SmartTrip: Persuasive Technology to Promote Conscious Driving Habits

Erik M. Johnson
Indiana University
School of Informatics
Bloomington, IN 47408
johnsoem@indiana.edu

Sam F. Shoulders
Indiana University
School of Informatics
Bloomington, IN 47408
ssshould@indiana.edu

HyunSeung Koh
Indiana University
School of Library and
Information Science
Bloomington, IN 47408
hskoh@indiana.edu

Jamie A. McAtee
Indiana University
School of Informatics
Bloomington, IN 47408
jamcatee@indiana.edu

Purvi Shah
Indiana University
School of Informatics
Bloomington, IN 47408
pnshah@indiana.edu

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ACM 1-xxxxxxxxxxxxxxxxxx.

Abstract
Heads of household with children living at home would be positively affected by a persuasive yet pervasive technology. This technology would help and inform them in completing reoccurring and unplanned errands. The benefits of such a technology encourages more conscious and efficient driving habits, which alleviates congestion therefore leading to a better quality life.

Keywords
Persuasive Technology, Conscious Driving, Pervasive Technology, Congestion, Trip Navigation

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous. H.5.2. User Interfaces: User-centered design

Introduction
The goal of our system is to reduce congestion on public roads by developing a solution for car drivers that will encourage more efficient and conscious use of their cars. Our research and observations informed us that our target group was opposed to using any form of public transit.

"Sure, carpooling sounds like a great idea. But in real life, it's almost impossible. There are practical reasons.

Needing to pick up kids after school or wanting to have a car to run errands during lunch breaks. ..." [1]

We concluded drivers in the U.S. generally hold a mindset in favor of liberal car usage and no desire for public transit. The first step toward influencing public transit would be to create a change in the current mindset of our target group of car drivers. We believe that changing the mindset and habits of car drivers in even a small way is the first step that must be taken toward reducing congestion on roadways in the United States.

The Car and Heads of Households

Our target group selection was informed by a series of user studies, which consisted of focus groups, contextual inquiry and a survey. The initial research showed that there was a portion of the car driving population that was reluctant to use any form of public transit. Further fieldwork supported this research by indicating a general target group that was attached to their cars. From this broader target group we choose to narrow our focus to heads of households who drive cars.

Specifically our target group consists of heads of households who have young children living at home. This group ranges from early 30's to early 50's in age and lives in the cities and suburbs of the United States. This target group is in charge of most errands for the household such as; grocery shopping and picking up children from events. Also these studies informed us, that our target group is concerned with saving time and would benefit the most by having an interactive pervasive computer system to help them to do so.

"The youngest and oldest age groups tend more to travel in the off-peak periods." [3] This implies that our target group contributes more than others during the most congested periods of a day. The goal of our design is to reduce the congestion on roadways in the United States and indirectly improve all modes of transit through instilling more conscious and efficient driving habits. This can be accomplished by persuading heads of household to drive less and make fewer trips.

Existing Approaches

Based on our focus group we found that our target group would appreciate features from a GPS navigation device and a voice activated list maker. Representatives from the target group indicated that they generally carry a cell phone most of the time as do many people in the United States [2]. Current technologies that influenced our design include the Smart Shopper, GPS navigation systems and mobile phones. The Smart Shopper (smartshopperusa.com) is a handheld device that allows the user to create lists by speaking to it. We see three separate technologies that in action alone do not provide an overall effect on our target groups' daily car habits. If we combine these three technologies into an integrated system they will have an overall effect on user car habits. It also provides information that will allow the user to make more thoughtful decisions about car usage. We see the system being complimented by existing smartphone technology. A smartphone is sometimes defined as a cell phone with special computer-enabled features that were not previously associated with a phone. The largest group of smartphone owners in 2006 was between the ages of 25-44 and we see this as representative of the group of people likely to have

Gender	% Smartphone users Q1 2006	% of Smartphone users Q3 2006	% of all mobile users Q3 2006
Male	68%	63%	49%
Female	32%	37%	51%
Age Groups	**% Smartphone users Q1 2006**	**% of Smartphone users Q3 2006**	**% of all mobile users Q3 2006**
15-17	10%	7%	7%
18-24	22%	15%	17%
25-34	29%	34%	27%
35-44	19%	20%	22%
45-54	12%	16%	15%
55+	8%	8%	11%

Source: Telephia European Subscriber and Device Report, Q3 2006

Figure 1: Gender and Age Distribution of Recent Phone Buyers in Europe [4]

Annual Cost of Congestion - Top 20 Urban Areas

ANNUAL COST DUE TO CONGESTION ($ MILLIONS)

