TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
SWUTC/93/7192-1		

4. Title and Subtitle	5. Report Date
Route Guidance Information for Elderly Passengers: Route Naming Methods	November 1993
	6. Performing Organization Code

7. Author(s)	8. Performing Organization Report No.
Laura L. Higgins, with contributions by Rodger J. Koppa, James K. Hennigan, Charles S. Lessard, and Robert Q. Brackett	RF7192-1

9. Performing Organization Name and Address	10. Work Unit No.
	11. Contract or Grant No. DOTS88-G-0006

12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered
Southwest Region University Transportation Center Texas Transportation Institute The Texas A&M University System College Station, TX 77843-3135	Study Report (1 of 2)
	14. Sponsoring Agency Code

15. Supplementary Notes

Supported by a grant from the U.S. Department of Transportation
University Transportation Centers Program

16. Abstract

The effect of bus route names on elderly transit riders' route-finding performance was investigated. A survey of public transit companies indicated that most identify routes with names and numbers, plus color coding, and most route names correspond to the streets on which the routes travel or to the route destinations. A second survey of local riders indicated a preference for route names that include cardinal directions. Maps and timetables from a typical medium size bus system in Washington State were used in the experimental portion of the study. These materials were altered to include cardinal directions plus other changes suggested by the literature and participants used versions either with or without such directions. Thirty-two Bryan-College Station, Texas residents aged 55 or older were asked to plan three different trips using these materials. Very few participants used route names, but rather used route numbers and colors. Participants ranked route names as the least helpful route-finding tool, below color coding and route numbers. Problems encountered by participants indicate that color coding, map detail and the addition of map use examples and/or explicit instructions may be important issues for future investigations.

17. Key Words	18. Distribution Statement
Transit, Maps, Timetables, Route Guidance, Elderly, Bus	

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
		54	

Form DOT F 1700.7 (8-69)

ROUTE GUIDANCE INFORMATION FOR ELDERLY PASSENGERS: ROUTE NAMING METHODS

A Research Study
by
Laura L. Higgins

With Contributions by
Rodger J. Koppa
James K. Hennigan
Charles S. Lessard
Robert Q. Brackett

Southwest Region University Transportation Center
Texas Transportation Institute
The Texas A&M University System
College Station

November 1993

TABLE OF CONTENTS

LIST OF FIGURES

Page

LIST OF TABLES

Page

INTRODUCTION

After surveying riders on a bus route that connects Eureka and Redding in California, Sperling and Goralka (1990) concluded that the population of elderly bus riders was by no means limited to "captive" elderly people (that is, individuals unable to use private transportation for some reason). In fact, most of the riders surveyed owned a vehicle and were licensed to drive, and chose public transportation only if it was convenient to their schedule and destination. More significant were the individuals who did not drive their own vehicles, and would therefore be the target group of riders for this rural intercity bus route. Out of 43 respondents in this category, only two had used the bus to travel into the city -- most relied on friends and relatives for transportation. The surveys suggested that many people were intimidated by the idea of using the bus system.

Similar trends have surfaced in other cities. According to the U.S. Department of Transportation, public transportation is used for only 4% of all trips (Moving People, 1981). Poor route and service information is a primary reason cited for this lack of patronage. A study in Yorkshire, Great Britain supported this hypothesis: use of the rural bus system in that area increased 13% in only four weeks after a leaflet was distributed containing comprehensive route and schedule information. Similar efforts in the nearby town of Bingley also produced positive results. (Ellson and Tebb, 1978b)

Bartram (1984) describes a "legible" bus system as one in which a passenger can travel from his selected starting point to his destination without fear of getting lost and without the need of outside assistance. To accomplish this, the system needs to provide the passenger with route-planning information at his departure point, with in-transit information such as well-labeled bus stops, and with "supportive" information: repeated maps and route information at bus stops and inside buses to reassure the passenger that he is going where he wants to go.

The dilemma faced in designing route information is that of providing the passenger all the information he needs to successfully complete his trip, without overloading him with irrelevant detail. What constitutes irrelevant detail varies with the passenger and with the trip: a frequent public transit user, familiar with the city, needs little more than a list of stops for each route in order to plan his trip, and will be frustrated by too much detail. A new or non-frequent rider, or a rider that is unfamiliar with the city, needs more information: route locations, transfer points, arrival and departure times, possibly a complete map of the city. In either case, route information that is hard to understand will confuse and frustrate a potential rider and will encourage him to find some other source of transportation! (Garland, et al, 1979) Several studies have addressed both the kinds of information that are needed by the bus passenger and methods for presenting that information to the passenger without overloading.

Schematization of a bus route map is a way of reducing "clutter", of irrelevant information, while emphasizing the information that the user needs for route-finding. Schematic maps range in style from strip maps which show only the succession of stops along a bus route to maps such as the Washington, D.C. Metrorail map (1992 version), which maintains the topographical layout of the city, eliminates only minor streets from the map, and reduces the visual contrast of the street map just enough to emphasize the superimposed Metrorail routes.

Studies measuring route-finding performance generally show faster task completion times and greater user preference for less-detailed schematic maps (Kaeser &Wilson, 1981; Garland et al, 1979; van der Kooi, 1989; Cheng, 1992). This is true especially when the user

is familiar with the city, when the trip-planning task is isolated within the transit network (that is, starting points and destinations are given as stops on the route) and in systems such as the London Underground where the routes do not follow city streets. Users that are faced with an unfamiliar city and an unfamiliar destination feel more confident with a map that provides street names and spatial information. (Bartram, 1984; Batelle, 1976)

Color coding maps has been shown to improve performance on route-finding tasks, particularly on detailed maps. In a study comparing four styles of transit maps in Ft. Worth, Texas, a high-detail, color-coded map produced better route-finding performance than either the low-detail or high-detail black-and-white maps. (Garland, et al, 1979) Bartram (1984) found the beneficial effects of color coding to be secondary to the benefits achieved by schematizing (simplifying) a high-detail map, but also stated that a high-detail map may be necessary to provide sufficient information to a public-transit user; color coding is especially useful for organizing this type of high-density information.

In a Batelle Institute survey of public transit user preferences, approximately half of the respondents preferred coding bus routes by color (the other half preferred coding by number). The survey also found approximately equal preferences for two other uses of color in a route map: designating transit service classes and designating geographical areas of the city. Most people surveyed (74%) felt that three to five colors were the maximum that could be used effectively on one map; 44% set the ideal number of colors at four. Christ (1984) sets the maximum number of colors in a visual display at nine when the colors are being used to identify different values or categories; for a map displaying nine or fewer routes, color coding should aid the reader in selecting a desired route.

Color is impractical for some situations: while Ellson and Tebb designed an eight-color leaflet for a rural bus system in Yorkshire (1978a), they rejected color-coding in a similar leaflet for an urban route in the town of Bingley (1981). Poor lighting conditions along the urban route would have made the colors in the map hard to distinguish. Color-coding routes loses effectiveness if the number of routes (and colors) is ten or more. Finally, the expense of printing colored literature limits its use. Experiments comparing color coding in visual displays with other types of coding have found color to be effective as an aid to identification and search tasks, but not significantly more effective than monochromatic coding techniques (Christ, 1984).

Bus riders ranked pocket schedules, or timetables, first out of eight suggested transit aids in a study conducted by Batelle Memorial Institute (1976). However, timetables generated poorer performance than maps in a route-finding exercise, even in locating departure times. Other studies have supported the conclusion that people generally perform poorly with timetables; moreover, performance with timetables seems to worsen with age (Madgett: reported in Bartram, 1984).

Several studies have focused on the effect of timetable formats on user performance. In general, formats that required the least amount of "translation" or interpolation by the user produced faster and more accurate responses. Users had difficulty with the coded timetables in a British bus route leaflet which used designations such as "odd" and "even" hours (Ellson and Tebb, 1978a). Other formats which hurt performance were timetables containing phrases such as "6:06 every 12 minutes until 7:06" to designate departure times. (Kaeser & Wilson, 1981) Full hour-and-minute presentation of departure times produced better performance. Twelve-hour clock times (2:15 a.m., 3:05 p.m.) were more usable than 24-hour times (0215, 1505), and designations such as "Morning", "Afternoon", and "Evening" seemed to be more effective than "a.m." and "p.m." (Sprent, et al, 1980)

Wildbur (1989) recommends generous spacing between timetable entries, breaks after every five entries to aid in visual searching, and analog clock faces instead of digital time entries. He also suggests including an example of timetable use in the display. Minimizing the use of printed lines and grids reduces clutter and allows the eye to focus on the time and location information. (Tufte, 1990) Arranging the timetable with the route (successive bus stops) represented on the horizontal axis and time on the vertical axis produced better performance than the reverse arrangement. (Sprent, et al, 1980)

Limited research data is available on the subject of route naming or coding schemes. Of four possible pieces of information listed on a bus stop sign, "route name" was ranked as the most useful by participants in the Batelle Institute survey, while "route number" was ranked as the least useful. On route maps, participants were almost evenly split in preferences for route designation method, with 53% preferring number designation and 45% preferring color designation. This study will compare users' route-selection performance under different styles of route designation and attempt to determine a route identification method that will aid the public transit rider in planning a bus trip.

Objectives: The objectives of this study are to

1) examine the various approaches used by public transit systems to identify and name bus routes
2) use information from literature and from transit operators to define the most effective method for naming or coding bus routes
3) test the hypothesized "best" method against other naming schemes to see if it improves users' speed and accuracy in identifying the correct route for their destination

PRELIMINARY STUDIES AND RESULTS

Phase I: Transit Company Survey

Approximately 100 transit companies were contacted by mail. A representative from each company was sent a copy of a five-question survey; the accompanying letter asked for the company's participation in the survey, which was conducted by telephone. The transit companies/systems were selected from the 1992 directory of the American Public Transit Association. Twenty-six states were represented, by bus systems ranging in size from four to 211 bus routes. Of the systems initially contacted by mail, 76 participated in the telephone survey, and of those, 65 sent samples of their passenger information materials. A copy of the survey is in Appendix A.

The survey's questions dealt with the system's uses of color and their route naming and/or numbering schemes. The last two questions asked how each company's route guidance information had been developed, and how well their route identification methods seemed to be working.

Almost all the systems responded that their route guidance information had been designed and established "in-house" years before. Many systems' route names were "historical", some referring to neighborhoods, streets, or landmarks that no longer exist. Boston, Massachusetts and Richmond, Virginia are two cities in which the current bus names were taken from the trolleys that were in service decades ago.

