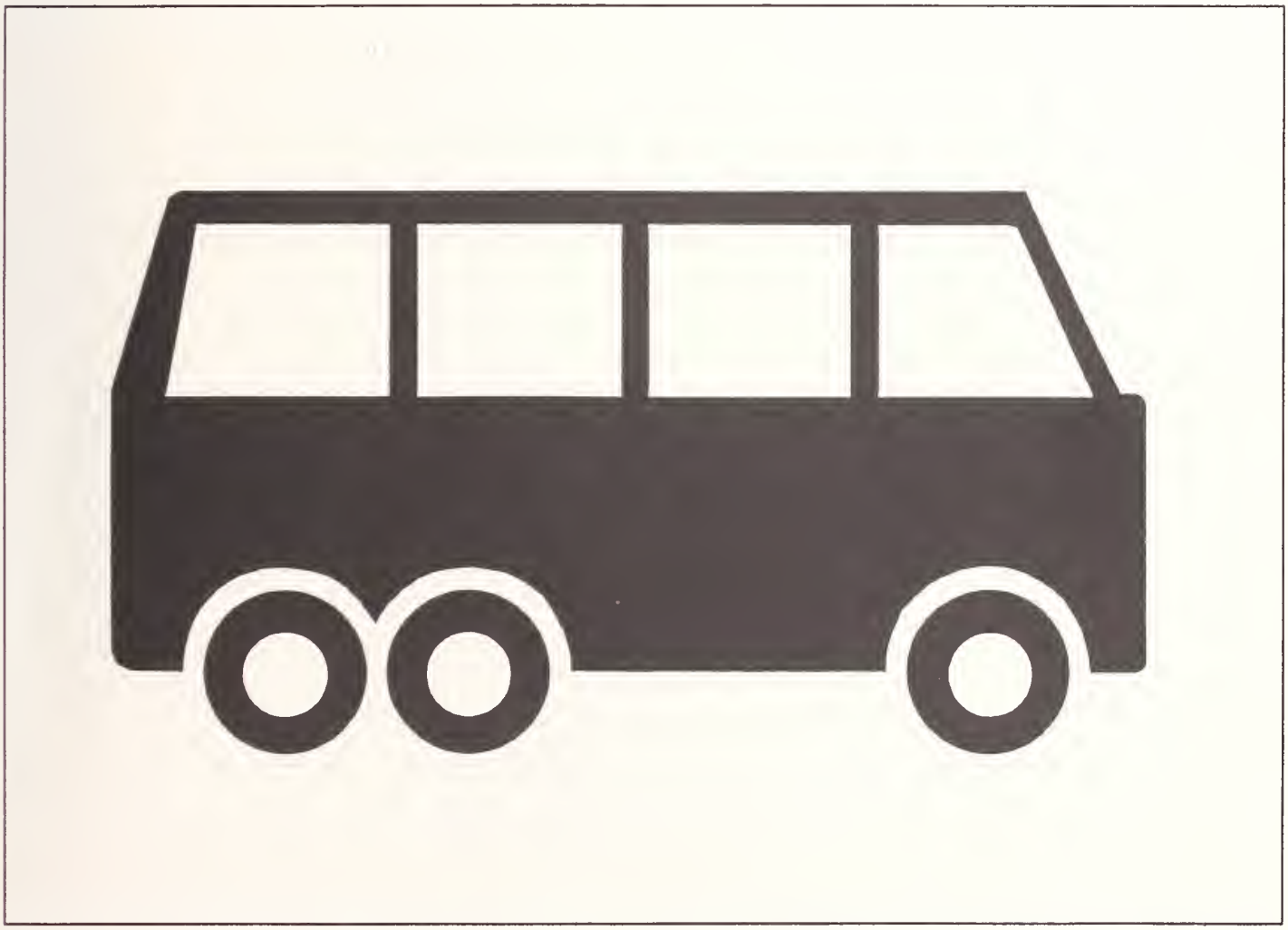
U.S. Department
of Transportation

Improving Bus Accessibility Systems for Persons with Sensory and Cognitive Impairments

August 1993



FEDERAL TRANSIT ADMINISTRATION

Improving Bus Accessibility Systems for Persons with Sensory and Cognitive Impairments

Final Report
August 1993

Prepared by

Katharine M. Hunter-Zaworski
and Martha Hron
Transportation Research Institute
Oregon State University
Corvallis, Oregon 97331

Prepared for

University Research and Training Program
Office of Technical Assistance
Federal Transit Administration
Washington, D.C. 20590

Distributed in Cooperation with

Technology Sharing Program
U.S. Department of Transportation
Washington, D.C. 20590

DOT-T-94-04

METRIC / ENGLISH CONVERSION FACTORS

ENGLISH TO METRIC

LENGTH (APPROXIMATE)

1 inch (in) = 2.5 centimeters (cm)
1 foot (ft) = 30 centimeters (cm)
1 yard (yd) = 0.9 meter (m)
1 mile (mi) = 1.6 kilometers (km)

AREA (APPROXIMATE)

1 square inch (sq in, in^2) = 6.5 square centimeters (cm^2)
1 square foot (sq ft, ft^2) = 0.09 square meter (m^2)
1 square yard (sq yd, yd^2) = 0.8 square meter (m^2)
1 square mile (sq mi, mi^2) = 2.6 square kilometers (km^2)
1 acre = 0.4 hectares (he) = 4,000 square meters (m^2)

MASS - WEIGHT (APPROXIMATE)

1 ounce (oz) = 28 grams (gr)
1 pound (lb) = .45 kilogram (kg)
1 short ton = 2,000 pounds (lb) = 0.9 tonne (t)

VOLUME (APPROXIMATE)

1 teaspoon (tsp) = 5 milliliters (ml)
1 tablespoon (tbsp) = 15 milliliters (ml)
1 fluid ounce (fl oz) = 30 milliliters (ml)
1 cup (c) = 0.24 liter (l)
1 pint (pt) = 0.47 liter (l)
1 quart (qt) = 0.96 liter (l)
1 gallon (gal) = 3.8 liters (l)
1 cubic foot (cu ft, ft^3) = 0.03 cubic meter (m^3)
1 cubic yard (cu yd, yd^3) = 0.76 cubic meter (m^3)

TEMPERATURE (EXACT)

$[(x - 32)(5/9)]\ ^\circ F = y\ ^\circ C$

METRIC TO ENGLISH

LENGTH (APPROXIMATE)

1 millimeter (mm) = 0.04 inch (in)
1 centimeter (cm) = 0.4 inch (in)
1 meter (m) = 3.3 feet (ft)
1 meter (m) = 1.1 yards (yd)
1 kilometer (km) = 0.6 mile (mi)

AREA (APPROXIMATE)

1 square centimeter (cm^2) = 0.16 square inch (sq in, in^2)
1 square meter (m^2) = 1.2 square yards (sq yd, yd^2)
1 square kilometer (km^2) = 0.4 square mile (sq mi, mi^2)
1 hectare (he) = 10,000 square meters (m^2) = 2.5 acres

MASS - WEIGHT (APPROXIMATE)

1 gram (gr) = 0.036 ounce (oz)
1 kilogram (kg) = 2.2 pounds (lb)
1 tonne (t) = 1,000 kilograms (kg) = 1.1 short tons

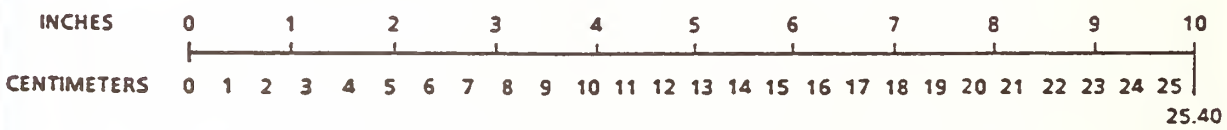
VOLUME (APPROXIMATE)

1 milliliter (ml) = 0.03 fluid ounce (fl oz)
1 liter (l) = 2.1 pints (pt)
1 liter (l) = 1.06 quarts (qt)
1 liter (l) = 0.26 gallon (gal)
1 cubic meter (m^3) = 36 cubic feet (cu ft, ft^3)
1 cubic meter (m^3) = 1.3 cubic yards (cu yd, yd^3)

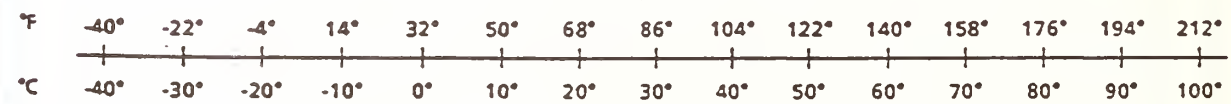
TEMPERATURE (EXACT)

$[(9/5)y + 32]\ ^\circ C = x\ ^\circ F$

QUICK INCH-CENTIMETER LENGTH CONVERSION



QUICK FAHRENHEIT-CELCIUS TEMPERATURE CONVERSION



For more exact and/or other conversion factors, see NBS Miscellaneous Publication 286, Units of Weights and Measures. Price $2.50. SD Catalog No. C13 10 286.

TABLE OF CONTENTS

ABSTRACT

With the passage of the American with Disabilities Act (ADA) it has become a civil rights violation to deny access to persons with disabilities to public transportation. The ADA requires transit agencies to provide accessible buses or equivalent services to persons with mobility, sensory or cognitive impairments. This study examines issues concerning persons with sensory and cognitive impairments, and their access to fixed route transit services.

The goals of this report are to specify operating guidelines, suggest technological changes, and offer operating policy and training program modifications that solve problems of transit access for persons with sensory and cognitive impairments. To determine where the access problems exist in fixed route transit systems, an examination was undertaken of existing technologies and programs that are in use by transit agencies in North America.

The available literature indicated that there were technologies and policies available for solving problems of persons with visual and hearing impairments. However, little appeared to be available for persons with cognitive impairments. To fill in this knowledge gap, surveys and interviews were conducted with persons with cognitive and other impairments, persons who train persons with sensory and cognitive impairments, and persons who provide transportation services.

This study concludes that, for persons with cognitive impairments, technological solutions are not the answer to increase bus accessibility. Personal interaction is needed to solve each individual circumstance with the transit user. Transit personnel need training so personnel become aware and more sensitive to the needs of all transit users. Transit users need training so use of the transit system is accomplished with grace, speed, efficiency and dignity. Trainers of persons with disabilities need training themselves so transit travelers will be informed of all the available services the transit agencies are offering. Also, visual signage must be standardized to be effective, including consideration of location, lighting, contrast, and content.

ACKNOWLEDGEMENTS

The authors wish to express their gratitude to Micki Kaplan of Lane Transit District in Eugene, Oregon, and Patricia Nielsen with Tri-Met in Portland, Oregon, for their invaluable support and guidance. They helped to coordinate the meetings of the advisory committees based in Eugene and Portland. The authors also thank all the volunteers and professionals who contributed their time and knowledge in assisting with the project. The authors thank Marina Drancsak, of the University Research and Training Program, and George Izumi at the USDOT Federal Transit Administration for their support and guidance of the project. The authors thank Nancy Coburn and Dave Norstrom at Battelle for sharing the draft of their reports with the project team, which permitted the continuation of the work that they had started.

The authors express their appreciation for the review and the general input by Drs. Robert Layton, Jon Kimerling, and Ken Funk of Oregon State University.

IMPROVING BUS ACCESSIBILITY SYSTEMS FOR PERSONS WITH SENSORY AND COGNITIVE IMPAIRMENTS

CHAPTER 1 INTRODUCTION

July 26, 1990, marked the passage of the Americans with Disabilities Act (ADA). As a result, it has become a civil rights violation to deny transportation to persons with disabilities. Most transit agencies in the country are feeling a significant impact. The ADA requires agencies to provide accessible buses or equivalent services to persons with mobility, sensory or cognitive impairments.

Some progress has been made regarding mobility access in transit applications with the advent of wheel chair lifts and securement systems. Access for persons with cognitive disabilities has received little attention in past research. This study examines access issues relating to persons with sensory and cognitive impairments in fixed route applications.

BACKGROUND

At the time of the enactment of the Americans With Disabilities Act (ADA) there were 43 million people in the United States who had one or more disabilities. As the population grows older, the number of persons with disabilities in America increases. The preamble of the ADA states that because there was no legal recourse, there was discrimination in areas such as employment, housing, public accommodations, education, and communications as well as in recreation, institutionalization, health services, voting, access to public services, and transportation. This discrimination denies people with disabilities the opportunity to compete on an equal basis for opportunities for which America is famous.

The ADA legislation is designed to eliminate discrimination against persons with disabilities. These examples of discrimination which are cited in the Act are specific to employment; public services; telecommunications; services operated by private entities; and transportation. The transportation regulations in this Act cover the vehicles, the system and facilities. The Act is clear in its intent to eliminate discrimination.

GOALS AND OBJECTIVES

There are four main goals of this report:

1. To determine existing technologies, operating policies, and training programs that are currently being used by transit agencies in North America to accommodate individuals with sensory and cognitive disabilities.

2. To examine the technological and operational needs where there are problems of transit access for individuals with disabilities which are not currently being addressed.
3. To specify design guidelines and conceptual designs that solve problems of transit access for individuals with disabilities.
4. To specify operating policy and training program modifications to increase transit access for individuals with disabilities.

APPROACH

The primary goal of the project is to improve transit accessibility for individuals with sensory and cognitive impairments. Figure 1 shows the systems approach taken to achieve these goals.

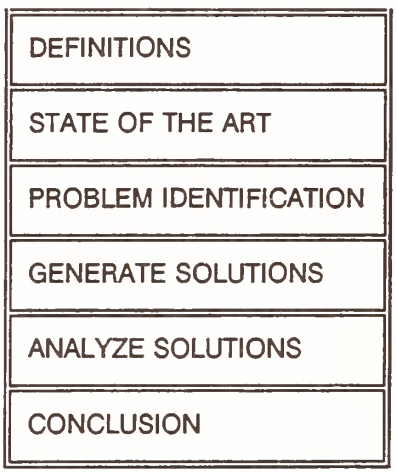


Figure 1. Research Approach

In the definition process, two major components are identified: 1) the actual tasks that are required to make a successful transit trip; and 2) the identification of impairments and the resulting limitations, and how these are related to fixed route transit situations.

The state of the art is analyzed through a review of technologies and practices. The literature review examines bus accessibility for persons with sensory and cognitive impairments. This review points out the severe lack of information to assist persons with cognitive impairments and the resulting need to make buses more accessible.

Problem identification was accomplished with the assistance of transit agency personnel, persons with disabilities, and professionals who train others with disabilities. This was accomplished through surveys and interviews. This report includes a copy of the survey and tabulated results of both the survey and interviews in Appendix B.

The use of symbolic encoding of information to assist persons with cognitive disabilities in the use of public transportation was also explored and is discussed briefly. Conclusions and recommendations to improve accessibility on fixed route transit systems are the result of the compilation and analysis of this information.

REPORT ORGANIZATION

There are seven sections in this report. After the introduction, the second section covers definitions and limitations. This section describes the necessary tasks required to ride a bus on a fixed route, defines the various disabilities and the resulting limitations for persons with sensory and cognitive impairments. The third section consists of the literature review. This section considers the technologies and exemplary practices to improve bus accessibility for persons with sensory and cognitive impairments. The literature review is organized according to the order of the tasks required to complete a transit trip. The fifth section is a study on access signage and symbolic encoding. The symbolic encoding of information is a component of assistive technology which can promote the successful use of transportation systems by persons with cognitive impairments. The fifth section discusses the results of the survey and interviews with professionals who provide training and transportation to persons with cognitive impairments. Summary and conclusions are presented in the sixth section and the last section includes the recommendations developed as a result of this research.

CHAPTER 2 DEFINITIONS

The ADA defines disability as

> "(a) a physical or mental impairment that substantially limits one or more of the major life activities of such individual; (b) a record of such an impairment; or (c) being regarded as having such an impairment."

To increase bus accessibility, the transit user needs to understand what is required by the transit agency to use the system and also the rider needs to be assessed to determine what his/her capabilities and limitations are with regards to using public transportation. Defined in this section are the rider tasks necessary to use a fixed route system and the limitations of sensory and cognitive disabilities related to using transit.

Categories of types of impairments provide a framework to identify subgroups that have similar transit needs and problems. For the purposes of this research effort, sensory and cognitive impairments have been divided into three categories:

1) deafness and hearing impairments
2) blindness and visual impairments
3) cognitive impairments.

RIDER TASKS

This section discusses the tasks necessary to ride a fixed route transit system. This is accomplished with the assistance of Battelle's matrix in *Guidelines For Improvements To Transit Accessibility For Persons with Disabilities* [Coburn, et al., 1992] and *Flight 201 Has Been Moved to Gate 102: Challenges Experienced by Travellers with Cognitive or Emotional Disabilities* [McInernery, et al., 1990]. The skills involve evaluation of riders needs, understanding the system, accessing the correct vehicle, entering the vehicle, travelling on the vehicle, departing the vehicle, and leaving the stop/station. The Battelle matrix is located in Appendix A of the report.

Evaluation of Rider's Transit Needs

Before contacting the transit agency, the rider needs to evaluate her/his transit needs. Transit needs include the identification of the origin and destination of the transit trip, and of any other special services that might be required. Special services are kneeling buses, wheelchair lifts, low floor buses, ramps, special routes, etc.

Understanding the System

The next step is acquiring the transit information for the part of the system to be used. Transit agencies readily supply this information via a telephone information service or through printed materials such as maps and route schedules. For a successful transit trip, it is critical that the correct media is used in communicating this information from the transit agency to the potential passenger.

Tasks in understanding the system:

1. Determine what part of the system is to be used.
    a. Which route(s) will be used.
    b. Where the initial and final stop on the route are located.
2. Determine if the use of transfers is necessary.
    a. How to receive a transfer.
    b. How to make the transfer.
3. Determine fare payment procedures/details.
    a. The cost of the total trip.
    b. Fare media, such as coins, tokens, or passes.
4. Determine if special provisions are provided, such as special routes, lifts, ramps, or low floor buses.

To make a complete trip all of this information is necessary. The type of media in which the information is given is critical. If there is any misunderstanding or missing information, the trip may be in jeopardy.

Accessing the Correct Vehicle

The user must locate the correct stop to initiate the trip. If the stop has several routes serving it, the rider must be able to differentiate between buses. At a transfer point where several buses are parked in a row, the rider needs to be able to distinguish between the buses in order to enter the correct vehicle.

To do this the user must:

1. not let others deter her/him from the trip plan,
2. use visual displays,
3. monitor auditory messages, and
4. wait.

Entering the Vehicle

When entering a vehicle, the user must be able to ascend the stairs or use the lift. To do this, vertical and horizontal gaps need to be negotiated. The horizontal gap varies with the distance between the curb and

stopped bus. The type of bus and curb (if any) height influences the vertical gap. Some buses have a kneel option that may help facilitate this. Additional tasks include locating fare boxes, paying the correct fare, and requesting a transfer if needed. The user must be able to identify and maneuver to an empty seat. Sometimes these actions take place as the vehicle is moving.

Travelling on the Vehicle

The user must accommodate the starts, stops and the motion of the vehicle. The rider must act appropriately and not let other passengers distract her/him from their transit tasks. The necessary skills when travelling on the bus are comprehension of announcements and determination of the appropriate response. These announcements could be ordinary, such as intersection announcements or instructions on what to do in case of an emergency.

Departing the Vehicle

Departing the vehicle at the correct stop may be difficult. The ADA requires that bus operators call out major intersections to help passengers identify the correct stop. The passenger must then notify the driver by pulling a chord or pressing a strip, move to a doorway and descend the stairs or use a lift to exit. When exiting the vehicle, the rider needs to establish which direction to move towards for her/his next destination.

This concludes the detailed description of the tasks necessary to ride a fixed route transit system. The next step in improving bus accessibility is the understanding of the limitations of the impairments of persons with sensory and cognitive disabilities as they perform these tasks.

DEAFNESS AND HEARING IMPAIRMENTS

Deafness is a profound or total loss of auditory sensitivity perception. Hearing impairment, with or without a hearing aid, is the inability to successfully process linguistic information through audition. The amount of hearing loss is measured in loudness (measured in decibels) and pitch (measured in hertz). Normal ranges are 0 to 130 decibels and 20 to 15,000 hertz [Hardman, et al., 1990].

Hearing impairment covers varying degrees of hearing loss. Factors influencing hearing sensitivity are the distance between the speaker and listener, background noise, language proficiency, past experience, environmental awareness and corresponding lack of compensatory judgment. Many persons with a mild loss may function well in quiet situations but may have difficulties when there is a noisy background or with a large group of people [Hardman, et al., 1990].

A hearing impairment may be a "hidden" disability. Bus operators may not be aware of the hearing impairment and, therefore, do not notice that assistance may be required. One area of concern within the

transit system is the inability to receive information from driver announcements or over a PA system. This is nonexistent in the usual way for persons with hearing impairments. These announcements may be routine (i.e., intersection announcements), abnormal (i.e., a small route detour), or emergency [Coburn, et al., 1992].

Deafness or hearing impairments impede one's ability to use normal communication methods, such as person to person conversations, or with devices such as a standard telephone. This affects the hearing impaired transit user when obtaining transfers, schedule information and normal interaction with other passengers.

There are wide ranges in hearing loss. In everyday situations difficulties arise in hearing driver announcements and obtaining schedule information. The most severe case is in emergency situations. Persons with hearing impairments, if not able to see the emergency, would only see others react to the situation. They would not know if they must react or what the appropriate action to take would be.

BLINDNESS AND VISUAL IMPAIRMENTS

Blindness, or visual impairment, is the total loss of visual perception, sufficiently diminished visual acuity, and/or limited fields of vision. Recognizing an object at a standard distance refers to visual acuity. Field of vision is the widest angle of sight.

Visual acuity is defined in a set of two numbers. The standard or normal visual acuity is 20/20. However, if a person with normal vision is able to read something at a distance of 200 feet and a second person is unable to read it until it is only 20 feet away the second person has a visual acuity of 20/200 [Hardman, et al., 1990].

To define "sufficiently diminished" visual acuity and limited fields of vision, several sets of criteria exist. These usually depend on the intended use. For example, to qualify for the federal income tax "blind" exemption a person must have "... a visual acuity greater than 20/200 but not greater than 20/70 in the better eye after correction" [Hardman, et al., 1990]. The definition of blindness adopted by the American Medical Association is:

> "A person shall be considered blind whose central visual acuity does not exceed 20/200 in the better eye with correcting lenses or whose visual acuity, if better then 20/200, has a limit in the central field of vision to such a degree that its widest diameter subtends an angle of no greater than twenty degrees" [Hardman, et al., 1990].

Persons with visual impairments experience many different types of problems. Some of these include not being able to distinguish the difference between light and dark, having only peripheral sight, and/or seeing

through a "fog." Other examples are seeing only parts of images and/or tunnel vision [Hickling-Partners, March 1983; Coburn, et al., 1992].

Challenging experiences exist in the transit system for persons with partial or total vision loss. Particular areas of concern in a transit system are: 1) receiving system information; 2) locating and using devices associated with a transit trip; and 3) physical movements throughout the system [Coburn, et al., 1992].

Printed matter, such as maps and schedules, are the most common sources of information used to learn the system. People who cannot see to read have a difficult time finding such media useful. Locating and using devices, such as fare boxes or token dispensers, is practically impossible without some type of non-visual assistive aid. To move through a transit system a person must be able to locate, enter, move through, and exit the transit vehicle. This also involves accommodating the movements of others while moving to different areas. Blind or visually impaired persons have difficulty orienting themselves to the environment or to other people because they cannot "see" them. They may fear injuring themselves, resulting in attempts to restrict their movements [Coburn, et al., 1992; Hardman, et al., 1990].

In summary, visual impairment includes blindness, sufficiently diminished visual acuity and/or limited fields of vision. Several criteria exist to describe visual impairments, and these usually depend on the intended use. The difficulties persons with visual impairments face are finding usable transit system information and locating the necessary transit devices. The most serious problem faced by visually impaired persons is difficulty orienting themselves to their surroundings.

COGNITIVE IMPAIRMENTS

"Cognitive Disorder: any disorder requiring special attention to, or alternate methods of, communicating concepts and instructions ..." [McInerney, et al., 1990]. Types of cognitive impairments are emotional disabilities, mental retardation, learning disabilities, brain injury, and any other intellectual capacity limitations. The varying abilities of persons with cognitive impairments result in a corresponding range of difficulty in a public transportation situation.

Emotional Impairments

There are many types of emotional disabilities, defining all of them are beyond the scope of this report. However, most disorders are accompanied by one or several symptoms, and it is these symptoms that cause problems in transit. The symptoms vary from person to person and in severity. Listed in Table 1 are some of the symptoms that may be experienced by persons with emotional impairments.

Table 1. Symptoms of Mental Illness [McInerney, et al., June 1990]

psychomotor agitation	antisocial behavior
paranoid ideation	suicidal ideation
irritability	anger
impaired judgment	tremors
anxiety	psychomotor retardation
impaired abstract thinking	indecisiveness and reticence
impaired concentration	impaired memory
compulsions	impaired speech
delusions	problems of elimination
hallucinations	mood shifts
	nausea, vomiting

In the transit system, persons with emotional impairments may find some situations difficult to cope with. Some of these situations may be a change in the routine or route, crowds, closed-in spaces, heights, and the possibility of being unable to cope in a "normal" fashion. A crisis or non-routine situation causes stress levels to rise for all passengers, but for persons with emotional disabilities these levels may rise severely. Elevated stress levels can be expressed as confusion, extreme shyness, withdrawal, and hesitancy. Emotionally impaired persons may react with mood changes; may need to ask several times for clarification and direction; may reach out to staff or other passengers for support; and may display any of the symptoms listed in Table 1 [Hickling-Partners, March 1983].

Learning Disabilities

There is a great variety in definitions for learning disabilities. The National Joint Committee for Learning Disabilities proposed the following definition:

> "Learning disabilities is a generic term that refers to a heterogeneous group of disorders manifested by significant difficulties in the acquisition and use of listening, speaking, reading, writing, reasoning, or mathematical abilities. These disorders are intrinsic to the individual and presumed to be due to central nervous system dysfunction ..." [Hardman, et al., 1990].

Learning disabilities make it difficult for an otherwise intelligent person to learn a particular concept. These concepts include reading and writing; giving or understanding directions; computing time and distance; short attention span and a lack of concentration; and problems in understanding signage [Hickling-Partners, March 1983].

Characteristics that may be seen in transit situations are impulsiveness, clumsy or awkward movements, confusion, losing possessions, and inability to follow directions. Some characteristic may be unnoticed.

Therefore, it is up to the person with learning disabilities to make her/his needs known [Hickling-Partners, March 1983].

Brain Injury

Brain injury is an organic impairment resulting in perceptual problems, thinking disorders, and emotional instability. Depending on the nature and extent of the injury, there may be evidence of language, memory, motor, and impulse-control difficulties [Hardman, et al., 1990].

There are several significant characteristics generally associated with brain injuries:

1. Slow processing, more time is needed to accomplish tasks.
2. Memory and organizational abilities will probably be affected. Memory for newly learned material will be affected to a greater extent than previously learned information.
3. The problems caused by the brain injury may be hidden to casual observers.
4. Rapid, erratic changes in behavior may be the effect of a brain injury. For example, a person may have appropriate behavior one day and inappropriate behavior the next day [Special Education Services Unit, March 1990].

Mental Retardation

Mental retardation is a below average intellectual functioning along with limitations in a person's ability to meet standards of maturation, learning, personal independence and social responsibility [Hardman, et al., 1990].

Several classification systems have been developed to discuss mental retardation. Some of these are based on causation, educable expectations, or severity of conditions. The most relevant to this discussion is severity of the conditions. Severity of conditions is based on the person's intellectual capabilities and adaptive behavior. This is described by using terms such as mild, moderate, severe and profound.

Characteristics of persons with mental retardation are listed in Table 2. As can been seen from the range of characteristics and severity, each circumstance in the transit situation must be treated individually. The varying degree of ability directly relates to the difficulty each individual will have in new situations.

Table 2. Characteristics of Individuals with Moderate to Profound Mental Retardation [Hardman, et al., 1990]

Moderate	Severe	Profound
Speech and Language Skills		
Most individuals are deficient in speech and language skills, but may develop language abilities that allow some level of communication with others.	Without exception, individuals exhibit significant speech and language delays and deviations; e.g., lack of expressive and receptive language, poor articulation, and little, if any spontaneous interaction.	Individuals do not exhibit spontaneous communication patterns. Bizarre speech may be evident; e.g., echolalic speech, speech out of context, purposeless speech. Language abilities are grossly inadequate.
Physical Characteristics		
Gross and fine motor co-ordination are usually deficient. However, the individual is usually ambulatory and capable of independent mobility. Perceptual-motor skills do exist (e.g., body awareness, sense of touch eye-hand coordination), but are often deficient in comparison to the norm.	Significant motor difficulties; i.e., poor or nonambulatory skills. Gross or fine motor skills may be present, but the individual may lack control, resulting in awk-ward or inept motor movement.	Some gross motor development is evident, but fine motor skills are inept. Individuals are usually nonambulatory and are not capable of independent mobility within the environment. Perceptual-motor skills are often nonexistent.

Other disorders that affect cognitive processing are cerebral palsy, epilepsy, and autism, to mention a few. The total range of cognitive disorders is too broad to be covered in the context of this report. However, the above sampling is representative. Cognitive impairments cover a wide range of disabilities with and without similar outward characteristics. In other words, two persons both with similar impairments may react in a similar or different manner to the same situation, as would two persons with different impairments.

From the listing of characteristics and symptoms the following is clear:

1. There is a wide variety and degree of intensity of symptoms or characteristics. The variety and degree of symptoms or characteristics may be in any combination or may exist individually.
2. Because of the wide variety of symptoms or characteristics of the different impairments, it is difficult to determine the type of impairment by the symptoms or characteristics displayed alone.
3. Cognitive impairments may affect all parts of the transit trip.
4. Each situation is unique and must be treated in a unique manner.

CHAPTER 3 LITERATURE REVIEW

Many persons with disabilities routinely ride the transit system successfully. The amount of difficulty that they experience depends on the nature and extent of the disability, the situation they are involved in, and the transit system being used. *Combined Research Results* states that it is important for transit agencies to acknowledge the variety of people with different disabilities, to identify subgroups of persons with disabilities and identify their specific transit needs [Project ACTION, 1990]. A person with a visual impairment can hear a special announcement that a bus operator makes while a hearing impaired person can not.

Four categories of disabilities are examined in the literature review. The first three reflect the different impairments and the necessary solutions for a successful transit trip. These categories are deafness and hearing impairments; blindness and visual impairments; and cognitive impairments. The fourth category addresses issues that are common among all disabilities, primarily focusing on training. The literature review is organized according to the previously discussed rider tasks necessary to use the transit system.

DEAFNESS AND HEARING IMPAIRMENTS

The two areas identified as major concerns for persons with hearing impairments are: 1) receiving information necessary to make a transit trip, and 2) hearing announcements by the driver or over a PA system.