URBAN AREA	DELAY	FUEL	TOTAL	RANK
Los Angeles, CA	10,880	1,690	12,570	1
New York, NY-Northeastern, NJ	8,720	1,025	9,745	2
Chicago, IL-Northwestern, IN	4,135	470	4605	3
San Francisco-Oakland, CA	2,635	420	3,055	4
Detroit, MI	2,530	280	2,810	5
Washington, DC-MD-VA	2,460	270	2,730	6
Houston, TX	2,410	255	2,665	7
Atlanta, GA	2,385	235	2,620	8
Boston, MA	1,940	215	2,155	9
Philadelphia, PA-NJ	1,795	195	1,990	10
Dallas, TX	1,685	180	1,865	11
Seattle-Everett, WA	1,630	230	1,860	12
San Diego, CA	1,570	250	1,820	13
Minneapolis-St. Paul, MN	1,405	160	1,565	14
St. Louis, MO-IL	1,355	140	1,495	15
Miami-Hialeah, FL	1,335	150	1,485	16
Denver, CO	1,270	145	1,415	17
Phoenix, AZ	1,220	165	1,385	18
San Jose, CA	1,080	170	1,250	19
Baltimore, MD	1,035	115	1,150	20

Source: Texas Transportation Institute, 2001 Urban Mobility Study.

Figure 2: Exhibit 4-10 - Annual Cost of Congestion [6]

children. (Figure 1) Also there is a growing interest in smartphones among women.

Why Congestion

Congestion is the overarching problem; there are many things that contribute to congestion. Our initial approach was to look at public transit, specifically buses, as the solution to getting people out of their cars. Based on our research and fieldwork, we found that public transportation was part of an even bigger problem. We see congestion as the overarching problem. Contributors to congestion are cars, buses, people, accidents, poor planning, bikers, natural elements and the like. Public transportation is more than an issue of design; it involves various stakeholders with agendas that are not necessarily user centered. Transportation decision making is also characterized as a process involving multiple participants or “stakeholders” [7]. The decisions commonly involve various interest groups as well as elected officials, governmental agencies, and the general public (see also Meyer and Miller 2001). We see this dynamic as an institutional limitation of public transportation. The effects of congestion have a tremendous impact on pollution, increase in fuel cost, deterioration of the quality of life, time wasted, and increase in accidents as well. Figure 2 is a chart that lists the cost of congestion in the top twenty urban areas [6].

Design Rationale

Once we decided to focus on congestion as the primary problem, and choose our target group the research informed design and the approach we would ultimately take. One was to change the habits of heads of households with cars; we would have to take an approach that would not be overt but somehow perceived as a compliment to their already busy schedules. Our target group is constantly on the go so ease of use as well will be of tremendous importance.

Our motivation and inspiration for our design is to utilize user evaluation methods to inform our design process from the outset [5]. Our intention is to design a persuasive and pervasive technology which mandates that we maximize user evaluative methods to really achieve the optimal user experience. Our artifact will be pervasive by incorporating technologies such as smartphones, GPS mapping technology, smart shopping list maker and therefore needs to be informed by context usage. Context is the set of environmental states and settings that either determines an application’s behavior or in which an application event occurs and is interesting to the user [18]. The SmartTrip is not a context aware technology, but our design process has been informed by the users dynamic contexts of use. By context aware we refer to the ability of the application to inform itself about its' location. This is a ubiquitous feature of our design as well. The formulation of our user test will have to be informed by this feature.

User Studies and Insights

To understand people who drove cars and people who used public transportation we conducted a focus group with representatives from these two groups. Some of our participants did not like buses and would not consider using them as a mode of transit. Cars give people the freedom to move about as needed that other forms of public transportation can not. Based on this research we chose to study people who drive cars further and conducted a contextual inquiry with a reprehensive of this group. From this research our new concepts centered on the idea of more efficient trip planning to reduce congestion. We believe that through making a small impact on the larger congestion problem we could see a measurable change in car use. Our concept focuses on influencing the driver to be more aware of their car usage and encourage a decrease in that usage.

The survey informed us that there were some other commonalities such as; they liked to make lists, would make several shopping trips and were concerned with fuel efficiency. To better inform us about our design we decided to combine a feature prioritization focus group and participatory design (FPFG/PD) session. FPFG is primarily centered on ideas about features of a design and the importance of the features. The goal of participatory design is to bring the user and the designer into the common design space. We see these as complimentary since FPFG is about the generalization of ideas and PD is about contextualizing these ideas. The FPFG/PD provided us with tremendous insights one, the participants express attitude of efficiency to the artifact itself, two, our target group as well wanted activities to be time efficient, and activities to be organized.

The complexity of transportation and congestion dictates the utilization of persuasive and pervasive technologies. Our big concept was that the trip starts before one gets in the car and continues after one gets out of the car. Our design was tremendously inspired by the pedometer, a persuasive technology. "A pedometer can be used as a tracking device, a feedback tool …, and as an environmental cue… Pedometers may be used in an effective way to increase daily physical activity." [8] We see the informative nature of the pedometer to be quite effective. Because of the pervasive nature of our design, the utility of a multimodal interface is important.