Five of the transit systems had hired outside consultants to design their route guidance materials: Detroit, Michigan in 1991; Bakersfield, California in 1986; San Antonio, Texas in 1981; and Seattle, Washington in 1977.

Only six of the systems had recently solicited customer input for the design of their passenger information aids. In Rock Island, Illinois, customer surveys in 1991 suggested the color-and-number scheme for the system's seven routes. In Lubbock, Texas, customer surveys led to more relevant information and less "clutter" on information aids. Customer input to the Lehigh, Pennsylvania system led to a change from a route-numbering system to a letter-and-color identification. Systems in Monterey, California; Tampa, Florida; and Phoenix, Arizona also designed or modified their route guidance information with advice and suggestions from their passengers.

Color

Of the 20 "small" bus systems that used color in their system maps, 16 (80%) used a separate color for each route or for each set of paired routes. This percentage drops as the size of the bus system increases: only 28% (5 of 18) of "medium-sized" systems used individual route or pair color coding, and only 8% (1 of 12) of large systems coded this way. This system, in Syracuse, New York, used ten colors to identify ten numbered groups of routes, which were individually coded by letters: for example, routes 7A, 7B, 7C, and so forth were shown on the map in red, and 5A, 5B, and so forth were all shown in blue. The average number of colors or color combinations used on a map that coded by individual routes was 11.67, with a range from 4 to 31. (Figure 1)

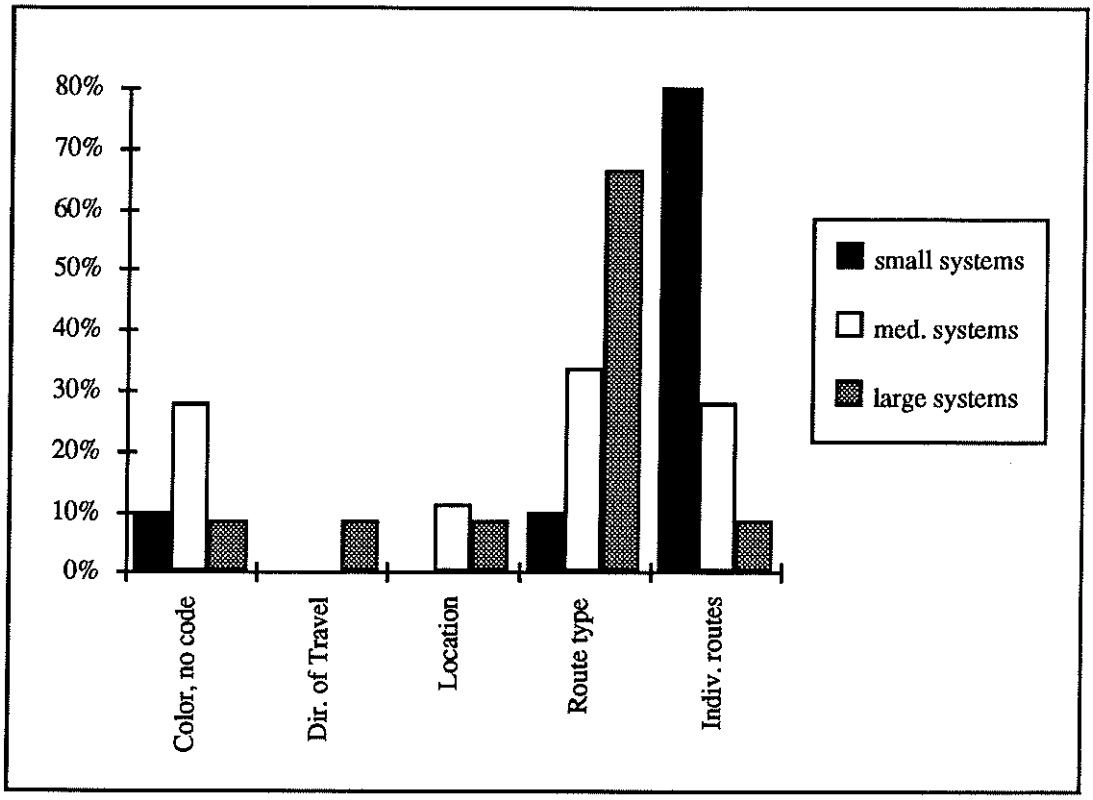


Figure 1. *Categories of color coding.*

The second most used type of color coding was a separate color for each type of bus route, for example "local", "express", and "rural". The trend for this category was opposite to that for individual-route coding, with only 10% of the small systems coding routes this way; 33% of medium-sized systems and 67% of large systems used this method. Numbers of route types/classes and colors ranged from 2 to 6.

Other types of color coding appeared less frequently. Coding by different areas of town is used in Kansas City, Missouri; Duluth, Minnesota; and San Antonio, Texas. In San Antonio, six different colors mark areas of town such as Northeast, Northwest, and South. In Duluth, four colors of schedule pamphlets similarly designate four geographical areas of the town.

Only one system of those surveyed classed its routes by direction of travel. The Metropolitan Suburban Bus system of Garden City, New York designates five directions of bus routing through the area (North-South, East-West and so on) and codes the routes accordingly with five colors.

The remainder of bus systems that used color in their maps used it as a method of distinguishing routes and/or landmarks without coding, i.e. as a strategy for enhancing contrast or for making the map more attractive.

Street Map Detail

Nine (14%) of the transit companies superimposed their system of routes on a complete, detailed street map of the city. This provides the maximum amount of location information

to the user and eliminates the need for a separate city map. It also, however, puts a great deal of visual detail in a limited space and may be hard to read. Several of the detailed maps were reduced, resulting in print sizes that were almost too small to read.

Simplified street maps, which maintain the spatial layout of the city with some of the street lines and names eliminated, provide less location information and so may need to be supplemented occasionally with a separate street map. This format was the one used by 29 (45%) of the transit systems in the survey.

A special case of simplified street maps were oblique maps, which showed artists' renderings of streets, landmarks, and some topographical information. Seven systems' maps were of this type.

Schematic maps, which may or may not reflect the spatial layout of the city, have few or no streets shown which are not part of the route lines. Their purpose is to show the relative locations and connections of the routes, and they usually provide no information concerning locations that are not on the routes. These maps are easiest to read because of the low amount of detail, but the transit companies that use them commented that customers often called for information concerning streets or locations that could not be found with the maps. Schematic maps were used by nine (14%) of the systems.

Route Names

All but one of the systems with 20 to 50 routes identify those routes with number or number-and-letter plus a route name. The exception is the Riverside, California "Ride Guide", which identifies routes by number only. All of the large systems (over 50 routes) number or number-and-letter the routes, and all but one include a route name. Of the 27 small systems, (under 20 routes) 25 numbered and named the routes; one of the two remaining systems used route names along with color coding, and the other system used shape coding for its six routes.

Transit systems used several methods for naming routes, sometimes combining two or more naming schemes. Most transit systems (89%) named routes according to the streets the routes traveled on or landmarks that they served. Geographical areas of the town, designated by North, South , East and West, were used to name routes in 22% of the systems. "Uptown" and "Downtown" were route names in 26% of systems, and color names or other "non-location" names were used in 17% of systems.

Table 1 summarizes the route identification methods used by the surveyed transit companies.

TABLE 1

Route identification methods used by transit companies.

Route Identification:	Under 20 routes		20-50 routes		Over 50 routes	
Number + Name	25	93%	21	95%	15	94%
Number only			1	5%	1	6%
Name only	1	4%				
Shape Coding	1	4%				
Route Names:						
Streets/Landmarks	24	89%	20	91%	14	88%
North, South, etc.	6	22%	3	14%	5	31%
Up/Downtown	4	15%	9	41%	4	25%
Non-Location	5	19%	3	14%	3	19%

Phase II: Student Survey -- Naming bus routes

Thirty-nine industrial engineering undergraduate students at Texas A&M University were given pamphlets for the Bryan-College Station routes of the Brazos Transit System. The pamphlet shows the seven bus routes superimposed in seven colors on a street map of the two cities. The stops and times for each route are listed on the back of the map, along with a small map showing "Downtown" detail of the streets and routes. The routes are named by their colors on the map: the Red route, the Green route, and so on.

Students were asked to pretend that they were newcomers to Bryan-College Station and that their only form of transportation was the local bus system. With that background, they were asked to name the seven routes in the way they thought would be the most helpful to a person trying to plan bus trips in the cities. Each student was also asked how often they had used public transit before (never, once or twice, occasionally, or regularly) and the city(s) in which they used it.

Of the 39 students, 19 had never used public transit, 10 had used it once or twice, 4 were "occasional" riders, and 6 were "regular" riders.

Five basic categories of route identification emerged: naming by geographical area of the city (North Bryan, East College Station, etc.), naming by functional area of the city, (Downtown, Business, Residential) naming for landmarks that are served by the route, naming for the major street the route travels on, and use of color names (the current method used by Brazos Transit) or other non-location names. In most cases, students combined two or more of these categories to name the seven routes.

The method that was used most often by students was naming routes according to the geographical area of the city they primarily covered; 69% of the students used "East", "West", "North", and so forth, with or without other identifiers such as streets or landmarks. Forty-one percent included city landmarks such as parks, businesses, and schools in their route names. Street names and "Uptown" or "Downtown" each appeared in 36% of the completed surveys. Names unrelated to location appeared in 15% of the surveys. In five of

the six surveys that used this category, the students wrote that the color names were easiest to remember. One student substituted "catchy" names such as "Banana", "Apple", "Peach", and so forth, feeling that the unusual names would draw interest and be remembered.

The large number of students choosing to include North-South, East-West geographical designations in route names contrasted with the relatively low number of surveyed transit systems that use these designations. Only 14 out of 65 bus systems that were interviewed (21.5%) used "North _____", "South _____" and so on to name their bus routes. Even among other "small" systems like Bryan/College Station (fewer than 20 routes) this naming method was used only 22% of the time.
Figure 2 compares the route naming methods used by the surveyed transit companies with the methods used by the students.

