstate 93, from Boston to Andover. If you are traveling between Boston and Plymouth on Route 3, all you have to do is call and punch in 32\*, to receive the latest information on Route 3. So what does this service cost? Nothing.

"Basically, we are trying to get people to plan ahead, before they leave, wherever they are, and not get on the road only to get stuck in traffic they didn't know about," said Peter Sturgis, traffic manager for SmarTraveler. Traffic tie-ups cause at least 50% of the congestion in Boston. Some tie-ups, such as road construction, are known well in-advance. However other tie-ups, such as accidents or breakdowns, cause major congestion and the location and duration cannot be predicted.

When any of these traffic related incidents occur, SmarTraveler swings into full operation. They quickly gather data on the road conditions from their numerous sources, and put the information on-line for the callers to retrieve.

Commuting in the Boston area is not going to become any easier in the coming years. However, with technology being used by SmarTraveler, commuting may be just a little bit easier.



**WON'T STEER YOU WRONG** - Eli Sherer, of SmartRoute Systems, helps create a call in commuter service with up-to-the minute information about major roadways near Boston.

---

## Phone Service Aids Boston Commuters

You're headed out the door on a typical weekday morning at rush hour. Suddenly, you're faced with the car commuter's dilemma: Which road should you take? The traffic gridlock could be anywhere. You need help and you need it fast. So, who ya gonna call? SmarTraveler!

This Boston area travel information service provides up-to-date traffic information by telephone to commuters all over eastern Massachusetts. Commuters need only dial the local number on a touch-tone telephone and, for 50 cents a call, they get instant information about all major Boston roadways as well as the city's commuter rail, bus, and subway systems.

"What is really profound and unique about this service is that traffic and

transit information is now available over the phone, not just over the radio," says David Stein, executive vice president of SmarTraveler.

To use the SmarTraveler service, commuters call the local telephone number and punch in a specific highway route. Besides up-to-date service, the system also includes "static" data such as ongoing construction projects and events that will slow traffic. The SmarTraveler system relies on several sources for traffic information, including live and slow-scan television cameras stationed along major highways, automobile detectors placed in the roadway, a team of commuters on contract who phone in traffic information regularly, airplanes, and radio and telephone contact with state highway and public safety agencies. Traffic data are then fed into the SmarTraveler's computers so that the information is continually updated.

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**"Traffic and transit information is now available over the phone, not just over the radio."**

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SmarTraveler company founder John Liebesny, together with Micrologic, Inc. of Watertown, Mass., developed the system's software. Mr. Liebesny, and electrical engineer, says he was inspired to design the service after enduring many grueling commutes in the Boston area. "The engineer in me said, 'There ought to be a better way.' It really came from that, a frustrated commuter."

Stressed-out commuters may indeed find the service useful, but some traffic experts are nevertheless doubtful: Will commuters actually bother calling in when they can listen to the radio and TV traffic broadcasts? But Mr. Stein likens SmarTraveler to call-in weather and time information, two services also available on radio and TV. "Forty-five million people in Greater Boston alone call time and weather over the course of the year," Stein says. "So the idea of calling for traffic is really like a pea in a pod. Time, weather, and traffic information really come together."

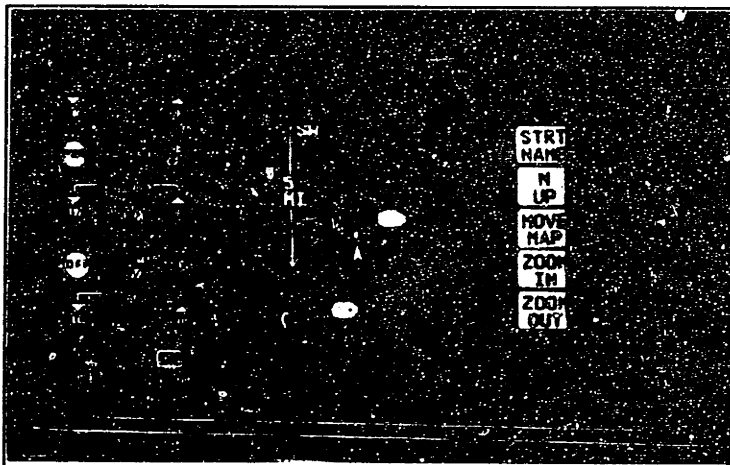
# WILL AUTOMATION REPLACE THE BACK SEAT DRIVER?

Many drivers when traveling in unfamiliar areas rely upon one of their passengers to read the maps and act as "navigator", providing directions when necessary, so that the driver can pay attention to driving. After all if you are simultaneously driving and struggling to read the map, the map will not tell you that the traffic signal ahead of you just turned red. So to make your life easier you designate a passenger as the "navigator", and all is well except that sometimes there is no passenger to navigate for you, or your navigator tries a short cut only to discover that the road is closed for construction. This problem is part of the reason that increasing numbers of drivers have turned to the use of a computerized navigator, such as the TravTek system.

The TravTek system consists of a small computer screen mounted on the dashboard of a car. The display can be programmed to show the best and quickest route to your destination, and unlike your

friend with the map it is always there and knows which roads are closed or congested before it suggests a shortcut. Much like your friend it talks to you and verbally tells you where to go as well as

printing directions and a map on the screen. Unlike your friend, if the voice ever bothers you it can be turned off at the touch of a button, letting you rely on the visual display.



*The TravTek electronic map provides information on vehicle location, traffic conditions, and step-by-step driving instructions.*

Before starting a trip you can ask the computer for directions to your destination, using the shortest or fastest route, or even asking it for the best route that does not involve paying tolls, since you forgot to bring any change. If you do not know where to go, the system can still help you by providing a directory of hotels, restaurants and other amenities or attractions in your area. In addition to being quite helpful on trips to new places from time to time, the TravTek system can also be used on your daily commute to suggest the least congested routes to get you to work on time so that you can grab that cup of coffee and get to your desk before your boss gets there.

The TravTek computer obtains all of its information from three sources. The first is a digital map that is stored on CD-ROM. A single disk is capable of storing a map of the entire United States road network. That one map can show you how to get from Boston to Boise Idaho, and once there will also show you that little street in the suburbs where your cousin lives. Such maps are updated continuously and are released several times a year, so you can always be up to date. Then in case you get lost while following the map, TravTek has a satellite receiver to tie into the global positioning system, and identify the exact location of your vehicle. So when you make that wrong turn in the middle of Iowa, the system will warn you before you end up lost in Arizona.

The third information source used by TravTek is the local area traffic information and monitoring system. Using a variety of methods such as permanently mounted video cameras, traffic detector loops in the pavement as well as aerial observation by helicopters and other aircraft, up to the minute traffic data is collected and compiled by a central facility in each metropolitan area, and then

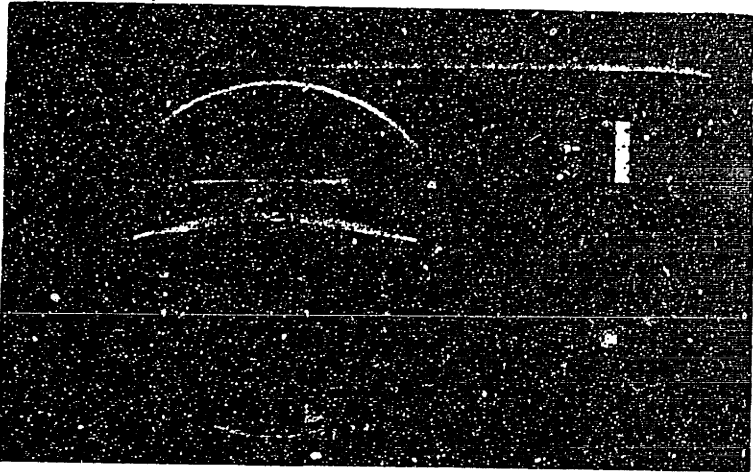
distributed via satellite link to individual vehicles equipped with the TravTek system. By using all of this information the system is able not only to get you to your destination, but to get you there quickly, by suggesting the shortest or most congestion free path to where you want to go.

So how do you get this automated back seat driver, which always gives the correct advice? For \$600 for the in-vehicle contraption and \$20 a month for the real-time traffic information, anyone can have it in their car. Some automobile manufacturers have begun to offer the system as an option on their vehicles and in a few cases, the system comes standard on pricier top of the line models. Some people question the need for such a system, after all you get to know most of the feasible short cuts on your route to work, and you also develop some sense of regular traffic congestion problems, and how to avoid them. So is it worth while to spend your hard earned dollars on another fancy device for your car if you do not really need it? Clearly with TravTek's success in the market place, some people think that the benefits of the system are worth the cost.



# High-Tech Travel Information

What do you add to a car after you've installed a CD player and a cellular telephone? A computerized navigation and traffic information system, of course! "TravTek", short for Travel Technology, puts extensive route guidance and travel information at drivers' finger tips.



*The TravTek system gives traffic and route guidance information to the driver via an on-board computer.*

TravTek's on-board computers give audio and visual instructions to drivers about current location, destinations, routes, prevailing traffic conditions, and drive times. The vehicle computers receive up-to-the-minute traffic reports, which are based on information from highway video cameras, traffic sensors, emergency vehicles, construction reports, and other sources of traffic information.

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**When a driver selects a destination, the TravTek system calculates the best route and provides driving instructions.**

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The information is displayed on a color video monitor in the car's dashboard. The display consists of a detailed electronic road map on a 5-inch color computer screen and can provide information on street names and current traffic conditions, the vehicle's location,

and the suggested route to the selected destination.

"What sets this system apart from other traffic information systems is the amount of detail of the traffic information, the control that the driver has over the information that is viewed, and the route-guidance capability", said Jeff Keltner, Vice President of TravTek.