Understanding the System

Many alternatives exist that can assist the person with hearing impairments in receiving transit information. Some of these are printed media, TDD, automatic speech recognition systems, and manual communications. Hearing aid compatible telephones, fax machines, and amplified telephones are other methods of receiving transit agency information [Crain-Revis, 1982; FitzPatrick, et al., 1989; Uslan, et al., 1990; Coburn, et al., 1992].

Telecommunications Device for the Deaf (TDD) is a device that allows messages to be sent back and forth over a telephone line by typing responses, providing a visual rather than auditory message. Both parties must have a special keyboard that connects to a telephone. This technique is used by many transit agencies. Some personal computer modems are capable of TDD transmission.

Automatic Speech Recognition Systems (ASR) provide data entry into computers by voice recognition. The hearing person speaks into a microphone connected to a computer. The computer acts as an interpreter and converts the speech to text. ASR is a rapidly evolving technology which is still in its infancy in transportation applications. Currently the computer only interprets 30 to 40 words per minute, which is not close to real time speech recognition. The system works on a matching principle in which memory patterns represent word sounds. When a sound is made that closely approximates a pattern, the corresponding word is chosen. The person who speaks into the device must be registered with the computer. Only after repeated use can the registered voice pattern be recognized. Technology is available to connect ASR devices with TDD's. This holds the potential for improved distribution of transit information.

The predominant language used by persons with hearing impairments is American Sign Language. It would be useful if transit personnel were provided with cards showing the basic signs or were able to learn a few signs.

Hearing aid compatible telephones enable transit users to converse on the telephone. The telephone and the user's hearing aid must be properly equipped to be compatible. The compatible telephone converts sound into magnetic energy. An induction coil sensitive to the telephone's magnetic energy is placed within the compatible hearing aid, and converts the energy back to sound. A t-switch allows magnification of sounds coming only from the induction coil.

Amplified telephones have adjustable volume and are able to amplify speech by 20 decibels and thereby reduce the influence of background noise. These are compatible with a hearing aid t-switch.

Facsimile machines have become part of everyday life. An advantage for the hearing impaired is the elimination of typing. Frequently older people find typing difficult, making use of a TDD impossible. Another advantage is the personal format a fax can use.

A counter-top device for facilitating dialogue between the target group and an airline station representative may have some customer service applications for mass transit. This system consists of two touch screens, one for the passenger and one for the agent. A computer controls the program flow and transmits messages from one screen to the other. This device is also multilingual [Rutenberg, 1990].

Accessing the Correct Vehicle

For assistance in accessing the correct vehicle, visual signs with clearly written instructions and visual displays of announcements are useful. The use of symbols that are not standard [Coburn, et al., 1992] may cause confusion. Visual displays may be electronic. Exterior signs have been flip dot because other

technologies are less visible in the sunlight. Other technologies include, reflective disc, liquid crystal display (LCD), light emitting diode (LED).

Entering the Vehicle

Since some hearing impaired persons rely on dogs for assistance, there must be sufficient room for hearing ear dogs within the vehicle. Standard visual signals will assist the deaf or hearing impaired passenger to enter the vehicle [Coburn, et al., 1992].

Travelling on the Vehicle

Upgrades to visual displays consistently help persons with hearing impairments to comprehend special announcements. Directional signage is assistive in the location of technical aids, such as assistive listening devices, a sign language communicator, and visual displays of announcements [FitzPatrick, et al., 1989; Coburn, et al., 1992].

Listening Systems

Assistive listening devices provide specific amplified messages directly to the user's ear. This diminishes the effect of the background noise which is a major problem for person's with hearing impairments. These can be used either within buses or in transit facilities. Three types of assistive listening devices are FM, infrared, and induction loop. Information booths or kiosks should also be equipped with an assistive listening system [Fitzpatrick, et al., 1989].

FM systems transmit a message spoken into a microphone to a signal on an assigned channel. Transmitters can be portable, run on batteries, and used by transit operators. Fixed transmitters usually use an available power supply. The person wishing to hear this message has a receiver. Receivers have adjustable volume, and receive one or more channels.

A disadvantage of the FM system is that equipment from different manufacturers is generally not compatible with each other. Due to FCC regulations each company has the option to choose a frequency, within the designated broadcast band, and band width to use. If an individual wishes to purchase their own receiver, they would have to find out which system is being used and which frequency is on its lines.

An infrared device system is similar to the FM system in that a transmitter sends out a signal which is picked up by a receiver. However, instead of an FM radio frequency, the signal is transmitted by infrared light. There are disadvantages to the infrared system. The infrared signal is limited to the line of "sight" transmitted, receivers must be able to "see" the signal to interpret its message. Infrared light systems do

not perform well in natural light, and are typically more expensive than the other two assistive listening device systems.

Manufacturers have agreed to use the same frequency to transmit the infrared signals. This allows people to purchase their own receivers. However, multiple transmission signals have not been standardized. If more than one signal is used, special receivers tuned to the correct frequency are necessary. Personal receivers will not be effective.

Induction loop systems are the least expensive assistive listening systems. Wire is looped around a room or area where the information is to be received. A microphone provides input to a transmitter that is attached to the looped wire. The transmitter generates a magnetic field that can be picked up by hearing aids that are t-switch equipped. The hearing aid converts the energy back to sound. The t-switch hearing aids are the same as those which are used with hearing aid compatible telephones. Persons without a t-switch hearing aid may carry a receiver to take in the transit information.

Extensive metal surroundings, such as in a bus, affect the strength of a signal. Magnetic interference from high voltage lines, fluorescent light ballasts, and computer cathode ray tubes may create a distracting hum and diminish the primary signal. Unlike the other two methods, only one message can be sent out at a time.

A Pocketalker is a portable communication system. This personal item consists of a small amplifier box, headphones, and a microphone. The microphone is attached directly to the amplifier or can be attached with an extension cord. This allows conversation with a person with hearing impairments. [Coburn, et al., 1992; FitzPatrick, et al., 1989].

Visual Signs

Transit agencies need signs that are consistent and uniform in design. They need to be easily located and accessible. Print information needs to be with symbols, pictographs and large print. High-quality visual information has the optimum use of color and brightness, such as yellow, orange or white on a dark or black background. Proper illumination must be used to avoid confusion. Glare is eliminated with the use of matte and non-glare surfaces. These techniques ensure good contrast between printed information and its background [Richesin, et al., 1987; Richesin, et al., 1989].

Interior electronic signs can be used in several ways. The sign may be preprogrammed to list all the stops on the route. A driver then just presses a button to display the next stop. A connection to an automatic vehicle location (AVL) system would automatically identify the location of the bus and the correct intersection would be displayed. A device that is located near an upcoming stop could transmit a signal and trigger the

sign to change the message to the one identified with the signal. Automatic speech recognition is another method of updating the message. The drivers announce the next stop over the PA system, and the information would be recognized and displayed on the interior sign.

Integrated Communication Information and Security System (ICISS): *For Visually and Hearing Impaired Persons A Transportation Application*

The ICISS is a display of station stop announcements, public and emergency information, and advertising messages. This communication system pairs auditory information with the appropriate visual information. This system consists of an auditory and visual display network that provides transit authorities the capability of delivering a specific, rapidly updated message. Three high intensity panels display images and text; it is driven remotely from a central point, and is placed inside the bus. The hardware can digitize, store and replay specific audio messages [Moreyne, M., July 1991].

A type of ICISS is called Visual Communication Network (VCN) by Telecite. This one panel display pairs visual and auditory information, is in real time, and broadcasts advertising. It is presently installed in the Montreal metro rail system [Moreyne, et al., 1992].

Successful emergency procedures depend largely on audio signalling such as alarms or announcements, visual signalling such as flashing lights or strobes, and human policing [FitzPatrick, et al., 1989].

Departing the Vehicle

Techniques of assistance to identify the desired stop area: using a PA system compatible with assistive listening systems, visual displays of announcements, and available seating near an on board "next stop" display [Coburn, et al., 1992]. Legible bus stop signs should include a visible flag that names the approaching cross street. A listing of transfer routes as well as cross streets specific to that route in each bus near the driver and exit door is helpful [Crain-Revis, 1982].

To notify the driver of a desire to stop, a visual confirmation (light) that the signal system is in operation is necessary. A visual indicator of the correct door will assist persons who are deaf or have hearing impairments to move to the correct door. This indicator should also have a door opening feature [Coburn, et al., 1992].

Exiting the Station/Terminal

To determine the desired exit direction, a visual sign will provide the necessary orientation [Coburn, et al., 1992].

Staff Training

Transit agencies need to provide awareness training, including information about deafness and hearing impairments, the use of technical devices, the fundamentals of communicating with people who are deaf and hard of hearing people; and some basic sign language instruction [FitzPatrick, et al., 1989].

Figure 2 is a list of directions for transit personnel when assisting persons with hearing impairments from Transfer, a manual for training travel trainers [Cerenio, 1992].

Transit Policy

Cards showing the basic signs, in American Sign Language, required to communicate with deaf travelers should be provided for the staff. These cards should be located in places where transit personnel and the travelling public come in contact. An effort to have a person on staff who is fluent in sign language should be made. Paper and pencils to facilitate communication should be located on all buses and information counters. All information booths or kiosks should be equipped with an assistive listening systems. [FitzPatrick, et al., 1989; Crain-Revis, 1982]. Auditory announcements should be upgraded to include one

Directions for Transit Personnel when Assisting Passengers who are Deaf or Hard of Hearing

"1. When communicating with deaf passengers that read lips:

- a) Look directly at them so they can see your lips.
- b) Talk normally and don't exaggerate you speech or lip movements. Accents do not usually affect lip reading.
- c) Speak with moderate speed without rushing your words. Be prepared to repeat yourself. Even expert lip readers will only understand about 75% of what you say the first time.
- d) If the lip reader has trouble reading your lips, try getting another person to talk to them.

2. When communicating with passengers using hand signals and finger spelling:

- a) Remember that it takes practice to become skillful in using hand signals and finger spelling.
- b) Use a pad and pencil when necessary.
- c) Keep your communication as clear and simple as possible.
- d) Remember that not all deaf persons can speak well. If they have been deaf from birth, they will usually speak in a flat and nasal tone.
- e) Never shout at a totally deaf person. They can't hear you!"

Figure 2. *Assisting Passengers Who Are Deaf and Hearing Impaired* [Cerenio, 1992]

or more forms of visual back-up; warning systems should be supplemented by visible signals, such as flashing lights or strobes [FitzPatrick, et al., 1989].

BLINDNESS AND VISUAL IMPAIRMENT

There are three areas of major difficulty for persons with visual impairments. These are receiving information, locating and using devices associated with a transit trip and the physical movements through the transit system.

Understanding the System

Guidelines for Improvements to Transit Accessibility For Persons with Disabilities suggest orientation and mobility training. Large print, high contrast written information; Braille materials; tactile maps; auditory maps; and audio cassette information also assist the visually impaired traveler [Coburn, et al., 1992].

Orientation and mobility training is provided by highly trained specialists. Orientation involves establishing one's position in relation to desired destinations and landmarks. Mobility is moving in a safe and dignified manner from one's current position to a desired location. Due to the complex physical, psychological and social makeup unique to each learner, training is individually prescribed [Richensin, et al., 1987].

There are a wide variety of techniques and devices to assist visually impaired persons to develop independent travel skills. Devices include short identification canes, the longer white canes used with touch techniques, and dog guides. Some electronic mobility aids on the market include the Mowat Sensor, Laser Cane, and the Sonicguide. Each of these is discussed in greater detail below.

Braille is system of writing that uses raised dots. It is important to note that only a small percentage of persons with a significant vision loss can read Braille. The American Foundation of the Blind estimates this to be less than 15% [Coburn, et al., 1992].

Guide dogs are trained to stop at elevation changes, to lead their owners around obstacles, and away from overhanging protrusions. Initially, the dog receives three months of training, then the owner and the dog train together to learn about this type of mobility and about each other [Richesin, et al., 1987]. For the guide dog to be effective it must receive the proper balance of praise and discipline from it's owner. To qualify to own a guide dog the owner must be mature and responsible; function at a cognitive level that allows consistent, safe and effective directions to a guide dog; be able to reinforce the dog's training; be physically able to care for the dog; and have sufficient visual impairment to depend on the dog for guidance without confusion by relying on their own vision [Richesin, et al., 1987].

Using a long white cane allows the users to move with independence, in the correct direction and in safety. A wide variety of techniques are used by persons carrying a cane. Differing techniques are either due to the lack of formal training or modification to training by the individuals. A common technique is to systematically move the cane before them in an arc and touching the ground lightly as the cane reaches either side. This identifies elevation changes or obstructions in the path ahead up to the waist level. Objects above waist level are not detected [Richesin, et al., 1987].

A Mowat Sensor is used to detect obstacles. This hand held device transmits a beam of high-frequency ultrasound. The beam is reflected off obstacles and returned to the device. The user is signaled by vibration when obstacles are detected. Information concerning the distance is provided by the rate of vibration. The Mowat Sensory must be directed towards the intended path. Because of this and its inability to detect changes in elevation, it is often used in conjunction with a long cane or guide dog [Richensin, et al., 1987].

The Laser Cane emits three pencil-thin beams of infrared light to determine elevation changes, objects at head height and objects in the travel path. The user is notified of an obstacle by an audible signal. The Laser Cane also has a tactile signal for objects determined to be directly in front of the user.

The Soniguide provides information about the surface characteristics and density of objects in the environment. Through the interpretation of high frequency audible signals, the skilled user can discriminate between a person standing on the corner and the bus stop pole. The Sonigide transmits pulses of inaudible high frequency sound ahead of the user. The sound reflects back, and is converted to an audible signal for interpretation by the user. This system is incapable of detection of elevation changes and is therefore also used with a long cane or guide dog [Richensin, et al., 1987].

Tactile Mapping is a combination of Braille, raised symbols, and large print mixed in such a manner to transform printed maps into useful tools [Crain-Revis, 1982]. Tactile maps used in Tokyo have different textures representing different objects, such as railroad tracks, entrances and exits, restaurants and newsstands. An audio signal indicates the location of the tactile map. Switches labeled in Braille activate a 3 dimensional model of the Tokyo transfer station with audio taped messages. The audio taped messages direct potential passengers to public facilities. Braille blocks embedded near a crosswalk or intersection, lead blind and visually impaired travelers from one end of the crosswalk directly to the bus stop [Uslan, et al., 1990].

Auditory maps are recorded on cassette tapes. Route maps describe specific pathways. An area or district map describes an area such as a neighborhood or college campus. These cost effective tapes also provide information concerning any special programs the transit agencies may offer [Crain-Revis, 1982].

Accessing the Correct Vehicle

To locate the stops at station terminal, tactile signs, tactile paths, and visual signage assist persons with visual impairments. PA announcements, "talking" bus stops, and "talking buses" are additional methods to assist the blind and visually impaired to the correct vehicle [Coburn, et al., 1992; Cerenio, 1992].

Tactile signs contain raised letters or characters which enable persons with visual impairments to read them. The American National Standards Institute has standards for height and font (ANSI A 11.7-1.1980.4.30-Signage). Applications in a transit system would be route and fare information on bus stops, information kiosks or customer service centers. Information at station pylons help passengers identify the correct bus stop [Coburn, et al., 1992].

Tactile Pathways are textured surfaces designed to be detectable by foot or cane and to be distinct from the surrounding ground area. Some textured surfaces are also distinct in color so as to be detectable by persons with low vision ability. In Japan the paths lead from major intersections to bus stops. [Crain-Revis, 1982; Coburn, et al., 1992].

Visual signage should be as described in the previous section. Combining other sensory information (i.e., auditory, wind, vibration) with visual information reinforces the message. For example, a textured floor surface should always be accompanied with visual information. A person who must rely on poor visual senses may have advance notice that a change was about to occur through a difference in the texture of the floor. This redundancy of sensory information gives confirmation and helps to compensate for visual distortion [Richesin, et al., 1989].

The technology used for talking signs is similar to that of the assistive listening devices described in the previous section. They are infrared, AM/FM radio frequency and induction loop. In each case a different type of receiver than those used by persons with hearing impairments is desirable [Love; Crain-Revis, 1982; Richensin, et al., 1987].

The Electronic Speech Information Equipment (ELSIE) was developed in England to enable visually impaired travelers to locate a bus stop, to activate audible route and schedule information, and to be alerted to the arrival of any given bus. There are three components in a "Talking Bus Stop" system: a component that uses digital speech, a unit that reads the route numbers of approaching buses, and a microcomputer that

coordinates the other two components. A low power radio transmitter is mounted by the road. Each bus is equipped with a small receiver. As the approaching bus picks up the signal it responds by transmitting a signal back that is encoded with the bus route number. A microprocessor at the bus stop interprets this signal. When a button at the bus stop is activated, a message announcing the approaching bus number, schedule information, and the arrival time of the next bus is given. The box to which the button is attached, emits a "click" about every second for button location purposes. This clicking also helps identify the bus stop to persons who are blind or visually impaired [Coburn, et al., 1992].

Talking buses can use digital speech to announce destinations, stopping points and intersections. Automatic messages can be programmed to be activated by opening the bus door, by pole transmitters along the route, or with other automatic vehicle locator devices. A manual message could be used by an operator depressing a number coded entry key. Current technologies exist so that digital speech could interface with a visual display allowing for simultaneous broadcast [Coburn, et al., 1992].

Auditory pathways are a system of speakers positioned throughout the desired path. There are several ways to the activate auditory pathways: the user carries a signalling device, by depressing a button when entering a station, using a motion detector to activate the speaker as she/he enters the area, or the person could wear something that would be detectable by the speakers.

Route cards are a low technology signalling device. These are large lettered or numbered cards which identify the desired route. These are held by the passenger in a position so the driver of an approaching bus can see them. If the route number displayed is the same as the approaching bus, the driver stops the bus and picks up the passenger [Project ACTION, 1990].

Entering the Vehicle

To ascend the stairs, standard illumination and a surface texture change on the step edges assists persons with visual impairments. A talking fare box in a standard location is also helpful. There must be enough room for seeing eye dogs so the other passengers won't trip as they get on and off the vehicle [Coburn, et al., 1992].

Travelling on the Vehicle

Orientation and mobility training, large print with high contrast written information, and PA announcements assists persons with visual impairments to travel on the bus [Coburn, et al., 1992]. A useful system for comprehending announcements is the Integrated Communication Information and Security Systems (ICISS) mentioned in the previous section. This system consists of an auditory and visual display network that provides transit authorities the capability of delivering a specific message that is rapidly updated. This

system is useful not only for intersection announcements but also abnormal and emergency announcements [Moreyne, M., 1991; Moreyne, et al., 1992]].

Departing the Vehicle

The correct stops can be identified by the use of PA announcements, non-glare signage with large print and high contrast. A uniformly located auditory signal system will enable the blind and visually impaired person to notify the driver of the desired stop. An auditory announcement helps identify the exit door, as does standard illumination. Using a cane on the step edges to descend the stairs and exit the vehicle is also helpful [Coburn, et al., 1992].

Exiting the Station or Terminal

The following are useful for determining the desired exit direction: orientation and mobility training, large print, non-glare, high contrast signage, electronic or tactile signs, and auditory pathway [Coburn, et al., 1992]. An auditory pathway is auditory signals that provide directional information.

Training the Users

Initially, a mobility evaluation of functional vision, conceptual and direction understanding of independent movement (up down, parallel, opposite, etc.) needs to be undertaken. Individualized programs may best serve performance difficulties, real or imagined, by persons with visual impairments [Uslan, 1990].

Training for Transit Agency Personnel

Training should include explanations of the particular problems of passengers who are blind or have visual impairments. An effective way to stimulate sensitivity to passengers' needs is to encourage communication between the drivers and their passengers [Uslan, et al., 1990]. *A Guide to Recognizing and Assisting Travellers with Disabilities* is a useful report for providing employees with sensitive and effective information to assist passengers with specials needs [Hickling-Partners Inc., 1983]. This guidebook states that the employee should recognize the special needs of an individual whose needs must be met differently than most people. It states that an understanding of persons who are blind or have visual impairments do not necessary have a hearing impairment; nor are all visually impaired persons totally blind; and they do not have a sixth sense. Persons with visual impairments know how to get around; they usually need little assistance, and like everybody else, have dignity. Listed in Figure 3 are suggestions for drivers in *Access to Mass Transit for Blind and Visually Impaired Travellers* [Uslan, et al., 1990].

Directions for Transit Personnel when Assisting Passengers who are Visually Impaired
"1. Tell direction or final destination of the bus before passenger boards. Specify if it is an express bus.
2. When directing a blind or visually impaired person to a seat, the seat adjacent to the door is preferable to the one behind the driver.
3. When handing a transfer to a blind or visually impaired person, place it directly in his/her hand rather than holding it out.
4. Call out major cross streets so that the passenger can anticipate his/her stop.
5. It is crucial to remember to call out requested stop.
6. Let a blind or visually impaired person exit the bus in a spot free of poles, newspaper stands etc. Otherwise, tell him/her that there are obstacles in the way.
7. Inform the blind or visually impaired person that he/she is exiting the bus at the curb or in the street a few steps away from the curb.
8. Always let a blind or visually impaired person off at the bus stop.
9. When giving direction use specific terms such as "turn right" instead of "over there".
10. When a blind or visually impaired person exits the bus, tell him/her what street the bus is traveling on and whether the bus stop is on the near or far side of the cross street."

Figure 3. Tips for Operators
Access to Mass Transit for Blind and Visually Impaired Travellers [Uslan, et al 1990]

When offering assistance, ask how you can help; people have different needs at different times and not all people are the same. Don't grab them, because this is dangerous as well as insulting and frightening. When guiding visually impaired persons, let them take the employee's arm. The person with visual impairments will walk about a half of step behind, following the employee's body motions. The person guiding should verbally try to familiarize the person with her/his surroundings. Use a normal tone of voice when giving directions, with clear and specific instructions. Describe any obstacles that are in the path of the traveller [Hickling-Partners Inc., 1983].

COGNITIVE IMPAIRMENTS

> "For persons with cognitive disabilities, simplified procedures mean fewer demands on their memory, problem-solving skills and the like; standardization allows travelling to become easier over time because what is learned about the procedures and operations can be applied to subsequent travel." [McInerney, et al., 1990]

For persons with cognitive impairments, training and personal interactions are very important. The transit agency can provide materials and other features to make the system easy to understand. One of the major

problems with most marketing materials is that persons with cognitive impairments cannot read or understand them [Project ACTION, 1990]. To describe the transit system, use simple text and graphics, standard symbols, and training [Coburn, et al., 1992]. Useful techniques to access the correct vehicle include uniform features, training, standard signage and symbols, audio and visual signals, and color coding [Coburn, et al., 1992]. Standard visual and audio signals along with training will help persons with cognitive impairments to move through the doorway, pay the fare, and identify a vacant seat or standing space [Coburn, et al., 1992]. Training, along with simple and clear communication techniques aid the comprehension of special announcements [Coburn, et al., 1992].

Training is needed to help the person with cognitive impairments look for landmarks and listen to PA announcements to identify the correct stop. Uniform location of a standard system to notify the driver of the desire to stop are also helpful [Coburn, et al., 1992]. At the exit to the station, training to determine the desired exit direction and orientation is useful [Coburn, et al., 1992].

Training

A Guide to Recognizing and Assisting Travellers with Disabilities is a guide for providing employees with sensitive and effective information to assist passengers with emotional or learning disabilities. Transit personnel need to comply with requests on an individual basis and use common sense in assessing the person's abilities. Sometimes passengers appear to be somewhat disoriented or confused. This may be the result of medication, so the employee should ask if any additional help is required [Hickling-Partners Inc., 1983].

Many travel problems could be solved by a helpful and understanding staff. Training should make personnel comfortable in serving persons with cognitive disabilities, as well as show staff how to help [McInerney, 1990].

"The majority of persons with cognitive impairments cannot use public transit services and facilities without training. They need to be trained where to get on a bus, how to pay the fare, and when to get off the bus" [Project ACTION, 1990].

COMMON ISSUES

There are some issues that are common to all disabilities. *Combined Research Results* complies general recommendations that apply to all disabilities [Project ACTION, 1990].

Signage

Incorporating standard signage is beneficial to persons with and without disabilities. Ideally, these would be standardized worldwide. Items to be considered for standardization are bus stop signs, architectural design, lighting, emergency alarm systems, icons and color coding, and priority seating [Coburn, et al., 1992].

Project ACTION identifies the need for signs on buses that can be easily seen and read [Project ACTION, 1990]. *"Modification Menu" for System-Wide Map and TimeTable Design,* presents criteria to consider when designing time tables and system maps. There is no precise formula for system map and timetable design. A balance must be struck when trying to meet what sometimes may be competing needs for successful transit district informational material. For example, a multi-colored map may aid someone with a cognitive impairment but confuse a person who is color blind. Some design considerations are listed below [Bloch, et al., February 1992].

The map size should allow ease in handling. Passengers are more likely to read a map small enough to be held totally open, rather than partially folded. A general rule is, the fewer the folds, and the smaller the size, the better the map. Consistency, simplicity, and legibility are three concerns when designing a map. The print should be as large as possible.

Directional concepts, such as north, south, east and west are difficult for persons with cognitive impairments. Showing significant landmarks, such as lakes and rivers, define an area better and help with orientation. Arrows, a symbol that is easily understood, can show the direction of a bus route.

Timetable print spacing should be far enough apart on the schedule grid. The print should be large, and type resolution sharp enough for easy reading. Bold type and a sans-serif font are considered easier to read. Consistency, such as labelling all the street names in the same manner, helps anyone with a learning problem. The greater the contrast between the letters and the background, the easier the timetable or map is to read. Black letters on a white background are recommended where possible. Also, the simpler the language is, the easier it is to read and comprehend.

A color-coded route system may allow someone who does not understand letters or numbers to match bus lines and negotiate a bus system. It is important to use another mode of identification along with color coding to assist persons who are color blind.

For people who cannot read, symbols can be sufficient for orientation. Symbols should be universal, easily recognized, and consistent throughout the map. Labeling next to symbols, rather than on a key, helps those who have processing problems.

Electronic Fare Collection Systems

To simplify the fare collection system, "Smart Cards" could be used. Smart Cards come in several forms: one is a card with a magnetic strip, and another is a card with a micro-chip embedded in it. The most significant difference between these two cards is the cost of the cards themselves. The magnetic strip card is less expensive, at approximately six cents apiece. The card with the small computer chip is capable of holding considerably more information, and is reprogrammable (reusable). However, the cost of this smart card is approximately six dollars. Other types of cards currently being tested emit a radio frequency or microwaves. These contactless cards allow for easy reading since the user does not need to have the coordination to pass the card through a card reader, but can just hold the card in close proximity to the card reader [Parker, 1992; Labell, et al., 1992]. These cards provide an electronic input into a billing and record keeping system. This means the user does not need to have the correct coins when she/he enters the vehicle. The passengers put their "Smart Card" through a card reader, and their accounts would automatically be debited the cost of the ride. This allows for a cashless system with a monthly billing process.

User Training

The goal of training programs for the users of transit services is to achieve speed, maximum agility, and smoothness when using transit services. This is important so time is not lost by the disabled passenger, the driver and other riders. One-on-one training for a new disabled user should be assisted by a person with similar disabilities. Independent living centers and training conducted by persons with disabilities provide the best training programs [McInerney, 1990].

Project ACTION, in *Training People with Disabilities to Access Public Transportation,* offers a five step training curriculum [Project ACTION, March 1992]. The steps are: referral, assessment, program planning, training, and, evaluation and follow up. The referral step includes a press release and brochures distributed to various agencies that provide services for persons with disabilities in the communities. In the second step, the potential user's cognitive abilities, general awareness, physical skills, interpersonal skills, and safety are assessed. From this checklist an individual program is planned. The program plan identifies goals and objectives, and is flexible so that either the trainer or the new user may revise the goals and objectives.

The training program is divided into four tracks. The first is classroom instruction for those who have little or no experience in the use of public transportation systems. The new user is given the opportunity to

develop skills necessary for route specific or general transit travel. The second track is for persons who have demonstrated track one skills and are ready for hands on transit training. Persons who do not live on an existing bus route, but may in the future have a need to ride a fixed route system, use the third track. These persons review the skills of track one and the use of para-transit systems. The last track is for persons who already use the transit system and are ready to expand their travelling distances. The follow-up activity serves as a periodic evaluation tool. The tool is used to determine if the person is using the transit systems and, if not, to determine the reason why. In most cases, it was found that persons are still using the transit system [Project ACTION, March 1992].

The People Accessing Community Transportation (PACT) prepared a *Travel Training Guide* to teach the skills necessary to competently and efficiently gain the ability and confidence to travel independently [Bloch and Hoyt, 1992]. The key principles used in this teaching document are individual instruction, teaching in the real environment, and a graduated lesson sequence.

The *Travel Training Guide* states that before the actual travel training begins, a pre-assessment to determine the needs of the user should be undertaken. A product of the pre-assessment is a psychosocial profile, the means of ambulating, and a skill inventory of the new user. During this evaluation, an opportunity is provided to develop and build a relationship between the trainee and the trainer. It is necessary for the trainer to convey that he or she is a person who can be trusted and gives value to the new user's feelings and opinions [Bloch and Hoyt, 1992].

Often many families experience anxiety about the safety of the trainee. With the permission of the trainee, steps should be taken to involve the family in the training process. The family involvement should be as much as they desire as long as it is not detrimental to the training process and the trainee is in agreement with family participation. Family involvement enhances the training for the trainee, promotes understanding, and relieves some of the anxiety of the family members.

The trainer needs to totally plan the route to be taken before any travel training begins. This includes checking to make sure the vehicle mobility equipment is compatible with the user's needs (for example, some bus securement devices can only fit certain models of wheelchairs and some lifts cannot take standees), that the correct fare media has been obtained, where the appropriate bus stops are located, and how the trainee will get to and from the bus stops.

The *Travel Training Guide* list two pre-mobility skills that are necessary before travelling on a transit system. One is the technique of pedestrian travel, such as safe street crossing. Trainees are taught to:

- cross streets at intersections using the pedestrian cross lights when applicable,
- cross perpendicular to stopped traffic,
- watch for traffic making right-hand turns,
- cross at intersections with stop signs when there is no traffic.

The other skill needed is the ability to distinguish safe and unsafe social situations, and where and when to seek help if needed. Role playing in simulated situations is recommended to prepare a trainee for real situations. Two rules are recommended by this training program:

- never leave the route with anyone you don't know,
- never accept anything from a stranger.

Riding a transit system does not happen in isolation, but with constant interactions with people. A natural network is formed by people who wait at the same bus stop, travel the same route, disembark at the same stop, work in the same place, and of course, the bus operator. During training, the trainer should remain alert for people who could be "natural helpers" and, if it seems appropriate, should find out if they are willing to be available to the trainee. These natural helpers would be the people the trainee can look to for support and assistance in any form needed.