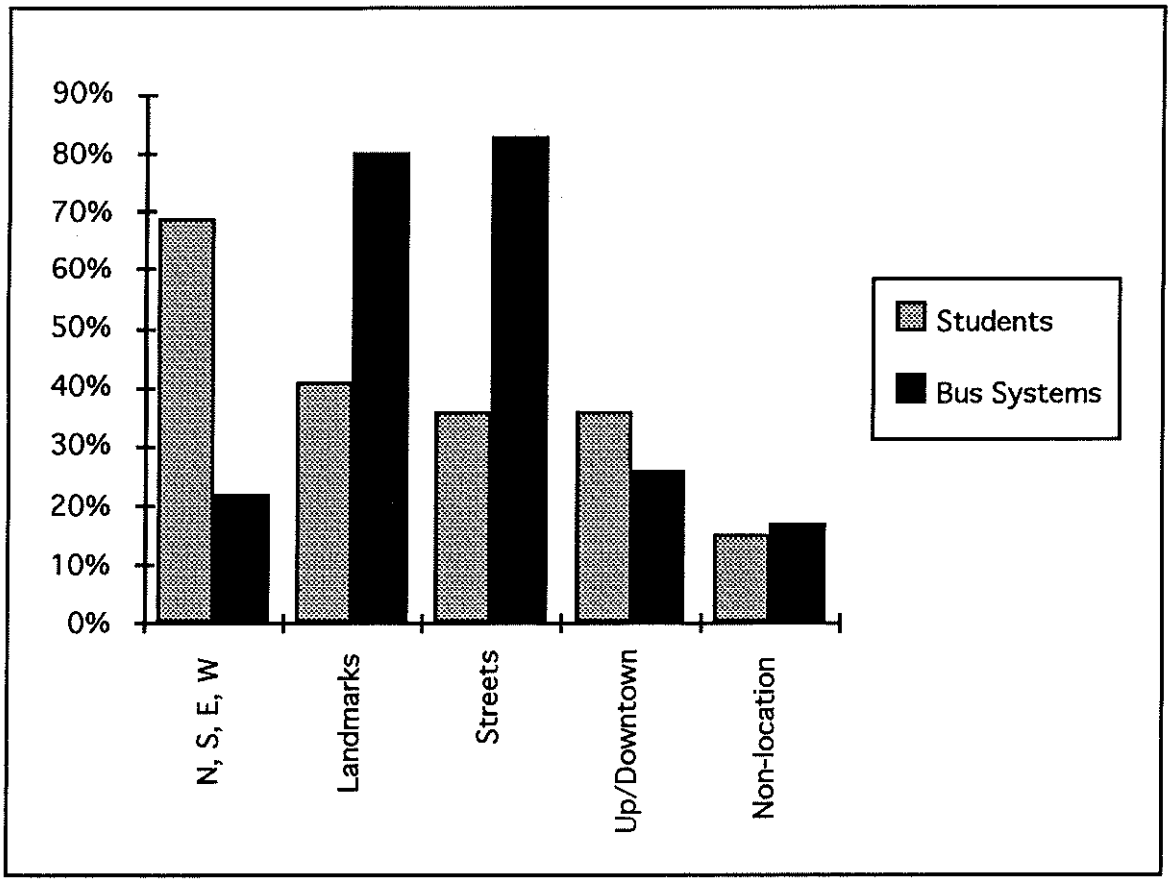


Figure 2. *Route names used by transit companies compared with route names suggested by students*

PERFORMANCE STUDY

Since the student survey indicated a preference for route names that used "North", "South", and so forth to identify routes' locations within a city, a trip-planning study was designed to compare route names that include these cardinal directions with names that do not.

The Clark County Public Transit system (C-TRAN) which serves the city of Vancouver, Washington and four surrounding towns, was selected to use in the trip-planning scenario. This system was chosen because the city is far enough away from Texas that the study participants would be unfamiliar with it, eliminating one source of variation between participants. Also, the map and other route guidance materials met several of the guidelines found in the literature for ease-of-use: color coding of routes, a simplified street map, and most print sizes above nine-point.

Method

Research Participants

Fourteen men and eighteen women over the age of 55 participated in this study. The men ranged in age from 57 to 75 years, with an average age of 67.8 years. The women ranged from 56 to 74 years of age, with an average of 65.3 years. The participants were all residents of the Bryan/College Station area, and unfamiliar with the Clark County area of Washington state, whose public transit map was used for this study. Table 2 profiles the participants' ages, gender, and frequency of use of public transit. Table 3 lists this information for each participant.

"Little" transit experience means that the participant has used public transit fewer than five times in recent years or that the participant's transit experience was greater than fifteen years ago. "Occasional" transit users are primarily those who use public transit in other cities or countries during travel. "Frequent" transit users either use local transit on a regular basis or spend a significant amount of their time traveling in other states or countries and use the public transit systems there on a regular basis.

TABLE 2

Profile of Research Participants

	Age Range	Transit Use			
	(years)	None	Little	Occasional	Frequent
Men	57-75	29%	29%	29%	14%
Women	56-74	44%	28%	17%	11%

TABLE 3

Data on Research Participants

subject	gender	age	transit experience
1	F	60	little
2	F	70	none
3	M	72	little
4	F	74	little
5	F	66	none
6	M	69	little
7	F	59	none
8	M	67	occasional
9	M	71	none
10	F	70	occasional
11	F	56	frequent
12	M	57	frequent
13	F	57	frequent
14	F	62	occasional
15	M	61	occasional
16	F	55+	none
17	F	55+	none
18	F	72	none
19	M	74	none
20	F	55+	occasional
21	F	68	little
22	M	69	little
23	F	69	little
24	F	71	little
25	M	68	none
26	M	58	occasional
27	M	75	occasional
28	M		little
29	F	66	none
30	M	68	none
31	F	64	none
32	M	73	frequent

Materials

Each research participant was given the system map and the "Rider's Digest", a booklet of route maps and timetables for the 27 routes in Clark County's "C-TRAN" bus system. These are the two pieces of information routinely distributed to customers by C-TRAN (Figures 3, 4, 5, and 6).

C-TRAN's system map, as published, provides no information that will help the map user find a street or landmark. Unless the user is already familiar with the layout of the city, streets can be found only by scanning the map, and landmarks are barely distinguishable To aid the participants in finding their start and destination points, a locator grid was added to the map, with the letters A through J as the horizontal axis and the numbers 1 through 12 as the vertical. An index of landmarks and streets was compiled and added to the materials; each landmark and street was listed with the letter and number that specified its place in the locator grid. In addition, the index listed the bus route numbers that serve each listed location; the route numbers were added to emulate the map index designed by Cheng (1992) for a previous study involving map usage (Figure 7).

Two versions of the map and the schedule book were prepared. The first was left unchanged except for the modifications already mentioned. The second was prepared with modified route names which added "N", "S", "E", or "W" to the street names which identified the routes: "Route 30 -- Burton", for example, became "Route 30 -- E -- Burton" (Figures 8 and 9). This change was added in response to the student survey, in which numerous participants had suggested using cardinal directions to indicate the area of town to which a route traveled.