TravTek exploits four familiar technologies: a computer runs it, a CD-ROM stores the maps and local information it needs, a satellite says where it is, and road sensors and other devices monitor traffic flows.

So, where do you get this contraption? It's sold for about \$600 by shops that sell car stereos and similar gear, and it is also sold as options on some new vehicles. Keep in mind though, that once you purchase the system, you still have to pay monthly subscription fees to receive the

up-to-the-minute traffic information. These subscriptions are about \$20 per month.

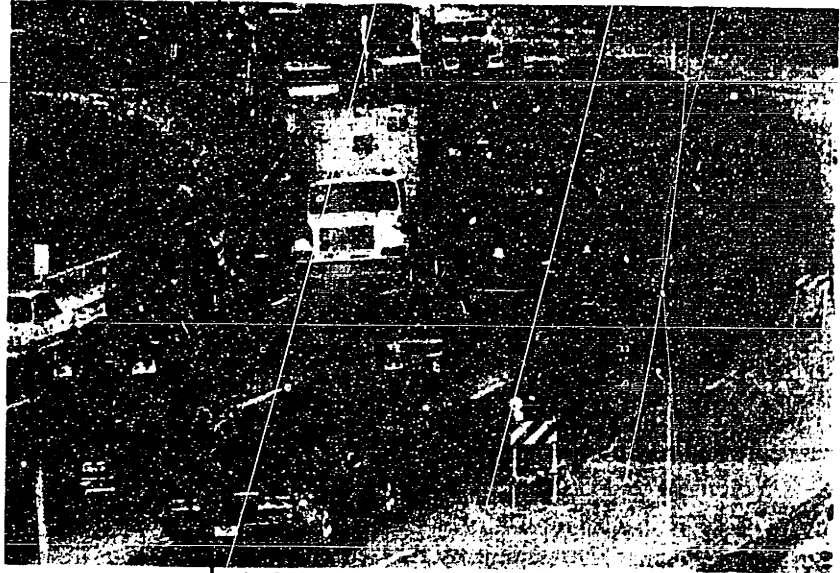
The manufacturers state that people with the TravTek system will be able to make their travel decisions more efficiently. In unfamiliar areas, the system will guide the driver to their destination. In areas which the driver is fairly familiar, knowing the prevailing traffic conditions will allow the driver to alter their destination, their route, their mode, or their travel time so as to spend the least amount of time in the car. "The system saves you time (by getting you to

your destination as quickly as possible), increases safety (since you know where the volatile traffic is), and saves you money that would otherwise be necessary for fuel. You'll be able to spend less time sitting in congestion and getting lost, and more time pursuing more productive and more fun activities," said Sue Chin, spokesperson for TravTek.

So how much time does this save you? It depends on your travel characteristics. Is it worth the price? It depends on the thickness of your pocketbook.

# FINDING TRAFFIC SOLUTIONS

Each year, some 135 million drivers spend about 2 billion hours trapped in traffic on America's highways. Another quarter-billion hours is spent by motorists getting lost. But, new technology could reduce traffic tie-ups, risks on the road, and the estimated \$46 billion a year American drivers lose to traffic delays, detours and wrong turns.



In light of this problem, new systems are springing up everywhere that are part of a group of products called "Advanced Traveler Information Systems", or ATIS. The goal of these systems is to report both network and traffic conditions to the driver, so that trip decisions can be made more efficiently.

There are many such systems on the market today. They range from the traditional traffic reports on television and radio, to a phone-based system in which people can call in and request up-to-the minute traffic information on particular routes, to a high-tech in-vehicle computer.

The most important attributes of the system that most consumers seem to be concerned with are the reliability or accuracy of the information, the relevancy of the information to their needs for travel

information (e.g. can they get information on the routes that they want, and is the information specific enough to them), and, of-course, the cost.

The reliability or accuracy of the traffic information is obviously an important factor of whether or not people will purchase such systems. However, the majority of the systems available today, from radio traffic reports, to the in-vehicle system, all use basically the same sources and level of technology for their information. Thus, all of the ATIS tend to have about the same level of accuracy. Data on the traffic conditions are collected through numerous sources, including vehicle sensing systems, surveillance cameras, mobile probes (i.e. drivers that report the conditions that they are experiencing), fixed-wing aircraft and helicopters, and communication with public agencies.

The sources for information vary over the traffic network, and thus their relative accuracy also varies. Once the high-tech, underground Central Artery is completed, it will have sensors every 200 feet that detect each vehicle that passes over them, and video cameras every 400 feet that are monitored by both computers and human personnel. Thus, the prevailing traffic conditions on these roads will be very accurate. There are also detectors and video cameras on the downtown city streets of Boston and on other highways, but they are not as frequent and their technology is a bit older. They also tend to be unreliable because they break down frequently and are difficult to repair. None-the-less, detailed information is known about these roads, but it is not as accurate as the Central Artery will be. Helicopters and fixed-wing aircraft are only used to collect traffic information during the morning and evening peak periods.

---

**The newer traveler information systems focus on providing more personalized, more on-call, and more detailed information to the driver.**

---

The primary difference between the different ATIS available today is the way that this information is conveyed to the driver, in terms of the level of detail and how personalized the information is to the specific driver's needs (relevancy) and cost.

As one would expect, the cost and relevancy vary inversely. The traditional radio and television traffic reports are free, but are only relevant to driver's who pass through major bottlenecks or travel on major highways during the morning and evening peak periods. Driver's also have to wait for the report to air on the radio. Radio/TV traffic reports also cannot provide navigation assistance, beyond information such as "there is a major accident on the Mass. Pike, it is advised that you take alternate routes."

The newer traveler information systems focus on providing more personalized (or relevant), more on-call, and more detailed information to the driver, but this comes at a price.

The Phone-based system, "SmarTraveler", is very much like a personalized, on-demand radio traffic report. At 50 cents a call, travelers can dial up the phone-service when they need information about the prevailing traffic conditions. They are then asked what routes they want information on, and are played a recording about traffic conditions on that route, including the location and severity of accidents and traffic congestion. In Boston, a traveler can get information on most major highways and arterials in the Boston Metropolitan area, including the following:

- Boston and Cambridge (including Downtown Area, Central Artery, Storrow Drive, Memorial Drive, and the Jamaica Way)

- Logan Airport and Approaches (including the Sumner and Calahan Tunnels)
- Mass Pike (Interstate 90)
- Routes 1, 2, 3, 9, 24, and 128
- Interstates 93, 95, and 495
- South-east Expressway
- Tobin Bridge
- To and From Cape Cod and The Islands

The advantage of the phone-based system is that it is available on demand, it provides a higher level of detail of traffic information than TV/radio reports, the traveler can select what information they want to hear (i.e. what routes), and it is fairly inexpensive (50 cents a call). Like the radio reports, the phone system does not provide much navigation advice.

The most advanced system is TravTek, an in-vehicle traveler information system. It is comprised of a micro-computer in the vehicle that shows the driver a detailed electronic map of the area, on which each road is color coded to represent the amount of traffic congestion on the link. This system also will calculate the shortest route to a selected destination based on prevailing traffic conditions. With the TravTek system, the driver is provided with the following information:

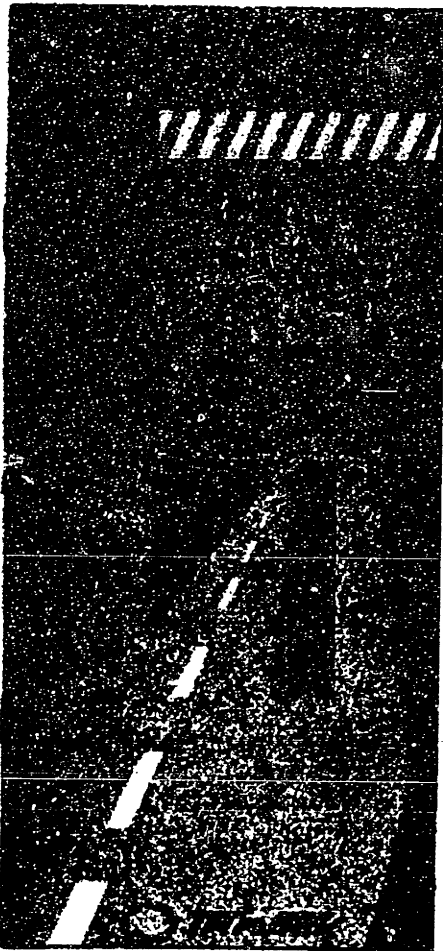
- Electronic map shown on 5-inch color display that includes all roads from small residential streets to major highways

- Location and description of traffic conditions (speed of traffic and location and severity of accidents) affecting the route and the surrounding area shown on electronic map, text, and audio
- Present vehicle location determined by Global Positioning System
- Step-by-step driving instructions to the chosen destination that take into account prevailing traffic conditions
- Information on parking locations and availability
- Yellow pages information database to businesses, attractions, and motorist services

The advantages of the TravTek system are the high level of detail of traffic information and the navigation ability. However, the major disadvantage is the cost. These systems now cost about \$600 for the in-vehicle equipment, and \$20/month for the subscription to receive the up-to-the-minute traffic information.

The traveler information system that is right for you depends on your personal and travel characteristics and the attributes of the product.





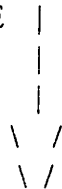
## **TravTek Offers a Solution to Your Traveling Problems**

Part of living in Boston, one of America's most congested cities, means having to deal with a lot of wasted time sitting in slow traffic. The delays often cause people to miss meetings, planes, and other events and, in general, cause aggravation. The bad news is that traffic congestion is getting worse. However, the good news is that with more detailed and accurate information about the current traffic information, you can save time and energy and piece-of-mind by choosing your travel patterns to spend the least possible time sitting in your car.