Concept

The SmartTrip assistant is a multimodal interface design activated by selecting the SmartTrip function on the user's smartphone. The user tells the phone what errand they need to run such as dry cleaning. Using one of the multimodal functions the system recognizes the input and gives them the closest dry cleaners based on location. The user has complete control over the choice of shopping destinations such as a preferred dry cleaner. The user can then enter a subsequent trip through the same method. The application also allows users to create a shopping list. The user thinks of something they need, says name of the item and multimodal functions on the assistant adds the item to the shopping list. The SmartTrip assistant has programmable reoccurring errands but is also able to handle unplanned errands by working them into the planned errand schedule. The user has the option to adjust any unplanned errands to his or her liking.

When the user is ready to run the errands the SmartTrip assistant suggests the most efficient route for doing the trip. The system takes into account the location of the user, the destinations selected and the current traffic situation to figure out the most efficient route. Our design keeps the user informed of the viability of making the trips at any given time. When a user reaches their first destination the system recognizes the location based on GPS coordinates and checks it off of the list. The assistant can be carried

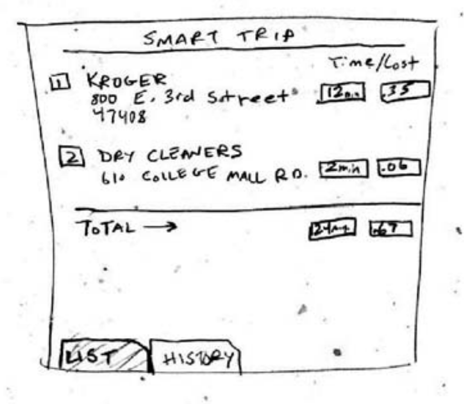

Figure 3: Low fidelity prototype of the SmartTrip interface

Figure 4: User testing our SmartTrip assistant prototype

inside so the user can view the list of items they need from this location. When the user finishes at a particular location the SmartTrip assistant recalculates the time needed to finish up the rest of the errand and reorganizes the list accordingly.

Evaluation

We conducted three different kinds of user testing to assist us in furthering our design. Our first test was to verify whether organization and representation of information in our design solution well fit into our target group's mental models. The second test was conducted to verify whether information itself is effectively persuasive in our target group's decision-making. The last test examined how four different input/output mechanisms fit into our target group's real contexts. We used low fidelity prototypes to test what kind of graphic representations and input mechanisms our target group would respond to.

In the first round of user testing, we developed a paper prototype with five different screens (see Figure 3). We arranged all screens in a logical way to test whether the five screens we set up make sense to our target group. The test was also used to evaluate whether the representation of information is clear enough to our target group. We walked participants through five screens from the first to the last and observed whether they have any difficulties in understanding the order of five steps and the representation of information. At the same time, we created three options of information (gas usage, greenhouse effect, time of each errand) in paper to test which option is most persuasive in our target group's decision-making. To test this, we explained context to participants first, such as "You are here at home. You're now ready to go shopping. You have the SmartTrip assistant", and asked what option of information is most persuasive in making a decision on making a plan for multiple errands.

We could not find any major difficulties participants encountered within the five screens we set up. The main feedback we received from participants was regarding the overwhelming information and need to be reduced. From the second user testing of "persuasiveness of information", we noted that our target group is more concerned about the total time to complete multiple errands instead of individual time of each errand. Based on results of two different user testing, we eliminated time of each errand and make information as simple as possible.

Based on input from the previous two tests we developed an additional paper prototype (Figure 4) that has a bigger screen than normal to emphasize four different input mechanisms of the SmartTrip assistant (a voice recognition system, a key pad, a touch screen, a stylus pen). We started the test with a home scenario and asked which input mechanism they prefer to use and why. We then moved the test outdoors to a car in the parking lot to help them visualize the driving scenario and asked the same question. Finally, we brought participants back inside and said they were at their destination in a public space and asked the same question.

For this third user testing of "input mechanism" most participants prefer to use a voice recognition system at home and in the car due to convenience and safety reason, whereas most participants prefer to use a keypad in a public place due to an ethical reason. Two other input mechanisms of a touch screen and a stylus pen were ranked low in both a private and a public place. As a result, in general most people prefer to use a voice recognition system, and different choices of different input mechanisms depend on situation, not place. In other words, people want to use different input mechanisms for different situations even at one place.

Conclusion

Our ultimate goal is to create an informative yet persuasive technology that embodied efficiency and sustainable car usage. Our target group wants to make efficient use of their time. This system provides them with information to be thoughtful and more efficient when planning their trips. More thoughtful trip planning leads to reduced time in the car and less gas usage. Fewer cars on the road reduce congestion, which in turn alleviates stress. The combination of these items brings about a reduction in automotive emissions and leads to a higher quality of life. The SmartTrip assistant fosters efficiency and encourages thoughtful driving habits.

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