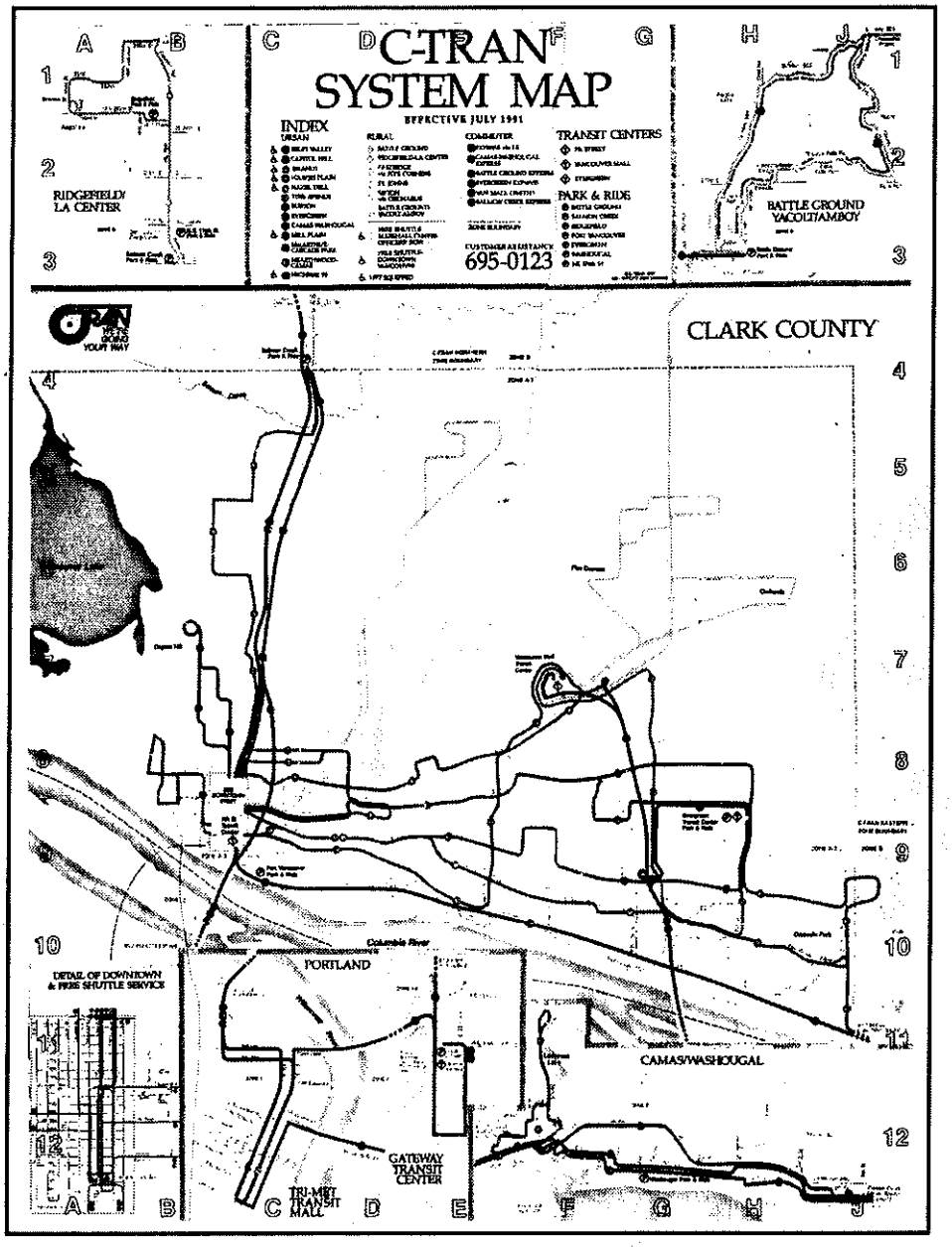


Figure 3. *C-TRAN Bus service system map (reduced).*

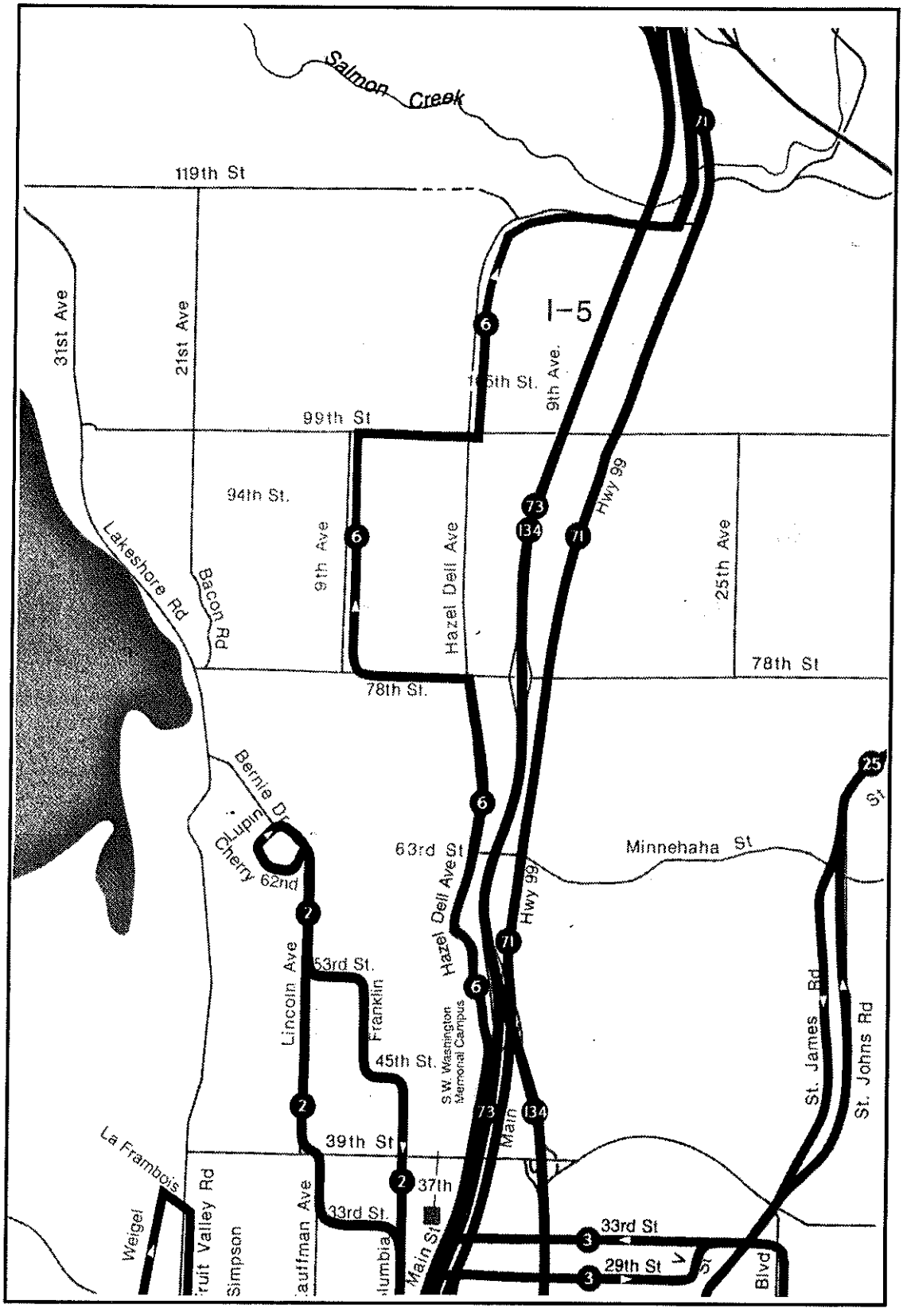
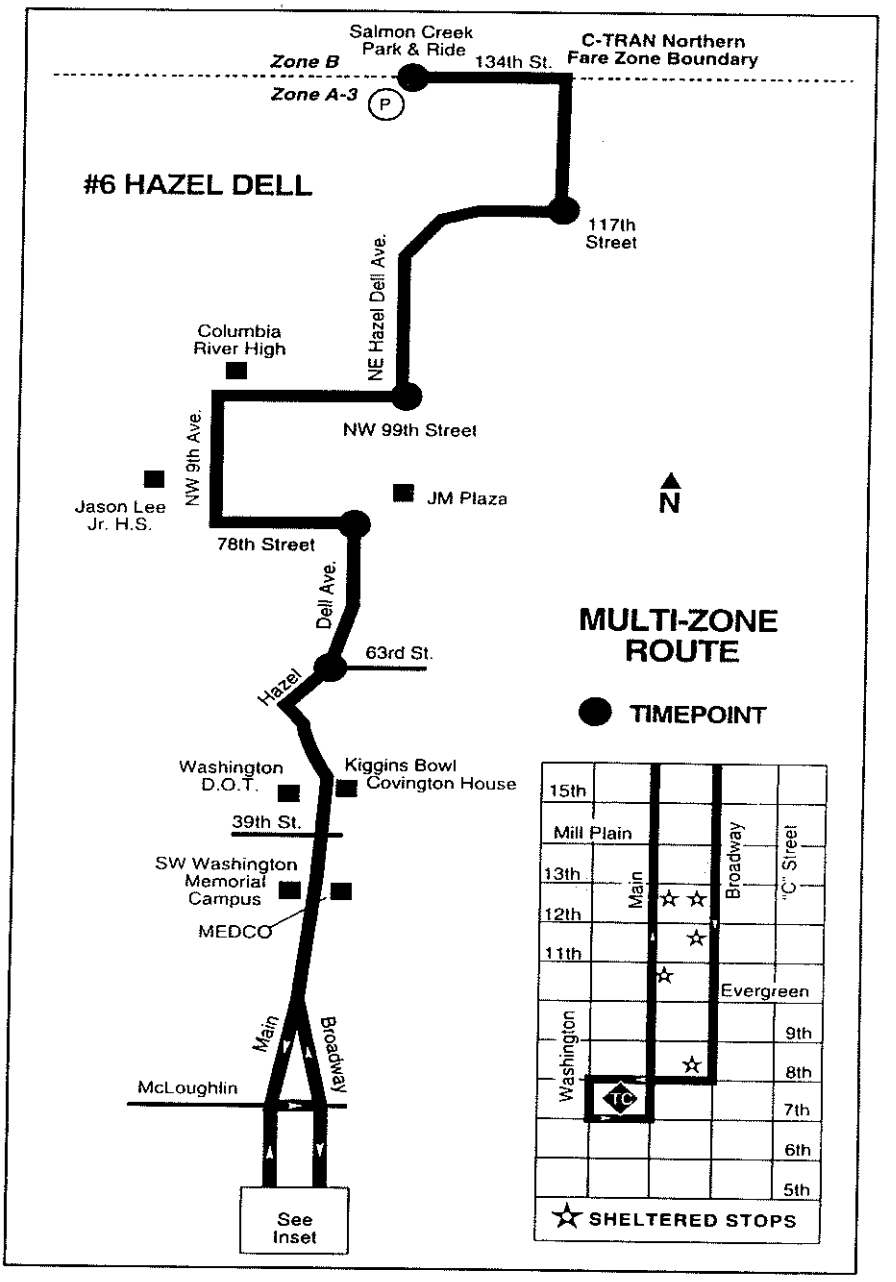


Figure 4. *Portion of C-TRAN system map showing Routes 6, 71, 73(actual size).*

6 HAZEL DELL



Lift-Equipped

Snow & Ice Route Information on page 85

Figure 5. *Route 6 map from C-TRAN "Rider's Digest".*

6 HAZEL DELL

weekdays

Weekday Northbound to Salmon Creek Park & Ride

7th Street Transit Center	NE Hazel Dell Ave & NE 63rd Street	NE Hazel Dell Ave & NE 78th Street	NE Hazel Dell Ave & NW 99th Street	117th Street & Klineline	Salmon Creek
5:45 a.m.	5:55 a.m.	5:58 a.m.	6:01 a.m.	6:05 a.m.	6:15 a.m.
♿ 6:15	6:25	6:28	6:31	6:35	6:45
6:45	6:55	6:58	7:01	7:05	7:15
♿ 7:15	7:25	7:28	7:31	7:35	7:45
7:45	7:55	7:58	8:01	8:05	8:15
♿ 8:15	8:25	8:28	8:31	8:35	8:45
♿ 9:15	9:25	9:28	9:31	9:35	9:45
♿ 10:15	10:25	10:28	10:31	10:35	10:45
♿ 11:15	11:25	11:28	11:31	11:35	11:45
♿ 12:15 p.m.	12:25 p.m.	12:28 p.m.	12:31 p.m.	12:35 p.m.	12:45 p.m.
♿ 1:15	1:25	1:28	1:31	1:35	1:45
♿ 2:15	2:25	2:28	2:31	2:35	2:45
2:45	2:55	2:58	3:01	3:05	3:15
♿ 3:15	3:25	3:28	3:31	3:35	3:45
3:45	3:55	3:58	4:01	4:05	4:15
♿ 4:15	4:25	4:28	4:31	4:35	4:45
4:45	4:55	4:58	5:01	5:05	5:15
♿ 5:15	5:25	5:28	5:31	5:35	5:45
5:45	5:55	5:58	6:01	6:05	6:15
♿ 6:15	6:25	6:28	6:31	6:35	6:45
♿ 7:15	7:25	7:28	7:31	7:35	7:45
♿ 8:15	8:25	8:28	8:31	8:35	8:45
♿ 9:15	9:25	9:28	9:31	9:35	9:45
♿ 10:15	10:25	10:28	10:31	10:35	10:45