The TravTek Traveler Information System can provide such information. We are not talking about the level of travel information gained from listening to a radio or television traffic report. These conventional types of traffic information are not available on demand, and they concentrate on large bottlenecks and major thoroughfares, which may not be where you are driving.

The TravTek system is a micro computer that fits into your car with video screens and other technologies that combine to take the frustration out of driving. TravTek can give you detailed traffic information when you want it, and on the roads you want. In addition, drivers with TravTek in their cars can program their destination into the system, and the TravTek computer deftly routes the driver around accidents and congestion by providing the driver with step by step instructions to their destination. Information on restaurants, hotels, attractions, and emergency services, are also just a touch screen away. You'll know the exact current conditions, and how best to make the trips you want to make. Imagine taking the stress and uncertainty out of driving!

MORE ON THE NEXT PAGE



### TravTek Puts Drivers Miles Ahead

The key to TravTek's in-vehicle system is an on-board computer loaded with road network data covering all roads in the Boston Metropolitan Area (and many other areas of North America) and yellow page information. Traffic conditions are collected from a state-of-the-art surveillance system: roadway sensors, video cameras, traffic signal monitors, aircraft, and communication with public agencies. Thus, the system knows the prevailing traffic conditions on each road, and this information is transmitted to the driver directly.

TravTek provides you with the following travel information:

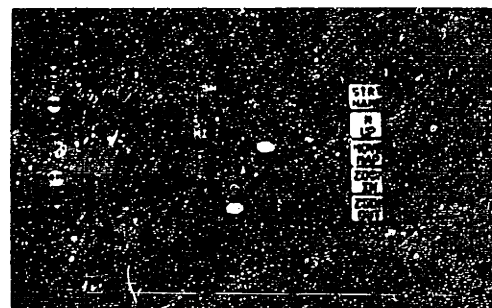
- ◆ Information on existing traffic conditions (traffic flow, traffic jams, accidents, detours, etc.) shown via color codes on the electronic map.
- ◆ Parking location and availability
- ◆ Your current location (shown on the electronic map)
- ◆ The best route to your chosen destination (highlighted on the electronic map)
- ◆ Step-by-step driving instructions to your destination (either visual or audio)
- ◆ Information on developing traffic situations that warrant a changing of route

- ◆ Yellow page listings of hotels, restaurants, businesses, etc.

With the traffic and route guidance information that TravTek provides you, you will:

- ◆ Reduce the travel time that you spend on the road
- ◆ Reduce fuel consumption, and thus save money and improve the environment
- ◆ Reduce your risk of being in traffic accidents because you will have prior knowledge of slowing or unstable traffic, and you will be able to avoid the most congested roads
- ◆ Reduce your level of stress and aggravation caused by driving in congestion and trying to guess the travel conditions on alternate routes

◆ Pictures of the TravTek System:





## Reasons to Get TravTek

**Loads of information:** Including traffic conditions, shortest route, yellow pages, parking locations and availability.

**Completeness of Information:** The TravTek system can give you the traffic conditions on almost all roads in the Boston Metropolitan area.

**Accurate Information:** Through its state of the art traffic surveillance system and numerous sources of traffic information, the TravTek system knows the prevailing traffic conditions almost exactly.

**Personalized Information:** You get the traffic information when you want it, and on what specific routes you want. No waiting, no scheduling, and no having to listen to irrelevant information.

**User-friendly:** The TravTek displays and input/output features were designed through comprehensive human factors tests.

**High speed:** Maps are retrieved and routes are selected in the blink of an eye.

**High Accuracy positioning:** Imagine always knowing exactly where you are!

**Superb picture quality on color view screen:** No squinting necessary!

**Completeness of maps available:** You can get maps for any area in the United States.

**Portability:** You can take the system inside so that you can get traffic information and directions even before you get in your car.

## Cost

There are two different costs for the system. The first is the investment of the micro-computer itself and data files of road networks and yellow pages. The cost for this is \$600. The second cost is the service fee for obtaining the current traffic information. This cost is \$20 per month. Is the cost worth it? Just ask TravTek users:

"I can't imagine what I did without it! It saves me time and aggravation on every trip I make."

-- Kristine Cornils,  
Environmental Engineer

"I thought I could read the traffic patterns on my commute perfectly just by looking out my window and listening to the radio traffic report. TravTek showed me how wrong I was. It shows me routes I never knew existed, and always sends me on the quickest path to my destination."

-- Arnold Montano,  
Financial Analyst

"I'm so happy to know that I will never have to fumble with a paper map while trying to stay on the road. TravTek may have saved my life."

-- Amy Wang, retired.





## Content of Conversations With People Information Sources

Number*	Radio/TV			Phone-based			In-Vehicle		
	Pos.	Neg.	Neutral	Pos.	Neg.	Neutral	Pos.	Neg.	Neutral
1	✓				✓				
2							✓		
3				✓					
4							✓		
5				✓					
6				✓					
7							✓		
8	✓							✓	
9	✓							✓	
10									✓
11			✓	✓					✓
12							✓		
13				✓					
14		✓							
15							✓		
16							✓		
17		✓					✓		
<b>Total</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>5</b>	<b>1</b>	<b>0</b>	<b>7</b>	<b>2</b>	<b>2</b>

\* Each number represents a different person's video.



# Appendix C

## Surveys

---

The following surveys were administered throughout the ATIS Market/Travel Simulator. For the time at which the surveys were administered in the Simulator, please see Chapter 4.





**For Questions 10 through 16, think about the typical automobile trip that you make most frequently, and answer the questions accordingly.**

10. What type of trip do you make most frequently?

- commute
- job-related, non-commute
- personal or household errands
- social
- other (please specify \_\_\_\_\_)

11. Think about the automobile trip you make most frequently. Assume "regular" traffic conditions, i.e. no extreme traffic delays, no major incidents, and no weather related problems. Under these conditions, how long does it usually take you to make this trip? Please enter a range such as 30-40 minutes.

( \_\_\_\_ ) - ( \_\_\_\_ ) minutes

12. How often does the travel time for this trip exceed the range you specified in question 12?

- never..... (0 times in 10)
- rarely..... (1-2 times in 10)
- occasionally... (3-4 times in 10)
- often..... (5-7 times in 10)
- very often..... (8-10 times in 10)

13. How often do you make this trip?

- very rarely..... (less than once a week)
- rarely..... (1-2 times a week)
- occasionally... (3-4 times a week)
- often..... (5-6 times a week)
- very often..... (more than 6 times a week)

14. How many alternative routes do you use to make this typical trip (the routes should be significantly different in that any two routes are at least a third different)?

- 1
- 2
- 3
- 4 or more

15. Approximately what time of day do you make this typical trip?

- 6:30 AM - 9:30 AM
- 9:31 AM - 3:59 PM
- 4:00 PM - 7:00 PM
- 7:01 PM - 11:00 AM
- 11:01 PM - 6:29 AM
- highly variable



16. How much flexibility do you have in terms of your arrival time at your destination for this typical trip?
- none
  - 1 - 15 minutes
  - 16 - 30 minutes
  - 31 - 60 minutes
  - more than 1 hour

**\*\*\* Your Prior Use of Traffic Information Systems \*\*\***

Unless otherwise specified, answer the following questions with ALL of your automobile trips (e.g. both work-trips and other trips) in mind.

17. How often do you use the following sources to acquire information on the road network or traffic conditions. Use the following scale:

- 1 = very rarely.... (less than once a month)
- 2 = rarely..... (once a month)
- 3 = occasionally.. (2-3 times a month)
- 4 = often..... (once a week)
- 5 = very often.... (more than once a week)

	very rarely..very often				
	1	2	3	4	5
a. road map	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b. TV traffic report	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c. radio traffic report	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d. phone-service	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e. other ( _____ )	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

18. If you use some of the sources mentioned in question 17, how often does this information influence/change your travel plans (for example, how often does this information change your decision to travel, trip destination, mode of transportation, departure time, or route).

- never..... (0 times in 10)
- rarely..... (1-2 times in 10)
- occasionally... (3-4 times in 10)
- often..... (5-7 times in 10)
- very often..... (8-10 times in 10)

19. How often do the prevailing traffic conditions that you see from your vehicle lead you to change your travel plans (i.e. without information from the sources listed in question 17).

- never..... (0 times in 10)
- rarely..... (1-2 times in 10)
- occasionally... (3-4 times in 10)
- often..... (5-7 times in 10)
- very often..... (8-10 times in 10)

20. Are you aware of a service in which travelers call a local telephone number and obtain information on prevailing traffic conditions for specific routes requested by the caller? Rate your level of knowledge of the phone-based service from 1 to 10, where 1 indicates that you have never heard of such a service, and 10 indicates that you are an expert about such services.

know nothing.....expert  
 1 2 3 4 5 6 7 8 9 10  
 ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( )

21. Knowing what you know now about the phone-based traffic information system, how likely would you be to use such a system?

- ( ) definitely would use ..... ( 100% )
- ( ) almost sure I would use ..... ( 90 - 99% )
- ( ) very probable I would use ..... ( 80 - 89% )
- ( ) probable I would use ..... ( 70 - 79% )
- ( ) good chance I would use ..... ( 60 - 69% )
- ( ) fairly good chance I would use ..... ( 50 - 59% )
- ( ) fair chance I would use ..... ( 40 - 49% )
- ( ) some chance I would use ..... ( 30 - 39% )
- ( ) slight chance I would use ..... ( 20 - 29% )
- ( ) very slight chance I would use ..... ( 10 - 19% )
- ( ) very, very slight chance I would use.. ( 1 - 9% )
- ( ) no chance I would use ..... ( 0% )

22. Are you aware of the existence and/or development of in-vehicle systems that provide person-specific traffic information and guidance to the driver? Rate your level of knowledge of the in-vehicle traffic information systems from 1 to 10, where 1 indicates that you have never heard of such a system, and 10 indicates that you are an expert about such systems.

know nothing.....expert  
 1 2 3 4 5 6 7 8 9 10  
 ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( )

23. Knowing what you know now about the in-vehicle navigation and traffic information system, what is the chance that you will purchase such a system?