The *Travel Training Guide* next divides travel-training into eight sequential steps. As no two people are alike, the travel-training process reflects the different transit needs and learning styles of each individual. The steps may take only one day or may be repeated as needed. The important issue is the involvement of the new traveller to the fullest extent possible in the planning and decision making process. The goals for each training session must be clearly articulated, and the trainer should use consistent language terms.

Step 1 The trainer picks up the trainee at her/his residence. The first lesson is a ride on the bus so the new user gets some bus experience or, if the trainee has previous bus experience, so the trainer learns what skills the trainee already possesses.

Step 2 The trainer meets the trainee in front of their residence and asks the trainee to locate the appropriate bus stop. At this stage, encouragement and praise is offered for any display of successful independent performance. If this task is not performed satisfactorily, the trainer needs to prompt by a verbal cue, physical reminder, or a gesture.

Step 3 The trainer meets the trainee at the appointed time at the bus stop. The trainee should be able to initiate and follow through on the proper bus procedures. If the trainee has any difficulties, trainer prompting should continue. At this point natural helpers can be integrated into the training process. It is important that the trainee retains the responsibility for a successful transit trip, and the natural helper lend a different level of support.

Step 4 By this stage the new user should be able to perform all procedures on her/his own. The trainer should follow the new traveller to the bus stop, board second, and sit behind the trainee. If the trainee has difficulties, the trainer is close enough to assist. At the end of this step, if a small mistake is made, the trainer may decide not to assist the trainee; this gives the trainee the opportunity to problem solve on her/his own.

Emergency procedures, such as missing the bus or missing the desired exit bus stop, need to be discussed. Role playing is an effective way of learning the proper procedures.

Step 5 The trainer's involvement continues to diminish. At this point the only trainer intervention is in case of a dangerous situation. The trainee is given the opportunity to problem solve in unexpected circumstances and learn from these experiences. Map reading, telephone use, and how to solicit assistance is initiated at this stage.

Step 6 The trainer follows the trainee in a car. The trainer will meet the trainee at the bus stop, any transfer points, and the final destination. These are the only time during the transit trip when contact is made. Afterwards, the trip should be reviewed, and lots of encouragement given for the newly acquired skills.

Step 7 The trainer follows the trainee in a car without the trainee's knowledge. If the trainee is successful she/he are considered travel trained.

Step 8 The new user is to report in with the trainer everyday during the first week of independent travel. This allows the trainer to stay in touch with any problems, reinforce techniques, and promotes further confidence building. After one and three months the trainer should meet with the trainee for a comprehensive review of the new user's progress.

Often travel training is full of negative emotions. These can be from the trainee, or the trainee's family. Fears may arise regarding personal safety, getting lost or stranded, forgetting the routes, crowds, having a seizure, becoming incontinent, not being able to communicate, falling, the bus itself, or being stigmatized. The trainer must find ways to communicate that the trainee's fears are understood, and to work through these feelings and take steps to overcome the problem. Families or guardians experience fears for the new traveller's personal safety. The trainer needs to enlist them as an ally and involve them in the training process to alleviate their fears. Figure 4 is a list of travel tasks, common to all persons, that are necessary to master during travel training. The trainer needs to assist in developing whatever skills are necessary for the new user to become successful at accomplishing each task (such as where to get weather reports to know what to dress for).

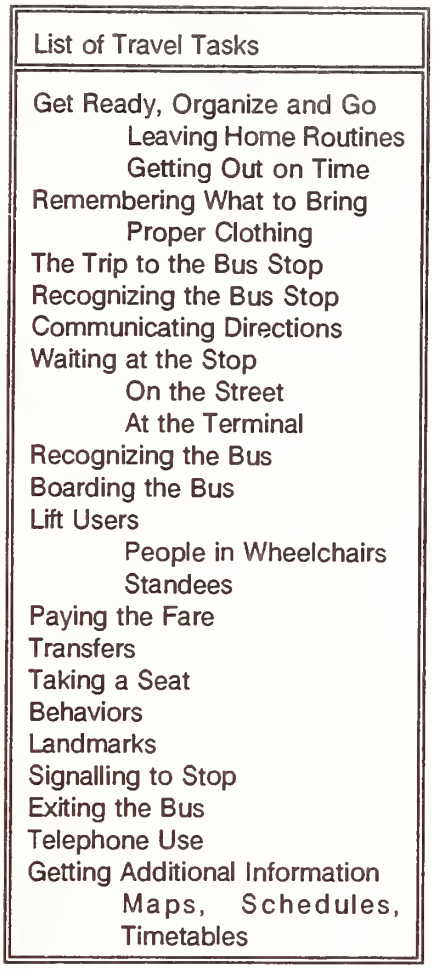


Figure 4. Travel Training Tasks [Bloch and Hoyt, 1992]

While in the transit environment, problems are bound to occur. These may be the trainee's mistake, such as arriving late at a bus stop, or external factors, such as a rerouted bus due to a temporary detour. The following is a list of some common situations, with strategies and techniques to address them. If any of these problems happen repeatedly, the trainer needs to investigate, set up a new travel schedule or assist with the correction of the problem.

Missing the Bus The new transit user will have to make a decision. She/he can either wait for the next scheduled bus and be a bit late, find another form of transportation, such as a taxi, or ask for parent or staff member intervention. It is important that the trainee know panicking will not help matters. During travel training, the trainer must give information regarding these options so the new user knows what to expect.

Missing the Bus Stop or Boarding the Wrong Bus Again the new user will have to make decisions. The available options are: if she/he miss their stop or recognize she/he are on the wrong bus in just a few blocks she/he could get off the bus and walk back; if the bus has gone to far to walk back the trainee could show an information card or tell the driver what their destination is and hope the driver will help her/him get back on the right track; or if the trainee gets off the bus and are confused the proper action is to look for a phone to call home, her/his employer, or staff members to come and get them.

Dealing with Inappropriate Drivers Drivers can intimidate trainees by hurrying them, asking nonessential questions, complaining or making rude statements to or about them, or refusing to use the lift or bus kneeling equipment. The trainees need to know their rights and, if an incident occurs, should report it to the transit authority.

To file a complaint the trainee must have the time, location of the vehicle, route number and, if possible, the driver's name or something to identify the driver (i.e., driver badge number). The trainee needs to know the procedure that the bus company will be taking to investigate the complaint and when they will get back to the trainee. Perseverance may be necessary.

At the end of the *Travel Training Guide* is a pre-assessment form, a travel training pre- and post-test form, a daily travel training report form, a progress evaluation of travel skills form, a follow-up form for one and three month, etc. This guide is a complete program structured to teach skills needed to competently and efficiently gain the ability and confidence for independent travel [Bloch and Hoyt, 1992].

Training for the Trainers and Transit Personnel

The goal of training programs for transit personnel should be to make bus operators more aware and sensitive to the abilities and needs of persons with all types of disabilities. To increase sensitivity, training should involve one-on-one group discussions with qualified persons having disabilities. Training should be provided on a regular basis and should extend to all transit personnel who interact with the public [Project ACTION, 1990; Coburn, et al., 1992].

Transfer, is a two module training manual which supports accessible transit systems. The first module is a training program for persons who will train fixed route and paratransit personnel on sensitivity issues. This module is broken into five units and nine lessons taking between 30 and 40 hours to present. The second module is titled *The Education of Trainers for Travel Training Persons with Disabilities*. Module Two has two units with three lessons taking 15 to 20 hours to present. The beginning of each lesson is a list of preparation materials that are needed for the lesson, vocabulary and terminology to be discussed in the lesson, and procedures and prompts consisting of detailed directions for presenting the lesson. Also

included are handouts to be copied and distributed to the class. The materials that the training sessions in module one cover are legal and policy issues, psychology of public transit use for the person with a disability, communication and advocacy skills, and developing model training sessions. Module Two material is concerned with the role of the travel trainer and developing travel training sessions [Cerenio, 1992]. The first module, lesson one, of *Transfer* introduces the class instructors and identifies the components of the training. This unit emphasizes the program's extreme importance and significance of the training that the new sensitivity trainers are about to receive. It also emphasizes that in the future it is they who will be instrumental in ensuring that the benefits of transportation are available to persons with disabilities [Cerenio, 1992].

The second unit of Module One is titled *The History of Accessible Transit*. The module covers the laws, the regulations, and the civil rights of transit users. The 1964 Civil Rights Act, the 1970 Amendment to the Urban Mass Transportation Act of 1964, 1973 Section 504 of the Rehabilitation Act, and the 1992 American with Disabilities Act (ADA) are federal laws that have addressed accessible services; however, the ADA is the general focus of the lesson. Any relative information on state and local laws specific to the training location should also be discussed. The second lesson in Module Two identifies groups that oversee transit services, identifies funding sources for specialized transit, and determines a plan of action to follow in case of an accessibility issue that should be addressed by local governing bodies. An outside speaker addresses the issue of the role and function of a citizen advisory group, while another speaker discusses the function of the governing body that oversees specialized transit.

The *Psychology of Public Transit Use for the Persons with a Disability* is the title of the third unit of Module One of *Transfer* [Cerenio, 1992]. A major goal of this section is understanding the various perspectives of transit users concerning the use of public transit, such as the driver and other transit personnel, the disabled user, the disabled consumer who is not a transit user, other transit consumers, and the general public. Speakers from different perspectives discuss their transit experiences. The second part of this unit focuses more closely on attitudes and perceptions about persons with disabilities that tend to dominate, rightly or wrongly, society's thinking. A video, *Nobody's Burning Wheelchairs,* is shown [American Public Transit Association, 1991]. This video explores the lives of people with disabilities and ways the general public is learning from them.

Lesson Four provides a specific focus on communication and advocacy skills. As sensitivity trainers, candidates must be able to assist transit operators with communication between themselves and disabled persons in an effective and courteous manner. A useful technique is to present the information visually as well as verbally. This allows for a better understanding of the material. Role playing a transit trip with drivers acting as the user with disabilities, reinforces sensitivity and communication. The second part of Lesson

Four provides trainees with an overview of what advocacy is and the many forms that it can take, from petition signing to initiation of a lawsuit.

The last unit of *Transfer* Module One provides an overview of training sessions specifically oriented to drivers. To build empathy and sensitivity, every driver should have hands on experience with a disability, such as wheelchair use, wearing earplugs, or being blindfolded while performing a task. Nine handouts to be duplicated and passed out to the trainees are incorporated in this training manual. They cover:

1. The different types of mobility aids,
2. Descriptions of different disabilities, their causes and effects,
3. Guidelines for wheelchair lift procedures, how to maneuver a wheelchair up and down stairs,
4. General tips to assist passengers with visual impairments,
5. Assisting passengers with speaking impairments,
6. Questions and answers about epilepsy.

Two sample eight-hour workshops are presented, including eight real life role playing situations, one for bus drivers and another for paratransit drivers [Cerenio, 1992].

Module Two is the training for the travel trainer. The first lesson provides an overview of the travel training program. The major point of the program is that,

> "... trainers should understand that the lack of accessible transportation is considered the single greatest barrier to equal opportunity in employment, recreation and community life for persons with disabilities" [Cerenio, 1992].

Unit one discusses the impact of the ADA and attitudinal obstacles from the general public. The goal of the first lesson is to affirm the critical importance of travel trainers in achieving equal opportunity and accessibility for persons with disabilities. To accomplish this task, skills of effective communication, sensitivity and assertiveness need to be exhibited by the new trainers and, eventually, by their clients.

The second lesson for the travel trainers is knowledge about the transit system(s) in their own locality. This includes transit policies, accessible routes and stations, schedules, fares, discount rate bus passes, transfer points, and transit information phone number and complaint division. Another important lesson in this unit is to overcome their own sense of embarrassment or uneasiness when dealing with persons with disabilities. The video *Nobody's Burning Wheelchairs* is shown in this lesson [American Public Transit Association]. Handouts are distributed regarding passengers with a mobility loss, blindness and low vision, deafness and

hearing impairments, speech impairments, developmental disabilities, epilepsy, and also, how to assist passengers in wheelchairs.

The last lesson in the second module provides the new trainer an opportunity to develop her/his own travel training sessions. A travel trainer's trip planning sheet is given to the new trainer to help plan the transit trip. On the sheet there are places for information concerning the needs of the traveler, and for trip information. During the session, brainstorming and role playing are used to help generate ideas on how to effectively train for travel [Cerenio, 1992].

Transit Policy

Sensitivity to passengers should be a high priority of the transit agency. Bus stops, landmarks and signage help the passenger with cognitive impairments identify a consistent location and establish a routine. Bus stops also eliminate the need to "flag down" a transit vehicle. The system should be made as user friendly as possible. The process of obtaining multipie ride passes or fare media should be designed with the user in mind. All equipment should be in good working order, since persons with disabilities become quickly discouraged when equipment malfunctions and their trip is consequently delayed. This includes the kneeling bus feature and next stop confirmation lights. Transit agencies should place a colored card in the bus window that corresponds to the color coding on the route map for the passenger that does not read [Project ACTION, March 1992].

CHAPTER 4 SIGNAGE INFORMATION

This section discusses the symbolic encoding of information, and the application of pictographs to transportation information systems. Dominique Velche has written *Access to Signage Information and Use of Transportation Systems by Mentally Disabled People*. The project studied the use of pictographs and signage to assist mentally disabled persons make the unusual transit trip [Velche, D., 1992]. The varying factors tested were the message form and environment, traveler's abilities to decode texts and signs, and the subjects familiarity with public transport systems.

There were 81 mentally retarded subjects involved in this study; 38.3% could read fluently and 17.3% had no access to reading. The average score on the Weschler Adult Intelligence Scale (WAIS) was 67.3 for 65 of the subjects. The use of public transportation by the subjects was 57%. Surprisingly, the degree of mental retardation, as measured by the WAIS scale, had no influence on the use or non-use of public transportation. Fifty-three percent were able to read time.

The subjects performed three tasks. The first was the identification of 47 isolated signs where most had pictographs, with or without a written message. The second task called for interpretation of slides presenting different degrees of complicated travel situations. The performance of an unusual real site-trip, with an observer, was the last task.

The results of the sign identification and interpretation showed a direct correlation to the WAIS score, reading and knowledge of figures, and ability to read time. The most discerning relationship is the formal cognitive test score and correct sign interpretation. There was no significant influence in identification and interpretation by sex or age of subjects and, surprisingly, the use of public transportation.

There were 4 categories of the 47 signs: 1) pictographic only signs, 2) pictographic and written signs, 3) mainly written signs, and 4) directional pictographic signs. Tabulated in Table 3 are the results.

There was conflict among the groups of subjects of the types of signs interpreted correctly. For subjects reading fluently, it was more difficult to understand pictographic signs than written signs; the more writing on the signs, the better this group understood the sign. However, in the groups that had no access to reading, the pictographic signs with directions (arrows, stairs, escalators) were interpreted correctly most often. The mainly written signs were interpreted correctly the least often. The more fluent the reading ability, the better the interpretation of media.

Table 3. Percentage of Correctly Identified Signs of Each Type Offered as a Function of Reading Abilities [Velche, D., 1992]

Reading Ability A = Fluent B = Difficult C = Some Words D = Some Letters E = None F = Total						
READING (# of signs)	A (%)	B (%)	C (%)	D (%)	E (%)	F (%)
PICTOGRAPHIC ONLY SIGNS (16)						
Total	50.6	49.4	40.0	33.1	25.0	42.5
Concrete Object (4)	70.0	80.0	65.0	57.5	47.5	67.5
Concrete Representation and Abstraction (8)	33.8	28.8	23.8	17.5	12.5	26.3
Ideal Abstract Representation (4)	62.5	60.0	50.0	40.0	27.5	52.5
PICTOGRAPHIC AND WRITTEN SIGNS (7)						
Total	72.9	68.6	47.1	27.1	27.1	54.3
Pictographic Signs Including Written Message (2)	80.0	85.0	55.0	40.0	40.0	65.0
Signs Associating Simple Text and Pictograph (5)	70.0	62.0	42.0	22.0	22.0	50.0
MAINLY WRITTEN SIGNS (8)						
Total	81.3	61.3	26.3	10.0	11.3	50.0
Signs with Simple Written Messages (5)	76.0	58.0	28.0	8.0	2.0	46.0
Signs with Complex Written Messages (3)	86.7	66.7	23.3	13.3	26.7	56.7
DIRECTIONAL PICTOGRAPHIC SIGNS (16)						
Total	70.0	76.3	56.3	45.6	36.9	60.6
Number of Subjects	31	17	7	12	14	81

Each type of sign was further analyzed as to its abstract or concrete pictorial content, and as to whether the written message was simple or complex. Signs giving a concrete representation of the object, were identified correctly with higher frequency than abstract representations. The sample size was not large enough to draw statistical conclusions; however, it was observed that concrete signs were accessible to people with relatively poor reading abilities. Pictographs with written messages, as opposed to pictographs with simple text, were better interpreted by all groups.

In the slide presentation, access to reading was again the determinant of correct interpretation of the photographs. These slides had an increased amount of written information, as they were illustrating a more complex real world environment. Again, surprisingly, there was no significant difference in correct interpretation if the subjects did or did not use public transportation. The slides were shown in and out of their environment, and proved to be very difficult to identify out of the context of their environment.

It was difficult to reach conclusions based on the trip performance. While 83% of the studied travellers easily identified and interpreted the major part of the pictographic or written signs, others had significant difficulties. Many made up for their deficiencies in interpreting information by asking other passengers for help. In 40% of the cases the observers had to intervene to direct attention in the correct direction.

Pictographs are effective, depending on their form, complexity, environment, and if there is previous experience with the message. However, pictographs are not an alternative to the written message. Mentally retarded persons who know how to read usually identify and interpret written messages the best. The mentally retarded person who has no access to reading may have some success with pictographs, but in any case, her/his success rate is low. The greater the person's mental capabilities, the greater the success rate of identifying and interpreting both written and visual signage.

In summary, the study by Velche indicates that the symbolic encoding of information is very complex and depends on environmental and cultural influences. The best application of pictographs should include written information for clarification as well as redundancy.

CHAPTER 5 SURVEY AND INTERVIEWS

The literature review revealed technologies and policies available as well as policies for persons with visual and hearing impairments, but little information was available for persons with cognitive impairments. To fill this knowledge gap, surveys and interviews were conducted with persons with cognitive and other impairments, trainers of persons with sensory and cognitive impairments, and providers of transportation services. This section describes methods and results of the survey and the interviews.

SURVEY METHODS

The basic structure of the survey followed the format of the trip tasks previously discussed, but additional tasks concerning emergency situations were included. For each task on the survey, there were nine media types and ten training formats listed. Participants were asked to rate each media type and training format for each trip task. The media refers to communication methods that the transit agency could provide to assist in making a successful transit trip, such as system maps, printed schedules, audio tapes, tactile maps or driver announcements. The training format describes different techniques and aids that would be used when training persons with cognitive impairments to ride a fixed route system, for example, training one-on-one with a trained guide, repetition, or computer games. Descriptions of media types and training formats were listed at the beginning of the survey. The rating scale was from one to five as follows:

5.....Extremely Important
4.....Very Important
3.....Important
2.....Not too Important
1.....Not Important

There was room on each page for additional comments, and verbal encouragement was given to participants to state any aids other than the ones listed on the survey that were beneficial. The survey is listed in Appendix B.

The Special Transportation Fund Advisory Committee of Lane Transit District (LTD) in Eugene was chosen to fill out the survey. This group is composed of 17 persons with the following affiliations: two with developmentally disabled services, three with paratransit services, three transit users with physical disabilities; three representatives from other transportation districts, two special interest groups, such as elderly, and four LTD staff including operators and customer service representatives. An exact listing is given Appendix B.

SURVEY RESULTS

A survey was completed by each individual, but was discussed as a group beforehand. During the discussion it was stated that persons often have more than one type of disability. It was difficult to make distinct separations as to which media or training format would prove successful for just cognitive impairments. To reach conclusions, a statistical analysis was conducted. For each media type per trip task, the rating mean was calculated. The highest mean rating, was compared to each of the other mean ratings per trip task, using Student's t-Test. In statistical analysis, the probability of a statistical significant difference occurring between two means is associated with a p-value. The larger p-values indicate that there was strong evidence to support that the difference between two means is zero. If the p-value is greater than 0.05, there is a 95% confidence level that there was not a statistical significant difference between the means. The same procedure was performed with the training formats. The original data, the calculated means, and the resulting probabilities or p-values are listed in Appendix C.

Media

Table 4 is tabulations of the highest mean ratings of the media types, per each trip task. The means have no significant statistical difference from the highest mean. Also evaluated were the highest means for each task category and for all the tasks combined.

Upon visual inspection of Table 4, a pattern is obvious. Of the nine media types listed on the survey, driver announcements and customer service consistently rated the highest. There was no significant difference between these two mean ratings in 9 out of 19 tasks. Visual signs was the next most helpful media type. In five tasks these top three were determined to have no significant difference between them. The results are:

1. For the tasks relating to understanding the system, the highest rated media was customer service and visual signs. Both are rated "very important."
2. For the tasks relating to accessing the correct vehicle, the highest rated media types are customer service, visual signs and driver announcements. The rating for these three media types indicate that they are "very important."
3. For the tasks entering and travelling on the vehicle, and departing the vehicle, driver announcements mean ratings are statistically significantly different from all the other media types. For the tasks involving entering and travelling on the vehicle, the mean rating is half way between "very important" and "extremely important". For the tasks involving departing the vehicle the mean rating is "very important."

Table 4. Media Mean Ratings With No Significant Difference to the Highest Mean

TASKS	Media				
	Visual Signs	Printed Schedule	Talking Signs	Customer Service	Driver Announcement
UNDERSTANDING THE SYSTEM					
A	4.29	3.53	3.75	4.18	4.13
B	3.50	3.64	3.83	4.13	3.56
C	3.88			4.44	
MEAN	3.90			4.25	
ACCESSING THE CORRECT VEHICLE					
A	4.41			4.44	4.65
B	4.00			4.53	4.07
C	4.41		3.88	4.36	
D	4.76		4.31		4.19
MEAN	4.39			4.36	4.11
ENTERING THE VEHICLE					
A					4.64
B					4.36
MEAN					4.50
TRAVELLING ON THE VEHICLE					
A				3.87	4.09
B					4.73
C					4.73
D			3.08	3.85	4.09
MEAN					4.49
DEPARTING THE VEHICLE					
A	3.94				4.50
B	2.87				3.73
MEAN					4.13

Task descriptions follow at the end of Table 4

Table 4. Media Mean Ratings With No Significant Difference to the Highest Mean (continued)

	Media				
TASKS	Visual Signs	Printed Schedule	Talking Signs	Customer Service	Driver Announcement
EXITING THE STATION/TERMINAL; DETERMINE DESIRED EXIT DIRECTION					
MEAN	4.06		3.60	3.29	3.36
EMERGENCIES					
A				4.19	4.54
B				4.87	
C	4.07			4.50	4.21
MEAN				4.54	4.25
TOTAL MEAN					4.15

Tasks Description

Understanding the System
- A. Learn routes, stops/stations, transfer points and fares
- B. Learn schedules
- C. Learn special services and provisions

Accessing the Correct Vehicle
- A. Locate stops, station, terminals
- B. Locate and access the fare system
- C. Move to proper boarding area
- D. Identify the correct incoming bus

Entering the Vehicle
- A. Pay fare
- B. Entering the vehicle-identify seat or standing area

Travelling on the Vehicle
- A. Comprehend announcements for special services
- B. Comprehend intersection announcements
- C. Comprehend driver announcements
- D. Comprehend automated announcements

Departing the Vehicle
- A. Identify the desired stop/station/terminal
- B. Notify driver of desired stop

Exiting the Station/Terminal; Determine Desired Exit Direction

Emergencies
- A. Route deviations
- B. Canceled routes
- C. Weather conditions — snow-fog

4. When exiting the station and determining the desired direction, visual signs, talking signs, driver announcements, and customer service, rated highest, with no statistical significant difference. The mean ratings for these tasks ranges from "important" to "very important."
5. In emergency situations, customer service and driver announcements rates the highest, with mean ratings ranging from "very important" to "extremely important."

Driver announcements had no significant statistical difference to the highest media mean rating 16 times. Learning special services and provisions, moving to the proper boarding area, and canceled routes were the tasks where driver announcements did not rank highest. When the overall media mean was calculated and compared to the other media means, driver announcements rated "very important," with evidence to support a statistical significant difference with all the other media. A number of written comments indicated that consistency and simplicity in driver announcements was important. Also commented, was that passengers should notify the driver verbally if there is difficulty in locating the desired destination stop.

Customer Service and visual signs mean ratings had no significant difference to the highest mean 13 and 10 times, respectively. Comments stressed that color coding, larger print, and better lighting are needed to improve visual signs.

Training Format

Table 5 tabulates the highest mean ratings for the training formats for each task. The means have no significant statistical difference from the highest mean. Also evaluated were the highest mean ratings for each task category and in general, over all tasks. Again, in Table 5 a pattern is evident. The most effective training formats are one-on-one with trained guide, repetition, and real time on bus. In 19 out of 19 tasks, there is no statistical significant difference between these three. However, when the overall means are calculated, only one-on-one with trained guide, and repetition are rated highest, with strong evidence to suggest that the means are similar.

Three training formats rate highest, without differing statistically, for the tasks in five categories. The categories are accessing the correct vehicle, entering the vehicle, travelling on the vehicle, departing the vehicle, and exiting the station. The three formats are one-on-one with trained guide, repetition and real time on bus. For the tasks involved in accessing the correct vehicle and departing the vehicle, the formats rated from "very important" to "extremely important." For the tasks in the categories entering the vehicle and travelling on the vehicle, all the formats rated "very important."

Table 5. Training Format Mean Ratings With No Significant Difference to the Highest Mean

	Training Format				
TASKS	1/1 with Trained Guide	1/1 with Guide	Repetition	Time on Bus	Simulated Trips
UNDERSTANDING THE SYSTEM					
A	4.65		4.56	4.29	
A	4.24		4.71	4.29	
C	4.29		4.25	3.47	
MEAN	4.38		4.52		
ACCESSING THE CORRECT VEHICLE					
A	4.35		4.56	4.29	
C	4.24		4.56	3.93	
C	4.59		4.27	4.27	
A	4.18		4.47	4.06	
MEAN	4.31		4.46	4.13	
ENTERING THE VEHICLE					
A	4.18		4.33	4.13	
C	4.25		4.56	3.88	
MEAN	4.22		4.45	4.00	
TRAVELLING ON THE VEHICLE					
A	4.25		4.25	4.13	
A	4.46		4.50	4.21	
C	4.59		4.56	4.00	
C	3.91		4.47	4.47	
MEAN	4.29		4.44	4.35	
DEPARTING THE VEHICLE					
A	4.59		4.44	4.44	
A	4.59		4.25	4.63	
MEAN	4.55		4.34	4.53	

Task description follow at end of Table 5

Table 5. Training Format Mean Ratings With No Significant Difference to the Highest Mean (continued)

	Training Format				
TASKS	1/1 with Trained Guide	1/1 with Guide	Repetition	Time on Bus	Simulated Trips
EXITING THE STATION/TERMINAL; DETERMINE DESIRED EXIT DIRECTION					
MEAN	4.56		4.50	4.56	
EMERGENCIES					
A	4.00		3.71	3.79	3.58
B	4.00	3.14	3.33	3.64	3.67
C	4.00	3.29	3.75	4.00	4.00
MEAN	4.00		3.61	3.81	3.75
TOTAL MEAN	4.31		4.34		

Task Description

Understanding the System
- A. Learn routes, stops/stations, transfer points and fares
- B. Learn schedules
- C. Learn special services and provisions

Accessing the Correct Vehicle
- A. Locate stops, station, terminals
- B. Locate and access the fare system
- C. Move to proper boarding area
- D. Identify the correct incoming bus

Entering the Vehicle
- A. Pay fare
- B. Entering the vehicle-identify seat or standing area

Travelling on the Vehicle
- A. Comprehend announcements for special services
- B. Comprehend intersection announcements
- C. Comprehend driver announcements
- D. Comprehend automated announcements

Departing the Vehicle
- A. Identify the desired stop/station/terminal
- B. Notify driver of desired stop

Exiting the Station/Terminal; Determine Desired Exit Direction

Emergencies
- A. Route deviations
- B. Canceled routes
- C. Weather conditions — snow-fog

For the tasks involving understanding the system, one-on-one with trained guide, and repetition mean ratings were considered highest with no statistical significant difference. The ratings were "very important" to "extremely important".

In emergency situations the tasks one-on-one with trained guide, repetition, real time on bus, and simulated trips rated highest without any statistical significant difference among them. They all rated as "very important."

INTERVIEW METHODS

The interviews were structured around the trip tasks. The goal of the interviews was to determine which techniques would best increase accessibility on a fixed route system for persons with cognitive impairments. A list of some currently available technologies was given to the participants. They were then asked to comment on areas where there was a need for improvement and provide information concerning helpful media types, training techniques, technologies, transit policies, or any other aids that prove effective in making transit systems more accessible.

A total of nine people were interviewed. Four people were trainers of persons with a full range of physical and mental disabilities. One person was a fixed route transit user with a brain injury, and the remaining four were coordinators of disabilities programs. The names, titles, and agencies are listed in Appendix D.

INTERVIEW RESULTS

The interview results are reported according to task.

Evaluation of Rider Transit Needs and Understanding the System

This step is usually completed by the trainer of persons with disabilities. The trainer evaluates the transit needs of their client for: which routes are to be used, what fare media is to be used, what type of assistance is needed to make necessary transfers, and any special services that are required. The next step is to set up a transit plan. To assist in this step, transit agencies should provide training to the trainers regarding the information available and the services that are available. This training should be repeated, as necessary, to reflect new or changed services offered by the transit agency. By keeping the trainers current on changed services, confusion by persons with cognitive impairments will be decreased when negotiating the transit system.

Video tapes would be helpful for general instruction. This would be a useful tool for a person who has never ridden the bus and would help review the transit trip for the experienced passenger if necessary. Not all persons with impairments know what the appropriate transit behavior is. The tapes could show all phases

of bus riding including where the route number on the bus is located, a demonstration of how to pay the fare, how to pull the buzzer to notify the driver of the desired final stop, etc. One of the characteristics of emotional and learning disabilities is the variability of behavior. The tape could be shown repeatedly, or whenever needed, as a reminder of proper conduct in a bus.

To easily identify the routes on system maps, the routes should be color coded. Transit personnel should be communicative and willing to help potential passengers in learning new information or confirming transit information already known by the user.

Accessing the Correct Vehicle

It is important for persons with cognitive impairments to receive confirmation that they are taking the proper bus. Drivers announcing the route name and number when the door opens offer assurance that the passenger is accessing the correct vehicle. Talking buses also would accomplish this task. To offer the best service, the voice of a talking bus should be nonabrasive and easily understood.

A lot can be done at major transfer points to increase accessibility. Transit agencies need to provide color coding and symbols to identify the correct transfer section. The coding should match the symbols and color coding on system maps. Route maps and a clock at each section are informative and reassuring; and there needs to be a distinct boundary around each section to avoid confusion. Buses with larger signs on the side would make route recognition easier.