Weekday Southbound to 7th Street Transit Center

Salmon Creek	Klineline & 117th Street	NE Hazel Dell Ave & NW 99th Street	NE Hazel Dell Ave & NE 78th Street	NE Hazel Dell Ave & NE 63rd Street	7th Street Transit Center
5:45 a.m.	5:47 a.m.	5:51 a.m.	5:55 a.m.	6:00 a.m.	6:15 a.m.
♿ 6:15	6:17	6:21	6:25	6:30	6:45
6:45	6:47	6:51	6:55	7:00	7:15
♿ 7:15	7:17	7:21	7:25	7:30	7:45
7:45	7:47	7:51	7:55	8:00	8:15
♿ 8:15	8:17	8:21	8:25	8:30	8:45
♿ 9:15	9:17	9:21	9:25	9:30	9:45
♿ 10:15	10:17	10:21	10:25	10:30	10:45
♿ 11:15	11:17	11:21	11:25	11:30	11:45
♿ 12:15 p.m.	12:17 p.m.	12:21 p.m.	12:25 p.m.	12:30 p.m.	12:45 p.m.
♿ 1:15	1:17	1:21	1:25	1:30	1:45
♿ 2:15	2:17	2:21	2:25	2:30	2:45
2:45	2:47	2:51	2:55	3:00	3:15
♿ 3:15	3:17	3:21	3:25	3:30	3:45
3:45	3:47	3:51	3:55	4:00	4:15
♿ 4:15	4:17	4:21	4:25	4:30	4:45
4:45	4:47	4:51	4:55	5:00	5:15
♿ 5:15	5:17	5:21	5:25	5:30	5:45
5:45	5:47	5:51	5:55	6:00	6:15
♿ 6:15	6:17	6:21	6:25	6:30	6:45
♿ 7:15	7:17	7:21	7:25	7:30	7:45
♿ 8:15	8:17	8:21	8:25	8:30	8:45
♿ 9:15	9:17	9:21	9:25	9:30	9:45

AM – Lighter Type
PM – Darker Type

Figure 6. *Weekday timetable for Route 6 from C-TRAN "Rider's Digest".*

** NOTE: **BOLD-FACE NUMBERS** ARE BUS ROUTE NUMBERS **

TRANSIT CENTERS

7th Street Transit Center:	C9 (Downtown Inset) **1, 2, 3, 4, 5, 6, 14, 25, 30, 32, 37, 38, 71, 73, 98, 99**
Evergreen Transit Center/ Park & Ride:	G9; **12, 30, 37, 41, 75**
Tri-Met Transit Mall/Park & Ride (Portland):	C12; **5, 14,75, 134**
Vancouver Mall Transit Center:	F7; **4, 7, 10, 12, 31, 32, 76**

PARK & RIDE

Battle Ground P&R:	H3; **7, 73, 78**
Evergreen Transit Center/ Park & Ride:	G9; **12, 30, 37, 41, 75**
Ft. Vancouver P&R:	C9;
N.E. 179th P&R:	B3; **8**
Ridgefield P&R:	B1; **8**
Salmon Creek P&R:	B3; **6, 8, 71**
Tri-Met Transit Mall/Park & Ride (Portland):	C12; **5, 14,75, 134**
Washougal P&R:	G12;

HOSPITALS & CLINICS

Kaiser Clinic:	G10; **37**
S.W. Washington Health Dist.:	C9 (D.I.); **25**
S.W. Washington Medical Ctr.:	F9; **37**
Veterans Hospital:	C8; **4, 25**

PARKS

Arnolds Park:	D8; **25**
Cascade Park:	G10; **12, 38**
Crown Park:	F11; **33**
David Douglas Park:	E9; **37**
Esther Short Park:	C9 (D.I.); **99**
Great Western Trailer Park:	J9; **41**
Lewisville Park:	H2; **78**
Lucia Falls Park:	J2; **78**
Moulton Falls Park:	J2; **73, 78**

SCHOOLS

Amboy Elem.:	J1; **78**
Baller Elem. (Camas):	F12; **33**
Burton Elem.:	H8; **30**
Camas JHS:	F12; **33**
Cascade JHS:	H9; **12, 30**
Clark College:	C9 (D.I.); **3, 25, 30, 98**
Columbia School:	H12; **33**
Columbia River HS:	B5; **6**
Evergreen HS:	H9; **12, 30**
Ft. Vancouver HS:	E8; **30**
Franklin Elem.:	B7; **2**
Fruit Valley Elem.:	B8; **1**
Hudson's Bay HS:	C9 (D.I.); **3, 30, 37, 38**
Jason Lee JHS:	B6; **6**
John Rogers Elem.:	D9; **3**
King Elem.:	D9; **37**
Lacamus Heights Elem. (Camas):	F11; **33**
Lincoln Elem.:	B8; **2**
Marshall Elem.:	E9; **38**
McLoughlin MS:	E9; **38**
Mountain View HS:	H10; **38**
Prairie HS:	H10; **7**
School for the Blind:	D9; **30**
School for the Deaf:	D9; **32**
Sifton Elem.:	H6; **31**
Silver Star Elem.:	G6; **10**
S.W. Washington Memorial Campus:	C8; **3, 6, 71**
Washington Elem.:	C8; **3**
Wy'East JHS:	H10; **12, 38**
Zellerbach M.S. (Camas):	F12; **33**

Figure 7. *Sample page from map index.*

Figure 8. *Map legend showing route numbers and names for unaltered map.*

Figure 9. *Map legend showing route numbers and names for altered map.*

Procedure
Each participant was asked to use the materials given to plan three bus trips in the Clark County area. Participants were paid ten dollars per hour for their participation in the study. Other than this compensation for their time, there were no incentives for participation.

For each trip, a starting point and a destination were given, along with the day of the week on which the trip would take place and the desired time of arrival at the destination. Participants were instructed to select the route or routes that would connect the two locations, to plan transfers, if necessary, and to select arrival and departure times from the timetables that would allow them to reach the destination by the specified time.

The three hypothetical trips represented three levels of difficulty: one involved a single bus route, with no transfers needed between the start and destination; one involved two routes with a transfer at a major Transit Center; and one required three routes, with one transfer at a Transit Center and another transfer at a "Park 'n' Ride" bus stop. The no-transfer trip was always presented first, in order to allow the participant to "learn" the map with a less difficult task. The other two trips were presented in two different orders, with each participant assigned to one of the two orders. Order 1 presented first the single-route trip (designated Trip 1 for the remainder of this paper), then the two-route, one-transfer trip (Trip 2), and finally the three-route, two-transfer trip (Trip 3). Order 2 presented first Trip 1, then Trip 3, then Trip 2.

Each participant was also assigned to one of the two versions of the map, creating four test groups.

Participants were given the map, "Rider's Digest", and map index, allowed to familiarize themselves with the layout of the materials, and were then presented with the three trips to plan using the materials. No time limit was set for working the problems. Participants were instructed to plan the trips without outside help. However, if a participant became frustrated to the point of giving up, a verbal prompt would be provided to help him or her through a specific difficulty. Any prompting given was noted and explained as part of the observations for the participant's trip-planning process.

The time each participant required to complete each trip plan was recorded. In addition, the results of the trip plan was recorded as "successful", meaning that the specified destination would be reached by the specified time, or "unsuccessful".

Results of Trip Planning Study

Trip Planning Success
A successful trip was defined as one which arrived on time at the specified location, with no missed transfers. If a trip required extra time because of an early departure, it was still classified as a successful trip. If a test participant became "stuck" and unable to proceed in the planning process with the given materials, he/she was "prompted", or given extra information, to get him/her past the current problem and on with the planning process. It is assumed that the subjects who had to be prompted on a given problem would not have solved that problem using only the materials provided, and would have needed outside help to plan that trip using this bus system. "Successful" in the graphs below means that the participant selected the correct routes for the trip without assistance.

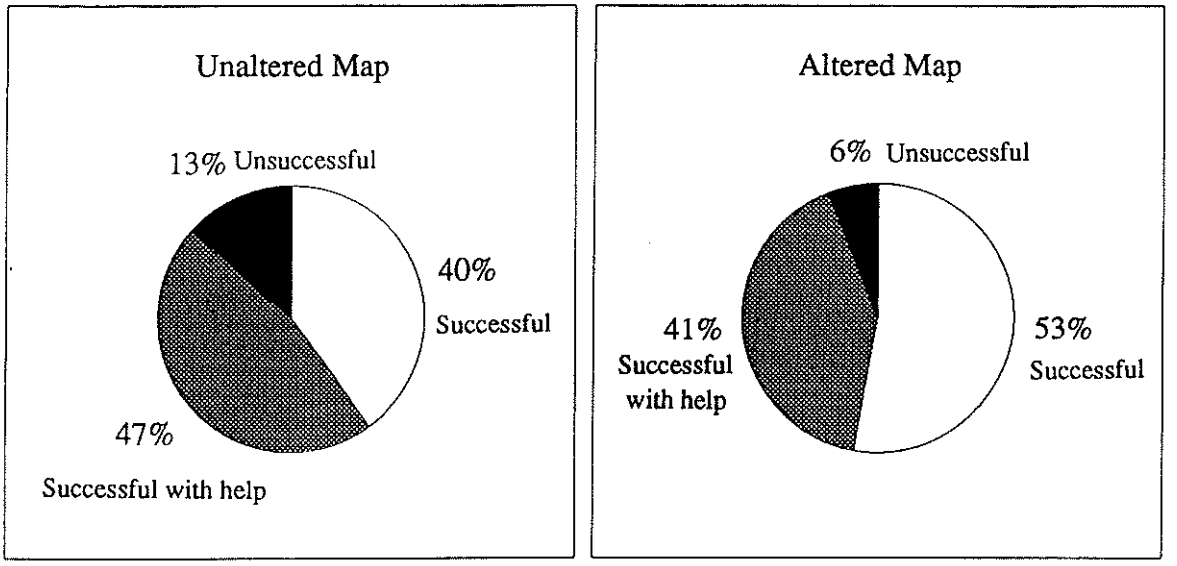


Figure 10. *Comparison of route-planning success between altered and unaltered maps.*

Route Planning Times

Wilcoxon Rank Sum tests were used to compare average route-planning times for each trip. This non-parametric statistical test was chosen because it does not require any distribution assumptions and will accommodate small-to-medium sample sizes.

For Trip 1, a comparison was made between the average planning time for all subjects using the unaltered version of the map versus the average planning time for all subjects using the altered version. A second comparison was made between the two average times after all unsuccessful Trip 1 plans were dropped from the averages (Table 4).

TABLE 4.
Comparison of average trip-planning times between map versions - Trip 1

Trip 1: Average Planning Times:	All Times Included	Unsuccessful Plans Dropped
Unaltered Map	18.87	18.21
Altered Map	14.41	14.17
Prob > /Z/	0.1860	0.2257

Similar tests were conducted for the average planning times for Trip 2 (Tables 5 and 6) and Trip 3 (Tables 7 and 8), with the two map versions and the two orders of trip presentation as the bases for comparison.