- ( ) definitely would use ..... ( 100% )
- ( ) almost sure I would use ..... ( 90 - 99% )
- ( ) very probable I would use ..... ( 80 - 89% )
- ( ) probable I would use ..... ( 70 - 79% )
- ( ) good chance I would use ..... ( 60 - 69% )
- ( ) fairly good chance I would use ..... ( 50 - 59% )
- ( ) fair chance I would use ..... ( 40 - 49% )
- ( ) some chance I would use ..... ( 30 - 39% )
- ( ) slight chance I would use ..... ( 20 - 29% )
- ( ) very slight chance I would use ..... ( 10 - 19% )
- ( ) very, very slight chance I would use.. ( 1 - 9% )
- ( ) no chance I would use ..... ( 0% )

**\*\*\* Attitudes and Perceptions \*\*\***

24. On a scale of 1 to 5 (strongly disagree to strongly agree, respectively), indicate your level of agreement with the following statements by circling the appropriate number. Unless otherwise specified, consider **both** work-related and other trips:

	disagree.....agree				
I am very interested in obtaining more information on phone-based traffic information systems.	1	2	3	4	5
I am very interested in obtaining more information on in-vehicle traffic information systems.	1	2	3	4	5
I am very familiar with the road network in my city.	1	2	3	4	5
I like discovering new routes.	1	2	3	4	5
I always rely on habit when choosing my route.	1	2	3	4	5
Congestion is a major problem in my commute trips.	1	2	3	4	5
Congestion is a major problem in my non-commute trips.	1	2	3	4	5
Having traffic information beyond what I can see outside my car window would help me in my travel decisions.	1	2	3	4	5
Having traffic information beyond what I can see outside my car window would help me reduce my time spent traveling.	1	2	3	4	5
Having traffic information beyond what I can see outside my car window would reduce the stress of driving.	1	2	3	4	5
Having more accurate information about prevailing traffic conditions (beyond what is provided today) would greatly reduce my time spent traveling.	1	2	3	4	5
Having more detailed information about prevailing traffic conditions on the routes I drive (beyond what is provided today) would greatly reduce my time spent traveling.	1	2	3	4	5
I am willing to pay for better traffic information.	1	2	3	4	5
Radio traffic reports are relevant for my travels.	1	2	3	4	5
Radio traffic reports are reliable.	1	2	3	4	5
I trust my own judgment more than traffic reports.	1	2	3	4	5
I get impatient waiting for the radio traffic report to be broadcast.	1	2	3	4	5
Traffic information provided by radio is detailed enough for my travels.	1	2	3	4	5
I frequently have to drive in areas with which I am unfamiliar.	1	2	3	4	5
I often have trouble finding destinations in areas that are unfamiliar to me.	1	2	3	4	5
I do not like to stop and ask for directions.	1	2	3	4	5
Computerized route-guidance would greatly reduce the time I spend traveling in areas of which I am familiar.	1	2	3	4	5
Computerized route-guidance would greatly reduce the time I spend traveling in areas of which I am NOT familiar.	1	2	3	4	5
I am willing to pay for detailed directions to my destination.	1	2	3	4	5
I like learning about new products and/or new technologies.	1	2	3	4	5



## SURVEY B

1. Rate your level of knowledge of the phone-based service described in this simulator from 1 to 10, where 1 indicates that you have never heard of such a service, and 10 indicates that you are an expert about such services.

know nothing.....expert  
 1 2 3 4 5 6 7 8 9 10  
 ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( )

2. Knowing what you know now about the phone-based traffic information system, how likely would you be to use such a system?

( ) definitely would use ..... ( 100% )  
 ( ) almost sure I would use ..... ( 90 - 99% )  
 ( ) very probable I would use ..... ( 80 - 89% )  
 ( ) probable I would use ..... ( 70 - 79% )  
 ( ) good chance I would use ..... ( 60 - 69% )  
 ( ) fairly good chance I would use ..... ( 50 - 59% )  
 ( ) fair chance I would use ..... ( 40 - 49% )  
 ( ) some chance I would use ..... ( 30 - 39% )  
 ( ) slight chance I would use ..... ( 20 - 29% )  
 ( ) very slight chance I would use ..... ( 10 - 19% )  
 ( ) very, very slight chance I would use.. ( 1 - 9% )  
 ( ) no chance I would use ..... ( 0% )

3. Rate your level of knowledge of the in-vehicle navigation and traffic information system described in this simulator from 1 to 10, where 1 indicates that you have never heard of such a system, and 10 indicates that you are an expert about such systems.

know nothing.....expert  
 1 2 3 4 5 6 7 8 9 10  
 ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( )

4. Knowing what you know now about the in-vehicle navigation and traffic information system, what is the chance that you will purchase such a system?

( ) definitely would use ..... ( 100% )  
 ( ) almost sure I would use ..... ( 90 - 99% )  
 ( ) very probable I would use ..... ( 80 - 89% )  
 ( ) probable I would use ..... ( 70 - 79% )  
 ( ) good chance I would use ..... ( 60 - 69% )  
 ( ) fairly good chance I would use ..... ( 50 - 59% )  
 ( ) fair chance I would use ..... ( 40 - 49% )  
 ( ) some chance I would use ..... ( 30 - 39% )  
 ( ) slight chance I would use ..... ( 20 - 29% )  
 ( ) very slight chance I would use ..... ( 10 - 19% )  
 ( ) very, very slight chance I would use.. ( 1 - 9% )  
 ( ) no chance I would use ..... ( 0% )

5. On a scale of 1 to 5 (strongly disagree to strongly agree, respectively), indicate your level of agreement with the following statements by circling the appropriate number. Unless otherwise specified, consider **both** work-related and other trips:

	disagree.....agree				
I am very interested in obtaining more information on phone-based traffic information systems.	1	2	3	4	5
I am very interested in obtaining more information on in-vehicle traffic information systems.	1	2	3	4	5
Having traffic information beyond what I can see outside my car window would help me in my travel decisions.	1	2	3	4	5
Having traffic information beyond what I can see outside my car window would help me reduce my time spent traveling.	1	2	3	4	5
Having traffic information beyond what I can see outside my car window would reduce the stress of driving.	1	2	3	4	5
Having more accurate information about prevailing traffic conditions (beyond what is provided today) would greatly reduce my time spent traveling.	1	2	3	4	5
Having more detailed information about prevailing traffic conditions on the routes I drive (beyond what is provided today) would greatly reduce my time spent traveling.	1	2	3	4	5
I am willing to pay for better traffic information.	1	2	3	4	5
Radio traffic reports are relevant for my travels.	1	2	3	4	5
Traffic information provided by radio is detailed enough for my travels.	1	2	3	4	5
The phone-based system is useless if I don't have a car phone.	1	2	3	4	5
The phone-based system appears easy to use.	1	2	3	4	5
The traffic information provided by the phone-based system is detailed enough for my purpose.	1	2	3	4	5
I think having an in-vehicle ATIS in my car is fascinating.	1	2	3	4	5
Computerized route-guidance would greatly reduce the time I spend traveling in areas of which I am familiar.	1	2	3	4	5
Computerized route-guidance would greatly reduce the time I spend traveling in areas of which I am NOT familiar.	1	2	3	4	5
I am willing to pay for detailed directions to my destination.	1	2	3	4	5
The traffic information provided by the in-vehicle system is detailed enough for my purpose.	1	2	3	4	5
The traffic information provided by the in-vehicle system is overly detailed for my purpose.	1	2	3	4	5

## SURVEY C

1. Rate your level of knowledge of the phone-based service described in this simulator from 1 to 10, where 1 indicates that you have never heard of such a service, and 10 indicates that you are an expert about such services.

know nothing.....expert  
 1 2 3 4 5 6 7 8 9 10  
 ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( )

2. Knowing what you know now about the phone-based traffic information system, how likely would you be to use such a system?

( ) definitely would use ..... ( 100% )  
 ( ) almost sure I would use ..... ( 90 - 99% )  
 ( ) very probable I would use ..... ( 80 - 89% )  
 ( ) probable I would use ..... ( 70 - 79% )  
 ( ) good chance I would use ..... ( 60 - 69% )  
 ( ) fairly good chance I would use ..... ( 50 - 59% )  
 ( ) fair chance I would use ..... ( 40 - 49% )  
 ( ) some chance I would use ..... ( 30 - 39% )  
 ( ) slight chance I would use ..... ( 20 - 29% )  
 ( ) very slight chance I would use ..... ( 10 - 19% )  
 ( ) very, very slight chance I would use.. ( 1 - 9% )  
 ( ) no chance I would use ..... ( 0% )

3. Rate your level of knowledge of the in-vehicle navigation and traffic information system described in this simulator from 1 to 10, where 1 indicates that you have never heard of such a system, and 10 indicates that you are an expert about such systems.

know nothing.....expert  
 1 2 3 4 5 6 7 8 9 10  
 ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( )

4. Knowing what you know now about the in-vehicle navigation and traffic information system, what is the chance that you will purchase such a system?