The interview revealed that the use of route cards, carried by the person with disabilities, would provide assistance in cases of disorientation and confusion. The card would show the origin, destination, identification and who to call in case of unforeseen circumstances. However, some persons do not enjoy the stigma that goes with being disabled and would feel labeled by the use of these cards. Though the use of these cards may be useful, they should be optional to preserve the dignity of the transit system passengers.

Entering the Vehicle

The proper way to enter and locate seating should be taught. Role playing is a way of teaching a person with disabilities how to enter the bus, pay the fare, and find a vacant seat. Keeping the front seats available for persons with disabilities helps the person with cognitive impairments to locate a vacant seat, reduce the effect of distractions, and stay focused on the transit trip plan.

To simplify the payment system, the transit agency should provide a fare structure that is easy to use. By keeping the number of coins low, that is, two quarters instead of one nickel, one dime and one quarter,

simplifies fare collection. Having passes, tokens, or having the correct amount of money ready ahead of time encourages smoothness in the fare paying transaction. This allows the passenger to enter the vehicle and be seated without drawing unwanted attention to themselves.

Travelling on the Vehicle

The transit agency should enforce the policy of keeping the front seats available for person with disabilities. Providing seats in the front section of the bus helps persons with cognitive impairments keep better focused on the trip plan and allows for easier physical maneuvering. If possible, the transit agency should try to eliminate standees or move standees further to the back section of the bus.

In cases of emergency, special announcements, or if inappropriate behavior is exhibited, special attention is required of the bus operator and transit personnel. Interviews revealed that it is important to keep instructions simple. Operators giving instructions need to be: 1) sensitive of passengers needs, and 2) aware of any uneasiness or confusion felt by the passenger. Individualized attention is often necessary. In some circumstances it may be necessary that the transit agency notify the training facility so that the passenger's transportation goals are met.

Departing the Vehicle

Locating the correct stop for the passenger's destination can be difficult. Training persons with impairments to recognize landmarks helps to locate the correct stop. In some cases, to identify the correct stop, cues can come from other passengers with a higher functioning level, for example, when groups of people working at the same location are travelling together.

When exiting the vehicle, a visual sign that lights up "Exit to Back of Bus" when buzzer has been rung is useful. The lighted sign provides confirmation that the buzzer has been rung and where to exit the vehicle.

Exiting the Station/Terminal

When first stepping off of the vehicle it necessary to orient oneself to the new environment. Repetition training to determine the desired exit direction serves to meet this end. When travelling in a group, as in the above situation, cues from persons with higher functioning levels help to identify the correct direction.

User Training

The interviews identified some overall procedures that are helpful for increasing fixed route accessibility. Carrying a route card that identifies the user, which route(s) are to be taken, the origin and destination stop and who to contact in case of unforeseen circumstances may be desirable. This card needs to be optional

because some persons feel degraded when labeled as disabled. It is important to treat all persons with dignity.

Trainers of persons with disabilities stated that ideally training would be accomplished one-on-one with a trained guide but that training can be successful in small groups. An important training technique is to monitor the client(s) to make sure the trip plan is followed. This is done by following the person with impairments in a car, making sure she/he gets off the bus at the proper stop and proceeds in the correct direction to his/her destination.

Transit Personnel

It was stressed in the interviews that transit personnel need to be sensitive to persons with disabilities and be aware of their needs. When giving instructions, employees need to be patient, talk in an uncomplicated manner, and be willing to answer questions. At times of emergencies or moments of confusion, persons with impairments need personal attention. Transit personnel must be aware of human rights and treat all persons with dignity.

If inappropriate behavior by the passenger occurs, driver intervention is necessary. Drivers need to know how to defuse the situation. Cooperation between the transit agency and training facility is necessary to alleviate any reoccurring problems.

Many people have more than one disability, persons with cognitive impairments may also have difficulty hearing. Trainers stated that knowing some American Sign Language is useful. It is helpful to always confirm a message, that is, repeat the message or say it in more than one way.

Additional Comments

Adapting to changes in routes, schedules or special services is difficult. Participants in the interview suggested avoiding seasonal changes and reducing the frequency of route changes in general. When major changes occur, extensive assistance by transit personnel is needed to explain and demonstrate new procedures or routes.

There is a need for timely and systematic flow of information from the transit agency to the training facilities. Programs for trainers including refresher courses should be provided by the transit agency. Cooperation between the transit agency and training facilities makes changes less difficult.

Operators assume everything is proceeding normally unless something indicates to them otherwise. Some disabilities that are not obvious, such as insufficient hearing levels or forgetfulness. In cases such as these, it is up to the individual with impairments to make her/his needs known to the driver.

Some persons are concerned with the stigma of being disabled. That is why it is important to treat all persons with respect, and to maintain the dignity of the person with impairments. Sometimes more help is given than is necessary.

Cooperation between the transit agency and the training facilities is necessary. Trainers should know who to contact within the transit agency if problems occur with other passengers, transit personnel, or if a person is missing. The consistency of having the same drivers on routes is helpful. In some cases they have learned characteristics unique to each of their passengers, know their regular passengers' origin and destination stops, where each passenger works, which agency to contact if there is a problem, and how to diffuse an inappropriate behavior situation if necessary.

CHAPTER 6 SUMMARY AND CONCLUSIONS

SUMMARY

In the literature review section, many of the technological solutions for persons with sensory impairments were presented. However, for persons with cognitive impairments, few technologies appear to be available to increase mobility. The surveys and interviews rated techniques involving human interaction as most helpful for persons with cognitive impairments. The following is a summary of the literature review, survey results and the interviews.

Deafness and Hearing Impairments

Receiving information and hearing announcements by the bus operator over a public address system are two areas of major concern for persons who are deaf or have hearing impairments. Several technologies exist to receive information via the telephone lines. The most popular being the TDD. Fax machines, hearing aid compatible telephones, and amplified telephones are other ways to receive information via the phone line.

Assistive listening devices aid in the understanding of announcements while traveling on the bus. Better still is a visual display paired with auditory or other sensory messages. A paired display confirms the message and compensates for hearing impairments. There are several technologies available to update visual messages inside a vehicle.

Sensitivity and awareness training for transit personnel is needed. Information about hearing impairments increases sensitivity to the needs of persons with hearing impairments. Use of technological devices by persons with hearing impairments increases understanding. Training in basic sign language should also be included. Above all, it is important to stress the dignity of all persons.

The above discussion in no way implies that all the barriers to travelling on fixed route systems have been removed for the hearing impaired. The World Federation of the Deaf is just one organization that aims for the removal of barriers in all aspect of life for persons with hearing impairments.

Blindness and Visually Impaired

In transit situations, persons with visual impairments experience the most problems in receiving transit information, locating and using devices associated with a transit trip, and physical movements throughout the system. Transit information is usually provided through printed media or a telephone information service from the transit agency. Alternatives for persons who are blind or have visual impairments are orientation and mobility training, tactile and auditory maps, audio cassette information, braille, and use of visual signage.

Locating and using devices associated with fixed route systems, such as a vending machine that dispenses tokens and fare boxes, is considered part of orientation and mobility. There is existing technology, such as electronic canes and assistive listening devices, that could be of assistance in identifying these devices. Tactile or auditory pathways could direct the user to the location and use of these devices. Braille, tactile and talking signs could be used for instruction to operate the devices. The same technologies and training to help locate devices would assist persons' movement throughout the system.

Visual signage is mentioned as assistive during all phases of the transit trip, from learning the system to knowing the desired direction when departing the bus. Signage should make use of the best contrast between information and background, avoid visual noise, optimize use of color and brightness, use non-glare surfaces, and use appropriate lighting. Signs should be standardized for easy understanding of the message and should be located in consistent and appropriate locations. Combining visual with other sensory information reinforces the messages and helps to compensate for visual distortion.

If a problem arises anywhere in the transit system, transit agency personnel will need to intervene. Transit personnel must be aware of any problems occurring and be sensitive to the person's needs. Training is needed to understand the disabilities, and to teach personnel the best ways to offer assistance to persons with visual impairments. In every case, it is important to maintain the dignity of the traveller.

Again, the above technologies do not imply that all barriers to persons with visual impairments have been removed. As demonstrated in the literature review, there are numerous studies available regarding appropriate technologies, policies, and practices to enable independent life styles. The American Foundation for the Blind and The American Council of the Blind are just two organizations that are continuing their efforts to remove barriers for persons with visual impairments.

Cognitive Impairments

Cognitive disorders encompass a large number of disabilities, and many more symptoms. Regardless of the disorder causing the symptom, when the symptom exists, such as irritability, it will probably cause the same travel difficulties. There is no easy consistent solution, technological or otherwise, to any of the trip tasks for persons with cognitive impairments.

Personal contact between individuals compensates for the variation of each unique transit trip problem. In the survey, the highest ratings for the media that would most assist persons with cognitive impairments involved human contact. The type of media that rated highest, regardless of the task, is driver announcements. Customer service and visual signs are next highest. The interviews also stressed attention from the transit personnel to diffuse inappropriate situations. There are no obvious technological solutions

to the problems persons with cognitive impairments face when travelling on a fixed route system. Real time on bus, repetition, and one-on-one with trained guide are rated highest for techniques in training persons with cognitive impairments. It is important to note that the techniques involving technologies rated as not important in the survey, while techniques involving personal contact rated as important or higher. The literature suggests that standardization and simplification reduce anxiety for persons with cognitive impairments. This applies to simple text and graphics, standard symbols, standard visual and audio signals, and auditory announcements.

Sensitivity and awareness training is needed by transit personnel. An eight-hour program that encourages sensitivity is reviewed. In this session the drivers learn about different disabilities, the assistive aids that are available, and actual time with a "mock" disability. Two aspects of training that need to be addressed are making personnel comfortable serving persons with cognitive disabilities and showing staff how to help. It is import for transit personnel to assess each situation individually and use common sense to diffuse any inappropriate behavior.

CONCLUSIONS

The literature review points out a deficiency in material available regarding accessibility of transit systems to persons with cognitive impairments. While cognitive impairments are mentioned in several studies, little research has been done directly relating to cognitive impairments and bus accessibility issues. Also, there are several organizations that act as advocates for persons with visual and hearing impairments, but because persons with cognitive impairments represents such a diverse group, such associations with advocates for accessible fixed route transportation are only beginning to become effective.

The conclusions reached to increase accessibility for persons with cognitive impairments are the result of a survey and interviews with trainers of persons with cognitive impairments and persons who provide transportation services for persons with cognitive impairments. Technologies were presented as possible techniques to increase accessibility to the transit system. However, it was concluded that unique solutions are required to resolve unique transportation problems. Technologies are noted for efficiently replacing a repeated action, such as paying the fare, and offer little assistance to unique situations. Personal interaction between individuals offers the best solution. For constructive personal interaction to occur, training is needed by transit personnel, the user, and the user's trainer.

Interaction between transit personnel and the transit traveler takes time. One way to provide the opportunity for interaction between bus operators and the users is to reduce operator tasks. Research to decrease operator tasks involving technologies and non-technological practices is needed. Areas where technology

may be of assistance is automated intersection announcements, and removing the fare collection system from the vehicle.

The concept of personal interaction between transit personnel and the transit traveller is easily expanded to all persons, with and without disabilities. Research is also needed to study ways to integrate accessible transportation solutions to assist all groups of impairments rather than assisting only one or two groups of persons with disabilities. Standardization of visual signs is an example were person with hearing impairments, poor vision, and the general public can benefit.

CHAPTER 7 RECOMMENDATIONS

Recommendation: Effective Visual Signage

For visual signage to be effective it should: 1) be placed consistently, 2) have large printing, 3) have optimum use of color and brightness, 4) be used with matte and other non-glare surfaces, 5) have proper luminance, and 6) be standardized. Signage should be paired with other sensory information, such as vibration, auditory, tactile, or air movement.

Visual signage is important for making a successful transit trip. As stated in the literature review, for persons affected by sensory and cognitive impairments, visual signage is of assistance when travelling. Visual signs are one of the top three rated media types in the survey. The interview results shows that color coding and symbols are helpful in training persons with cognitive impairments.

The literature review stresses symbols and pictographs, large printing, and consistent placement. The signs should have proper illumination to avoid visual noise. Sensory information should use high quality visual information, non-glare surfaces and make optimal use of color and brightness. The Velche article, discussed in chapter 4, states that mentally retarded persons who can read or at least recognize some words understood signs with written words the best. Persons who do not read do best with concrete symbols.

The contradiction between symbols and written messages for sign content supports the argument for standardization. Standardization should include the bus stop signs, sign location, the lighting system, icons, written messages, and color coding. Standardization of signs allows for easy recognition of the sign's message. This is of importance not only to persons with sensory and cognitive impairments, but for travelers unfamiliar with the transit system.

Pairing the visual message with other sensory information, such as vibration, tactile or an auditory text, would reinforce the message and give confirmation to those that are uncertain or anxious. This would be an advantage to persons with visual, hearing, and cognitive impairments, and to any new traveler in the system.

Recommendation: Training for the User

The goal of training programs for the users of transit services is to achieve speed, maximum agility, and smoothness when using transit services. This is important so time is not lost by the passenger with disabilities, the driver or other riders. One-on-one training for a person who has recently become disabled should be provided by a person with similar disabilities if possible. Independent living centers and training conducted by person with disabilities provide the best training programs.

User training should include:

- How to obtain information on fare structures,
- how to plan trips,
- how to make transfers,
- what to expect when using the transit system,
- how to report problems with transit personnel, and
- how to interact with transit personnel.

Individualized programs best serve performance difficulties.

Recommendation: Training for Transit Personnel

Transit agencies should provide sensitivity and awareness training for all transit personnel who come into contact with the public. Information concerning different causes and characteristics of hearing, visual and cognitive impairments should be discussed. Any technologies used, such as hearing aids, electronic canes, and assistive listening devices, should be demonstrated, or used by transit personnel to promote an understanding of what the devices are capable of doing and not doing. Driver sensitivity classes that include the use of opaque glasses help to increase driver awareness and sensitivity of persons with visual impairments.

Information concerning fundamentals of communication with persons with hearing impairments and some basic sign language should be given. An effective way to stimulate sensitivity to passengers' needs is to encourage communication between the drivers and their passengers.

Visually impaired persons need extra help with orientation. The operator needs to give explicit directions when persons with visual impairments are looking for a vacant seat or departing the vehicle, that is, "we are stopped at the bus stop on the north east side of 29th and Willamette St."

Difficulties with persons who have cognitive impairments need to be handled on an individual basis. Operators need to be aware if their passengers are unusually uncomfortable or anxious. If inappropriate behavior is exhibited, common sense must be used in assessing the person's abilities and defusing the situation. Operators should be trained to ask if additional help is required. While helping passengers make a successful transit trip, personnel must treat others with dignity and respect. Assistance should be offered but not forced on the passenger.

Recommendation: Reduce Bus Operator Tasks

In the literature review, survey, and interviews, it has been stated that in an unusual case operator assistance is necessary to assist the person with disabilities. In the usual case the driver has to be aware and sensitive

to the passenger needs. In the Americans with Disabilities Act, drivers are given the responsibility to announce major intersections. Drivers are also required to operate wheelchair lifts, give schedule information, handle any difficult passenger situations, and monitor the fare box. In addition, they negotiate traffic, make transfers, stay on schedule, announce major intersections, change destination signs and follow all transit polices. Other things that drivers do is remind a passenger where to get off the bus, make sure a front seat is available for a senior or a person with a disability, be sensitive to all their passengers needs, be aware of conditions on the bus and, in general, be aware if anything is not right with their passengers. The driver must also treat persons with dignity and respect at all times.

Recommendation: Use Technology to Reduce Operator Workload

The research indicated that more personal interaction is needed between the vehicle operator and the passengers, particularly those with special needs. The operator has more time available to interact with passengers if some of their tasks are completed automatically. Further research is required to study ways that technology may assist with the reduction in vehicle operator workload. Some of the tasks that technology could perform would be the automatic changing of destination signs and performing intersections announcements.

Recommendation: Cooperation Between Training Facility and Transit Agency

In cases of repeated difficult situations, the training facility and the transit agency must work together to solve the problem. This is especially true in the case of the persons with cognitive impairments. If the training facility does not know inappropriate behaviors are being exhibited, they will not be corrected. If a person is lost and afraid to get off the bus, transit personnel need to know who to contact. When there are changes in routes or fares, training facilities need to retrain their clients to the new procedures.

Recommendation: Training for Trainers

The interviews pointed out that there is a need for trainers of persons with cognitive disorders. Trainers need to be continually updated regarding transit information, services and any changes in services provided by the transit agency. This can easily be expanded to all trainers of persons with disabilities.

Recommendation: Integration of Assistive Technology

The research indicated that assistive technologies may only benefit one group of persons with a particular disability and raise barriers for other groups. Further research is required to insure that assistive technology benefits all groups of person with disabilities.

BIBLIOGRAPHY

American Public Transit Association, *Nobody's Burning Wheelchairs*, 1201 New York Ave. NW, Suite 400, Washington, DC

American with Disabilities Act, July 1990, U.S. Public Law 101-336, 101st Congress, Washington DC

Bloch, W., Hoyt, R., 1992, *Travel Training Guide*, Kennedy Center, Inc., Bridgeport, CN 06605

Bloch, W., Hoyt, R., February 1992, *"Modifications Menu" for System-Wide Map and Timetable Design*, Kennedy Center, Inc., Bridgeport, CN 06605

Crain-Revis Associated, April 1982, *Handbook Describing Low Cost Concepts and Techniques to Make Public Transportation More Assessable For Visually and Hearing Impaired Persons*, Department of Transportation, Urban Mass Transportation Administration, DTM 60-81-72903

Cerenio Management Group, April 1992, *Transfer*, 544 Golden Gate Avenue, San Francisco, CA

Coburn, N., Martin, C., Thompson, R., Norstrom, D., September 1992, *Guidelines for Improvements to Transit Accessibility for the Persons with Disabilities*, Battelle, Federal Transit Administration, Washington, DC, DOT-T-93-04

Fitzpatrick, M.E., Barkow, B., Beattie, J., September 1989, *Intercity Travel and the Deaf and Hard of Hearing Traveller: An Analysis of the Current State of Accessibility*, Transport Canada TP9839 E

Hardman, M.L., Drew, C.J., Egan, M.W., Wolf, B., 1990, The Human Exceptionality, Allyn and Bacon, A Division of Simon & Schuster, Inc., Needham Heights, MA 02194

Hickling-Partners Inc., 1983, *A Guide to Recognizing, Understanding and Assisting Travellers with Disabilities*, Transport Canada, TP 3461

Labell, L.N., Schweiger, C.P., Kihl, M., April 1992, *Advanced Public Transportation Systems: The State of the Art Update '92*, Federal Transit Administration, Washington, DC, DOT-VNTSC-FTA-92-3

Love, B., *Signage for the Blind*, INFOGRIP Inc., P.O.Box 963, Goldendale, WA 98620

McInerney, P., Stein, S., Barkow, B., Wiseman, S., June 1990, *Flight 201 has been Changed to Gate 102: Challenges Experienced by Travellers with Cognitive or Emotional Disabilities*, Transport Canada TP10450E

Moreyne, Marshall, July 1991, *Integrated Communication, Information and Security Systems (ICISS) for Visually and Hearing Impaired Persons — A Transportation Application*, Transport Canada, TP 10187E

Moreyne, M., Bouiron, A., Smith, T., August 1992, *The Visual Communication Network: An Integrated Communication, Information and Security System Inside Transit Vehicles,* Transportation Research Board, National Conference on Advanced Technologies in Public Transportation, San Francisco, CA

PACT, People Accessing Community Transportation, February, 1992, *"Modifications Menu" for System-Wide Map and Timetable Design*, Kennedy Center, Inc., Bridgeport, CT

Parker, Jeffrey A., March 1991, *Mobility Management and Market-Oriented Local Transportation*, Urban Mass Transportation Administration, U.S. Department of Transportation, Washington, DC, DOT-T-91-07

Project ACTION, 1990, *Combined Research Results*, National Easter Seals Society, Washington, DC

Project ACTION, 1989, *Reconnaissance Survey of Selected Transit Agencies*, National Easter Seals Society, Washington, DC

Project ACTION, March 1992, *Training People with Disabilities to Access Public Transportation*, Easter Seals

Richesin, C., Grace, G. Iantkow, M., and Gillies, T.K., December 1987, *Access Needs of Blind and Visual Impaired Travellers in Transportation Terminals: A Study and Design Guidelines*, Transport Canada TP 9048E

Richesin, C., Grace, G. Iantkow, M., and Gillies, T.K., December 1989, *Design Guidelines for Meeting the Access Needs of Blind and Visually Impaired Travellers in Transportation*, Transport Canada TP 10067E

Rutenberg, U., July 1990, *Development of a Portable Communicator/Translator Prototype*, Transport Canada TP 10556E

Special Education Services Unit, *Traumatic Brain Injuries, Guideline Paper*, March 1991, Colorado State Department of Education, Denver

Uslan, M.M., Peck,A.F., Wiener, W.R., and Stern, A., 1990, *Access to Mass Transit for Blind and Visually impaired Travellers*, American Foundation for the Blind 15 West 16th Street, New York, NY 10011

Velche, Dominique, 1992, *Access to Signage Information and Use of Transportation Systems by Mentally Disabled People*, "Mobility and Transport For Elderly and Disabled Persons Proceedings of the 6th International Conference" French National Institute for Transport and Safety Research

ANNOTATED BIBLIOGRAPHY

Behnke, Robert W., February 1991, *California Smart Traveler System*, Technology Sharing Program, U.S. Department of Transportation, DOT-T-92-16

This report describes how audiotex and videotex systems can be used to develop more interest in public transportation. The report also discusses how the new system can be integrated with conventional transit, paratransit and ridesharing modes. The outcome will be the reduction of traffic congestion, gasoline consumption, air pollution and mobility problems at a low cost to taxpayers.

This report also describes how telephone-based information services can be used to develop low-cost, user-friendly Advanced Traveler Information Systems that will tell drivers and riders the "best" ways to get between any two points in an area via private vehicle or public transportation. The proposed California Smart Traveler System will enable travelers to obtain more timely and accurate information on which to base their local or regional travel decisions.

Casey, R.F., Labell, L.N., Prensky, S.P., and Schweiger, C.L., 1991, *Advanced Public Transportation Systems: The State of the Art*, U.S. Department of Transportation, Urban Mass Transportation Administration

This report discusses how the latest technology will help: disseminate pretrip passenger information, real time ride share matching, integrated multimodal fare media, in-terminal information systems, in-vehicle information systems, electronic ticketing and automated trip payment.

Also presented is vehicle operations and communications, automatic vehicle location, automatic passenger counter, demand-response dispatching systems, HOV facility operation; signal preemption, lane control, automatic toll collection, automatically guided transit buses, and computer information systems with real-time bus location. Included in the appendix is a list of contacts.

Coburn, N., Martin, C., Thompson, R., Norstrom, D., September 1992, *Guidelines for Improvements to Transit Accessibility for Persons with Disabilities*, Battelle, Federal Transit Administration, Washington, DC, DOT-T-93-04

This report examines barriers to persons with sensory and cognitive impairments, and persons who are semi-ambulatory in public transit. A 6 page matrix lists the transit skills necessary to use the bus system, and suggests techniques to improve transit accessibility generally and for persons with visual, hearing, and cognitive impairments.

For persons with cognitive impairments most of the recommendations were for simple, standard signage and training. Other techniques suggested for persons with cognitive impairments included cooperative training of transit personnel with advocacy groups and community agencies serving people with cognitive impairments; transit information in accessible formats (PC electronic bulletins; automated telephone information systems, and fax machines); and standardization (bus stop signs, architectural design, lighting, emergency alarm systems, electronic signs, icons and color coding, priority seating identification).

Crain-Revis Associates Inc. and The Washington Consulting Group, April 1982, *A Handbook Describing Low Cost Concepts and Techniques to Make Public Transportation More Assessable for Visually and Hearing Impaired Persons*, U.S. Department Of Transportation, Urban Mass Transportation Administration, Contract No. DTUM 60-81-C-72903

This report discusses information dissemination concepts for persons with visual impairments including auditory mapping, talking signs, audible street crossing devices, tactile mapping, and textured surfaces, Braille schedule information, tape recorded transit information. Teletype or TTY systems and a Bart's Handbook for Communicating with hearing impairments is also discussed. Listed are the names of the companies that manufacture the products and some of the agencies that have used them.

Davis, P., Hill, C., Emmontt, N., and Siviter, J., 1991, *Assessment of Advanced Technologies for Transit and Rideshare Applications*, National Cooperative Transit Research and Development, Transportation Research Board, National Research Council, Project 60-1A

This report presents the results of a study that examined advanced technologies and systems that can by applied to high occupancy vehicles, ridesharing and transit needs. Advanced technologies can be used to encourage the use of transit and rideshare facilities by improving their attractiveness, accessibility and reducing operational costs while offering higher levels of service to the public.

Technologies were reviewed in the areas of traveler information systems, traffic management systems, fleet management and control systems, and automatic vehicle control systems. Within these areas, developments in the U.S., Europe and Japan were considered. Qualitative and quantitative assessments of the technologies were undertaken. Assessment frameworks were established to provide comparisons of system benefits and costs.

FitzPatrick, M.E., Barkow, B., and Beattie, J., September 1989, *Intercity Travel and the Deaf and Hard of Hearing Traveller: An Analysis of the Current State of Accessibility*, Transportation Development Centre, Transport Canada, TP 9839 E

This report presents an analysis of Canadian intercity transportation facilities and their accessibility for travelers with deaf and hearing impairments. It places particular emphasis on both physical design of facilities and the availability of assistive devices.

Data was collected through 1) personal visits to and observations of airports, train stations and bus and ferry terminals across Canada, and 2) a mail-out survey to deaf and hearing impaired individuals across the country. The primary goal of this survey was the identification of specific problems encountered in travel, as well as a general overview of accessibility.

Recommendations are made for improvements to transportation facilities as well as for further research and development to benefit persons with hearing impairments.

Guthrie, B., Campbell, P., Fernie, G., and Gravel, M., December 1988, *Accessibility of Small Aircraft to Disabled Travellers: Preliminary Design Study*, Transportation Development Centre Policy and Coordination Group, Transport Canada, TP9566E

This report addresses the accessibility of small aircraft to disabled travellers in Canada. Particular emphasis is given to wheelchair users and the level change from tarmac to aircraft floor.

The user characteristics, user market, personal mobility aids, aircraft and airport characteristics, and current practice is examined. The physical dimensions and configurations of various small air craft, the lack of appropriate lift equipment and the existing boarding procedures demonstrate the need for innovative new concepts.

A framework for evaluating alternative design solutions is developed. Several factors are emphasized: integration with the flow of able-bodied traffic; minimal transfers for wheelchair users; protection from

weather; negligible modification of the aircraft; and, design simplicity, ease of operation and low cost. Conceptual designs for loading bridges, platform lifts, and specialized boarding chair are presented. Two conceptual designs are recommended for detailed design and prototyping; a low level loading bridge (modelled after existing jet-ways) and an integrated platform lift and stairway.

Hickling-Partners Inc., March 1983, *A Guide to Recognizing and Assisting Travellers With Disabilities*, Transport Canada Publication No. TP3461

The transportation industry is recognizing a need to ensure that employees meeting the public are prepared to provide sensitive and effective service to passengers with special needs. This resource handbook summarizes the information that should be understood by individuals providing service to travelers with special needs. The reader is taught how to recognize, understand and assist travellers who fall within five functional disability groups. Trainers in the transportation industry can use this document to assist in training program for assisting the disabled traveller. Excellent resource, should be used when training persons who work with the general public.

***Innovations Deserving Exploratory Analysis (IDEA) Program and Testing and Evaluation of IDEA Products,* 1991-1993, Program Announcement, National Research Council Strategic Research Program**

Discusses goals of the 2 phases of the SHRP program. Explains proposal preparation, evaluation criteria, and eligibility.

Labell, L., Schweiger, C., Kihl, M., April 1992, *Advanced Public Transportation Systems: The State of the Art Update "92*, Federal Transit Administration, TTS-30

This report is an update to the previous *Advanced Public Transportation Systems: The State of the Art*, US Department of Transportation, Urban Mass Transportation Administration document published in 1991 (main author Casey). The focus of this state of the art document was: market development, customer interface, vehicle operations and communications and high occupancy vehicle facility operations. The "Smart Traveler" and "Smart Vehicle" were discussed in detail.

Layton, B., Hunter, K., and Safford, R., *A Study of the Human Factors in Public Transportation Safety, Final Report*, Urban Mass Transportation Administration, Washington, DC

The overall goal of this research was to apply a systematic approach to the investigation of the effects of human factors on safety in public transportation. The research focused on safety of fixed route bus operations. Human factors related to both drivers and passengers are examined with special emphasis given to safety problems for handicapped and elderly passengers. The bus cockpit design and lay out was identified as a major problem for driver safety in the short and over long term. Impacts of the bus cockpit design was undertaken during an in-depth analysis of the human factor effects.

A major problem identified and analyzed in depth for passenger safety was the use of powered scooter-type wheelchairs. Constrained schedules were identified as significant potential contributors to safety for both drivers and passengers.

Love, Bill, *Signage for the Blind,* INFOGRIP, Inc., P.O. Box 963, Goldendale, WA 98620, Smith-Kettlewell Eye Research Institute, San Francisco, CA

Talking signs do for print-disabled persons what printed signs do for those able to read them. They are small, inexpensive voice-modulated infrared transmitters whose message is heard by means of a pocket-sized receiver which speaks the signs' messages and indicates the direction of their source. The receiver uses a sensitive light detector-demodulator with a speaker to say the message, small enough to be carried in a pocket, loud enough to be understood, rugged, dependable with occasional battery changes, and inexpensive.

McGean, Thomas J., October 1991, *Innovative Solutions for Disabled Transit Accessibility*, U.S. Department of Transportation, Urban Mass Transportation Administration, Report No. UMTA-OH-06-0056-91-8

This report identifies major innovative technology developments which show promise for provision of transit accessibility in compliance with the Americans with Disabilities Act while at the same time being compatible with economic constraints and with the broader mission of transit to serve the general public. Key developments include low floor vehicles (rail and bus), miniplatforms and platform edge warning systems.

In all cases, the report provides information on cost, maintainability, acceptance by operators and the disabled community and regulatory implications. It also recommends fruitful areas of research, development and demonstration activity.

McInerney, P., Stein, S., Barkow, B., Wiseman, S., June 1990, *Flight 201 has been Changed to Gate 102: Challenges Experienced by Travellers with Cognitive or Emotional Disabilities*, Transport Canada TP10450E

This report presents an analysis of difficulties created by cognitive or emotional disabilities in the use of Canadian public transportation. Included in this study is the purpose and use of the appropriate terminology, classification of mental disability, and an analysis of Canadian legal issues. Recommendations are provided for personnel training, user training, improvements in procedures operation and information design, technology and facilities for terminals, and further exploratory research.