TABLE 5.
Comparison of average trip-planning times between map versions - Trip 2

Trip 2: Average Planning Times:	All Times Included	Unsuccessful Plans Dropped
Unaltered Map	16.37	15.97
Altered Map	16.62	16.03
Prob > /Z/	0.9548	0.9999

TABLE 6.
Comparison of average trip-planning times between orders of trip presentation - Trip 2

Trip 2: Average Planning Times:	All Times Included	Unsuccessful Plans Dropped
Trip 2 presented second	19.87	19.21
Trip 2 presented third	13.53	13.35
Prob > /Z/	0.0586	0.0768

TABLE 7.
Comparison of average trip-planning times between map versions - Trip 3

Trip 3: Average Planning Times:	All Times Included	Unsuccessful Plans Dropped
Unaltered Map	15.33	14.67
Altered Map	17.53	16.22
Prob > /Z/	0.5208	0.6474

TABLE 8.
Comparison of average trip-planning times between orders of trip presentation - Trip 2

Trip 3: Average Planning Times:	All Times Included	Unsuccessful Plans Dropped
Trip 3 presented second	20.00	18.59
Trip 3 presented third	12.53	11.46
Prob > /Z/	0.0258	0.280

No significant difference was found between map versions for the average planning times on Trip 1, 2, or 3. Time differences remained non-significant when times for unsuccessful plans were dropped.

Significant differences were found in the average times for Trip 3 based on whether it was presented as the second or third excercise. A similar comparison of average times for Trip 2 did not show a significant difference at the p=.05 level, but differed by five minutes. This may suggest that a learning curve is involved in the first attempts at using this information package.

Prompts Needed

The numbers given are the number of participants who needed prompting at the specified point in the planning process; some participants needed prompting more than once for the same type of difficulty.

Problem requiring prompting	# of subjects	# using unaltered map	# using altered map
• Identification of transfer points:	8	5 (33%)	3 (18%)
• Identification of landmarks/bus stops:	6	3 (20%)	3 (18%)
• Identification of the route lines on the map:	5	3 (20%)	2 (12%)
• Availability of information in the package:	3	2 (13%)	1 (6%)
• Location/use of inset maps:	3	1 (7%)	2 (12%)
• Interpretation of the index:	1		1 (6%)
• Meaning of route names:	1	1 (7%)	

Additional Problems

These were points of difficulty encountered by participants which did not require outside help but added to the time taken to plan the trip.

Problem (not requiring prompting)	# of subjects	# using unaltered map	# using altered map
• Identification of transfer points:	15	6 (40%)	9 (53%)
• Timetable use/labeling:	9	4 (27%)	5 (29%)
• Identification of landmarks/bus stops:	7	4 (27%)	3 (18%)
• Route schedules not adjacent to route maps:	3	2 (13%)	1 (6%)
• Print size/contrast:	2	1 (7%)	1 (6%)
• Identification of routes and route numbers:	2		2 (12%)
• Meaning of route names:	1	1 (7%)	
• Location/use of inset maps:	1	1 (7%)	
• Directional symbol inadequate:	1	1 (7%)	

The problem encountered most often in the use of the maps was in determining transfer points between routes. Although the trip planning scenarios were designed so that

necessary transfers could be accomplished at designated Transit Centers or Park-and-Rides, approximately 75% of test subjects had difficulty either in seeing these labeled points on the map or in determining whether or not a bus stopped there. One-third of those having trouble had to be helped at this point in the planning process, and the other two-thirds experienced delays as they examined the schedules of two or more routes to determine which one stopped where they needed to transfer to another route. The most common trouble spot was the 7th Street Transit Center, where a small inset map showed a network of fifteen routes that intersect in downtown Vancouver. Problems also occured at the Salmon Creek Park-and-Ride: two routes on the same red line appeared to stop at Salmon Creek, where in fact only one of them did. There were also problems with the name of that stop -- three subjects searched their schedule booklets for a stop named "134th St.", which would have been consistent with the "7th Street" Transit Center.

A related problem, which created difficulties for 46% of subjects, was locating bus stops for the start and end points of the trips. No indication of bus stops was given on the system map, and so route planning required trial-and-error scanning of possible routes' schedules to locate a stop. The schedule booklet states that there are more stops than those listed as timepoints in the schedules, bus does not state that buses stop at every corner -- only that the bus stops wherever there is a sign posted on the street, which gives no information to the person who is using the map.

Use of the timetables presented difficulties for 9 of the 32 subjects; all of these subjects attempted the schedules without assistance, but all experienced delays and several made errors in reading the tables and selecting times. Six of the nine "unsuccessful" trip plans were unsuccessful due to a mistake in interpreting the timetables or to using the wrong timetable for the correct route (for instance, inadvertantly using a weekday schedule instead of a weekend schedule).

Participants searched for the routes they needed in three ways: (1) by finding start and destination locations on the map and scanning for nearby route lines, (2) checking the routes whose numbers were listed in the index next to the start or destination, and (3) by scanning the list of route names in the legend for a name that corresponded to the location of interest. Most subjects used more than one of these methods during their three trip plans, switching from one method to another if they experienced difficulties or wanted to clarify their choices of routes.

- 31 (97%) searched for *route lines* on the map;
- 16 (50%) searched for *route numbers* in the index;
- 6 (19%) searched for *route names* in the map legend or the Rider's Digest.

The six participants who tried to find route names that corresponded to their destination or starting point all experienced difficulties and switched to checking route lines or route numbers to determine the correct route. The difficulties arose because many streets and landmarks are served by more than one route, and a route that is named for a particular street or landmark may not be the only one that travels there. Additionally, one participant rejected a route because its name did not mention the destination he needed. These difficulties occurred with equal frequency for both versions of the route names.

Suggestions
These suggestions were made by participants as comments during the trip-planning process or during the opinion questionnaire that followed.

	Number of Participants making suggestion
Use black print instead of gray for street map.	10
Include information on stops/transfers on the map.	8
Include instructions/examples for use of the materials.	4
Increase print sizes.	4
Clarify streets/street names on system map.	3
Use darker colors for route lines.	2
Use route numbers only, not names.	1
Use shape coding for routes.	1
Include a more prominent direction symbol. (N,S,E,W)	1
Orient all route maps with North at the top.	1
Give each route a separate line on the system map.	1
Use decimal-number locator index on system map.	1
Better labeling/orientation of inset maps.	1
Consolidate all information in one guide.	1
Provide a 24-hour information service.	1

The most common complaint voiced by the study participants was the difficulty of reading the gray print that was used for lines and text in the street map. While it was supposed to reduce visual "clutter" and emphasize the route lines, it made detection of street names and landmarks difficult. These participants felt that the colored route lines would stand out just as well against a street map with black lines and text. Other suggestions concerning the format of the system map were to increase print sizes for landmark names and for the downtown inset (four participants) and to reposition some street names to clarify the location of streets (three participants).

As expected from the number of people who had difficulty with bus stops and transfers, the next most common suggestion was to provide more information about these points on the map. Most of these suggestions specified adding labels to the map at bus stops and transfer points.

Four participants suggested the addition of instructions for use and/or examples to demonstrate how to use the materials to plan a trip. Several other participants commented, after completing the first or second of their trip plans, that the process was "getting easier" now that they had figured out how to use and coordinate the maps and timetables.

CONCLUSIONS

Potential public transit riders fall into two general categories: (1) those who are familiar with the system they will ride and (2) those who are new to the area and/or new to the public transit system for that area. The latter group was the one targeted by this study.

The route names used in the original map and schedules for the Clark County bus system were based on the main streets that the buses followed. In the altered version of the map, cardinal directions (N, S, E, W) were added to each route name, corresponding to the direction each route traveled as it left the center of town; this modification was added due to the student survey that suggested cardinal directions as an effective route-selection aid. The change in route names was the variable in question for the performance study, to determine if the different naming scheme would improve route-finding accuracy and/or speed.

Observations of the test participants suggested what was later supported by comparisons of participants' planning times and accuracy between the two versions of the map: route names were virtually ignored by most of the test participants. At best, the names were a redundancy, noted after the route's line had been selected from the map and its number identified; at worst, the street or landmark that named the route caused confusion as the participant tried unsuccessfully to match that name with other destinations the route served.

Since no improvement in route-finding accuracy or speed was realized with the change in route names and since route names were ranked as "least helpful" of three route-selection tools by 63% of participants, the conclusion of this study is that route names, added to route numbers or other arbitrary designators, have no significantly beneficial effect and could likely be eliminated from passenger information aids without diminishing understanding and ease of use of the system.

Number identification, combined with color coding or other grouping, appears to be the best method for naming routes.

RECOMMENDATIONS

Because of the constraints imposed by ADA requirements for letter height on signs, the amount and format of route guidance information may have to be modified for bus stop and bus terminal displays. Several areas of the United States must deal with a high illiteracy rate and/or a large number of customers for whom English is a second language. Some research, then, should be devoted to investigating possible formats which make the best use of alphanumerics, symbols, and pictures. Possible models for a multilingual or "non-word" information system are European transit systems such as the London or Paris Underground. Options such as shape coding or single-letter/number route "names" may provide such a solution. Subject preferences in this study supported previous findings about the beneficial effect of color coding of routes. Even with only five colors used for the 27 routes in this schedule, 75% of subjects cited the color coding as "very helpful". The actual categories that the colors represented (urban, rural, commuter, and "free shuttle" routes) were not as important to subjects; they valued the colors simply as a search/selection aid.

A few of the subjects suggested adding a "sample problem" to the route guidance information that would demonstrate how to use the maps and schedules to plan a trip between two points. Wildbur (1989) made a similar suggestion regarding timetables. A study might compare a route guidance information package with and without a sample problem demonstrating its use.

The map used in this study was a simplified version of a regular (topographical) street map, with bus routes shown as colored lines superimposed on the street lines. Other types of maps that appeared in the sample obtained from the transit company survey included (1) schematics which showed only the general courses of the routes and connections (no street detail) and (2) oblique maps which showed a schematized view of the routes, city streets, and major buildings/landmarks. This second type was called a "cartoon" map by one transit system's representative who described her company's map in the telephone survey. A representative from another system that used an oblique map with "cartoons" said that passengers liked this "new" map better than the street-map format that was previously used, but the operators who answered passengers' route questions over the phone kept the old street-map version because of its more detailed information about streets and locations. A study could investigate how an increased level of graphics and schematization and the associated decrease in street detail affect route-finding performance.

Graphics may also play a part in timetable comprehension. The timetables published by the SmartMaps company are printed on the same page as a schematized map of the route, which is oriented from left to right on the page. The columns of times are then placed under the locations of the steps shown in the route map, to emphasize that the table is read left to right, with each row representing one beginning-to-end "run" of the route. Would a format such as this one improve the performance of individuals who have difficulty interpreting traditional timetable formats like the one used in this study?