( ) definitely would use ..... ( 100% )  
 ( ) almost sure I would use ..... ( 90 - 99% )  
 ( ) very probable I would use ..... ( 80 - 89% )  
 ( ) probable I would use ..... ( 70 - 79% )  
 ( ) good chance I would use ..... ( 60 - 69% )  
 ( ) fairly good chance I would use ..... ( 50 - 59% )  
 ( ) fair chance I would use ..... ( 40 - 49% )  
 ( ) some chance I would use ..... ( 30 - 39% )  
 ( ) slight chance I would use ..... ( 20 - 29% )  
 ( ) very slight chance I would use ..... ( 10 - 19% )  
 ( ) very, very slight chance I would use.. ( 1 - 9% )  
 ( ) no chance I would use ..... ( 0% )

5. How much would you be willing to pay per call to the phone-based traveler information system such as the one described in this market simulator?

\$ \_\_\_\_\_ per call

How much would you be willing to pay for unlimited use of the phone-based traveler information system for one month?

\$ \_\_\_\_\_ per month

6. How much would you be willing to pay for the in-vehicle traveler information system such as the one described in this market simulator (assume the real-time traffic information is free)?

\$ \_\_\_\_\_ per system

7. Think about your information search process for products that are currently in the market, such as faxes, computers, or VCRs. Compare the time span over which you acquired information on these existing products prior to making a purchase with the information search that you just completed on the simulator. Please make a rough guess at the time span that you think your search on the computer would have taken in real life:

Inactive Search: \_\_\_\_\_

Active Search: \_\_\_\_\_



8. On a scale of 1 to 5 (strongly disagree to strongly agree, respectively), indicate your level of agreement with the following statements by circling the appropriate number. Unless otherwise specified, consider **both** work-related and other trips:

	disagree.....agree				
I am very interested in obtaining more information on phone-based traffic information systems.	1	2	3	4	5
I am very interested in obtaining more information on in-vehicle traffic information systems.	1	2	3	4	5
Having traffic information beyond what I can see outside my car window would help me in my travel decisions.	1	2	3	4	5
Having traffic information beyond what I can see outside my car window would help me reduce my time spent traveling.	1	2	3	4	5
Having traffic information beyond what I can see outside my car window would reduce the stress of driving.	1	2	3	4	5
Having more accurate information about prevailing traffic conditions (beyond what is provided today) would greatly reduce my time spent traveling.	1	2	3	4	5
Having more detailed information about prevailing traffic conditions on the routes I drive (beyond what is provided today) would greatly reduce my time spent traveling.	1	2	3	4	5
I am willing to pay for better traffic information.	1	2	3	4	5
Radio traffic reports are relevant for my travels.	1	2	3	4	5
Traffic information provided by radio is detailed enough for my travels.	1	2	3	4	5
The phone-based system is useless if I don't have a car phone.	1	2	3	4	5
The phone-based system appears easy to use.	1	2	3	4	5
The traffic information provided by the phone-based system is detailed enough for my purpose.	1	2	3	4	5
I think having an in-vehicle ATIS in my car is fascinating.	1	2	3	4	5
Computerized route-guidance would greatly reduce the time I spend traveling in areas of which I am familiar.	1	2	3	4	5
Computerized route-guidance would greatly reduce the time I spend traveling in areas of which I am NOT familiar.	1	2	3	4	5
I am willing to pay for detailed directions to my destination.	1	2	3	4	5
The traffic information provided by the in-vehicle system is detailed enough for my purpose.	1	2	3	4	5
The traffic information provided by the in-vehicle system is overly detailed for my purpose.	1	2	3	4	5
The computer search system was easy to use.	1	2	3	4	5
The travel simulator was easy to use.	1	2	3	4	5
The overall search experience was realistic.	1	2	3	4	5
The information provided was realistic.	1	2	3	4	5
The experiment was too long.	1	2	3	4	5



## Appendix D

# Conversations With People Information Sheet

The following handout was given to and discussed with the students who volunteered to be used for the conversations with people information source. The purpose of the handout was to teach them about the products simulated on the market environment and help them develop their comments.

## Word-of-Mouth (WOM) Participant Information Sheet

### I. DEFINITION OF Advanced Traveler Information Systems (ATIS)

### II. GOAL OF RESEARCH PROJECT

### III. HOW WE ARE STUDYING MARKET POTENTIAL

### IV. WHAT I NEED YOUR HELP WITH

### V. PLAN FOR THIS EVENING

- (1) describe to you the ATIS products that will be available to participants on the simulator.
- (2) discuss how you can develop a character who has used ATIS, and discuss what you would say if someone asked you how you liked a system.
- (3) ask you to pretend that you are a user of ATIS (using your knowledge from 1 and 2 above), and to talk for a minute in front of a video camera about your travel patterns, what you think of ATIS, how you have used it, and how you have found it helpful or not.

### VI. ATIS PRODUCTS AVAILABLE ON THE SIMULATOR

#### TRADITIONAL

Road Map

Radio Traffic Report

#### "ADVANCED"

These systems have four main advantages over traditional traveler information systems:

- (1) Reliability - Technology is improving the accuracy with which we know the existing traffic conditions. Note that this will ALSO improve the traditional information systems (TV and radio traffic reports), because they will also have more reliable traffic information.
- (2) Customization - Advanced systems allow travelers to acquire traveler information that is relevant only to their specific trip, not on the entire network in general. TV and radio traffic reports tend to focus on major bottlenecks and major commute routes.
- (3) On-Call - Advanced systems allow travelers to acquire traffic information whenever they want. TV and radio traffic reports are available at given time intervals (with frequent reports during rush hours, and infrequent reports at other times of the day).
- (4) New Information - Future ATIS may also provide information that is not available in the traditional traveler information systems such as

travelers' present vehicle location, information on parking locations and availability, and yellow pages information databases to businesses, attractions, and motorist services.

Two versions of ATIS are offered on the Market Simulator:

Phone-Based ATIS - This is a service in which people can telephone a center and request information on current traffic conditions on specific routes (such as the *SmarTraveler* system in Boston). Traffic information (such as congestion levels, backups, and location and duration of accidents) can be obtained on all highways and major arterials (such as Storrow and Memorial Drives) in the metropolitan area. Information on major events or construction that may disrupt the regular pattern of traffic is also provided.

In-Vehicle System - The most advanced system on the simulator is an in-vehicle system. It is comprised of a micro-computer in the vehicle that shows the driver a detailed electronic map of the area, on which each road is color coded to represent the amount of traffic congestion on the link. This system also will calculate the shortest route to a selected destination based on prevailing traffic conditions. With the in-vehicle system, the traveler is provided with the following information:

- Electronic map shown on a 5-inch color display that includes all roads from small residential streets to major highways.
- Location and description of traffic conditions (speed, and location and severity of congestion and accidents) affecting the route and the surrounding area shown on electronic map, text, and audio.
- The vehicles present location determined by Global Positioning System.
- Step-by-step driving instruction to the entered destination that take into account prevailing traffic conditions.

#### SUMMARY OF ATIS AVAILABLE ON THE SIMULATOR

Traveler Information System	Cost		Traffic Information	
	Access	Usage	Customization	Reliability
Road Map	low	none	n/a	n/a
Radio Traffic Report	none	none	low	set by design of experiment
Phone-based	free	free to moderate	moderate	set by design of experiment
In-Vehicle - traffic information - route guidance	high	free to moderate	high	set by design of experiment

## **VII. HOW TO DEVELOP YOUR WORD-OF-MOUTH VIDEO**

### **1. Things to remember:**

- You need to ACT like you have used one of the ATIS products.
- The simulated environment is the year 2000.
- You do not necessarily have to act like yourself.

### **2. Think of your character's personal characteristics and how these may influence your character's perception to ATIS.**

### **3. Think of your character's travel patterns, and how these may influence your character's perceptions of ATIS.**

### **4. How would better traffic information and route guidance help?**

- SPEND LESS TIME IN TRANSIT

SAVE TIME by adjusting your travel plans according to the prevailing traffic conditions. After receiving information on current traffic conditions, a traveler may be able to change their travel plans and save time. They may decide to do any one or several of the following:

- not to travel at all
- change the the time of departure of their trip
- change the destination of their trip
- select a different mode of transportation
- select a different route

SAVE TIME by not making wrong turns or getting lost

- SAVE FUEL because of the driving time saved (save money, better for environment)
- REMOVING THE UNCERTAINTY AND STRESS FROM DRIVING because you don't have to guess the traffic conditions in the area based on incomplete information, such as what you see out of your car window and the reports on the radio.
- BETTER TRAFFIC INFORMATION MAY NOT HELP YOU AT ALL OR YOU MAY FEEL IT IS NOT WORTH THE PRICE

### **5. What ATIS product would you use? Under what conditions would you use ATIS? Why**

### **6. How does the ATIS product or service help? Not help?**

### **8. If friends asked you of your opinion on the ATIS product you have selected, what would you tell them? Would you recommend that they buy/use it? Why or why not?**