Moreyne, M., January 1990, *Integrated Communication, Information and Security Systems (ICISS) for Visually and Hearing Impaired Persons*, Transportation Development Centre, Transport Canada TP10187E

This document outlines the research and development activities undertaken for a new communications product and service. This product, a computer-controlled color LED electronic display system, pairs auditory information with appropriate visual information for use in transit applications. Major activities completed during the study were: the construction of a prototype to demonstrate the systems capabilities, preparation of sketches of possible placements of the display in the Metro, user group sessions with elderly, disabled persons and a control group of passengers, interviews with potential sponsors of the system, ergonomic review of the existing design, and technical feasibility study.

The research showed that the communication system was very appropriate for both the disabled persons and the general public. There were no commercial or technical barriers to this information system implementation.

Parker, Jeffery A., and Associates, and International Taxicab and Livery Association, March 1991, *Mobility Management and Market Oriented Local Transportation*, Office of Technical Assistance and Safety, Urban Mass Transportation Administration DOT-T-92-07

The Mobility Manager is a mechanism for achieving the integration and coordination of transportation services offered by multiple providers (public, private for profit, and private non-profit) involving a variety of travel modes (bus, taxi, vanpools, rail, etc.) and multiple sources of funding. This integration is accomplished through electronic technologies, allowing the programmatic integrity of all participants to be preserved while at the same time automating most of the transactions, financial and otherwise, which occur in the system. Through a single point of contact it offers information to tripmakers on all relevant travel choices and their price-service characteristics. It is important to note that many of the technologies which are central to the function of the Mobility Manager are also prominent in DOT's Intelligent Vehicle and Highway System (IVHS) program. This report discusses user-side subsidy experiences and proposes demonstration projects at 5 different sites.

Pavlos, E., Sanford, J., and Steirnfeld, E., October 1985, *Detectable Tactile Surface Treatments*, The Architectural and Transportation Barriers Compliance Board

The purpose of this research is to provide sufficient information to establish as needed, technical and usage requirements for surface treatments at stairs; curb ramps; ramps; edges of streets without curbs, guardrails, changes in direction; means of egress; and other locations where it may be necessary to provide additional information for orientation and safety. Laboratory testing of selected surface materials was undertaken in order to determine a range of materials that are detectable; and field testing was completed in order to determine the effectiveness of detectable surfaces as warning and orientation devices.

Pekilies, B., and Heti, H., January 1992, *Automatic Vehicle Location and Control Systems for Small and Medium Ontario Transit Properties: Phase 1 Report (Final)*, Transportation Technology and Energy Branch, Ministry of Transportation, Report No. TCT-91-02

This report assesses Automatic Vehicle Location and Control (AVLC) systems, and their associated technologies for small and medium Ontario transit properties. Evaluated were Loran, Omega, GPS, Dead Reckoning, Signpost and combinations thereof.

The purpose of this report is to provide the background information necessary for the creation of functional specifications in preparation for a series of AVLC demonstration projects at several participating Ontario transit properties. User requirements were identified through a survey of participating Ontario, Canada transit properties. Identified were essential, desirable, and optional system requirements. Vender information and prices presented.

Project Action, 1990, *Combined Research Results,* National Easter Seals, Washington, DC

The focus of this report is: the ability to identify people with disabilities in the community and their transit needs, develop outreach and marketing strategies, develop training programs for transit providers, develop training programs for persons with disabilities, apply technology to solve critical barriers, and involving person with disabilities in the transit decision making process. This is accomplished with a tabulation of interviews from Project Action's steering committee members and other experts, a tabulation of survey responses from Project Action's resource council members, Project Action literature search, a critical needs assessment and an innovation analysis.

Project Action, 1989, *Reconnaissance Survey of Selected Transit Agencies*, National Easter Seals, Washington, DC

This is the results of a survey from 112 transit systems around the United States. Among the items queried were; purchased policy commitments and target dates for achieving full fixed route accessibility, accessible fixed route service and the cost of maintaining lifts, annual accessible fixed route lift usage and the role of paratransit services, outreach and marketing, fare policy, unmet needs and problems, and innovations and accomplishments. The purpose of the reconnaissance survey was to identify general patterns and trends with respect to the provision of accessible transit services for people with disabilities.

Richesin, C., Grace, G., Iantkow, M., and Gilles, T.K., December 1989, *Design Guidelines for Meeting the Access Needs of Blind and Visually Impaired Travellers in Transportation Terminals,* Transportation Development Centre, Transport Canada Publication No. TP10067E

Orientation and mobility for persons with blind and visually impairments travel is discussed. The use of mobility aids (guide dog, white cane, electronic devices, etc.) and of sensory information to effect safe and graceful travel through an environment is described and also discussed. Specific design recommendations for orientation, mobility and sensory information to accommodate the needs of persons with blind and visually impairments in transportation terminals is given. Also included are recommendations for construction barriers, traffic lights for pedestrian walkways and other exterior terminal requirements.

Richesin, C., Grace, G., Iantkow, M., and Gilles, T.K., December 1989, *Access Needs of Blind and Visually Impaired Travellers in Transportation Terminals: A Study and Design Guidelines*, Transportation Development Centre, Transport Canada Publication No. TP 9048E

This excellent resource defines visual impairment and describes how persons with visual impairments persons travel. A review of Canadian building codes relevant to th .isually impaired is listed and design guidelines to terminals given in response to the need of the visually impaired to travel independently, safely and purposefully.

Specific design recommendations for orientation, mobility and sensory information to accommodate the needs of persons with blind and visual impairments in transportation terminals is given. Also included are recommendations for construction barriers, traffic lights for pedestrian walkways and other exterior terminal requirements.

Rutenberg, U., *Development of a Portable Communicator/Translator Prototype*, July 1990, Transport Canada TP 10556E

This booklet describes a multi-language, counter-top device for facilitating dialogue between the target group and the agent at the airlines check-in counter. Six broad areas of airport passenger check-in are covered, ticket request, passenger identification, seating needs selection and assignment, baggage and boarding pass issue. The system can be readily adapted for use at rail, bus or ferry terminals. This system consists of two touch screens, one for the passenger and one for the agent. They are joined through a computer that controls program flow and transmits messages from one screen to the other.

Uslan, M.M., Peck, A.F., Wiener, W.R., and Stern, A., 1990, *Access to Mass Transit for Blind and Visually Impaired Travellers*, American Foundation for the Blind, 15 West 16th Street, New York, NY 10011

Light Rail and bus travel issue and concerns are discussed, an overview how mass transit affects persons with blind and visually impairments, technological innovation in the field that assist with light rail and bus

travel, and approaches and techniques that have been recently developed in orientation and mobility training. Excellent resource!!

Walker, J., Alicandri, E., Sedney, C., and Roberts, K., May 1991, *In-Vehicle Navigation Devices: Effects of Safety and Driver Performance*, U.S. Department of Transportation, Federal Highway Administration, FHWA-RD-90-053

This is a report of a test using 6 electronic navigation devices, three visual and three audio. Three age groups were tested in FHWA HYSIM simulator. The workload is assumed to increase as greater psychomotor, perceptual and cognitive stimulus is placed on the user. Four basic types of data were collected during this driving simulation; heart rate, speed, lateral placement, and reaction time.

In general, older drivers performed less safely, drove more slowly, had larger variability in lateral road placement and had longer reaction times to the gauges. Comparing the three auditory devices to the three visual devices, subjects using the former did not reduce their speeds as much during high load situations and made fewer navigational errors than those using visual devices. Also simple devices audio or visual were more effective that the complex devices.

APPENDIX A

Battelle Matrix Summary

Appendix A

Battelle Matrix Summary

(bus application)

1. **Understanding the System**
   - a. Learn routes, stops/station and transfer points
   - b. Learn schedules
   - c. Learn fare schedules and payment media
   - d. Learn special services and provisions
2. **Accessing the Correct Vehicle**
   - a. Locate the stops/station/terminal
   - b. Identify correct incoming vehicle
   - c. Identify and move to vehicle doorway
3. **Entering the Vehicle**
   - a. Move through doorway
   - b. Ascend stairs/utilize lift
   - c. Pay fare
   - d. Identify vacant seat or standing space
   - e. Reach seat or standing space
4. **Travelling on Vehicle**
   - a. Accommodate to motion of vehicle
   - b. Accommodate entrance and egress movements of others
   - c. Comprehend announcements
   - d. Respond to selected special announcements
   - e. Respond to emergency announcements
5. **Departing the Vehicle**
   - a. Identify desired stop/station/terminal
   - b. Notify driver of desire to stop
   - c. Move to doorway
   - d. Descend stairs/utilize lift
   - e. Exit vehicle and reach platform/pad
6. **Exiting the Station/Terminal**
   - a. Determine desired exit direction

TABLE 1. TECHNIQUES TO IMPROVE TRANSIT ACCESSIBILITY FOR PERSONS WITH DISABILITIES

Transit Function	General	Visual	Hearing	Cognitive	Semi-Ambulatory (Non Wheelchair)
1. Understanding the System					
a. Learn routes, stops/stations, and transfer points b. Learn schedules c. Learn fare schedules and payment media d. Learn special services and provisions	Training of transit operations personnel in communication and assistance techniques* Electronic file on computer disk Electronic bulletin board FAX Mobility training Automated telephone information system	Orientation and mobility training Large print/high contrast written information Braille materials Tactile maps Auditory mapping Audio cassette information	Directional signage to assist in locating technical aids TDD* Assistive listening devices (infrared, FM, induction loop) Automatic speech recognition systems Manual communication Adjustable volume telephone Hearing aid compatible telephone	Simple text and graphics Standard symbols Training	

*Required by FTA regulation
(b) = applicable to bus transit systems
(r) = applicable to rail transit systems

TABLE 1. TECHNIQUES TO IMPROVE TRANSIT ACCESSIBILITY FOR PERSONS WITH DISABILITIES

Transit Function	General	Visual	Hearing	Cognitive	Semi-Ambulatory (Non Wheelchair)
2. Accessing the Correct Vehicle					
a. Locate the stop/station/terminal	Training of transit operations personnel in communications and assistance techniques* Maps Standard logos and symbols Uniform architectural features	Tactile paths Large print/high contrast lighted signage	Visual signs	Uniform features Training	
b. Locate and access fare system (r)	Training of transit operations personnel in communications and assistance techniques* Audio, visual, and textural circulation aids	Tactile/braille vending machines Standard illumination levels Large print, non-glare, high contrast instructional signage Audio instructions	Clearly written instructions for use	Training Standard signage and symbols	Accessible path*
c. Activate and pass through fare gate (r)	Pre-paid pass system "Smart" card	Standard illumination levels Audio signal	Visual signals	Training Audio and/or visual signals	Minimum 32-inch clear width opening*

*Required by FTA regulation
(b) = applicable to bus transit systems
(r) = applicable to rail transit systems

TABLE 1. TECHNIQUES TO IMPROVE TRANSIT ACCESSIBILITY FOR PERSONS WITH DISABILITIES

Transit Function	General	Visual	Hearing	Cognitive	Semi-Ambulatory (Non Wheelchair)
d. Move to proper boarding area/platform (r)	Training of transit operations personnel in communication and assistance techniques* Uniform signage Standardized symbols Horizontal signage (versus vertical)	Auditory pathways Electronic or tactile circulation aids Detectable platform edge warning*	Visual displays of announcements	Training Uniform signage Standard symbols Color coding system	Accessible level changes (ramps with railings, escalators with two contiguous treads, elevators)* Standard stair intervals* Contrast edges on steps*
e. Identify correct incoming vehicle*	Training of transit operations personnel in communication and assistance techniques* External PA announcements (r)* Front, side, and rear signs displayed for sufficient time (b) Uniform station lighting (r) Passenger information system signifying next train arrival (r)	PA announcements* Large print/high contrast signage "Talking" bus stop (b) Electronic signals Auditory vehicle identification system (r)	Visual signs of next bus arrival (b) Visual train approaching signal (r) Visual vehicle identification system	Training Color coding system Audio/visual vehicle identification system	

*Required by FTA regulation
(b) = applicable to bus transit systems
(r) = applicable to rail transit systems

TABLE 1. TECHNIQUES TO IMPROVE TRANSIT ACCESSIBILITY FOR PERSONS WITH DISABILITIES

Transit Function	General	Visual	Hearing	Cognitive	Semi-Ambulatory (Non Wheelchair)
f. Identify and move to vehicle doorway		Audio cue Fixed stopping point Between-car barriers (pantographs, chains, motion detectors, etc.)* system			
3. Entering the Vehicle					
a. Move through doorway/ cross railcar gap (r)	Minimized horizontal and vertical car - platform gaps (r)*	Standard illumination (r)* Auditory doors closing warning (r)*	Visual door opening signal (r) Visual door closing signal (r)*		Handrails and stanchions for boarding via steps (LRVs) (r)* Clear door openings of 32 inches (r)* Slip-resistant surfaces (r)* *Level change mechanisms (lift, ramp) (r)* Indications for standing on lifts (r)

*Required by FTA regulation
(b) = applicable to bus transit systems
(r) = applicable to rail transit systems

TABLE 1. TECHNIQUES TO IMPROVE TRANSIT ACCESSIBILITY FOR PERSONS WITH DISABILITIES

Transit Function	General	Visual	Hearing	Cognitive	Semi-Ambulatory (Non Wheelchair)
b. Ascend stairs/utilize lift/ utilize ramp (b)	Training of transit operations personnel in communication techniques* Lower entry step (b) Low floor buses (b)	Standard illumination (b)* Surface change on step edges (b)			Slip-resistant floors and steps (b)* Contrast edges on steps (b)* Level change mechanism (lift, ramp, or kneeling bus) (b)* Indicators for standing position on lifts (b) Low head clearance sign (b) Properly placed handrails and assists (b)
c. Pay fare (b)	Training of transit operations personnel in communication and assistance techniques* Pass system "Smart" card	"Talking" fare box Standard locations for fare collection equipment	Standard visual signals	Standard visual/audio signals Training	Farebox located/designed to facilitate use by persons with mobility aids*
d. Identify vacant seat or standing space	Uniformly located priority seating for disabled persons			Training	

*Required by FTA regulation
(b) = applicable to bus transit systems
(r) = applicable to rail transit systems

TABLE 1. TECHNIQUES TO IMPROVE TRANSIT ACCESSIBILITY FOR PERSONS WITH DISABILITIES

Transit Function	General	Visual	Hearing	Cognitive	Semi-Ambulatory (Non Wheelchair)
e. Reach seat or standing space	Training of transit operations personnel in communication techniques* Priority seating located near bus entrance* Hand grips*	Sufficient room for seeing eye dogs	Sufficient room for hearing ear dogs		Sufficient room for mobility aids, including support dogs Hand grips and arms to assist in sitting and standing up
4. Traveling on Vehicle					
a. Accommodate to motion of vehicle					Hand grips*
b. Accommodate entrance and egress movements of others	Uniformly located priority seating for disabled persons*	Sufficient room for seeing eye dogs	Sufficient room for hearing ear dogs		Hand grips* Sufficient room for mobility aids, including support dogs
c. Comprehend special announcements	Training of transit operations personnel in communication and assistance techniques* Standard symbols and directions On-board PA* General safety/emergency information in accessible formats	Orientation and mobility training Large print/high contrast written information PA announcements*	Directional signage to assist in locating technical aids Assistive listening devices (infrared, FM, induction loop) Manual communication Visual displays of announcements Emergency strobe light system	Training Simple and clear communication techniques	

*Required by FTA regulation
(b) = applicable to bus transit systems
(r) = applicable to rail transit systems

TABLE 1. TECHNIQUES TO IMPROVE TRANSIT ACCESSIBILITY FOR PERSONS WITH DISABILITIES

Transit Function	General	Visual	Hearing	Cognitive	Semi-Ambulatory (Non Wheelchair)
d. Respond to selected special announcements	Emergency evacuation procedures Standard safety features (non-slip flooring, stanchions, handrails, etc.)*	Orientation and mobility training	Training	Training	
5. Departing the Vehicle					
a. Identify desired stop/station/terminal	Training of transit operations personnel in communication and assistance techniques* On-board PA and visual announcements Uniform station lighting (r) Station signage visible from inside car (r)	PA announcements* Pre-dispatch check of PA system Large print/high contrast/non-glare signage	PA system compatible with assistive listening systems Visual displays of announcements Seating near on-board "next stop" display Pre-dispatch check of passenger information system	PA announcements* Training to look for landmarks	Audio and visual next stop announcements
b. Notify driver of desire to stop (b)	Auditory/visual stop request system (b)*	Uniformly located auditory signal system (buzzer, bell) (b)	Visual confirmation that signal system is operating (light) (b)	Uniform location and standard systems (b)	Reachable pressure operated signal system (b)*
c. Move to doorway	Training of transit operations personnel in communication and assistance techniques*	Auditory announcement of correct door	Visual indicator of correct door		Hand grips to assist in standing up

*Required by FTA regulation
(b) = applicable to bus transit systems
(r) = applicable to rail transit systems

TABLE 1. TECHNIQUES TO IMPROVE TRANSIT ACCESSIBILITY FOR PERSONS WITH DISABILITIES

Transit Function	General	Visual	Hearing	Cognitive	Semi-Ambulatory (Non Wheelchair)
d. Descend stairs/utilize lift/utilize ramp (b)	Training of transit operations personnel in communication techniques* Lower entry step (b) Low floor buses (b)	Standard illumination (b)* Surface change on step edges (b)			Slip-resistant floors and steps (b)* Contrast edges on steps (b)* Level change mechanism (lift, ramp, or kneeling bus) (b)* Indicators for standing position on lifts (b) Low head clearance sign (b) Properly placed handrails and assists (b)
e. Exit vehicle and reach platform/pad	Minimized horizontal and vertical car - platform gaps (r)*	Standard illumination*	Visual indication of door opening signal (especially for exiting)		Handrails and stanchions* Clear door openings of 32 inches* Slip-resistant surfaces* Level change mechanisms Indications for standing on lifts

*Required by FTA regulation
(b) = applicable to bus transit systems
(r) = applicable to rail transit systems

TABLE 1. TECHNIQUES TO IMPROVE TRANSIT ACCESSIBILITY FOR PERSONS WITH DISABILITIES

Transit Function	General	Visual	Hearing	Cognitive	Semi-Ambulatory (Non Wheelchair)
6. Exiting the Station/Terminal (r)					
a. Determine desired exit direction (r)	Uniform signage Standard lighting	Orientation and mobility training Large print/ non-glare, high-contrast signage Electronic or tactile circulation aids Auditory pathways		Training	
b. Activate and pass through fare control gate (r)	Pre-paid pass system "Smart" card	Standard illumination levels Audio signal	Visual signals	Training Audio and/or visual signals	Minimum 32-inch clear width opening*
c. Exit station/ terminal (r)	Uniform external design (r) Standardized signage (r) Directional signage (r)	Large print, non-glare, high contrast signage (r)		Training	Accessible path*

*Required by FTA regulation
(b) = applicable to bus transit systems
(r) = applicable to rail transit systems

APPENDIX B

Survey

Survey
Bus Accessibility for Persons With Cognitive Impairments

Your Name_____

Title_____

Company_____

Address_____

_____

Phone_____

Fax_____

Please return this questionnaire to:
Kate Hunter-Zaworski
Transportation Research Institute
Oregon State University
100 Merryfield Hall
Corvallis, Or. 97331 - 4304

Description of Media

Visual Signs Signs placed in the appropriate position giving information to locate and identify buses, stops and different sections at transfer stations. These signs will use optimum color/brightness, will avoid visual noise, use proper illumination and eliminate glare, ensure good contrast between printed matter and background, and be simplistic in nature.

Printed Schedules The standard bus route schedules that are available through the transit agencies.

Maps The standard bus route maps that are available through the transit agencies.

Tactile Maps Maps that have different textures representing different objects such as different sections at transfer stations, landmarks, rest rooms, and local businesses.

Talking Signs Talking signs are small infra-red transmitters encoded with the kind of information usually present on printed signs. This message is transmitted via a frequency modulated infrared beam which is received by a photocell carried by the traveler. When the receiver is directed at the talking sign it picks up the infrared light source, decodes the sign and speaks the sign's message.

Auditory Maps Auditory maps are usually recorded on cassette tapes. Route maps describe specific pathways from a bus stop to a transfer station. They provide very specific directions and suggestions for a particular route. An area or district map provides an overall description of an area such as a neighborhood or college campus. Tapes may also provide information concerning any special programs the transit agency may offer.

Video Tapes Video tapes explain the system, routes, transfer points, appropriate behavior, fare structure, etc. These tapes may range from simulated bus rides to general instruction.

Customer Service Personnel service offered at customer service counters.

Driver Announcements On bus information given by driver announcements, such as intersections and emergency information.

Training Format

1 On 1 Training with Trained Guide

1 On 1 Training with Untrained Guide

Group Training

Repetition

Audio Tapes

Video Tapes

Print

Real Time On Bus

Simulated Bus Trips

Computer Games

Understanding the System

Learn routes, stops/stations, transfer points and fares.

Rating Scale	Mark	5 For Extremely Important 4 For Very Important 3 For Important 2 For Not To Important 1 For Not Important

---

	Media		Training Format
5 4 3 2 1	Visual Signs	5 4 3 2 1	1 on 1 Training w/ Trained Guide
5 4 3 2 1	Printed Schedules	5 4 3 2 1	1 on 1 Training w/ Untrained Guide
5 4 3 2 1	Maps	5 4 3 2 1	Group Training
5 4 3 2 1	Tactile Maps	5 4 3 2 1	Repetition
5 4 3 2 1	Talking Signs	5 4 3 2 1	Audio Tapes
5 4 3 2 1	Auditory Maps	5 4 3 2 1	Video Tapes
5 4 3 2 1	Video Tapes	5 4 3 2 1	Print
5 4 3 2 1	Customer Service	5 4 3 2 1	Real Time On Bus
5 4 3 2 1	Driver Announcements	5 4 3 2 1	Simulated Bus
5 4 3 2 1	_____	5 4 3 2 1	Computer Games
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____

Comments:

Learn Schedules

Rating Scale	Mark	5 For Extremely Important 4 For Very Important 3 For Important 2 For Not To Important 1 For Not Important

	Media		Training Format
5 4 3 2 1	Visual Signs	5 4 3 2 1	1 on 1 Training w/ Trained Guide
5 4 3 2 1	Printed Schedules	5 4 3 2 1	1 on 1 Training w/ Untrained Guide
5 4 3 2 1	Maps	5 4 3 2 1	Group Training
5 4 3 2 1	Tactile Maps	5 4 3 2 1	Repetition
5 4 3 2 1	Talking Signs	5 4 3 2 1	Audio Tapes
5 4 3 2 1	Auditory Maps	5 4 3 2 1	Video Tapes
5 4 3 2 1	Video Tapes	5 4 3 2 1	Print
5 4 3 2 1	Customer Service	5 4 3 2 1	Real Time On Bus
5 4 3 2 1	Driver Announcements	5 4 3 2 1	Simulated Bus
5 4 3 2 1	_____	5 4 3 2 1	Computer Games
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____

Comments:

Learn Special Services and Provisions

Rating Scale	Mark	5 For Extremely Important 4 For Very Important 3 For Important 2 For Not To Important 1 For Not Important

	Media		Training Format
5 4 3 2 1	Visual Signs	5 4 3 2 1	1 on 1 Training w/ Trained Guide
5 4 3 2 1	Printed Schedules	5 4 3 2 1	1 on 1 Training w/ Untrained Guide
5 4 3 2 1	Maps	5 4 3 2 1	Group Training
5 4 3 2 1	Tactile Maps	5 4 3 2 1	Repetition
5 4 3 2 1	Talking Signs	5 4 3 2 1	Audio Tapes
5 4 3 2 1	Auditory Maps	5 4 3 2 1	Video Tapes
5 4 3 2 1	Video Tapes	5 4 3 2 1	Print
5 4 3 2 1	Customer Service	5 4 3 2 1	Real Time On Bus
5 4 3 2 1	Driver Announcements	5 4 3 2 1	Simulated Bus
5 4 3 2 1	_____	5 4 3 2 1	Computer Games
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____

Comments:

Accessing the Correct Vehicle

Locate The Stops, Station Terminals

Rating Scale	Mark	5 For Extremely Important 4 For Very Important 3 For Important 2 For Not To Important 1 For Not Important

	Media		Training Format
5 4 3 2 1	Visual Signs	5 4 3 2 1	1 on 1 Training w/ Trained Guide
5 4 3 2 1	Printed Schedules	5 4 3 2 1	1 on 1 Training w/ Untrained Guide
5 4 3 2 1	Maps	5 4 3 2 1	Group Training
5 4 3 2 1	Tactile Maps	5 4 3 2 1	Repetition
5 4 3 2 1	Talking Signs	5 4 3 2 1	Audio Tapes
5 4 3 2 1	Auditory Maps	5 4 3 2 1	Video Tapes
5 4 3 2 1	Video Tapes	5 4 3 2 1	Print
5 4 3 2 1	Customer Service	5 4 3 2 1	Real Time On Bus
5 4 3 2 1	Driver Announcements	5 4 3 2 1	Simulated Bus
5 4 3 2 1	_____	5 4 3 2 1	Computer Games
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____

Comments:

Accessing the Correct Vehicle

Locate and Access Fare System

Rating Scale	Mark	5 For Extremely Important 4 For Very Important 3 For Important 2 For Not To Important 1 For Not Important

	Media		Training Format
5 4 3 2 1	Visual Signs	5 4 3 2 1	1 on 1 Training w/ Trained Guide
5 4 3 2 1	Printed Schedules	5 4 3 2 1	1 on 1 Training w/ Untrained Guide
5 4 3 2 1	Maps	5 4 3 2 1	Group Training
5 4 3 2 1	Tactile Maps	5 4 3 2 1	Repetition
5 4 3 2 1	Talking Signs	5 4 3 2 1	Audio Tapes
5 4 3 2 1	Auditory Maps	5 4 3 2 1	Video Tapes
5 4 3 2 1	Video Tapes	5 4 3 2 1	Print
5 4 3 2 1	Customer Service	5 4 3 2 1	Real Time On Bus
5 4 3 2 1	Driver Announcements	5 4 3 2 1	Simulated Bus
5 4 3 2 1	_____	5 4 3 2 1	Computer Games
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____

Comments:

Accessing the Correct Vehicle

Move to Proper Boarding Area

Rating Scale	Mark	5 For Extremely Important 4 For Very Important 3 For Important 2 For Not To Important 1 For Not Important

	Media		Training Format
5 4 3 2 1	Visual Signs	5 4 3 2 1	1 on 1 Training w/ Trained Guide
5 4 3 2 1	Printed Schedules	5 4 3 2 1	1 on 1 Training w/ Untrained Guide
5 4 3 2 1	Maps	5 4 3 2 1	Group Training
5 4 3 2 1	Tactile Maps	5 4 3 2 1	Repetition
5 4 3 2 1	Talking Signs	5 4 3 2 1	Audio Tapes
5 4 3 2 1	Auditory Maps	5 4 3 2 1	Video Tapes
5 4 3 2 1	Video Tapes	5 4 3 2 1	Print
5 4 3 2 1	Customer Service	5 4 3 2 1	Real Time On Bus
5 4 3 2 1	Driver Announcements	5 4 3 2 1	Simulated Bus
5 4 3 2 1	_____	5 4 3 2 1	Computer Games
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____

Comments:

Accessing the Correct Vehicle

Identify Correct Incoming Bus

Rating Scale — Mark

5 For Extremely Important
4 For Very Important
3 For Important
2 For Not To Important
1 For Not Important

	Media		Training Format
5 4 3 2 1	Visual Signs	5 4 3 2 1	1 on 1 Training w/ Trained Guide
5 4 3 2 1	Printed Schedules	5 4 3 2 1	1 on 1 Training w/ Untrained Guide
5 4 3 2 1	Maps	5 4 3 2 1	Group Training
5 4 3 2 1	Tactile Maps	5 4 3 2 1	Repetition
5 4 3 2 1	Talking Signs	5 4 3 2 1	Audio Tapes
5 4 3 2 1	Auditory Maps	5 4 3 2 1	Video Tapes
5 4 3 2 1	Video Tapes	5 4 3 2 1	Print
5 4 3 2 1	Customer Service	5 4 3 2 1	Real Time On Bus
5 4 3 2 1	Driver Announcements	5 4 3 2 1	Simulated Bus
5 4 3 2 1	_____	5 4 3 2 1	Computer Games
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____

Comments:

Entering the Vehicle

Pay Fare

Rating Scale	Mark	5 For Extremely Important 4 For Very Important 3 For Important 2 For Not To Important 1 For Not Important

	Media		Training Format
5 4 3 2 1	Visual Signs	5 4 3 2 1	1 on 1 Training w/ Trained Guide
5 4 3 2 1	Printed Schedules	5 4 3 2 1	1 on 1 Training w/ Untrained Guide
5 4 3 2 1	Maps	5 4 3 2 1	Group Training
5 4 3 2 1	Tactile Maps	5 4 3 2 1	Repetition
5 4 3 2 1	Talking Signs	5 4 3 2 1	Audio Tapes
5 4 3 2 1	Auditory Maps	5 4 3 2 1	Video Tapes
5 4 3 2 1	Video Tapes	5 4 3 2 1	Print
5 4 3 2 1	Customer Service	5 4 3 2 1	Real Time On Bus
5 4 3 2 1	Driver Announcements	5 4 3 2 1	Simulated Bus
5 4 3 2 1	_____	5 4 3 2 1	Computer Games
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____

Comments:

Entering the Vehicle

Identify Vacant Seat or Standing Area

Rating Scale	Mark	5 For Extremely Important 4 For Very Important 3 For Important 2 For Not To Important 1 For Not Important

	Media		Training Format
5 4 3 2 1	Visual Signs	5 4 3 2 1	1 on 1 Training w/ Trained Guide
5 4 3 2 1	Printed Schedules	5 4 3 2 1	1 on 1 Training w/ Untrained Guide
5 4 3 2 1	Maps	5 4 3 2 1	Group Training
5 4 3 2 1	Tactile Maps	5 4 3 2 1	Repetition
5 4 3 2 1	Talking Signs	5 4 3 2 1	Audio Tapes
5 4 3 2 1	Auditory Maps	5 4 3 2 1	Video Tapes
5 4 3 2 1	Video Tapes	5 4 3 2 1	Print
5 4 3 2 1	Customer Service	5 4 3 2 1	Real Time On Bus
5 4 3 2 1	Driver Announcements	5 4 3 2 1	Simulated Bus
5 4 3 2 1	_____	5 4 3 2 1	Computer Games
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____

Comments:

Travelling on Vehicle

Comprehend Announcements For Special Services

Rating Scale	Mark	5 For Extremely Important 4 For Very Important 3 For Important 2 For Not To Important 1 For Not Important