In any study involving the design of route information, the familiarity of the subject population with the city in "use" must be defined. Are the subjects being asked to plan routes in an unfamiliar city, as if they were newcomers or visitors (the approach used this study)? Or are they planning routes in the town where they are long-term residents? The assumption heard most often from transit companies that were surveyed was that the typical passenger would be a long-term resident, familiar with the city and the public transit system. While this describes one group of riders, it neglects the new riders or potential riders of the system, who may be either new to the area or new to public transit, or simply traveling to an unfamiliar part of the city. This is the group for which passenger information aids should be designed --

the potential customers who may choose not to ride public transit due to their fear of getting lost or stranded.

REFERENCES

Bartram, D. The presentation of information about bus services. *Information Design*, ed. by R. Easterby & H. Zwaga, John Wiley & Sons Ltd., New York, 1984; p.299-320.

Batelle Memorial Institute, Transit user information aids: an evaluation of consumer attitudes. Department of Transportation, Urban Mass Transit Adminstration, Office of Transit Management, Washington, D.C., Feb. 1976.

Cheng, P. Aging driver needs in a automobile-oriented region: design of route guidance information for elderly bus passengers. Texas Transportation Institute, College Station, Texas, 1992.

Christ, R.E. Research for evaluating visual display codes: an emphasis on color coding. *Information Design*, edited by R. Easterby & H. Zwaga, John Wiley & Sons Ltd., New York, 1984; p. 209-228.

Ellson, P.B. and Tebb, R.G.P., Requirements, design and comprehensibility of leaflets to promote existing bus services. Supplementary Report 371, Transport and Road Research Laboratory; Berkshire, Great Britain, 1978a.

Ellson, P.B. and Tebb, R.G.P. Costs and benefits of a bus-service leaflet. TRRL Laboratory Report 825, Transport and Road Research Laboratory; Berkshire, Great Britain, 1978b.

Ellson, P.B. and Tebb, R.G.P., Leaflets giving information about existing urban public transport services: requirements, design and comprehensibility. TRRL Laboratory Report 990, Transport and Road Research Laboratory; Berkshire, Great Britain, 1981.

Garland, H.C., Haynes, J.J., Grubb, G.C. Transit map color coding and street detail: effects on trip planning performance. *Environment and Behavior, 11(2)*, 1979, 162-184.

Kaeser & Wilson Design, Ltd. User survey of surface transit information systems. Final report prepared for the New York City Department of Transportation, Bureau of Planning and Research; October, 1981.

Sperling, D., Goralka, R. Demand for intercity bus by the rural elderly. Transportation Research Record 1202, Transportation Research Group, University of California, Davis, California, 1990.

Sprent, N., Bartram, D., Crawshaw, C.M. Intelligibility of bus timetables. *Human Factors in Transport Research*, Edited by D.J. Osborne and J.A. Levis; Academic Press, New York, 1980, Vol.1, p.319-327.

Tufte, E.R. *Envisioning Information.* Graphics Press; Cheshire, Connecticut, 1990, p. 101-105.

Van der Kooi, H. Case study -- designing new maps for the Municipal Transit Company of Amsterdam. *Information Graphics*, by Peter Wildbur; Van Nostrand Reinhold Co., New York, 1989, p. 74-77.

Wildbur, P. *Information Graphics*; Van Nostrand Reinhold, New York, 1989, p. 90-103 and p. 14.

APPENDIX A

TRANSIT COMPANY SURVEY AND COVER LETTER

Texas Transportation Institute
Texas A&M University System
College Station, TX 77843
June 15, 1993

Name
Bus System
Address

Dear ___

As part of a research study on public transit passenger information aids for the Texas Transportation Institute, I am conducting a telephone survey to collect information about the formats used in route guidance information by public bus systems. I will be telephoning your office during the week of _____ to ask for your participation in this survey.

I have enclosed the survey questions so that you will know ahead of my call what the survey will consist of. The survey should take no more than ten or fifteen minutes.

I look forward to talking with you and hope that you will have the time to participate. If you have any questions, please call me at (409) 862-2801 (office) or (409) 268-1051 (home).

Sincerely yours,

Laura L. Higgins

Transit Company Survey

1) What type of literature do you distribute for your passengers?

   Network maps showing all routes?
   Individual route maps and schedules?

2) How are routes identified in the literature?

   A. In the network map:

   Color coded, with legend
   Color coded, without legend

   Number/letter coded, with legend
   Number/letter coded, without legend

   Named by streets/location
   Names not corresponding to street/location

   Other

   B. In the individual route maps/schedules: *

   Color names
   Street/location names
   Letter/number + street/location names
   Letter/number only
   Other

3) How are routes identified on bus stop signs or bus terminal displays?

   Color names
   Street/location names
   Letter/number + street/location names
   Letter/number only
   Other

4) How was this naming system selected?

5) How well is this naming system working?

   Do you like it?
   Are you planning to change the way you identify routes?

*NOTE: this refers to the route name as given in the title of the leaflet or brochure

APPENDIX B

STUDENT SURVEY - NAMING BUS ROUTES

Human Factors of Bus Route Information

In this exercise, you are asked to imagine that you are a newcomer to Bryan/College Station, have no car, and must rely on the public bus system to get around in the two cities. The Brazos Transit routes are marked on the map. The map and the schedules on the back are the only information you have to help you in your travels.

Exercise: Name these seven bus routes in a way that you feel would be the most helpful to you as you tried to plan bus trips through town.

- Briefly describe how/why you decided on the naming scheme you use.
- Please work on your own, without consulting your classmates or others. There are no wrong answers!
- You can mark on the map itself or on the back of this sheet of paper. You can also use your own paper if you need more room.

*** Have you used public transit systems before? Please mark the response below that describes your experience with public transit. If you have ridden public transit, please write down the name(s) of the city(s) where you rode.

I have used public transit:

__ **Never**

__ **Once or twice in** _____(city,state)

__ **Occasionally in** _____

__ **Regularly in** _____

APPENDIX C

CONSENT FORM FOR TRIP PLANNING STUDY

TEXAS TRANSPORTATION INSTITUTE
The Texas A&M University System

INSTRUMENT TO OBTAIN INFORMED CONSENT

You have been asked to participate in a study entitled "Route Guidance Information for Elderly Bus Passengers: Route Identification Methods". This research is funded by the University Transportation Centers Program. The purpose of the research is to make certain that people are able to use the information provided by a bus system in order to get to desired destinations without the assistance of other people. Thirty people will participate in this study.

In this study, you will be asked to pretend that you are a newcomer to a city which you have never visited before. You have no private transportation and must use the bus system to get to a few places. You will be given some bus schedules and maps for different bus routes. You are asked to use this information to plan how to get from some starting point to three different desired destinations. You will be asked to plan these trips without any assistance from anyone, which means that I will not be able to answer any questions about the schedules once we begin. After you complete this part of the experiment, I will talk with you about difficulties or problems you might have had while you were planning your trips.

Please remember that the purpose of this study is **not** to test your abilities to use the information provided to you. The goal of the study is simply to find out the types of problems and difficulties people have in using information provided by bus systems.

To reimburse you for your time and trouble to work with us, we will pay you ten dollars per hour, payable when your participation is complete. This payment is not subject to the outcome of your trip-planning process. You will paid regardless of whether you choose to withdraw from the study at a later date.

You may be called again to answer more questions or critique some design features of the information package. You will receive payment again for additional participation.

Other than the repayment of your expenses, there are no other benefits to you for working with us. You are doing a service for the Texas Transportation Institute and me to help us understand how to design better information for elderly bus passengers.

Other than questions about how to use the route information and maps, I will be happy to answer any questions that you may have to the best of my knowledge.

Once again, you are free to stop at any time for any reason. We appreciate your willingness to work with us as a participant in our research, and will be calling on you again regardless of whether you complete this project or not.

Participant's Initials:_____

We will be using information that we get from you for design and statistical purposes only. We will never disclose your identity or allow anyone not on this project to see your data with your name on it. Our files will kept under lock and key.

This research has been reviewed and approved by the Institutional Review Board -- Human Subjects in Research, Texas A&M University. For research related problems or questions regarding subjects' rights, the Institutional Review Board may be contacted through the Office of University Research, (409) 845-1812.

I , the undersigned, have been read the above explanations, and give my consent to my voluntary participation in this research project entitled "Route Guidance Information for Elderly Bus Passengers: Route Identification Methods".

Signature of Participant Date

Signature of Researcher

Laura Higgins
303K Zachry Engr. Ctr.
Texas A&M University
862-2801

Principal Investigator:
Rodger J. Koppa
Transport Operations Program
TTI
845-3540

APPENDIX D

INSTRUCTIONS TO PARTICIPANTS

SCENARIO

You are a newcomer to Vancouver, Washington. You do not have a car but need to get to a few places in the city and to some nearby towns. Your only means of transportation is the Vancouver "C-Tran" public bus system, which operates in Vancouver and also travels to four other communities. You wrote to C-Tran for bus information, and they have sent you their information package, which consists of a map of the city with all the bus routes, a "Rider's Digest" which contains individual maps and schedules for each route, and an index of selected city streets and Points of Interest. Your telephone has not been installed, so you are unable to call C-Tran for assistance in planning your bus trips. Therefore, you must rely solely on the package of information sent to you to ride the buses.

RULES

1. You will be given the bus system map, the Rider's Digest, and the index of streets and points of interest. You are asked to use this information to plan trips from three starting points to three destinations. You will have some time to familiarize yourself with the materials before the study begins.

2. I will be happy to answer any questions concerning this study, but I cannot answer questions about how to use the schedule and map information.

3. Assume that all buses will arrive on time.

4. Allow 10 minutes for transfers between buses.

5. For the purposes of this study, all starting points and destinations are bus stops as listed in the schedules. Please be sure, if you make any transfers, that both buses actually stop at the same corner or Transit Center.

6. Several spaces are provided on the worksheet for each trip to write down bus route numbers and arrival/departure times. You may not need to use all the spaces for every trip.

7. I will take notes on your route-planning process. As much as you can, please tell me what you are doing as you go along.

8. Please work at a pace that is comfortable. There is no time limit on your planning process. **The purpose of this study is <u>not</u> to test your abilities to use the information that is provided.** This study is intended to test different ways of presenting bus information, in order to find out what people can use most effectively.

APPENDIX E

DATA SHEETS FOR TRIP PLANNING STUDY

Name:_____

Start Time:_____ Finish Time:_____ Total Time:_____

Trip 1: From the Marshall Center, you want to arrive at the corner of E.18th Street and Andreson Road by 9:30 A.M. on Wednesday.