## **VIII. VIDEO TAPING**

# Appendix E

## Data Summary

## Summary of Information Search Data

	Ads	Conver- sations	Newspaper	Retail Outlet		Total Search Time (h:mm:ss)	Surveys	Travel Simulator	Total																																								
				Brochure	Test- Drive																																												
<b>Subject 1</b>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td colspan="10"><b>No. of sources viewed:</b></td> </tr> <tr> <td>- Inactive</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0:00:00</td> <td>-</td> <td>-</td> <td>-</td> </tr> <tr> <td>- Active</td> <td>1</td> <td>11</td> <td>7</td> <td>1</td> <td>2</td> <td>0:47:29</td> <td>-</td> <td>-</td> <td>-</td> </tr> <tr> <td><b>Time (h:mm:ss)</b></td> <td><b>0:02:21</b></td> <td><b>0:11:15</b></td> <td><b>0:19:44</b></td> <td><b>0:06:29</b></td> <td><b>0:04:11</b></td> <td><b>0:47:29</b></td> <td><b>0:26:49</b></td> <td><b>0:29:59</b></td> <td><b>1:48:48</b></td> </tr> </table>									<b>No. of sources viewed:</b>										- Inactive	0	0	0	0	0	0:00:00	-	-	-	- Active	1	11	7	1	2	0:47:29	-	-	-	<b>Time (h:mm:ss)</b>	<b>0:02:21</b>	<b>0:11:15</b>	<b>0:19:44</b>	<b>0:06:29</b>	<b>0:04:11</b>	<b>0:47:29</b>	<b>0:26:49</b>	<b>0:29:59</b>	<b>1:48:48</b>
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<b>Subject 2</b>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td colspan="10"><b>No. of sources viewed:</b></td> </tr> <tr> <td>- Inactive</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0:00:00</td> <td>-</td> <td>-</td> <td>-</td> </tr> <tr> <td>- Active</td> <td>0</td> <td>1</td> <td>0</td> <td>1</td> <td>0</td> <td>0:02:31</td> <td>-</td> <td>-</td> <td>-</td> </tr> <tr> <td><b>Time (h:mm:ss)</b></td> <td><b>0:00:00</b></td> <td><b>0:01:24</b></td> <td><b>0:00:00</b></td> <td><b>0:00:49</b></td> <td><b>0:00:00</b></td> <td><b>0:02:31</b></td> <td><b>0:23:38</b></td> <td><b>0:22:07</b></td> <td><b>0:50:10</b></td> </tr> </table>									<b>No. of sources viewed:</b>										- Inactive	0	0	0	0	0	0:00:00	-	-	-	- Active	0	1	0	1	0	0:02:31	-	-	-	<b>Time (h:mm:ss)</b>	<b>0:00:00</b>	<b>0:01:24</b>	<b>0:00:00</b>	<b>0:00:49</b>	<b>0:00:00</b>	<b>0:02:31</b>	<b>0:23:38</b>	<b>0:22:07</b>	<b>0:50:10</b>
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- Active	0	1	0	1	0	0:02:31	-	-	-																																								
<b>Time (h:mm:ss)</b>	<b>0:00:00</b>	<b>0:01:24</b>	<b>0:00:00</b>	<b>0:00:49</b>	<b>0:00:00</b>	<b>0:02:31</b>	<b>0:23:38</b>	<b>0:22:07</b>	<b>0:50:10</b>																																								
<b>Subject 3</b>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td colspan="10"><b>No. of sources viewed:</b></td> </tr> <tr> <td>- Inactive</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0:00:00</td> <td>-</td> <td>-</td> <td>-</td> </tr> <tr> <td>- Active</td> <td>2</td> <td>4</td> <td>3</td> <td>0</td> <td>0</td> <td>0:08:47</td> <td>-</td> <td>-</td> <td>-</td> </tr> <tr> <td><b>Time (h:mm:ss)</b></td> <td><b>0:01:19</b></td> <td><b>0:03:20</b></td> <td><b>0:03:25</b></td> <td><b>0:00:00</b></td> <td><b>0:00:00</b></td> <td><b>0:08:47</b></td> <td><b>0:18:23</b></td> <td><b>0:30:39</b></td> <td><b>1:04:21</b></td> </tr> </table>									<b>No. of sources viewed:</b>										- Inactive	0	0	0	0	0	0:00:00	-	-	-	- Active	2	4	3	0	0	0:08:47	-	-	-	<b>Time (h:mm:ss)</b>	<b>0:01:19</b>	<b>0:03:20</b>	<b>0:03:25</b>	<b>0:00:00</b>	<b>0:00:00</b>	<b>0:08:47</b>	<b>0:18:23</b>	<b>0:30:39</b>	<b>1:04:21</b>
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- Active	2	4	3	0	0	0:08:47	-	-	-																																								
<b>Time (h:mm:ss)</b>	<b>0:01:19</b>	<b>0:03:20</b>	<b>0:03:25</b>	<b>0:00:00</b>	<b>0:00:00</b>	<b>0:08:47</b>	<b>0:18:23</b>	<b>0:30:39</b>	<b>1:04:21</b>																																								
<b>Subject 4</b>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td colspan="10"><b>No. of sources viewed:</b></td> </tr> <tr> <td>- Inactive</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0:00:00</td> <td>-</td> <td>-</td> <td>-</td> </tr> <tr> <td>- Active</td> <td>0</td> <td>5</td> <td>0</td> <td>1</td> <td>1</td> <td>0:11:32</td> <td>-</td> <td>-</td> <td>-</td> </tr> <tr> <td><b>Time (h:mm:ss)</b></td> <td><b>0:00:00</b></td> <td><b>0:04:11</b></td> <td><b>0:00:00</b></td> <td><b>0:03:27</b></td> <td><b>0:02:56</b></td> <td><b>0:11:32</b></td> <td><b>0:23:09</b></td> <td><b>0:18:39</b></td> <td><b>0:53:15</b></td> </tr> </table>									<b>No. of sources viewed:</b>										- Inactive	0	0	0	0	0	0:00:00	-	-	-	- Active	0	5	0	1	1	0:11:32	-	-	-	<b>Time (h:mm:ss)</b>	<b>0:00:00</b>	<b>0:04:11</b>	<b>0:00:00</b>	<b>0:03:27</b>	<b>0:02:56</b>	<b>0:11:32</b>	<b>0:23:09</b>	<b>0:18:39</b>	<b>0:53:15</b>
<b>No. of sources viewed:</b>																																																	
- Inactive	0	0	0	0	0	0:00:00	-	-	-																																								
- Active	0	5	0	1	1	0:11:32	-	-	-																																								
<b>Time (h:mm:ss)</b>	<b>0:00:00</b>	<b>0:04:11</b>	<b>0:00:00</b>	<b>0:03:27</b>	<b>0:02:56</b>	<b>0:11:32</b>	<b>0:23:09</b>	<b>0:18:39</b>	<b>0:53:15</b>																																								
<b>Subject 5</b>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td colspan="10"><b>No. of sources viewed:</b></td> </tr> <tr> <td>- Inactive</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0:00:00</td> <td>-</td> <td>-</td> <td>-</td> </tr> <tr> <td>- Active</td> <td>1</td> <td>4</td> <td>1</td> <td>1</td> <td>1</td> <td>0:11:44</td> <td>-</td> <td>-</td> <td>-</td> </tr> <tr> <td><b>Time (h:mm:ss)</b></td> <td><b>0:01:10</b></td> <td><b>0:03:20</b></td> <td><b>0:03:20</b></td> <td><b>0:00:40</b></td> <td><b>0:02:24</b></td> <td><b>0:11:44</b></td> <td><b>0:11:31</b></td> <td><b>0:21:55</b></td> <td><b>0:45:08</b></td> </tr> </table>									<b>No. of sources viewed:</b>										- Inactive	0	0	0	0	0	0:00:00	-	-	-	- Active	1	4	1	1	1	0:11:44	-	-	-	<b>Time (h:mm:ss)</b>	<b>0:01:10</b>	<b>0:03:20</b>	<b>0:03:20</b>	<b>0:00:40</b>	<b>0:02:24</b>	<b>0:11:44</b>	<b>0:11:31</b>	<b>0:21:55</b>	<b>0:45:08</b>
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- Active	1	4	1	1	1	0:11:44	-	-	-																																								
<b>Time (h:mm:ss)</b>	<b>0:01:10</b>	<b>0:03:20</b>	<b>0:03:20</b>	<b>0:00:40</b>	<b>0:02:24</b>	<b>0:11:44</b>	<b>0:11:31</b>	<b>0:21:55</b>	<b>0:45:08</b>																																								
<b>Subject 6</b>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td colspan="10"><b>No. of sources viewed:</b></td> </tr> <tr> <td>- Inactive</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0:00:00</td> <td>-</td> <td>-</td> <td>-</td> </tr> <tr> <td>- Active</td> <td>1</td> <td>2</td> <td>0</td> <td>1</td> <td>1</td> <td>0:11:46</td> <td>-</td> <td>-</td> <td>-</td> </tr> <tr> <td><b>Time (h:mm:ss)</b></td> <td><b>0:00:54</b></td> <td><b>0:02:07</b></td> <td><b>0:00:00</b></td> <td><b>0:04:26</b></td> <td><b>0:02:58</b></td> <td><b>0:11:46</b></td> <td><b>0:18:06</b></td> <td><b>0:12:30</b></td> <td><b>0:47:17</b></td> </tr> </table>									<b>No. of sources viewed:</b>										- Inactive	0	0	0	0	0	0:00:00	-	-	-	- Active	1	2	0	1	1	0:11:46	-	-	-	<b>Time (h:mm:ss)</b>	<b>0:00:54</b>	<b>0:02:07</b>	<b>0:00:00</b>	<b>0:04:26</b>	<b>0:02:58</b>	<b>0:11:46</b>	<b>0:18:06</b>	<b>0:12:30</b>	<b>0:47:17</b>
<b>No. of sources viewed:</b>																																																	
- Inactive	0	0	0	0	0	0:00:00	-	-	-																																								
- Active	1	2	0	1	1	0:11:46	-	-	-																																								
<b>Time (h:mm:ss)</b>	<b>0:00:54</b>	<b>0:02:07</b>	<b>0:00:00</b>	<b>0:04:26</b>	<b>0:02:58</b>	<b>0:11:46</b>	<b>0:18:06</b>	<b>0:12:30</b>	<b>0:47:17</b>																																								