	Media		Training Format
5 4 3 2 1	Visual Signs	5 4 3 2 1	1 on 1 Training w/ Trained Guide
5 4 3 2 1	Printed Schedules	5 4 3 2 1	1 on 1 Training w/ Untrained Guide
5 4 3 2 1	Maps	5 4 3 2 1	Group Training
5 4 3 2 1	Tactile Maps	5 4 3 2 1	Repetition
5 4 3 2 1	Talking Signs	5 4 3 2 1	Audio Tapes
5 4 3 2 1	Auditory Maps	5 4 3 2 1	Video Tapes
5 4 3 2 1	Video Tapes	5 4 3 2 1	Print
5 4 3 2 1	Customer Service	5 4 3 2 1	Real Time On Bus
5 4 3 2 1	Driver Announcements	5 4 3 2 1	Simulated Bus
5 4 3 2 1	_____	5 4 3 2 1	Computer Games
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____

Comments:

Travelling on Vehicle

Comprehend Intersection Announcements

Rating Scale	Mark	5 For Extremely Important 4 For Very Important 3 For Important 2 For Not To Important 1 For Not Important

	Media		Training Format
5 4 3 2 1	Visual Signs	5 4 3 2 1	1 on 1 Training w/ Trained Guide
5 4 3 2 1	Printed Schedules	5 4 3 2 1	1 on 1 Training w/ Untrained Guide
5 4 3 2 1	Maps	5 4 3 2 1	Group Training
5 4 3 2 1	Tactile Maps	5 4 3 2 1	Repetition
5 4 3 2 1	Talking Signs	5 4 3 2 1	Audio Tapes
5 4 3 2 1	Auditory Maps	5 4 3 2 1	Video Tapes
5 4 3 2 1	Video Tapes	5 4 3 2 1	Print
5 4 3 2 1	Customer Service	5 4 3 2 1	Real Time On Bus
5 4 3 2 1	Driver Announcements	5 4 3 2 1	Simulated Bus
5 4 3 2 1	_____	5 4 3 2 1	Computer Games
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____

Comments:

Travelling on Vehicle

Comprehend Driver Announcements

Rating Scale	Mark	5 For Extremely Important 4 For Very Important 3 For Important 2 For Not To Important 1 For Not Important

	Media		Training Format
5 4 3 2 1	Visual Signs	5 4 3 2 1	1 on 1 Training w/ Trained Guide
5 4 3 2 1	Printed Schedules	5 4 3 2 1	1 on 1 Training w/ Untrained Guide
5 4 3 2 1	Maps	5 4 3 2 1	Group Training
5 4 3 2 1	Tactile Maps	5 4 3 2 1	Repetition
5 4 3 2 1	Talking Signs	5 4 3 2 1	Audio Tapes
5 4 3 2 1	Auditory Maps	5 4 3 2 1	Video Tapes
5 4 3 2 1	Video Tapes	5 4 3 2 1	Print
5 4 3 2 1	Customer Service	5 4 3 2 1	Real Time On Bus
5 4 3 2 1	Driver Announcements	5 4 3 2 1	Simulated Bus
5 4 3 2 1	_____	5 4 3 2 1	Computer Games
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____

Comments:

Travelling on Vehicle

Comprehend Automated Announcements

Rating Scale	Mark	5 For Extremely Important 4 For Very Important .3 For Important 2 For Not To Important 1 For Not Important

	Media		Training Format
5 4 3 2 1	Visual Signs	5 4 3 2 1	1 on 1 Training w/ Trained Guide
5 4 3 2 1	Printed Schedules	5 4 3 2 1	1 on 1 Training w/ Untrained Guide
5 4 3 2 1	Maps	5 4 3 2 1	Group Training
5 4 3 2 1	Tactile Maps	5 4 3 2 1	Repetition
5 4 3 2 1	Talking Signs	5 4 3 2 1	Audio Tapes
5 4 3 2 1	Auditory Maps	5 4 3 2 1	Video Tapes
5 4 3 2 1	Video Tapes	5 4 3 2 1	Print
5 4 3 2 1	Customer Service	5 4 3 2 1	Real Time On Bus
5 4 3 2 1	Driver Announcements	5 4 3 2 1	Simulated Bus
5 4 3 2 1	_____	5 4 3 2 1	Computer Games
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____

Comments:

Departing the Vehicle

Identify Desired Stop/Station/Terminal

Rating Scale — Mark

5 For Extremely Important
4 For Very Important
3 For Important
2 For Not To Important
1 For Not Important

	Media		Training Format
5 4 3 2 1	Visual Signs	5 4 3 2 1	1 on 1 Training w/ Trained Guide
5 4 3 2 1	Printed Schedules	5 4 3 2 1	1 on 1 Training w/ Untrained Guide
5 4 3 2 1	Maps	5 4 3 2 1	Group Training
5 4 3 2 1	Tactile Maps	5 4 3 2 1	Repetition
5 4 3 2 1	Talking Signs	5 4 3 2 1	Audio Tapes
5 4 3 2 1	Auditory Maps	5 4 3 2 1	Video Tapes
5 4 3 2 1	Video Tapes	5 4 3 2 1	Print
5 4 3 2 1	Customer Service	5 4 3 2 1	Real Time On Bus
5 4 3 2 1	Driver Announcements	5 4 3 2 1	Simulated Bus
5 4 3 2 1	_____	5 4 3 2 1	Computer Games
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____

Comments:

Departing The Vehicle

Notify Driver of Desire to Stop

Rating Scale — Mark

5 For Extremely Important
4 For Very Important
3 For Important
2 For Not To Important
1 For Not Important

	Media		Training Format
5 4 3 2 1	Visual Signs	5 4 3 2 1	1 on 1 Training w/ Trained Guide
5 4 3 2 1	Printed Schedules	5 4 3 2 1	1 on 1 Training w/ Untrained Guide
5 4 3 2 1	Maps	5 4 3 2 1	Group Training
5 4 3 2 1	Tactile Maps	5 4 3 2 1	Repetition
5 4 3 2 1	Talking Signs	5 4 3 2 1	Audio Tapes
5 4 3 2 1	Auditory Maps	5 4 3 2 1	Video Tapes
5 4 3 2 1	Video Tapes	5 4 3 2 1	Print
5 4 3 2 1	Customer Service	5 4 3 2 1	Real Time On Bus
5 4 3 2 1	Driver Announcements	5 4 3 2 1	Simulated Bus
5 4 3 2 1	_____	5 4 3 2 1	Computer Games
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____

Comments:

Exiting the Station /Terminal

Determine Desired Exit Direction

Rating Scale	Mark	5 For Extremely Important 4 For Very Important 3 For Important 2 For Not To Important 1 For Not Important

	Media		Training Format
5 4 3 2 1	Visual Signs	5 4 3 2 1	1 on 1 Training w/ Trained Guide
5 4 3 2 1	Printed Schedules	5 4 3 2 1	1 on 1 Training w/ Untrained Guide
5 4 3 2 1	Maps	5 4 3 2 1	Group Training
5 4 3 2 1	Tactile Maps	5 4 3 2 1	Repetition
5 4 3 2 1	Talking Signs	5 4 3 2 1	Audio Tapes
5 4 3 2 1	Auditory Maps	5 4 3 2 1	Video Tapes
5 4 3 2 1	Video Tapes	5 4 3 2 1	Print
5 4 3 2 1	Customer Service	5 4 3 2 1	Real Time On Bus
5 4 3 2 1	Driver Announcements	5 4 3 2 1	Simulated Bus
5 4 3 2 1	_____	5 4 3 2 1	Computer Games
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____

Comments:

Emergencies

Route Deviations

Rating Scale	Mark	5 For Extremely Important 4 For Very Important 3 For Important 2 For Not To Important 1 For Not Important

	Media		Training Format
5 4 3 2 1	Visual Signs	5 4 3 2 1	1 on 1 Training w/ Trained Guide
5 4 3 2 1	Printed Schedules	5 4 3 2 1	1 on 1 Training w/ Untrained Guide
5 4 3 2 1	Maps	5 4 3 2 1	Group Training
5 4 3 2 1	Tactile Maps	5 4 3 2 1	Repetition
5 4 3 2 1	Talking Signs	5 4 3 2 1	Audio Tapes
5 4 3 2 1	Auditory Maps	5 4 3 2 1	Video Tapes
5 4 3 2 1	Video Tapes	5 4 3 2 1	Print
5 4 3 2 1	Customer Service	5 4 3 2 1	Real Time On Bus
5 4 3 2 1	Driver Announcements	5 4 3 2 1	Simulated Bus
5 4 3 2 1	_____	5 4 3 2 1	Computer Games
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____

Comments:

Emergencies

Cancelled Routes

Rating Scale	Mark	5 For Extremely Important 4 For Very Important 3 For Important 2 For Not To Important 1 For Not Important

	Media		Training Format
5 4 3 2 1	Visual Signs	5 4 3 2 1	1 on 1 Training w/ Trained Guide
5 4 3 2 1	Printed Schedules	5 4 3 2 1	1 on 1 Training w/ Untrained Guide
5 4 3 2 1	Maps	5 4 3 2 1	Group Training
5 4 3 2 1	Tactile Maps	5 4 3 2 1	Repetition
5 4 3 2 1	Talking Signs	5 4 3 2 1	Audio Tapes
5 4 3 2 1	Auditory Maps	5 4 3 2 1	Video Tapes
5 4 3 2 1	Video Tapes	5 4 3 2 1	Print
5 4 3 2 1	Customer Service	5 4 3 2 1	Real Time On Bus
5 4 3 2 1	Driver Announcements	5 4 3 2 1	Simulated Bus
5 4 3 2 1	_____	5 4 3 2 1	Computer Games
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____

Comments:

Emergencies

Weather Conditions - snow/fog

Rating Scale	Mark	5 For Extremely Important 4 For Very Important 3 For Important 2 For Not To Important 1 For Not Important

	Media		Training Format
5 4 3 2 1	Visual Signs	5 4 3 2 1	1 on 1 Training w/ Trained Guide
5 4 3 2 1	Printed Schedules	5 4 3 2 1	1 on 1 Training w/ Untrained Guide
5 4 3 2 1	Maps	5 4 3 2 1	Group Training
5 4 3 2 1	Tactile Maps	5 4 3 2 1	Repetition
5 4 3 2 1	Talking Signs	5 4 3 2 1	Audio Tapes
5 4 3 2 1	Auditory Maps	5 4 3 2 1	Video Tapes
5 4 3 2 1	Video Tapes	5 4 3 2 1	Print
5 4 3 2 1	Customer Service	5 4 3 2 1	Real Time On Bus
5 4 3 2 1	Driver Announcements	5 4 3 2 1	Simulated Bus
5 4 3 2 1	_____	5 4 3 2 1	Computer Games
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____
5 4 3 2 1	_____	5 4 3 2 1	_____

Comments:

APPENDIX C

Survey Statistics

	Visual Signs		Maps		Talking Signs		Video Maps		Driver Ann'ts	1/1 w untrain Guide		Repetition		Video Tapes		Real Time on Bus		Computer Games
	Printed	Schedules		Tactile Maps		Auditory Maps		Customer	Service	1/1 w/ train Guide		Group Training		Audio Tapes		Print	Simulated Bus	Trips
	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Understanding the System																			
Learn routes, stops/stations, transfer points and fares.																			
	5	3	3	3	5	2	2	3	5	5	2	2	5	2	2	2	5	5	2
	5	5	1	1	5	1	1	5	1	3	3	3	5	5	1	5	1	1	3
	1	3	3	2	3	1	1	3	3	4	2	2	2	1	1	3	3	3	3
	5	5		2				4		5	3	3	5				5		
	5	5	3	2	4	2	2	5	4	5	4	2	5	2	2	5	5	5	2
	4	2	3		4	4	4	4	4	4	3	3	5	4	4	5	4		
	5	5	5	5	5	5	5	5	5	5	5	5	5	5	1	5	5	5	1
	4	3	2	3	2	2	3	4	4	5	3	4	4	3	2	3	4	5	3
	5	5	1	1	5	3	1	4	5	5	3	3	5	2	1		5	1	1
	4	2	2	2	2	1	5	4	5	5	4	3	5	3	3	2	5	3	3
	4	3	2	1	2	2	2	4	5	4	1	3	3	1	3	3	2	3	1
	4	5	5	2	3		2	5	3	4	2	3	4	3	3	4	5	4	
	2	1	2	2	3	2	1	4	2	5	3	2	5	2	1	1	5	1	1
	5	2	3	3	4	3	3	4	5	5	5	4	5	2	2	1	4	3	1
	5	5	4	5	5	5	1	4	5	5	1	5	5	5	2	5	5	5	3
	5	5	3	1	3	3	3	4	5	5	3	1	5	1	1	1	5	2	
	5	1	1	3	5	5	1	5	5	5	5	1	5	5	1	1	5	1	1
Mean	4.29	3.53	2.69	2.36	3.75	2.73	2.31	4.16	4.13	4.65	3.06	2.66	4.59	2.66	1.66	3.07	4.29	3.13	1.92
S.DEV.	1.16	1.55	1.25	1.26	1.16	1.44	1.40	0.64	1.26	0.61	1.25	1.17	0.67	1.50	0.96	1.67	1.21	1.64	0.95
VAR.	1.35	2.39	1.56	1.56	1.40	2.07	1.96	0.40	1.56	0.37	1.56	1.36	0.76	2.25	0.92	2.76	1.47	2.70	0.91

THE VALUES BELOW ARE THE PROBABILITY ASSOCIATED WITH A STUDENTS' T-TEST FOR TWO SAMPLES.

	C	D	E	F	G	H	I	J
B	0.05669	0.00029	0.00004	0.09499	0.00116	0.00006	0.35846	0.66993
C		0.04469	0.01126	0.32061	0.06541	0.01106	0.08262	0.11263
D			0.24265	0.00974	0.46064	0.21534	0.00015	0.00145
E				0.00166	0.22957	0.44611	0.00002	0.00023
F					0.02019	0.00195	0.10691	0.19604
G						0.20601	0.00096	0.00369
H							0.00004	0.00029
I								0.34496
J								

	L	M	N	O	P	Q	R	S	T
K	0.00005	0.00001	0.41036	0.00014	0.00000	0.00142	0.14701	0.00173	0.00000
L		0.33654	0.00014	0.35263	0.00226	0.49411	0.00313	0.44366	0.00395
M			0.00004	0.86762	0.01071	0.72351	0.00156	0.62661	0.01512
N				0.00026	0.00000	0.00231	0.21156	0.00269	0.00000
O					0.01674	0.36919	0.00264	0.32443	0.01916
P						0.01160	0.00000	0.00702	0.44030
Q							0.01292	0.45391	0.00965
R								0.01636	0.00000
S									0.01062

WHEN P≤0.05 WE ARE AT LEAST 95% CONFIDENT THAT THERE IS A SIGNIFICANT DIFFERENCE IN THE MEANS

	Visual Signs		Maps		Talking Signs		Video Maps		Driver Ann'ts	1/1 w untrain Guide		Repetition		Video Tapes		Real Time on Bus		Computer Games
	Printed Schedules		Tactile Maps		Auditory Maps		Customer Service		1/1 w/ train Guide	Group Training		Audio Tapes		Print		Simulated Bus Trips		
	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Understanding the System																			
Learn Schedules																			
	1	1	1	1	1	1	1	5	5	5	5		5	1	1	1	5	5	
	5	5	3	1	4	3	1	4	5	1	3	5	5	3	2	4	5	2	1
								5		5			5	5					
	5	3	3	3	4	3	2	5	5	5	5	4	5	2	2	2	4	3	1
	2	1	1	2	3	2	3	4	1	5	3	2	5	1	1	1	5	2	1
	5	3	2	3	2	2	1	3	2	5	3	3	4	2	3	4	5	4	3
	4	4	4	2	1	1	1	5	5	3	2	2	4	1	1	3	1	3	1
	2	2			3		2	5	4	5	4	3	5	2	2	1	5	4	3
	1	5	2	2	5	3	1	5	1	5	3	2	5	2	4	4	5	1	3
	2	5	3	2	2	2	4	1	1	5	3	4	4	2	3	4	2	4	3
	5	5	5	5	5	5	5	5	5	5	5	5	5	5	1	5	5	5	1
	3				4		4		5	4	4	4	5		4		5	5	
	5	5	2	2	4	2	2	5	4	5	4	2	5	2	2	5	5	5	2
	5								5	5			5				5	4	
	1	4	1	1	3	1	1	2	3	1	1	2	3	1	1	3	1	1	1
	5	5	1	1	5	1	1	5	1	3	3	3	5	5	1	5	1	1	3
	5	3	3	3	5	2	2	3	5	5	2	2	5	2	2	2	5	5	2
Mean	3.50	3.64	2.36	2.15	3.40	2.15	2.07	4.13	3.58	4.24	3.33	3.07	4.71	2.40	2.00	3.14	4.00	3.36	1.92
S. Dev.	1.71	1.50	1.26	1.14	1.40	1.14	1.33	1.30	1.75	1.39	1.16	1.14	0.59	1.45	1.07	1.51	1.67	1.54	0.95
Var.	2.93	2.25	1.59	1.31	1.97	1.31	1.78	1.70	3.06	1.94	1.36	1.30	0.35	2.11	1.14	2.29	2.80	2.38	0.91

THE VALUES BELOW ARE THE PROBABILITY ASSOCIATED WITH A STUDENTS' T-TEST FOR TWO SAMPLES.

	C	D	E	F	G	H	I	J		L	M	N	O	P	Q	R	S	T
B	0.40320	0.02327	0.00719	0.42884	0.00719	0.00652	0.12168	0.45988	K	0.02691	0.00730	0.10655	0.00051	0.00001	0.02311	0.33188	0.05127	0.00000
C		0.01130	0.00308	0.32791	0.00308	0.00246	0.17696	0.44526	L		0.28846	0.00028	0.02277	0.00151	0.35416	0.10224	0.48837	0.00053
D			0.31473	0.02680	0.31473	0.25353	0.00058	0.01966	M			0.00006	0.08643	0.00665	0.44093	0.03980	0.26566	0.00397
E				0.00757	0.50000	0.42376	0.00009	0.00610	N				0.00001	0.00000	0.00105	0.06348	0.00217	0.00000
F					0.00757	0.00831	0.07250	0.38700	O					0.16765	0.08323	0.00246	0.02929	0.12863
G						0.42376	0.00009	0.00610	P						0.01190	0.00022	0.00360	0.41389
H							0.00005	0.00548	Q							0.07343	0.33740	0.00676
I								0.14648	R								0.14046	0.00011
J									S									0.00145

WHEN P≤0.05 WE ARE AT LEAST 95% CONFIDENT THAT THERE IS A SIGNIFICANT DIFFERENCE IN THE MEANS

	Visual Signs		Maps		Talking Signs		Video Maps		Driver Ann'ls	1/1 w untrain	Guide	Repetition		Video Tapes		Real Time on Bus		Computer Games
	Printed	Schedules	Tactile Maps		Auditory Maps		Customer	Service	1/1 w/ train	Guide	Group Training		Audio Tapes		Print	Simulated Bus		Trips
	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Understanding the System																			
Learn Special Services and Provisions																			
	5	1	1	1	1	1	5	5	1	3	3	3	4	5	5	5	1	1	3
	1	1	1	1	3	1	3	3	1	1	1	1	1	3	3	3	1	1	1
	5	4						5	4	5			5				5	5	
	5	5	2	2	2	2	2	5	3	5	4	2	5	2	2	5	2	2	2
	4	3					4	5	5	5	5	5	5		5	3	4	4	
	5	5	5	5	5	5	5	5		5	5	5	5	5	5	5	5	5	1
	4	4	2	2	3	3	4	2	2	4	3	5	4	3	4	4	2	3	4
	1	1	1	1	5	1	1	5	5	5	2	1	5	1	1	1	4	1	1
	2	1			3		2	5	4	5	4	3	5	2	2	1	5	4	1
	4	3	3	2	1	1	1	4	5	3	3	3	2	2	3	5	3	4	1
	5	2	4	3	2	2	3	4	4	5	3	3	2	2		4	4	3	2
	1	2			3	3	3	4	1	5	3	2	5	3	3	2	5	2	1
	5	2	2	2	4	3	3	4	4	5	5	4	5	2	3	2	4	3	1
	5							5		5		5	5						
	5	5	4	1	5	5	4	5	5	2	2	5	5	3	3	2	2	5	
	5	1	1	1	1	1	1	5	5	5	3	1	5	1	1	1	5	1	1
Mean	3.88	2.67	2.36	1.91	2.92	2.33	2.93	4.44	3.50	4.25	3.29	3.20	4.25	2.82	3.06	3.07	3.47	2.93	1.56
S. Dev.	1.63	1.59	1.43	1.22	1.50	1.50	1.36	0.89	1.81	1.29	1.20	1.57	1.34	1.26	1.36	1.59	1.51	1.53	1.00
Var.	2.65	2.52	2.05	1.49	2.24	2.24	1.92	0.80	2.58	1.67	1.45	2.46	1.80	1.59	1.91	2.53	2.27	2.35	0.99

THE VALUES BELOW ARE THE PROBABILITY ASSOCIATED WITH A STUDENTS' T-TEST FOR TWO SAMPLES.

	C	D	E	F	G	H	I	J		L	M	N	O	P	Q	R	S	T
B	0.02192	0.00557	0.00029	0.05406	0.00634	0.04542	0.11882	0.26249	K	0.02065	0.02576	0.5	0.00066	0.01286	0.01769	0.08538	0.00762	2.6E-07
C		0.27327	0.05387	0.2944	0.25494	0.29046	0.00035	0.06726	L		0.43288	0.02256	0.07614	0.34002	0.34571	0.35837	0.23914	0.00015
D			0.21649	0.18046	0.48038	0.18199	0.00032	0.0177	M			0.02736	0.12867	0.41126	0.41222	0.31166	0.31082	0.00067
E				0.04066	0.23051	0.02925	6.9E-06	0.00086	N				0.00102	0.0116	0.01664	0.08831	0.00832	7.7E-07
F					0.16776	0.49806	0.00224	0.15702	O					0.17926	0.20778	0.05378	0.28558	0.01505
G						0.1493	0.00023	0.02213	P						0.49616	0.23817	0.39477	0.00159
H							0.00101	0.15192	Q							0.24572	0.40414	0.00361
I								0.0329	R								0.17237	0.00019
J									S									0.00255

WHEN P≤0.05 WE ARE AT LEAST 95% CONFIDENT THAT THERE IS A SIGNIFICANT DIFFERENCE IN THE MEANS

UNDERSTANDING THE SYSTEM

THE VALUES BELOW ARE THE PROBABILITY ASSOCIATED WITH A STUDENTS' T-TEST FOR TWO SAMPLES.

	C	D	E	F	G	H	I	J		L	M	N	O	P	Q	R	S	T
B	0.02700	0.00000	0.00000	0.04348	0.00000	0.00000	0.08544	0.30570	K	0.00000	0.00000	0.25544	0.00000	0.00000	0.00001	0.05051	0.00002	0.00000
C		0.00517	0.00013	0.36819	0.00311	0.00305	0.00029	0.07719	L		0.24536	0.00000	0.01572	0.00018	0.33701	0.00513	0.40981	0.00000
D			0.12194	0.00143	0.39754	0.39271	0.00000	0.00002	M			0.00000	0.05502	0.00190	0.43361	0.00094	0.35289	0.00000
E				0.00002	0.18964	0.18389	0.00000	0.00000	N				0.00000	0.00000	0.00000	0.01213	0.00000	0.00000
F					0.00087	0.00085	0.00037	0.12296	O					0.08654	0.07380	0.00001	0.04341	0.00071
G						0.49624	0.00000	0.00002	P						0.00346	0.00000	0.00149	0.02093
H							0.00000	0.00002	Q							0.00442	0.42622	0.00000
I								0.02725	R								0.00878	0.00000
J									S									0.00000
Mean	3.90	3.26	2.50	2.18	3.39	2.43	2.42	4.25	3.74	4.38	3.22	3.04	4.52	2.84	2.27	3.09	3.94	3.15	1.82

	Visual Signs		Maps		Talking Signs		Video Maps		Driver Ann'ts	1/1 w untrain Guide		Repetition		Video Tapes		Real Time on Bus		Computer Games
	Printed Schedules		Tactile Maps		Auditory Maps		Customer Service		1/1 w/ train Guide	Group Training		Audio Tapes		Print		Simulated Bus Trips		
	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Accessing The Correct Vehicle																			
Locate Stops, Station Terminals																			
	5	1	1	1	1	1	1	5	5	5	4	1	5	1	1	1	5	1	1
	5	3	5	4	5	5	5	5	5	5	2	3	5	4	5	3	5	1	1
	4	5		5	5	5	1	5	5	5						5	5	5	
	4	2	3	4	4	3	2	5	5	5	5	4	5	2	3	2	4	3	1
	3	2	3	2	3	3	2	5	4	5	3	2	5	2	2	2	5	2	1
	4	3	4	2	2	3	3	4	4	4	3	3	4	2	4	4	3	3	2
	5	3	4	2	2	2	1	4	5	2	1	3	3	1	1	4	2	4	1
	4	1	2	2	3	1	2	5	5	5	4	3	5	1	2	1	4	3	2
	5	1	1	1	5	1	1	5	5	5	4	4	5	1	1	1	5	1	1
	5	3	3	4	2	3	2	4	4	4	3	4	3	3	4	2	2	4	5
	5	5	5	5	5	1	5	5	5	5	5	5	5	5	5	5	5	5	1
	4				4		4	4	5	5	5	5	5		5		5	5	
	5	5	3	2	5	2	2	5	4	5	4	2	5	2	2	5	5	5	2
	5								5	5	4		5				5	3	
	2	1	2	1	2	2	1	2	3	1	1	3	3	2	2	3	3	1	2
	5	1	5	5	5	5	5	5	5	3	3	3	5	5	5	5	5	2	1
	5	1	3	3	5	2	4	3	5	5	3	2	5	2	4	2	5	5	2
Mean	4.41	2.47	3.14	2.87	3.63	2.60	2.56	4.44	4.85	4.35	3.38	3.13	4.58	2.36	3.07	3.00	4.29	3.12	1.54
S. Dev.	0.87	1.55	1.35	1.51	1.45	1.45	1.55	0.89	0.81	1.22	1.28	1.13	0.81	1.39	1.58	1.58	1.10	1.58	1.08
Var.	0.78	2.41	1.82	2.27	2.12	2.11	2.40	0.80	0.37	1.49	1.58	1.27	0.88	1.94	2.50	2.43	1.22	2.49	1.17

THE VALUES BELOW ARE THE PROBABILITY ASSOCIATED WITH A STUDENTS' T-TEST FOR TWO SAMPLES.

	C	D	E	F	G	H	I	J		L	M	N	O	P	Q	R	S	T
B	0.00015	0.003	0.00101	0.03831	0.00017	0.00017	0.48885	0.18401	K	0.01511	0.00295	0.28111	0.00013	0.00818	0.00586	0.44194	0.00798	1.5E-07
C		0.09812	0.23984	0.02042	0.40497	0.43137	0.00014	3.8E-05	L		0.2878	0.00195	0.02074	0.27654	0.22014	0.01849	0.29855	0.00012
D			0.29816	0.17356	0.14071	0.13293	0.00283	0.0006	M			0.00022	0.05033	0.44757	0.38893	0.00294	0.4887	0.00036
E				0.08233	0.31278	0.28901	0.00097	0.00022	N				2E-05	0.00179	0.00072	0.21388	0.00098	8.9E-09
F					0.02988	0.02729	0.03424	0.00848	O					0.09827	0.11803	0.00013	0.07297	0.07122
G						0.4721	0.00017	3.8E-05	P						0.4513	0.00905	0.48321	0.00332
H							0.00016	3.5E-05	Q							0.00822	0.41501	0.00423
I								0.2192	R								0.00879	1E-07
J									S									0.0014

WHEN P≤0.05 WE ARE AT LEAST 95% CONFIDENT THAT THERE IS A SIGNIFICANT DIFFERENCE IN THE MEANS

	Visual Signs		Maps		Talking Signs		Video Maps		Driver Ann'ts	1/1 w untrain Guide		Repetition		Video Tapes		Real Time on Bus		Computer Games
	Printed	Schedules	Tactile Maps		Auditory Maps		Customer	Service	1/1 w/ train Guide		Group Training		Audio Tapes		Print	Simulated Bus		Trips
	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Accessing the Correct Vehicle																			
Locate and Access the Fare System																			
	5	1	1	1	5	1	4	3	4	5	3	2	5	2	4	2	5	5	2
	5	1	1	1	5	1	5	5	1	3	3	3	5	5	4	5	5	2	1
	1	1	1	1	2	1	1	2	2	1	1	3	3	2	2	3	2	2	2
	5					5		5	5	5		3				5			
	5	4	1	1	2	1	2	5	3	4	5	1	5	2	2	5	3	2	1
	4				4			4	5	5	5	5	5		5		5	5	
	5	5	5	5	5	5	5	5	5	5	5	5	5	5	1	5	5	5	1
	3	3	1	1	4	2	2	5	5	4	3	5	4	3	3	5	2	4	4
	4							5		5	4	5	5	1	1	1	5	5	5
	3	1	1	1	2	2	3	5	5	5	4	3	5	2	2	1	5	4	2
	4	1	1	1	1	1	3	4	4	4	2	4	3	2	2	4	1	2	1
	5	3	3	2	3	2	2	4	2	4	2	3	3	2	3	4	2	3	3
	2	3			4		2	5		5	3	2	5	2	2	1	5	2	1
	4	2	2	2	3	3	2	5	5	5	5	4	5	2	3	2	4	3	3
	5	5	1	1	5	5		5	5	5	1	5	5	4	1	5		2	1
	3	2	1	1	4	1	4	5	5	2	2	4	5	5	5	5	5	5	2
	5	1	1	1	1	1	1	5	5	5	4	1	5	1	1	1	5	1	1
Mean	4.00	2.36	1.54	1.46	3.33	2.21	2.77	4.53	4.07	4.24	3.22	3.41	4.56	2.67	2.58	3.38	3.93	3.25	2.00
S. Dev.	1.22	1.50	1.20	1.13	1.45	1.63	1.38	0.87	1.39	1.20	1.35	1.37	0.81	1.40	1.36	1.75	1.49	1.44	1.26
Var.	1.50	2.26	1.44	1.27	2.10	2.64	1.86	0.76	1.92	1.44	1.83	1.88	0.66	1.95	1.86	3.06	2.21	2.07	1.57

THE VALUES BELOW ARE THE PROBABILITY ASSOCIATED WITH A STUDENTS' T-TEST FOR TWO SAMPLES.