Route Number:

Departure Location:_____ Departure Time:_____

Arrival Location:_____ Arrival Time:_____

Route Number:

Departure Location:_____ Departure Time:_____

Arrival Location:_____ Arrival Time:_____

Route Number:

Departure Location:_____ Departure Time:_____

Arrival Location:_____ Arrival Time:_____

Route Number:

Departure Location:_____ Departure Time:_____

Arrival Location:_____ Arrival Time:_____

Name:_____

Start Time:_____ Finish Time:_____ Total Time:_____

Trip 2: From the Veterans Hospital, you want to arrive at the Battle Ground Park & Ride by 1:15 p.m. on Saturday.

Route Number:

Departure Location:_____ **Departure Time:**_____

Arrival Location:_____ **Arrival Time:**_____

Route Number:

Departure Location:_____ **Departure Time:**_____

Arrival Location:_____ **Arrival Time:**_____

Route Number:

Departure Location:_____ **Departure Time:**_____

Arrival Location:_____ **Arrival Time:**_____

Route Number:

Departure Location:_____ **Departure Time:**_____

Arrival Location:_____ **Arrival Time:**_____

Name:_____

Start Time:_____ Finish Time:_____ Total Time:_____

Trip 3: From the corner of Simpson and 18th Street you want to arrive at Ridgefield by 5:34 p.m. on Tuesday.

Route Number:

Departure Location:_____ Departure Time:_____

Arrival Location:_____ Arrival Time:_____

Route Number:

Departure Location:_____ Departure Time:_____

Arrival Location:_____ Arrival Time:_____

Route Number:

Departure Location:_____ Departure Time:_____

Arrival Location:_____ Arrival Time:_____

Route Number:

Departure Location:_____ Departure Time:_____

Arrival Location:_____ Arrival Time:_____

APPENDIX F

OPINION QUESTIONNAIRE FOR TRIP PLANNING STUDY PARTICIPANTS

Form A - Questionnaire

Name:
Time Start:
Time Finish:
Total Time:
Gender:
Age:
Frequency of Use:

1. The print sizes on the map (for street names, landmarks, etc.)

   __ were very easy to read.
   __ were reasonably easy to read.
   __ were slightly difficult to read.
   __ were very difficult to read.

2. Transfer points between buses

   __ were very easy to find.
   __ were reasonably easy to find.
   __ were slightly difficult to find.
   __ were very difficult to find.

3. __ It was very easy to tell where buses stopped.
   __ It was reasonably easy to tell where buses stopped.
   __ It was slightly difficult to tell where buses stopped.
   __ It was very difficult to tell where buses stopped.

4. The inset maps were

   __ very easy to use.
   __ reasonably easy to use.
   __ slightly difficult to use.
   __ very difficult to use.

5. The index of street names and points of interest was

   __ very helpful.
   __ slightly helpful.
   __ not very helpful.
   __ not at all helpful.
   __ I didn't use the index.

6. The individual route maps in the Rider's Digest were

__ very helpful.
__ slightly helpful.
__ not very helpful.
__ not at all helpful.
__ I didn't use these maps.

7. The information given on the system map was

__ completely adequate.
__ pretty adequate.
__ pretty inadequate.
__ completely inadequate.

8. The timetables for each route were

__ very easy to understand.
__ reasonably easy to understand.
__ slightly difficult to understand.
__ very difficult to understand.

9. The color coding of route types (local, express, rural) was

__ very helpful in locating particular routes.
__ somewhat helpful in locating particular routes.
__ not very helpful in locating particular routes.
__ not at all helpful in locating particular routes.

10. The names of the routes (Fruit Valley, Express via I-5, etc.) were

__ very helpful in locating particular routes.
__ somewhat helpful in locating particular routes.
__ not very helpful in locating particular routes.
__ not at all helpful in locating particular routes.

11. Of the following, which was the most helpful to you as you searched for the routes you needed?

__ Route colors
__ Route names
__ Index of route numbers

Which was the least helpful?

__ Route colors
__ Route names
__ Index of route numbers

12. Do you feel confident that you can use this information package to take the buses to get to where you want to go (without outside information or assistance)?

__ Very confident
__ Reasonably confident
__ Somewhat unsure
__ Very unsure

13. Is there anything you would change in the way routes are identified in this information package? Check any items that apply and jot down how you would change them.

__ Route Names:

__ Route Number

__ Color:

__ Route Classifications:

__ Route Indexing:

__ Other:

14. Is there any other information you would add to the package?

APPENDIX G

SAS OUTPUT FOR WILCOXON RANK SUM TESTS: TRIP PLANNING TIMES

Comparison of planning times for Trip 1 between altered and unaltered versions of the map. Planning time for an unsuccessful Trip 1 plan has been dropped, leaving 14 times for the unaltered map and 17 for the altered map.

N P A R 1 W A Y P R O C E D U R E

Wilcoxon Scores (Rank Sums) for Variable TIME1
Classified by Variable VERSION

VERSION	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
unalt	14	255.0	224.0	25.1773494	18.2142857
alter	17	241.0	272.0	25.1773494	14.1764706

Average Scores were used for Ties

Wilcoxon 2-Sample Test (Normal Approximation)
(with Continuity Correction of .5)

S= 255.000 Z= 1.21141 Prob > |Z| = 0.2257

T-Test approx. Significance = 0.2352

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ= 1.5160 DF= 1 Prob > CHISQ= 0.2182

Comparison of planning times for Trip 2 between altered and unaltered versions of the map. Planning time for an unsuccessful Trip 2 plan has been dropped, leaving 15 times for the unaltered map and 16 for the altered map.

N P A R 1 W A Y P R O C E D U R E

Wilcoxon Scores (Rank Sums) for Variable TIME2
Classified by Variable VERSION

VERSION	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
unalt	15	239.500000	240.0	25.2548303	15.9666667
alter	16	256.500000	256.0	25.2548303	16.0312500

Average Scores were used for Ties

Wilcoxon 2-Sample Test (Normal Approximation)
(with Continuity Correction of .5)

S= 239.500 Z= 0 Prob > |Z| = 0.9999

T-Test approx. Significance = 0.9999

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ= 0.00039 DF= 1 Prob > CHISQ= 0.9842

Comparison of planning times for Trip 2 between two orders of presentation: Trip 2 presented second in the planning exercise (Order 1) or presented third (Order 2). Planning time for an unsuccessful Trip 2 plan has been dropped, leaving 14 times for Order 1 and 17 for Order 2.

N P A R 1 W A Y P R O C E D U R E

Wilcoxon Scores (Rank Sums) for Variable TIME2
Classified by Variable ORDER

ORDER	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	14	269.0	224.0	25.1493817	19.2142857
2	17	227.0	272.0	25.1493817	13.3529412

Average Scores were used for Ties

Wilcoxon 2-Sample Test (Normal Approximation)
(with Continuity Correction of .5)

S= 269.000 Z= 1.76943 Prob > |Z| = 0.0768

T-Test approx. Significance = 0.0870

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ= 3.2016 DF= 1 Prob > CHISQ= 0.0736

Comparison of planning times for Trip 3 between altered and unaltered versions of the map. Planning time for unsuccessful Trip 3 plans have been dropped, leaving 14 times for the unaltered map and 16 for the altered map.

N P A R 1 W A Y P R O C E D U R E

Wilcoxon Scores (Rank Sums) for Variable TIME3
Classified by Variable VERSION

VERSION	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
unalt	14	205.500000	217.0	24.0474626	14.6785714
alter	16	259.500000	248.0	24.0474626	16.2187500

Average Scores were used for Ties

Wilcoxon 2-Sample Test (Normal Approximation)
(with Continuity Correction of .5)

S= 205.500 Z= -.457429 Prob > |Z| = 0.6474

T-Test approx. Significance = 0.6508

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ= 0.22870 DF= 1 Prob > CHISQ= 0.6325

Comparison of planning times for Trip 3 between two orders of presentation: Trip 3 presented third in the planning exercise (Order 1) or presented second (Order 2). Planning time for unsuccessful Trip 3 plans have been dropped, leaving 13 times for Order 1 and 17 for Order 2.

N P A R 1 W A Y P R O C E D U R E

Wilcoxon Scores (Rank Sums) for Variable TIME3
Classified by Variable ORDER

ORDER	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	13	149.0	201.500000	23.8858877	11.4615385
2	17	316.0	263.500000	23.8858877	18.5882353

Average Scores were used for Ties

Wilcoxon 2-Sample Test (Normal Approximation)
(with Continuity Correction of .5)

S= 149.000 Z= -2.17702 Prob > |Z| = 0.0295

T-Test approx. Significance = 0.0378

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ= 4.8310 DF= 1 Prob > CHISQ= 0.0280

APPENDIX H

OPINION QUESTIONNAIRE RESULTS

	very good		good		poor		very poor		n/ a	
	unalt.	alter	unalt.	alter	unalt.	alter	unalt.	alter	unalt.	alter
print sizes	6 40%	1 6%	6 40%	6 35%	2 13%	10 59%	1 7%	0%	0%	
transfer points	3 20%	6 35%	7 47%	7 41%	4 27%	2 12%	1 7%	2 12%	0%	
bus stops	4 27%	8 47%	6 40%	5 29%	4 27%	3 18%	1 7%	1 6%	0%	
inset maps	5 33%	10 59%	7 47%	4 24%	3 20%	2 12%	0%	0%	0%	
st./landmark index	11 73%	15 88%	3 20%	2 12%	0%	0%	0%	0%	1 7%	0%
route maps	10 67%	10 59%	1 7%	1 6%	0%	1 6%	1 7%	0%	3 20%	5 29%
system map information	6 40%	8 47%	9 60%	8 47%	0%	1 6%	0%	0%	0%	
timetables	11 73%	11 65%	3 20%	5 29%	0%	1 6%	1 7%	0%	0%	
color coding	11 73%	13 76%	4 27%	3 18%	0%	1 6%	0%	0%	0%	
route names	5 33%	5 29%	3 20%	6 35%	2 13%	1 6%	5 33%	5 29%	0%	
overall confidence	5 33%	6 35%	6 40%	10 59%	3 20%	1 6%	1 7%	0%	0%	

	colors		names		index of #'s	
	unalt.	alter	unalt.	alter	unalt.	alter
most helpful	11 73%	15 88%	0%	1 6%	4 27%	3 18%
least helpful	0%	0%	9 60%	11 65%	6 40%	6 35%