## Summary of Information Search Data (Continued)

	Ads	Conver- sations	Newspaper	Retail Outlet		Total Search (h:mm:ss)	Surveys	Travel Simulator	Total
				Brochure	Test- Drive				
<b>Subject 7</b>									
No. of sources viewed:	0	0	0	0	0	0:00:00	-	-	-
- Inactive	1	5	3	0	1	0:13:13	-	-	-
- Active									
Time (h:mm:ss)	0:01:51	0:03:29	0:04:03	0:00:00	0:02:57	0:13:13	0:26:21	0:28:16	1:11:34
<b>Subject 8</b>									
No. of sources viewed:	0	0	0	0	0	0:00:00	-	-	-
- Inactive	0	0	0	1	0	0:02:24	-	-	-
- Active									
Time (h:mm:ss)	0:00:00	0:00:00	0:00:00	0:02:00	0:00:00	0:02:24	0:21:59	0:15:06	0:45:02
<b>Subject 9</b>									
No. of sources viewed:	0	0	0	0	0	0:00:00	-	-	-
- Inactive	1	5	4	1	0	0:11:12	-	-	-
- Active									
Time (h:mm:ss)	0:00:38	0:02:58	0:02:17	0:02:13	0:00:00	0:11:12	0:11:17	0:13:36	0:42:57
<b>Subject 10</b>									
No. of sources viewed:	1	2	2	0	0	0:14:38	-	-	-
- Inactive	0	1	0	0	0	0:02:23	-	-	-
- Active									
Time (h:mm:ss)	0:01:03	0:03:02	0:11:25	0:00:00	0:00:00	0:17:01	0:12:19	0:17:45	0:47:56

### AVERAGE OVER THE TEN SUBJECTS

No. of sources viewed:	0.1	0.2	0.2	0.0	0.0	0:01:28	-	-	-
- Inactive	0.7	3.8	1.8	0.7	0.6	0:12:18	-	-	-
- Active									
Time (h:mm:ss)	0:00:56	0:03:31	0:04:25	0:02:00	0:01:33	0:13:46	0:19:21	0:21:03	0:57:39



## **Explanation of Figures on Pages 216-219**

The subjects were surveyed several times throughout the experiment:

Pre-Simulator: Before the subject has entered the Market Simulator.

Pre-Travel Simulator: After the subject has been in the Market Simulator, but just prior to entering the Travel Simulator for the first time.

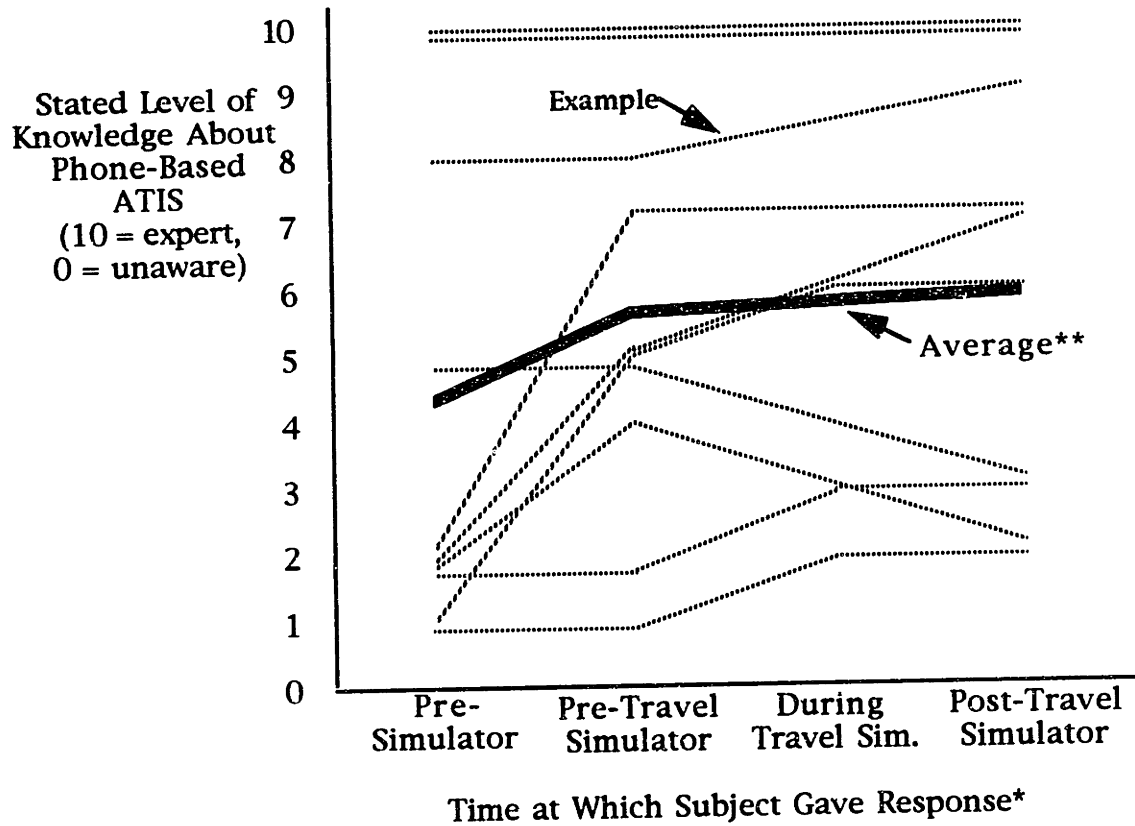
During Travel Simulator: Just prior to re-entering the Travel Simulator after leaving the Travel Simulator to obtain additional product information from the Market Simulator.

Post Travel Simulator: After the subject is done with the product information search and the required eight trips on the Travel Simulator.

Each of the ten lines on the following four graphs (not including the one thick line on each graph) represents the progression of one subject's level of knowledge about or stated probability of purchase of a particular ATIS. For example, the line marked "example" on Figure #, shows that this particular subject initially stated that he had a level 8 knowledge about the the phone-based ATIS, and remained at level 8 after his first period in the Market Simulator (prior to his first trip on the Travel Simulator). This subject chose not to return to the Market Simulator for more product information throughout the 8 required trips on the Travel Simulator, and he felt he had progressed to a level 9 knowledge after completing all the trips on the travel simulator.

To see the wording of the questions that were given to the subjects, see the surveys in Appendix C.

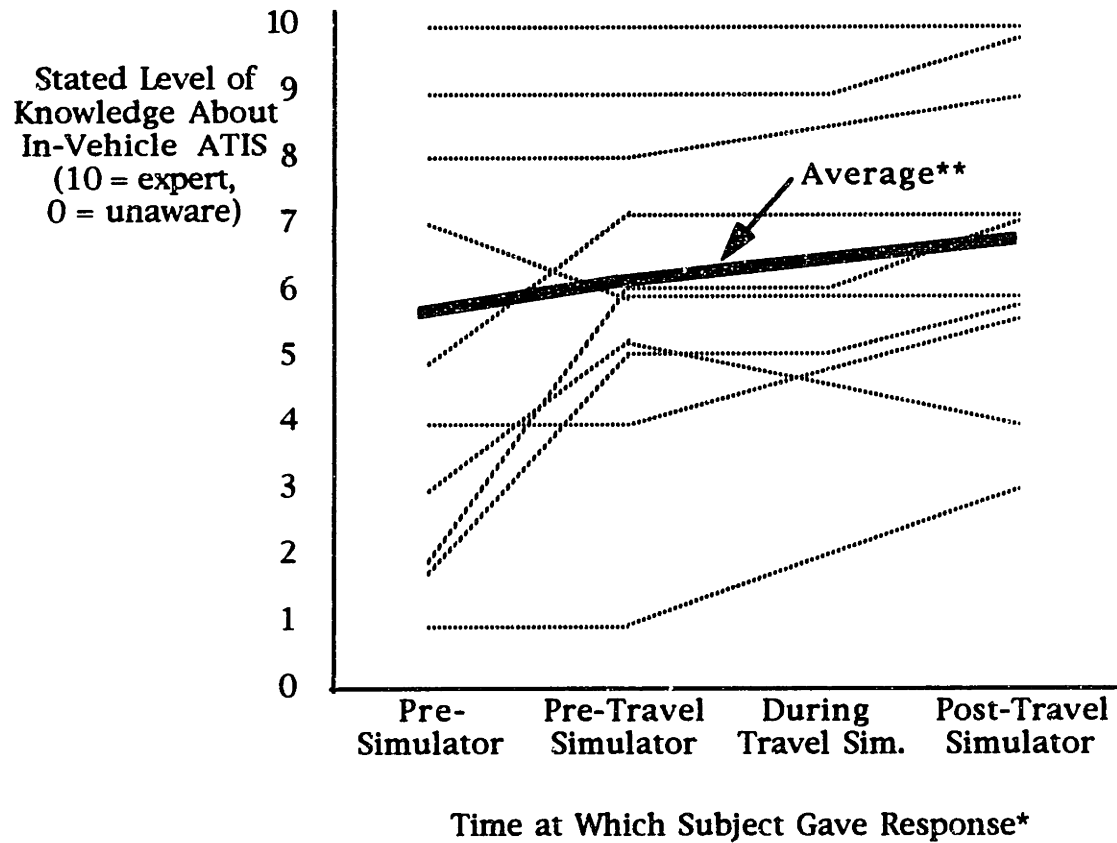
## **Explanation of Pages 216-219**



\* For an explanation, see Page 215

\*\* The average was not taken for the third stage ('during travel simulator') because only 4 people answered this survey.