	C	D	E	F	G	H	I	J		L	M	N	O	P	Q	R	S	T
B	0.00140	0.00000	0.00000	0.08523	0.00103	0.00787	0.07884	0.44156	K	0.01465	0.03595	0.18033	0.00099	0.00038	0.05588	0.28617	0.02038	0.00001
C		0.06353	0.04466	0.04258	0.39886	0.21559	0.00005	0.00162	L		0.34331	0.00114	0.13039	0.09110	0.38517	0.07860	0.47497	0.00594
D			0.43375	0.00063	0.09714	0.01051	0.00000	0.00001	M			0.00325	0.06597	0.04209	0.47313	0.15199	0.37156	0.00203
E				0.00033	0.07011	0.00643	0.00000	0.00000	N				0.00007	0.00002	0.00963	0.08063	0.00204	0.00000
F					0.02221	0.14276	0.00526	0.08140	O					0.41329	0.10670	0.01002	0.12486	0.09001
G						0.13552	0.00006	0.00139	P						0.08517	0.00552	0.08779	0.10728
H							0.00031	0.00823	Q							0.16233	0.40996	0.00779
I								0.13781	R								0.09946	0.00026
J									S									0.00633

WHEN P≤0.05 WE ARE AT LEAST 95% CONFIDENT THAT THERE IS A SIGNIFICANT DIFFERENCE IN THE MEANS

	Visual Signs	Maps		Talking Signs		Video Maps		Driver Ann'ls	1/1 w untrain Guide		Repatition		Video Tapes		Real Time on Bus		Computer Games
	Printed	Schedules	Tactile	Maps	Auditory	Maps	Customer	Service	1/1 w/ train	Guide	Group	Training	Audio	Tapes	Print	Simulated	Bus Trips
	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Accessing The Correct Vehicle																			
Move To Proper Boarding Area																			
	1	1	1	1	1	1	1	5	5	5	4	1	5	1	1	1	5	1	1
	5	3	5	5	5	5	4	5	2	5		2	5	2	5	1	5	2	2
	5									5									
	5	2	3	3	4	4	3	5	3	5	5	4	5	2	3	2	4	3	2
	5	4	3	2	4	4	1	5	1	5	3	2	5	2	2	1	5	2	1
	5	2	4	2	2	3	3	4	3	3	3	4	2	2	2	4	3	3	2
	5	1	1	3	3	3	1	4	5	3	2	3	3	3	1	4	1	3	1
	4	2	2	2	3	2	3	5	4	5	4	3	5	2	2	1	5	4	3
	5				5	5		5	5	5	3		5				4	4	
	3	1	3	3	4	3	2	3	4	5	3	4	3	2	3	2	4	4	4
	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	1
	5		4		4		4		5	5	5	5	5				5	5	
	5	5	3	2	4	3	2	5	3	5	4	3	5	2	2	5	5	4	1
	5				5	5				5								4	4
	2	3	3	1	3	3	1	2	2	3	1	3	1	1	1	3	3	1	1
	5	1	3	3	5	5	3	5	1	3	3	3	5	5	5	5	5	2	1
	5	1	5	4	5	2	2	3	5	5	3	2	5	2	3	2	5	5	2
Mean	4.41	2.38	3.21	2.77	3.66	3.53	2.50	4.36	3.53	4.53	3.43	3.14	4.27	2.36	2.69	2.77	4.27	3.25	1.86
S. Dev.	1.23	1.50	1.31	1.30	1.20	1.30	1.29	1.01	1.51	0.87	1.16	1.17	1.33	1.26	1.49	1.64	1.16	1.34	1.10
Var.	1.51	2.26	1.72	1.69	1.45	1.70	1.65	1.02	2.27	0.76	1.34	1.38	1.78	1.59	2.23	2.69	1.35	1.80	1.21

THE VALUES BELOW ARE THE PROBABILITY ASSOCIATED WITH A STUDENTS' T-TEST FOR TWO SAMPLES.

	C	D	E	F	G	H	I	J		L	M	N	O	P	Q	R	S	T
B	0.00029	0.00703	0.00078	0.10840	0.02935	0.00012	0.44573	0.04127	K	0.00347	0.00057	0.26018	0.00002	0.00045	0.00131	0.23931	0.00169	0.00000
C		0.05927	0.24805	0.00363	0.01809	0.41455	0.00034	0.02387	L		0.25613	0.03991	0.01466	0.06452	0.10844	0.03040	0.34614	0.00016
D			0.19080	0.07724	0.24720	0.07881	0.00740	0.26961	M			0.01097	0.05189	0.16878	0.24619	0.00752	0.40736	0.00100
E				0.01194	0.05911	0.29221	0.00089	0.07335	N				0.00033	0.00350	0.00727	0.50000	0.02114	0.00000
F					0.22757	0.00236	0.11756	0.24422	O					0.28787	0.25479	0.00019	0.03749	0.11555
G						0.01410	0.02965	0.50000	P						0.45079	0.00261	0.14561	0.04950
H							0.00006	0.02615	Q							0.00586	0.19564	0.04731
I								0.04337	R								0.01537	0.00000
J									S									0.00150

WHEN P≤0.05 WE ARE AT LEAST 95% CONFIDENT THAT THERE IS A SIGNIFICANT DIFFERENCE IN THE MEANS

	Visual Signs		Maps		Talking Signs		Video Maps		Driver Ann'ts	1/1 w untrain Guide		Repetition		Video Tapes		Real Time on Bus		Computer Games
	Printed	Schedules	Tactile Maps		Auditory Maps		Customer Service		1/1 w/ train Guide		Group Training		Audio Tapes		Print	Simulated Bus		Trips
	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Accessing the Correct Vehicle																			
Identify the Correct Incoming Bus																			
	5	1	3	3	5	1	1	3	5	5	3	2	5	2	2	2	5	5	2
	5	1	1	1	5	1	1	5	5	3	3	3		5	5	5	5	2	1
	3	1	1	1	1	1	1	2	3	1	1	2	3	1	1	3	3	1	1
	5								5	5	4		5				4	3	
	5	5	2	2	4	2	2	2	2	4	4	3	5	2	2	5	5	5	3
	5				5			5		5	5	5	5		5		5	5	
	5	5	1	5	5	5	1	5	5	5	5	5	5	1	1	5	5	5	1
	4	3	2	3	4	2	2	4	5	4	3	5	4	1	3	2	2	4	4
	5				5			3	5	5	3	4	5				4	4	
	4	1	2	2	3	2	3	5	5	5	4	3	5	2	3	1	5	4	3
	5	2	2	2	4	4	2	4	5	4	2	4	3	4	4	4	1	1	1
	5	4	2	2	4	3	2	4	4	3	3	2	2	2	2	4	2	3	2
	5	2	4	2	5	4	1	5	1	5	3	2	5	2	3	2	5		
	5	2	3	3	4	3	2	5	5	5	5	4	5	2	3	1	4	3	3
	5				5			4	5	5						5			
	5	1	1	1	5	2	5	5	2	2	5	1	5	4	4	3	5	4	4
	5	1	1	1	5	1	1	5	5	5	4	1	5	1	1	1	5	1	1
Mean	4.76	2.23	1.92	2.15	4.31	2.38	1.85	4.13	4.19	4.18	3.56	3.07	4.47	2.23	2.79	3.07	4.08	3.33	2.17
S. Dev.	0.56	1.54	0.95	1.14	1.06	1.33	1.14	1.09	1.36	1.24	1.15	1.39	0.99	1.30	1.37	1.59	1.34	1.50	1.19
Var.	0.32	2.36	0.91	1.31	1.18	1.78	1.31	1.18	1.90	1.53	1.33	1.92	0.98	1.69	1.87	2.53	1.80	2.24	1.42

THE VALUES BELOW ARE THE PROBABILITY ASSOCIATED WITH A STUDENTS' T-TEST FOR TWO SAMPLES.

	C	D	E	F	G	H	I	J		L	M	N	O	P	Q	R	S	T
B	0.00003	0.00000	0.00000	0.07402	0.00001	0.00000	0.02344	0.08736	K	0.07380	0.01156	0.22811	0.00014	0.00302	0.02066	0.40021	0.04845	0.00007
C		0.27320	0.44307	0.00023	0.39345	0.23625	0.00054	0.00066	L		0.14466	0.01271	0.00349	0.05299	0.15984	0.13353	0.31871	0.00202
D			0.29068	0.00000	0.15966	0.42894	0.00000	0.00001	M			0.00166	0.04695	0.29235	0.49838	0.02562	0.30643	0.03336
E				0.00001	0.31947	0.24965	0.00003	0.00007	N				0.00000	0.00020	0.00249	0.17048	0.00984	0.00001
F					0.00014	0.00000	0.31398	0.38715	O					0.13270	0.06578	0.00045	0.02057	0.44940
G						0.13930	0.00039	0.00080	P						0.29274	0.00769	0.15501	0.10240
H							0.00000	0.00001	Q							0.03353	0.31481	0.04607
I								0.44298	R								0.08103	0.00024
J									S									0.01429

WHEN P≤0.05 WE ARE AT LEAST 95% CONFIDENT THAT THERE IS A SIGNIFICANT DIFFERENCE IN THE MEANS

Accessing the Correct Vehicle

	C	D	E	F	G	H	I	J		L	M	N	O	P	Q	R	S	T
B	0.00000	0.00000	0.00000	0.00200	0.00000	0.00000	0.49778	0.08911	K	0.00001	0.00000	0.21674	0.00000	0.00000	0.00000	0.19107	0.00000	0.00000
C		0.36141	0.40314	0.00000	0.10834	0.40250	0.00000	0.00000	L		0.20441	0.00000	0.00003	0.00624	0.10597	0.00060	0.20410	0.00000
D			0.28494	0.00000	0.16220	0.47398	0.00000	0.00000	M			0.00000	0.00051	0.04341	0.30626	0.00004	0.48277	0.00000
E				0.00000	0.06198	0.30364	0.00000	0.00000	N				0.00000	0.00000	0.00000	0.05361	0.00000	0.00000
F					0.00004	0.00000	0.00174	0.07347	O					0.07702	0.00669	0.00000	0.00095	0.01507
G						0.13834	0.00000	0.00000	P						0.13778	0.00000	0.05415	0.00013
H							0.00000	0.00000	Q							0.00005	0.32941	0.00001
I								0.09733	R								0.00009	0.00000
J									S									0.00000
Mean	4.39	2.39	2.47	2.32	3.77	2.73	2.45	4.39	4.11	4.31	3.40	3.22	4.48	2.43	2.79	3.09	4.13	3.21	1.91

	Visual Signs		Maps		Talking Signs		Video Maps		Driver Ann'ts	1/1 w untrain Guide		Repetition		Video Tapes		Real Time on Bus		Computer Games
	Printed	Schedules	Tactile Maps		Auditory Maps		Customer Service		1/1 w/ train Guide		Group Training		Audio Tapes		Print	Simulated Bus		Trips
	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Entering The Vehicle																			
Pay Fare																			
	1	1	1	1	1	1	1	1	5	5	4	1	5	1	1	1	5	1	1
	5	1	1	1	5	1	5	5	5	1	1	5	5	3	5	5	1	3	5
	5								5	5							4	4	
	4	3	3	3	4	3	3	5	5	5	5	4	5	2	3	2	4	3	3
	3	3			4		2	5		5	3	2	5	2	2	2	5	2	
	4	1	1	1	3	1	1	3	3	3	3	3	2	1	1	3	3	2	2
	5	2	2	1	1	1	1	4	5	4	3	4	2	3	4	4	1	1	1
	3	1	1	1	1	1	2	3	5	5	4	3	5	1	3	1	5	4	2
	5	1								5	3		5				5		
	2	1	1	1	5	2	4	1	5	5	4	4	4	2	3	1	5	4	4
	4				4				5	5	5	5	5				5	5	
	5	4	1	1	3	1	1	5	4	3	3	3	4	1	1	5	5	4	1
	5				5			5	5	5	3		5		5		5	4	
	1	1	1	1	2	1	1	2	3	3	1	3	3	1	1	3	3	2	1
	5	1	1	1	5	5	1	5	5	3	3	3	5	5	1	5	5	2	1
	5	1	1	1	1	1	4	3	5	5	3	2	5	2	2	2	5	5	2
Mean	3.88	1.62	1.27	1.18	3.14	1.84	2.17	3.62	4.84	4.19	3.20	3.23	4.33	2.00	2.48	2.83	4.13	3.07	2.09
S. Dev.	1.45	1.04	0.85	0.80	1.66	1.29	1.47	1.58	0.74	1.22	1.15	1.17	1.11	1.21	1.51	1.59	1.41	1.33	1.38
Ver.	2.12	1.09	0.42	0.38	2.75	1.65	2.15	2.42	0.55	1.50	1.31	1.38	1.24	1.45	2.27	2.52	1.98	1.78	1.89

THE VALUES BELOW ARE THE PROBABILITY ASSOCIATED WITH A STUDENTS' T-TEST FOR TWO SAMPLES.

	C	D	E	F	G	H	I	J		L	M	N	O	P	Q	R	S	T
B	1.6E-05	4.1E-07	2.2E-07	0.10287	0.00012	0.0023	0.32208	0.03498	K	0.01324	0.01863	0.36431	3.3E-05	0.00131	0.01059	0.44715	0.0104	0.00026
C		0.15348	0.09483	0.00303	0.48239	0.1487	0.00035	1.9E-09	L		0.47227	0.00519	0.00511	0.07595	0.24909	0.02693	0.38448	0.01875
D			0.38834	0.00032	0.20776	0.03888	3.2E-05	9.3E-12	M			0.00813	0.00635	0.05846	0.23832	0.03425	0.38312	0.01706
E				0.0002	0.15316	0.02475	2.1E-05	2.3E-12	N				1.4E-05	0.00122	0.01147	0.65008	0.00789	0.00026
F					0.00894	0.05686	0.22485	0.00295	O					0.18488	0.08124	9.2E-05	0.01512	0.43417
G						0.18304	0.00092	2.5E-08	P						0.26608	0.00253	0.12885	0.25432
H							0.01149	3.8E-05	Q							0.0168	0.33791	0.1198
I								0.01973	R								0.01948	0.00049
J									S									0.03513

WHEN P≤0.05 WE ARE AT LEAST 95% CONFIDENT THAT THERE IS A SIGNIFICANT DIFFERENCE IN THE MEANS

	Visual Signs			Maps		Talking Signs		Video Maps		Driver Ann'ts	1/1 w untrain Guide			Repetition		Video Tapes		Real Time on Bus		Computer Games
	Printed Schedules			Tactile Maps		Auditory Maps		Customer Service		1/1 w/ train Guide		Group Training		Audio Tapes		Print		Simulated Bus Trips		
	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Entering the Vehicle																				
Identify Vacant Seat or Standing Area																				
	1	1	1	1	1	1	3	5	3	5	3	2	5	2	2	2	5	5	2
	1	1	1	1	1	1	1	1	2	3	3	3	5	1	5	1	5	2	1
	5									3	2	3	3	1	1	1	3	2	2
	5	1	1	1	1	1	1	1	5	5	3		5				4	4	
	2								5	3	3	1	4	1	3	4	5	5	2
	1	1	1	1	1	1	1	1	5	5	5	5	5				5	5	
	5	1	3	1	4	1	4	1	3	5	5	5	5	1	1	1	1	5	1
									5	5	4	3	4	1	3	2	5	4	4
	3	1	1	1	1	1	3	2	4	5	3		5				5	3	
	4	1	1	1	1	1	3	4	5	5	4	3	5	1	1	1	5	4	2
	5	2	3	1	2	2	1	3	4	5	3	4	4	2	4	2	1	5	1
								5		3	3	2	3	1	1	3	2	2	2
	5	1	1	2	3	3	3	2	5	5	3	3	5				5	2	
									5	5	5	4	5	1	3	1	5	4	2
	3	1	1	1	1	1	1	1	5	1	1	5	5	5	5	1	5	5	5
	1	1	1	1	1	1	1	5	5	5	4	1	5	1	1	1	1	1	1
Mean	3.15	1.09	1.38	1.09	1.55	1.27	2.00	2.58	4.38	4.25	3.38	3.14	4.56	1.50	2.50	1.87	3.88	3.83	2.08
S. Dev.	1.77	0.30	0.81	0.30	1.04	0.65	1.18	1.73	1.01	1.24	1.09	1.35	0.73	1.17	1.57	0.98	1.67	1.41	1.24
Var.	3.14	0.09	0.65	0.09	1.07	0.42	1.40	2.99	1.02	1.53	1.18	1.62	0.53	1.38	2.45	0.97	2.78	1.98	1.54

THE VALUES BELOW ARE THE PROBABILITY ASSOCIATED WITH A STUDENTS' T-TEST FOR TWO SAMPLES.

	C	D	E	F	G	H	I	J		L	M	N	O	P	Q	R	S	T
B	0.00035	0.00146	0.00036	0.00442	0.00083	0.03014	0.19288	0.01854	K	0.02111	0.01318	0.19831	1.2E-08	0.00208	5.8E-07	0.23819	0.09634	5.1E-05
C		0.15715	0.5	0.09411	0.20504	0.01532	0.00365	9.3E-10	L		0.30551	0.0006	9.7E-05	0.05371	6.9E-05	0.18231	0.28929	0.00372
D			0.15715	0.32579	0.38705	0.07924	0.01501	6.8E-09	M			0.00111	0.00102	0.13278	0.00128	0.09567	0.17259	0.02038
E				0.09411	0.20804	0.01532	0.00355	9.3E-10	N				1.8E-07	0.00038	2.8E-08	0.07303	0.01351	5.8E-08
F					0.23453	0.17488	0.03722	3.8E-07	O					0.04552	0.35459	5.4E-05	5.8E-05	0.1241
G						0.04861	0.00899	1E-09	P						0.08784	0.01577	0.02767	0.23904
H							0.16178	1.7E-05	Q							6.4E-05	5.2E-05	0.18821
I								0.0016	R								0.32516	0.00125
J									S									0.00187

WHEN P≤0.05 WE ARE AT LEAST 95% CONFIDENT THAT THERE IS A SIGNIFICANT DIFFERENCE IN THE MEANS

ENTERING THE VEHICLE

	C	D	E	F	G	H	I	J		L	M	N	O	P	Q	R	S	T
B	1.8E-08	5.3E-09	5.3E-10	0.00614	1.3E-07	0.00022	0.16191	0.00342	K	0.0011	0.00093	0.19588	1.9E-10	9.7E-08	7.7E-07	0.28372	0.00521	4.4E-08
C		0.3988	0.09899	0.00174	0.38241	0.01633	1.3E-05	2.3E-19	L		0.38776	1.7E-05	3.3E-05	0.013	0.00208	0.01908	0.41952	0.00028
D			0.18289	0.0008	0.30432	0.00985	4.5E-08	3E-19	M			3.3E-05	3.1E-05	0.02713	0.00873	0.01288	0.31093	0.00121
E				0.0001	0.09521	0.00145	6.7E-07	6.9E-22	N				5.5E-12	6E-07	4.5E-08	0.07965	0.00027	2.1E-09
F					0.00488	0.19348	0.07126	6.3E-07	O					0.02801	0.09851	2.4E-08	6.7E-08	0.17714
G						0.03827	3.7E-05	1.7E-14	P						0.28842	0.00018	0.01254	0.15793
H							0.00904	2.5E-09	Q							2E-05	0.00221	0.34034
I								0.00024	R								0.04093	1.9E-08
J									S									3.3E-04
Mean	3.55	1.38	1.32	1.14	2.44	1.45	2.09	3.12	4.50	4.22	3.29	3.19	4.45	1.75	2.48	2.25	4.00	3.35	2.09

	Visuel Signs		Maps		Talking Signs		Video Maps		Driver Ann'ts	1/1 w unfrain	Guide	Repetition		Video Tapes		Real Time on Bus		Computer Games
	Printed	Schedules	Tactile	Maps	Auditory	Maps	Customer	Service	1/1 w/ train	Guide	Group	Training	Audio Tapes		Print	Simulated	Bus	Trips
	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Travelling On Vehicle																			
Comprehend Announcements For Special Services																			
	1	1	1	1	1	1	1	5	5	1	1	5	1	1	1	5	1	4
	2	1	1	1	5	1	3	3	5	4	2	4	5	4	4	2	5	5	
									5										2
	2	1	1	1	3	2	2	2	5	5	5	5	5	2	3	1	4	3	
	1	3						5	5	5	3	2	5				5	2	2
	3	5	1	1	3	1	3	4	3	3	3	3	3	1	1	4	3	2	1
	4	4	2	4	4	4	2	5	5	5	3	4	4	2	4	2	5	5	2
	1	1	1	1	2	1	2	3	4	3	2	1	4	1	1	1	4	3	
	5				5			5	5	5			5						5
	2	2	1	1	2	1	4	5	5	5	3	4	4	2	2	2	4	4	1
	5	5	5	5	5	5	5	5	1	5	5	5	5	5	5	5	5	5	
	4				4			4	5	5	5	5	5				5	5	1
	4	1	1	1	3	1	3	5	2	2	3	2	2	3	3	4	1	1	
	5								5	5	4		5	5			4	5	2
	1	1	1	1	3	1	3	3	3	3	2	1	1	2	2	1	2	2	1
	1	1	1	1	1	1	1	5	5	3	3	3	5	5	1	5	5	2	2
	1	1	1	1	5	5	5	3	5	5	3	2	5	2	2	2	5	5	
Mean	2.63	2.06	1.42	1.58	3.29	2.00	2.83	3.87	4.29	4.25	3.13	3.00	4.25	2.69	2.42	2.50	4.13	3.33	2.09
S. Dev.	1.63	1.61	1.16	1.36	1.44	1.85	1.34	1.30	1.26	1.06	1.19	1.52	1.24	1.55	1.38	1.57	1.25	1.59	1.30
Var.	2.65	2.58	1.36	1.90	2.07	2.73	1.79	1.70	1.60	1.13	1.41	2.31	1.53	2.40	1.90	2.45	1.55	2.52	1.89

THE VALUES BELOW ARE THE PROBABILITY ASSOCIATED WITH A STUDENTS' T-TEST FOR TWO SAMPLES.

	C	D	E	F	G	H	I	J		L	M	N	O	P	Q	R	S	T
B	0.16712	0.0074	0.02808	0.11083	0.14372	0.34	0.01011	0.00135	K	0.00492	0.00809	0.5	0.00268	0.00047	0.00168	0.39029	0.03587	9.1E-05
C		0.1228	0.20876	0.02179	0.45328	0.10432	0.00182	0.00021	L		0.39703	0.00763	0.19919	0.07819	0.12253	0.01624	0.34965	0.00388
D			0.37808	0.00043	0.1647	0.00567	9.5E-08	5.1E-07	M			0.01038	0.28566	0.14721	0.20081	0.01906	0.28028	0.01616
E				0.00209	0.25475	0.01724	6.9E-05	8.4E-08	N				0.00343	0.00083	0.00206	0.39726	0.04234	0.00011
F					0.02139	0.19983	0.12997	0.02401	O					0.31229	0.37492	0.00618	0.13787	0.08541
G						0.09432	0.00196	0.0003	P						0.44584	0.00126	0.05133	0.19091
H							0.0251	0.00312	Q							0.00388	0.08271	0.16497
I								0.17542	R								0.06836	4.9E-08
J									S									0.00356

WHEN P≤0.05 WE ARE AT LEAST 95% CONFIDENT THAT THERE IS A SIGNIFICANT DIFFERENCE IN THE MEANS

	Visual Signs		Maps		Talking Signs		Video Maps		Driver Ann'ts	1/1 w untrain Guide		Repetition		Video Tapes		Real Time on Bus		Computer Games
	Printed	Schedules	Tactile Maps		Auditory Maps		Customer Service		1/1 w/ train Guide		Group Training		Audio Tapes		Print	Simulated Bus		Trips
	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Travelling On Vehicle																			
Comprehend Intersection Announcements																			
	1	1	1	1	5	5	5	3	5	5	3	2	5	5	5	2	5	5	1
	1	1	1	1	1	1	1	5	5	3	3	3	5	1	1		5	2	1
	1	1	2	2	2	2	1	1	2	2	2	2	2	1	1	2	2	2	
	5								5	5	4		5				5	4	3
	5	4	3	2	4	2	2	2	5	5	4	3	5	3	2	4	4	4	
	5	1	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4
	3	3	2	1	2	1	4	1	5	5	3	4	4	3	4	2	5	4	2
	2	1	2	2	2	2	2	1	5	5	4	3	5	1	1	1	5	4	1
	2	2	4	4	2	2	2	4	5	5	3	4	4	4	4	3	2	4	2
	3	2	4	2	3	2	3	4	5	3	3	2	3	2	2	3	2	2	
	3	3						5	4	5	3	2	5	3	3	1	5	2	2
	2	1	1	1	3	2	1	1	5	5	5	4	5	2	3	1	4	3	
									5										3
	1	2	1	1	3	4	4	2	5			5	5	4	4	3	5	5	1
	1	1	1	1	1	1	1	1	5	5	4	1	5	1	1	1	5	1	
Mean	2.50	1.77	2.25	1.92	2.75	2.42	2.58	2.69	4.73	4.46	3.54	3.08	4.50	2.69	2.77	2.33	4.21	3.36	2.00
S Dev.	1.56	1.01	1.42	1.31	1.36	1.44	1.56	1.70	0.80	1.05	0.88	1.26	0.94	1.49	1.54	1.30	1.25	1.34	1.05
Var.	2.42	1.03	2.02	1.72	1.84	2.06	2.45	2.90	0.64	1.10	0.77	1.58	0.88	2.23	2.38	1.70	1.57	1.79	1.11

THE VALUES BELOW ARE THE PROBABILITY ASSOCIATED WITH A STUDENTS' T-TEST FOR TWO SAMPLES.

	C	D	E	F	G	H	I	J		L	M	N	O	P	Q	R	S	T
B	0.06525	0.32774	0.14095	0.32359	0.44125	0.44393	0.37699	6E-05	K	0.01154	0.00166	0.46041	0.00084	0.00148	7.2E-05	0.28944	0.01004	1.9E-06
C		0.16827	0.37621	0.02553	0.10235	0.06842	0.0544	7.9E-09	L		0.12696	0.00526	0.04278	0.06233	0.00659	0.05606	0.33295	0.00023
D			0.27836	0.19388	0.38916	0.29525	0.23341	2.7E-05	M			0.00163	0.24217	0.29071	0.06026	0.01287	0.28679	0.00732
E				0.07016	0.19207	0.13522	0.09576	2.4E-06	N				0.00065	0.00114	5.6E-05	0.26058	0.00766	5.6E-06
F					0.28296	0.39152	0.46114	0.00016	O					0.44904	0.25749	0.00423	0.11711	0.07607
G						0.39437	0.32666	6.4E-05	P						0.21819	0.00862	0.14955	0.05887
H							0.43174	0.00027	Q							0.00048	0.02747	0.21215
I								0.00053	R								0.04582	1.2E-05
J									S									0.00201

WHEN P≤0.05 WE ARE AT LEAST 95% CONFIDENT THAT THERE IS A SIGNIFICANT DIFFERENCE IN THE MEANS

	Visual Signs		Maps		Talking Signs		Video Maps		Drivar Ann'ts	1/1 w untrain Guide			Repetition		Video Tapes		Real Time on Bus		Computer Games
	Printed Schedulas			Tactile Maps		Auditory Maps		Customer Service	1/1 w/ train Guide		Group Training			Audio Tapes		Print	Simulated Bus Trips		
	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Travelling On Vehicle																			
Comprehend Driver Announcements																			
	1	1	1	1	1	1	1	1	5	5	4	1	5	1	1	1	5	1	3
	2	4	1	1	4	1	4	3	5	5	1	5	5	4	4	1	5	4	
										5							5		2
										5	5	4	5	2	3	1	4	3	
					3			5	4	5	3	2	5	2	2	1	5	2	2
	4	2	2	2	3	2	2	3	5	5	5		5	2	2	2	3	3	1
	1	1	3	4	2	3	2	4	5	2	2	4	2	4	3	2	4	4	2
	1	1	1	1	1	1	1	2	5	5	4	3	5	1	1	1	4	3	
										5			5						5
	1	3	3	1	1	1	1	4	5	5	3	3	5	4	3	2	5	4	1
	1	1	1	1	1	1	1	5	5	5	5		5	1	5	1	5	5	
									5	5	5	5	5				5	5	2
	4	4	3	2	2	2	3	5	5	5	4	3	5	2	3	4	5	4	
	5					5	5		5	5	4		5				5	4	2
	1	1	1	1	1	1	1	2	3	3	2	2	1	1	1	1	3	3	1
	1	1	1	1	1	1	1	5	5	3	3	3	5	1	1	1	5	2	2
	1	1	1	1	5	5	5	3	5	5	3	2	5	5	5	2	5	5	
Mean	1.92	1.62	1.64	1.45	2.08	2.00	2.25	3.50	4.79	4.59	3.53	3.08	4.58	2.31	2.62	1.54	4.56	3.47	2.09
S. Dev.	1.51	1.25	0.92	0.93	1.38	1.54	1.60	1.38	0.58	0.94	1.25	1.24	1.21	1.44	1.45	0.88	0.73	1.19	1.14
Var.	2.27	1.56	0.85	0.87	1.90	2.36	2.57	1.91	0.34	0.88	1.55	1.54	1.46	2.06	2.09	0.77	0.53	1.41	1.29

THE VALUES BELOW ARE THE PROBABILITY ASSOCIATED WITH A STUDENTS' T-TEST FOR TWO SAMPLES.

	C	D	E	F	G	H	I	J		L	M	N	O	P	Q	R	S	T
B	0.42421	0.266	0.16438	0.37548	0.44724	0.30235	0.00258	1.3E-05	K	0.00624	0.001	0.47308	3.9E-05	0.00019	4.3E-10	0.46499	0.00329	4.3E-06
C		0.35131	0.22474	0.31502	0.36519	0.21921	0.00239	2.9E-06	L		0.16837	0.01334	0.0112	0.04045	1.3E-05	0.00529	0.44091	3.3E-05
D			0.32565	0.18125	0.21644	0.11001	0.00038	2.2E-06	M			0.00207	0.06847	0.1656	0.00041	0.00085	0.20506	0.00451
E				0.10316	0.12262	0.05883	0.00016	1.2E-08	N				7.3E-05	0.00036	1E-06	0.5	0.00815	8.2E-06
F					0.43825	0.38353	0.00988	8.5E-08	O					0.29562	0.05757	4.1E-05	0.01355	0.26112
G						0.35016	0.00433	2.1E-05	P						0.01836	0.00019	0.04873	0.05332
H							0.01611	7.8E-05	Q							3.6E-10	1.2E-05	0.01386
I								0.00482	R								0.00264	1.9E-09
J									S									0.00016

WHEN P≤0.05 WE ARE AT LEAST 95% CONFIDENT THAT THERE IS A SIGNIFICANT DIFFERENCE IN THE MEANS

	Visual Signs		Maps		Talking Signs		Video Maps		Driver Ann'ts	1/1 w untrain Guide		Repetition		Video Tapes		Real Time on Bus		Computer Games
	Printed	Schedules		Tactile Maps		Auditory Maps		Customer	Service	1/1 w/ train Guide		Group Training		Audio Tapes		Print	Simulated Bus	Trips
	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Travelling On Vehicle																			
Comprehend Automated Announcements																			
	1	1	1	1	5	5	5	3	5	5	3	2	5	4	4	2	5	5	1
	1	1	1	1	1	1	1	5	5	3	3	3	5	1	1	1	5	2	1
	1	1	1	1	1	1	2	2	2	2	1	1	1	1	1	2	3	2	
	5					5				5	4		5	5			5	4	2
	4	1	1	1	5	2	1	5	2	4	4	3	4	4	1	2	5	5	
	4						5			5	5	5	5		5		5	5	1
	5	5	5	5	5	5	5	5	3	5	5	5	5	5	5	5	5	5	4
	4	3	3	4	5	4	3	4	4	4	3	5	5	4	2	2	3	4	
										5	4						5		2
	1.5	1	1	1	1	1	2	4	4	5	4	3	5	2	2	1	5	4	1
	4	2	3	3	3	2	2	4	5	3	2	4	3	3	4	3	4	4	1
	5	1	1	1	2	1	2	3	5	2	2	2	4	2	3	3	2	2	
					5			5		5	3	2	5	2	2	1	5	2	2
										5	5	4	5	3	3	1	4	3	
								4		5							5		2
	1	1	1	1	3	1	5	5	5	1	3	5	5	4	4	2	5	5	1
	1	1	1	1	1	1	1	1	5	2.5	1	1	5	1	1	1	5	1	
Mean	2.88	1.64	1.73	1.82	3.08	2.42	2.83	3.85	4.09	3.91	3.25	3.21	4.47	2.93	2.71	2.00	4.47	3.53	1.84
S. Dev.	1.78	1.29	1.35	1.47	1.83	1.76	1.70	1.26	1.22	1.37	1.29	1.48	1.13	1.44	1.49	1.15	0.94	1.41	0.92
Ver.	3.17	1.85	1.82	2.16	3.38	3.17	2.88	1.64	1.49	1.88	1.87	2.16	1.27	2.07	2.22	1.33	0.89	1.98	0.85

THE VALUES BELOW ARE THE THE PROBABILITITY ASSOCIATED WITH A STUDENTS' T-TEST FOR TWO SAMPLES.