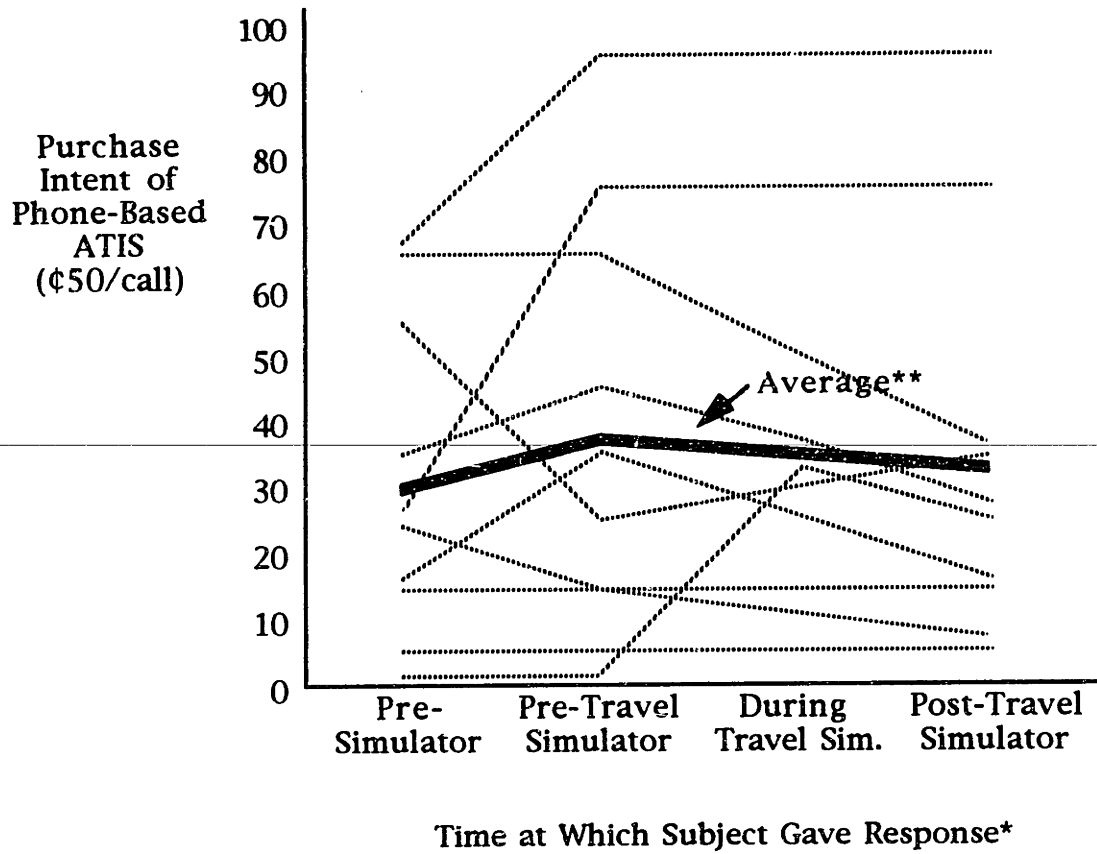
### Progression of Level of Knowledge of Phone-Based ATIS



\* For an explanation, see Page 215.

\*\* The average was not taken for the third stage ('during travel simulator') because only 4 people answered this survey.

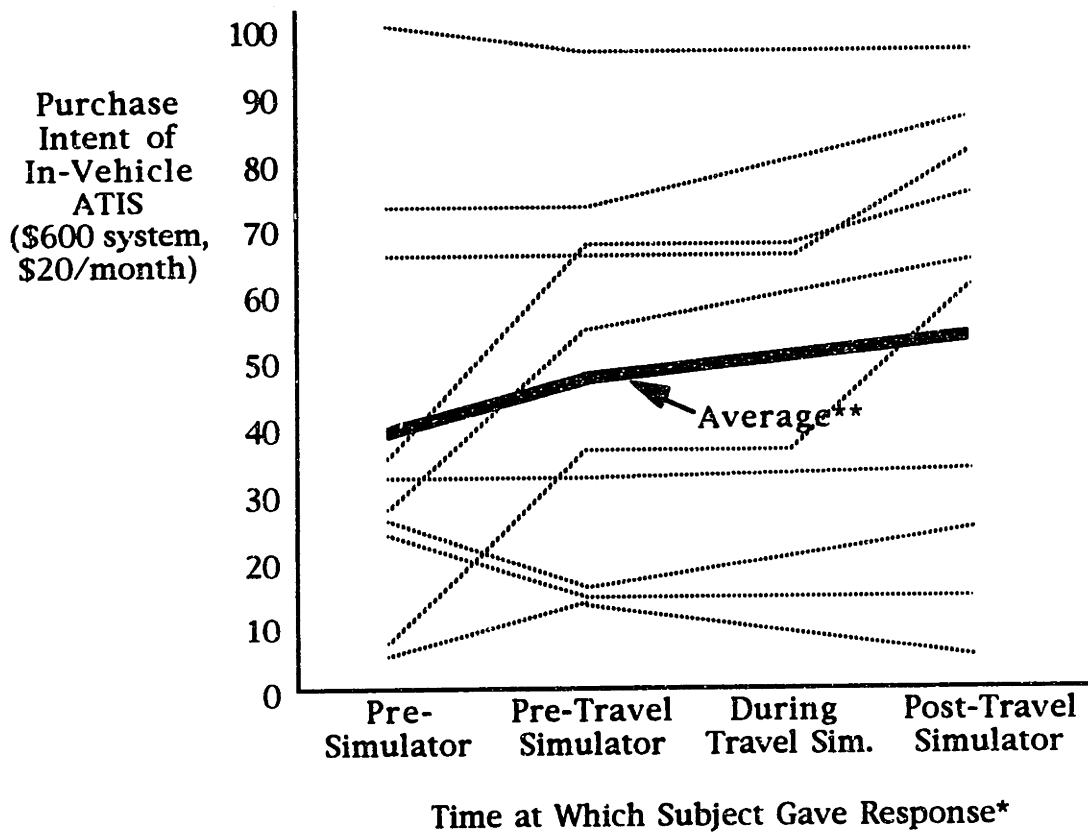
### Progression of Level of Knowledge of In-Vehicle ATIS



\* For an explanation, see Page 215.

\*\* The average was not taken for the third stage ('during travel simulator') because only 4 people answered this survey.

### Progression of Purchase Intent of Phone-Based ATIS



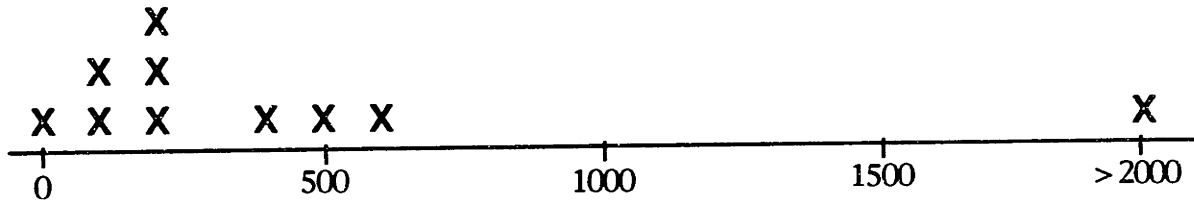
\* For an explanation, see Page 215

\*\* The average was not taken for the third stage ('during travel simulator') because only 4 people answered this survey.

**Progression of Purchase Intent of In-Vehicle ATIS**

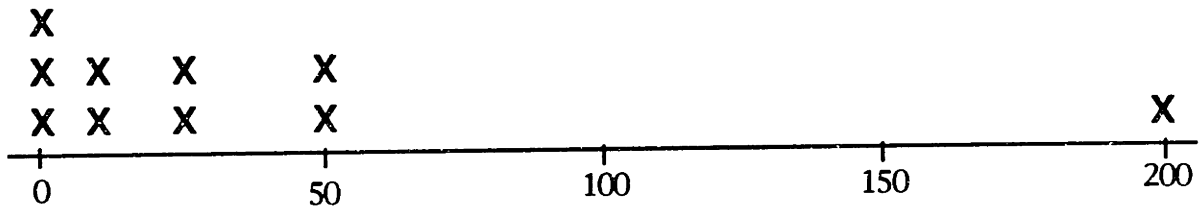
### Willingness to Pay Data

Each 'x' represents an answer from one subject.  
 No scale was given to the respondents.  
 The question was asked at the end of the experiment only.

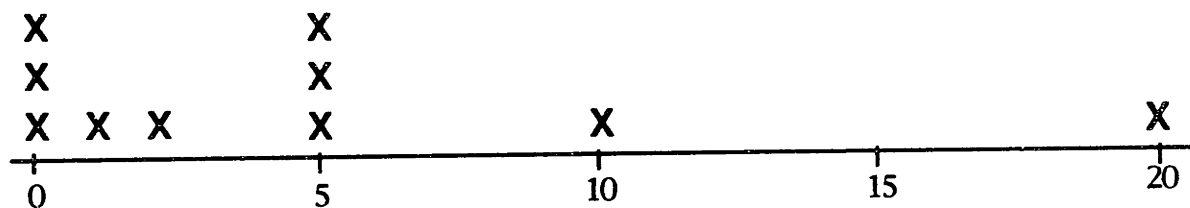


#### Willingness to Pay for In-Vehicle Dynamic Route Guidance System (\$/in-vehicle equipment)

The response assumes free dynamic traffic information.



#### Willingness to Pay for Phone-Based ATIS (cents per call)



#### Willingness to Pay for Phone-Based ATIS (subscription fee in \$/month for unlimited use of service)



Subject Number	Number of trips (out of 8) for which each subject used the following ATIS:		
	Radio	Phone-Based	In-Vehicle
1	5	1	3
2	0	1	3
3	2	2	3
4	1	1	5
5	2	2	3
6	2	1	5
7	1	2	7
8	0	0	1
9	2	2	4
10	1	2	2
Average No. of Trips	1.6	1.4	3.6
Variance	2.0	0.5	2.9
Average % of Trips	20%	18%	45%

### ATIS Usage in Travel Simulator