	C	D	E	F	G	H	I	J		L	M	N	O	P	Q	R	S	T
B	0.02439	0.03581	0.05382	0.38601	0.25751	0.47004	0.0526	0.02581	K	0.07963	0.08884	0.10431	0.02887	0.01288	9.5E-05	0.0886	0.22024	2.2E-06
C		0.43655	0.38043	0.01876	0.1052	0.02882	0.00017	8.9E-05	L		0.4721	0.0043	0.25753	0.15071	0.004	0.00228	0.28131	6.8E-05
D			0.44071	0.02417	0.13784	0.0416	0.00035	0.00017	M			0.00852	0.29099	0.19035	0.01029	0.00571	0.2782	0.00022
E				0.03843	0.18048	0.08194	0.00088	0.00042	N				0.00189	0.00078	2.7E-08	0.49578	0.02755	8.3E-08
F					0.15968	0.35743	0.12272	0.08087	O					0.33717	0.03131	0.00113	0.12733	0.00191
G						0.26304	0.01085	0.00509	P						0.0755	0.00047	0.08992	0.00922
H							0.04436	0.02151	Q							1E-08	0.00161	0.18188
I								0.31577	R								0.01911	1.7E-07
J									S									2.2E-05

WHEN P≤0.05 WE ARE AT LEAST 95% CONFIDENT THAT THERE IS A SIGNIFICANT DIFFERENCE IN THE MEANS

TRAVELLING ON THE VEHICLE

	C	D	E	F	G	H	I	J		L	M	N	O	P	Q	R	S	T
B	0.00842	0.00289	0.00143	0.13384	0.16871	0.33516	0.00026	2.1E-12	K	6.3E-08	3.9E-07	0.2295	4.9E-10	2.5E-10	8.9E-17	0.37598	6.4E-05	1.4E-19
C		0.3891	0.29883	0.00028	0.09029	0.00258	6.8E-09	5.8E-20	L		0.13026	3.4E-07	0.00259	0.00188	7.9E-08	1E-08	0.38438	1.3E-13
D			0.40132	0.00011	0.05573	0.00119	1.2E-09	1.2E-20	M			3.9E-08	0.04544	0.04087	4.2E-05	1E-07	0.09714	9.8E-09
E				5.4E-05	0.03583	0.00084	5.5E-10	9.9E-21	N				4.3E-11	2.2E-11	7.2E-18	0.32559	6.8E-08	1.1E-20
F					0.02045	0.25391	0.01205	1.3E-09	O					0.46212	0.01335	1.1E-10	0.0021	0.00033
G						0.08853	8.8E-06	6.9E-14	P						0.01783	5.9E-11	0.00149	0.00043
H							0.00139	5.7E-11	Q							1.8E-17	1.1E-07	0.24352
I								3.3E-05	R								2.4E-05	1.3E-25
J									S									2.8E-12
Mean	2.50	1.83	1.76	1.70	2.82	2.21	2.63	3.49	4.49	4.29	3.36	3.09	4.44	2.88	2.63	2.06	4.35	3.42	1.95

	Visual Signs		Maps		Talking Signs		Video Maps		Driver Ann'ts	1/1 w untrain Guide		Repetition		Video Tapes		Real Time on Bus		Computer Games
	Printed Schedules		Tactile Maps		Auditory Maps		Customer Service		1/1 w/ train Guide	Group Training		Audio Tapes			Print	Simulated Bus Trips		
	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Departing The Vehicle																			
Identify The Desired Stop/Station/Terminal																			
	1	1	1	1	1	1	1	1	1	5	4	1	5	1	1	1	5	1	
	5	5	5	2	1	1	2	2	5	5	3	2	5	3	4	3	5	4	
									5										1
	3	1	2	2	4	2	4	3	5	5	5	4	5	1	2	1	4	3	
	3	2	2	2		3	2	5	5	5	3	2	5	2	2	1	5	2	2
	5	3	3	1	3	4	3	3	4	4	3	2	2	2	2	4	3	3	1
	5	3	3	2	4	3	3	4	5	4	3	4	4	3	4	4	2	4	3
	5	1	2	2	3	2	2	4	5	5	4	3	5	2	2	1	5	4	
	5				5				5	5	4		5				5		3
	5	4	4	4	5	3	1	1	5	5	3	4	4	1	5	3	4	3	1
	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	
	4				4				5	5	5	5	5				5	5	2
	5	5	3	2	4	3	3	5	5	5	4	3	5	2	3	5	5	5	
	5					5				5	5		5				5	4	2
	1	2	2	2	3	3	1	2	2	2	1	1	1	2	1	2	3	2	1
	1	1	5	5	1	5	1	5	5	3	3	3	5	1	1	1	5	2	2
	5	2	2	3	5	5	5	3	5	5	3	2	5	4	4	2	5	5	
Mean	3.94	2.69	3.00	2.54	3.43	3.21	2.54	3.31	4.50	4.58	3.63	2.93	4.44	2.23	2.77	2.54	4.44	3.47	1.80
S. Dev.	1.61	1.60	1.35	1.33	1.50	1.42	1.45	1.49	1.21	0.69	1.09	1.33	1.21	1.24	1.46	1.56	0.96	1.30	0.79
Var.	2.60	2.58	1.83	1.77	2.26	2.03	2.10	2.23	1.47	0.60	1.18	1.76	1.46	1.53	2.19	2.44	0.93	1.70	0.62

THE VALUES BELOW ARE THE THE PROBABILITY ASSOCIATED WITH A STUDENTS' T-TEST FOR TWO SAMPLES.

	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
B		0.02266	0.0476	0.00743	0.18836	0.09955	0.00958	0.13943	0.13421	K	0.00822	0.00037	0.37093	5.4E-06	0.00055	0.00029	0.35306	0.00567	8.9E-09
C			0.30089	0.39611	0.10953	0.18443	0.39976	0.16054	0.00136	L		0.0822	0.02748	0.00148	0.04385	0.02036	0.01652	0.35832	6.6E-06
D				0.19466	0.2132	0.34133	0.20495	0.29362	0.00226	M			0.00155	0.07463	0.36115	0.23806	0.00087	0.13975	0.00105
E					0.05266	0.09995	0.5	0.08922	0.00018	N				2.5E-05	0.00159	0.00075	0.5	0.01993	1.2E-07
F						0.34265	0.08016	0.4135	0.02131	O					0.16216	0.29135	1.2E-05	0.00886	0.05074
G							0.11032	0.43288	0.0051	P						0.35116	0.00106	0.09584	0.00675
H								0.09764	0.00034	Q							0.00054	0.04659	0.01451
I									0.01429	R								0.01321	2.2E-06
J										S									4.6E-06

WHEN P≤0.05 WE ARE AT LEAST 95% CONFIDENT THAT THERE IS A SIGNIFICANT DIFFERENCE IN THE MEANS

	Visual Signs		Maps		Talking Signs		Video Maps		Driver Ann'ts	1/1 w untrain Guide		Repetition		Video Tapes		Real Time on Bus		Computer Games
	Printed Schedules		Tactile Maps		Auditory Maps		Customer Service		1/1 w/ train Guide	Group Treining		Audio Tapes		Print		Simulated Bus Trips		
	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Departing The Vehicle																			
Notify Driver Of Desired to Stop																			
	5	1	1	1	1	5	5	3	5	5	3	2	5	4	4	2	5	5	2
	1	1	1	1	1	1	3	1	1	3	3	3	5	1	3	1	5	2	1
	1	1	1	1	1	1	1	1	2	2	2	2	2	1	1	2	2	2	2
	5								5	5	4		5				5	4	
	4	1	1	1	3	1	3	4	4	5	4	3	5	2	3	2	5	5	3
	5						4		5	5	5	5	5		4	4	5	5	
	1	1	1	1	1	1	1	5	5	5	5	5	5	5	5	5	5	5	1
	4	1	3	2	1	1	1	1	4	5	4	4	2	1	1	2	5	5	4
										5	4	4	5				5		
	1	1	1	1	1	1	3	1	1	5	4	3	5	2	3	1	5	4	3
	4	1	1	1	1	1	1	4	5	4	3	4	2	2	2	2	5	4	1
	3	3	2	1	2	1	1	2	3	3	3	3	2	2	2	3	3	3	2
	3	2	2	2		3	2	5	5	5	3	2	5	2	2	1	5	2	
	3	1	2	2	3	2	1	1	5	5	5	4	5	2	3	1	4	4	1
										5									
	2	2	3	1	1	3	5	3	5	5	5	1	5	2	4	3	5	2	
	1	1	1	1	1	1	1	1	1	5	4	1	5	1	1	1	5	1	1
Mean	2.67	1.31	1.54	1.23	1.42	1.69	2.29	2.46	3.73	4.53	3.81	3.07	4.25	2.06	2.71	2.14	4.63	3.53	1.91
S. Dev.	1.60	0.83	0.78	0.44	0.79	1.25	1.54	1.61	1.67	0.94	0.91	1.26	1.34	1.19	1.27	1.23	0.89	1.41	1.04
Var.	2.55	0.40	0.60	0.19	0.63	1.56	2.37	2.60	2.78	0.69	0.83	1.64	1.80	1.41	1.60	1.52	0.76	1.96	1.09

THE VALUES BELOW ARE THE THE PROBABILITIY ASSOCIATED WITH A STUDENTS' T-TEST FOR TWO SAMPLES.

	C	D	E	F	G	H	I	J		L	M	N	O	P	Q	R	S	T
B	0.00041	0.00208	0.00021	0.00116	0.01297	0.15609	0.24277	0.07862	K	0.01656	0.00059	0.24811	1.6E-06	6.4E-05	1.6E-06	0.3825	0.01432	7.6E-07
C		0.20898	0.36076	0.35192	0.16771	0.01753	0.01459	1.7E-05	L		0.03735	0.14512	0.00012	0.00844	0.00017	0.00789	0.28057	3.6E-05
D			0.11427	0.34996	0.35512	0.05503	0.04007	5.9E-05	M			0.00862	0.01719	0.22934	0.02765	0.00031	0.17258	0.00446
E				0.23569	0.11429	0.01043	0.00954	1.2E-05	N				3.6E-05	0.00149	5E-05	0.17984	0.07813	1.1E-05
F					0.25031	0.03456	0.01742	2.6E-05	O					0.09026	0.44169	9.6E-07	0.00266	0.35806
G						0.13376	0.09362	0.00041	P						0.11853	4.6E-05	0.055	0.04
H							0.38499	0.01036	Q							1E-06	0.00422	0.29225
I								0.0234	R								0.00852	4.8E-07
J									S									0.00065

WHEN P≤0.05 WE ARE AT LEAST 95% CONFIDENT THAT THERE IS A SIGNIFICANT DIFFERENCE IN THE MEANS

DEPARTING THE VEHICLE

	C	D	E	F	G	H	I	J		L	M	N	O	P	Q	R	S	T
B	0.00031	0.00192	4.6E-05	0.01677	0.01297	0.00741	0.10344	0.03908	K	0.00041	6.4E-07	0.23107	2.7E-11	1.9E-07	3.8E-09	0.47497	0.00034	3.7E-14
C		0.23772	0.37382	0.10636	0.11075	0.14949	0.0165	2.7E-07	L		0.00869	0.01588	7.3E-07	0.00132	3.2E-05	0.00058	0.23424	1.1E-09
D			0.13577	0.27646	0.26908	0.35827	0.08682	2.2E-06	M			5.6E-05	0.00496	0.22662	0.03076	1.1E-08	0.07211	2.6E-05
E				0.05106	0.0526	0.07884	0.00849	1.3E-06	N				3.2E-09	6.3E-06	1.7E-07	0.24931	0.00639	7.5E-12
F					0.46162	0.4088	0.17484	9E-05	O					0.04777	0.30457	3.7E-11	7.1E-05	0.12699
G						0.4256	0.16915	3E-05	P						0.13929	2.4E-07	0.01751	0.00143
H							0.12654	1.9E-05	Q							4.9E-09	0.00094	0.03922
I								0.00164	R								0.00044	5E-14
J									S									6.2E-06
Mean	3.42	2.00	2.27	1.66	2.50	2.46	2.41	2.66	4.13	4.56	3.72	3.00	4.34	2.15	2.74	2.33	4.53	3.50	1.66

	Visual Signs		Maps		Talking Signs		Video Maps		Driver Ann'ts	1/1 w untrain Guide		Repetition		Video Tapes		Real Time on Bus		Computer Games
	Printed Schedules		Tectile Maps		Auditory Maps		Customer Service		1/1 w/ train Guide	Group Training		Audio Tapes		Print		Simulated Bus Trips		
	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Exiting The Station/Terminal																			
Determine Desired Exit Direction																			
	1	1	1	1	1	1	1	1	1	5	4	1	5	1	1	1	5	1	1
	4	2	4	4	5	5	5	3	5	5	5	5	5	5	5	2	5	5	
	4	1	2	2	3	2	1	5	3	5	5	4	5	1	2	1	4	3	1
	4		2	1	4	4	3	5	1	5	3	2	5	1	1	1	5	1	
	5		3	3	3	2	2	4	3	3	2	2	3	2	2	3	2	2	1
	5	2	2	2	4	1	2	2	4	5	3	4	4	4	2	3	5	4	1
	2	1	1	1	1	1	2	1	2	5	4	3	5	1	2	1	5	4	2
	4		4	4	4	3				5	4	3	5				5		
	5	1	4	4	4	4	2	1	5	5	3	4	3	1	3	2	5	4	4
	5	1	1	1	5	5	5	5	5	5	5	5	5	5	5	5	5	5	1
	5				5				5	5	5	5	5		3	3	5	5	
	5	2	3	2	4	3	2	5	1	5	4	2	5	2	2	5	5	5	2
	5							5		5	4		5				5	4	
	1	1	1	1	1	1	1	1	2	2	2	2	2	1	1	1	2	2	2
	5	1	5	5	5	5	1	5	5	3	3	3	5	2	1	5	5	2	1
	5	1	3	3	5	2	4	3	5	5	3	2	5	4	5	2	5	5	2
Mean	4.06	1.27	2.57	2.43	3.60	2.79	2.36	3.29	3.36	4.56	3.69	3.13	4.50	2.31	2.50	2.50	4.56	3.47	1.64
S. Dev.	1.44	0.47	1.34	1.40	1.50	1.56	1.45	1.77	1.69	0.96	1.01	1.30	0.97	1.60	1.51	1.56	1.03	1.51	0.92
Var.	2.06	0.22	1.80	1.96	2.26	2.49	2.09	3.14	2.66	0.93	1.03	1.70	0.93	2.56	2.27	2.42	1.06	2.27	0.65

THE VALUES BELOW ARE THE THE PROBABILITITY ASSOCIATED WITH A STUDENTS' T-TEST FOR TWO SAMPLES.

EXITING THE STATION/TERMINAL

	C	D	E	F	G	H	I	J		L	M	N	O	P	Q	R	S	T
B	1.7E-07	0.00297	0.00174	0.19269	0.01376	0.00204	0.1005	0.11525	K	0.00904	0.00094	0.42794	0.00013	0.00012	0.00016	0.5	0.01234	2.6E-06
C		0.00124	0.00276	7.9E-06	0.00145	0.00926	0.00023	7.3E-05	L		0.0995	0.01366	0.00659	0.01014	0.01162	0.01089	0.31906	4.6E-06
D			0.39247	0.02699	0.35097	0.36316	0.11141	0.0644	M			0.00136	0.07066	0.11906	0.12363	0.00112	0.26043	0.00041
E				0.01767	0.26591	0.46763	0.07553	0.05546	N				0.00016	0.00016	0.00021	0.43037	0.01657	4E-08
F					0.08055	0.01797	0.29956	0.34326	O					0.37531	0.3771	0.00014	0.02636	0.06231
G						0.24639	0.21411	0.17716	P						0.5	0.00013	0.04746	0.03037
H							0.07531	0.05647	Q							0.00017	0.05025	0.04452
I								0.45536	R								0.01346	3.4E-06
J									S									0.00011

WHEN P≤0.05 WE ARE AT LEAST 95% CONFIDENT THAT THERE IS A SIGNIFICANT DIFFERENCE IN THE MEANS

	Visual Signs		Maps		Talking Signs		Video Maps		Driver Ann'ts	1/1 w untrain Guide		Repetition		Video Tapes		Reel Time on Bus		Computer Games
	Printed Schedules		Tactile Maps		Auditory Maps		Customer Service		1/1 w/ train Guide	Group Training		Audio Tapes		Print		Simulated Bus Trips		
	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Emergencies																			
Route Deviations																			
	5	1	5	5	1	5	1	5	5	2	1	1	1	2	2	2	2	2	2
	1	1	1	1	2	1	2	2	2	5	4		5				3	5	
	5				5			5	5	3	3	1	1	1	1	5	3	5	3
	5	2	3	1	3	2	2	5	4	5	5	5	5		4		5	5	
	5		4		4			5	5	5	5	5	5	5	5	5	5	5	
	5	1	1	1	5	1	1	5	5	3	2	5	3	1	2	2	4	4	2
	2	1	3	3	3	3	1	5	5	5			5				5		
										4	3	2	4	1	2	1	5	4	2
	1	1	1	1	1	1	1	2.5	4	3	2	4	4	4	2	4	4	3	1
	5	3	3	2	3	3	2	4	5	1	1		3				2	2	1
	1	1	1	1	1	1	1	4	4	5	3		5				5	1	
								5	5	5	5	4	5	1	2	1	3	2	2
	2	1	2	2	3	2	2	5	5										
										5	1	1	1	1	4	1	2	5	
	1	1	3	1	5	4	5	2	5	5	4		5				5		
Mean	3.17	1.30	2.45	1.80	3.00	2.30	1.80	4.19	4.54	4.00	3.00	3.11	3.71	2.00	2.67	2.63	3.79	3.58	1.86
S. Dev.	1.95	0.67	1.37	1.32	1.54	1.42	1.23	1.22	0.88	1.38	1.53	1.83	1.84	1.60	1.32	1.77	1.25	1.51	0.69
Var.	3.79	0.46	1.87	1.73	2.36	2.01	1.51	1.48	0.77	1.85	2.33	3.38	2.88	2.57	1.76	3.13	1.57	2.27	0.48

THE VALUES BELOW ARE THE THE PROBABILITITY ASSOCIATED WITH A STUDENTS' T-TEST FOR TWO SAMPLES.

	C	D	E	F	G	H	I	J		L	M	N	O	P	Q	R	S	T
B	0.00226	0.16321	0.02815	0.4091	0.10938	0.02358	0.06662	0.02018	K	0.04159	0.10282	0.30987	0.00481	0.01019	0.03473	0.33393	0.23098	2.2E-05
C		0.00947	0.15202	0.00082	0.03273	0.13927	1.6E-07	8.9E-10	L		0.43958	0.12314	0.07805	0.28811	0.30419	0.07875	0.17117	0.00517
D			0.13158	0.17904	0.39837	0.12328	0.00178	0.00023	M			0.20956	0.09347	0.2822	0.28699	0.16583	0.25347	0.01591
E				0.02537	0.21231	0.5	0.00012	2.3E-05	N				0.0128	0.04586	0.08072	0.44894	0.4148	0.00011
F					0.12892	0.02182	0.02162	0.00382	O					0.17933	0.23562	0.00828	0.01582	0.37584
G						0.2054	0.00155	0.0003	P						0.47825	0.02335	0.05684	0.01741
H							7E-05	1.1E-05	Q							0.0584	0.09792	0.09373
I								0.2072	R								0.35411	2.8E-05
J									S									0.00017

WHEN P≤0.05 WE ARE AT LEAST 95% CONFIDENT THAT THERE IS A SIGNIFICANT DIFFERENCE IN THE MEANS

	Visual Signs		Maps		Talking Signs		Video Maps		Driver Ann'ts	1/1 w untrain Guide		Repetition		Video Tapes		Real Time on Bus		Computer Games
	Printed Schedules		Tactile Maps		Auditory Maps		Customer	Service	1/1 w/ train Guide		Group Training		Audio Tapes		Print	Simulated Bus		Trips
	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Emergencies																			
Cancelled Routes																			
	5	5	5	2	5	5	2	5	1	5	1	1	1	4	1	5	5	5	
								5											
	5	2	2	2	4	2	1	5	5	5	5	4	5	1	1	2	1	1	1
								5	5	5	3	1					5		
	4	4	2	2	2	2	3	4	3	3	3	2	3	2	2	2	3	3	2
	5	2	3	1	4	1	1	4	5	1	1	1	1	5	5	5	5	3	1
	2.5	1	1	1	2.5	1	2	5	5	4	3	2	4	2	1	1	5	4	2
	5				5			5	2.5	5	4						5		
	4	2	4	2	4	4	1	5	1	5	2	4	3	1	1	4	3	5	5
	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	1	5	1
	4				5			5	5	5	5	5	5		4		5	5	
	5	3	3	2	2	1	1	5	5	3	3	1	2	1	1	5	3	4	3
	5							5	5	5	4		5				3	5	
	1	2	1	1	2	1			3	2	2	1	1	1	1	1	2	2	2
	5	5	1	1	5	1	1	5	5	3	3	3	5	1	1	5	5	2	1
								5	5										
Mean	4.27	3.10	2.70	1.90	3.79	2.30	1.89	4.87	4.03	4.00	3.14	2.50	3.33	2.30	2.09	3.50	3.64	3.67	2.00
S. Dev.	1.24	1.52	1.57	1.20	1.30	1.70	1.36	0.35	1.52	1.36	1.35	1.62	1.72	1.70	1.70	1.78	1.55	1.44	1.32
Var.	1.53	2.32	2.46	1.43	1.70	2.90	1.86	0.12	2.30	1.85	1.82	2.64	2.97	2.90	2.89	3.17	2.40	2.08	1.75

THE VALUES BELOW ARE THE THE PROBABILITITY ASSOCIATED WITH A STUDENTS' T-TEST FOR TWO SAMPLES.

	C	D	E	F	G	H	I	J		L	M	N	O	P	Q	R	S	T
B	0.03109	0.00894	7.2E-05	0.17755	0.00346	0.00027	0.01174	0.32435	K	0.05306	0.00891	0.14244	0.00822	0.00306	0.22786	0.26125	0.27196	0.00108
C		0.26499	0.03339	0.1299	0.14151	0.04041	0.00214	0.0678	L		0.14199	0.37923	0.09929	0.05342	0.29466	0.16583	0.17364	0.0226
D			0.10846	0.04449	0.29571	0.11391	0.00053	0.02107	M			0.10832	0.384	0.27789	0.08202	0.03819	0.03262	0.199
E				0.00078	0.27594	0.49253	8.6E-08	0.00024	N				0.07936	0.0452	0.41007	0.31447	0.30596	0.01952
F					0.01671	0.00178	0.00496	0.32653	O					0.38751	0.07041	0.02604	0.02695	0.33081
G						0.27999	0.00038	0.00787	P						0.03627	0.01271	0.01255	0.44456
H							7.4E-05	0.00081	Q							0.41749	0.40462	0.02321
I								0.02592	R								0.46347	0.005
J									S									0.0048

WHEN P≤0.05 WE ARE AT LEAST 95% CONFIDENT THAT THERE IS A SIGNIFICANT DIFFERENCE IN THE MEANS

	Visual Signs		Maps		Talking Signs		Video Maps		Driver Ann'ts	1/1 w untrain Guide		Repetition		Video Tapes		Real Time on Bus		Computer Games	
	Printed	Schedules	Tactile Maps		Auditory Maps		Customer Service		1/1 w/ train Guide	Group Training		Audio Tapes			Print	Simulated Bus Trips			
	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Emergencies																			
Weather Conditions - Snow/Fog																			
	5	5	3	1	5	4	5	5	2	5	3	1	2	4	2	5	2	5	
	5	1	1	4	5	2	2	5	5	5	3	2	5	2	2	2	5	5	2
	5	1	5	5	5	5	1	5	5	3	3	3	5	5	1	5	5	2	1
	1	1	1	1	2	1	1	3	3	1	1	1	1	1	1	2	3	3	2
	5					5				5	4		5				3	5	
	3	1	1	1	1	1	3	5	5	3	3	1	1	3	3	4	2	4	3
	5				5			5	5	5	5	5	5		4		5	5	
	3	1	1	1	1	1	1	5	5	5	5	5	5	1	1	5	5	5	1
	4	1	1	1	4	1	1	5	5	2	2	4	3	2	2	2	4	4	4
	5				5			5	3	4	3						5		
	2	2	1.5	1	1	1	1	5	5	5	4	3	5	2	1	1	5	4	2
	5	3	3	3	4	2		4	5	3	2	4	3	4	4	4	4	3	1
	4	1		1			1	1	1										
	5							5	5	5	3	5					5		
	4	2	2	2	4	2	2	5	5	5	5	4	5	1	2	1	3	3	1
Mean	4.07	1.73	1.95	1.91	3.50	2.27	1.80	4.50	4.21	4.00	3.29	3.17	3.75	2.50	2.09	3.10	4.00	4.00	1.89
S. Dev.	1.26	1.27	1.34	1.45	1.73	1.62	1.32	1.16	1.37	1.36	1.20	1.59	1.66	1.43	1.14	1.86	1.16	1.04	1.05
Ver.	1.64	1.62	1.80	2.09	3.00	2.62	1.73	1.35	1.87	1.85	1.45	2.52	2.75	2.06	1.29	2.77	1.38	1.09	1.11

THE VALUES BELOW ARE THE THE PROBABILITY ASSOCIATED WITH A STUDENTS' T-TEST FOR TWO SAMPLES.

	C	D	E	F	G	H	I	J		L	M	N	O	P	Q	R	S	T
B	5.3E-05	0.00039	0.00034	0.17532	0.00313	0.00017	0.1713	0.3825	K	0.0766	0.08242	0.33963	0.00816	0.00036	0.08466	0.5	0.5	0.00016
C		0.34972	0.37674	0.00379	0.17055	0.44639	7.1E-06	4.2E-05	L		0.41641	0.21495	0.06173	0.00886	0.38075	0.08227	0.0588	0.00336
D			0.47328	0.0115	0.29607	0.39912	6.5E-05	0.00017	M			0.18364	0.14155	0.03196	0.46033	0.0714	0.06189	0.00943
E				0.00995	0.2737	0.42809	5.5E-05	0.00024	N				0.03276	0.0048	0.18054	0.33107	0.33164	0.00163
F					0.03084	0.00606	0.03966	0.11305	O					0.22933	0.19959	0.00628	0.0063	0.1417
G						0.21243	0.00012	0.00044	P						0.05746	0.00017	0.00019	0.33183
H							2.9E-05	0.00012	Q							0.07623	0.07607	0.03034
I								0.27631	R								0.5	6.1E-05
J									S									9.7E-05

WHEN P≤0.05 WE ARE AT LEAST 95% CONFIDENT THAT THERE IS A SIGNIFICANT DIFFERENCE IN THE MEANS

EMERGENCIES

	C	D	E	F	G	H	I	J		L	M	N	O	P	Q	R	S	T
B	5.2E-07	2.4E-05	2.5E-06	0.10905	2.2E-05	9.9E-09	0.0084	0.10758	K	0.00217	0.00107	0.11955	3.4E-06	2.3E-07	0.00943	0.25465	0.19968	2.1E-10
C		0.1699	0.31921	6.2E-05	0.23851	0.27576	1.1E-11	9E-10	L		0.24845	0.08725	0.00753	0.00341	0.45793	0.01215	0.02432	2.5E-05
D			0.07199	0.00159	0.4117	0.05549	4E-10	4.3E-08	M			0.0319	0.05444	0.04166	0.31455	0.00526	0.0071	0.00082
E				5.5E-08	0.11562	0.44706	8.3E-14	1.5E-11	N				0.00045	0.00015	0.11053	0.26824	0.33602	2.3E-07
F					0.00091	3.4E-06	0.00012	0.00516	O					0.47034	0.03191	2.2E-05	4.5E-05	0.13381
G						0.09291	3.1E-10	2.5E-08	P						0.0184	2.4E-06	6.7E-06	0.12016
H							1.7E-13	1.4E-11	Q							0.03076	0.04444	0.0008
I								0.12657	R								0.41902	1.4E-09
J									S									5.7E-09
Mean	3.86	2.03	2.37	1.67	3.43	2.29	1.63	4.54	4.25	4.00	3.15	2.91	3.61	2.29	2.26	3.11	3.61	3.75	1.92

	Visual Signs		Maps		Talking Signs		Video Maps		Drivar Ann'ls	1/1 w untrain Guide		Repetition		Video Tapes		Real Time on Bus		Computer Games
	Printed	Schedules		Tactile Maps		Auditory Maps		Customer	Service	1/1 w/ train Guide		Group Training		Audio Tapes		Print	Simulated Bus	Trips
	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Overall Totals																			
Mean	3.67	2.20	2.20	1.96	3.21	2.37	2.38	3.88	4.15	4.31	3.38	3.09	4.34	2.40	2.55	2.68	4.18	3.38	1.90
S. Dev.	1.58	1.47	1.33	1.27	1.53	1.49	1.40	1.38	1.32	1.14	1.17	1.32	1.17	1.39	1.39	1.55	1.25	1.41	1.06
Variance	2.51	2.17	1.77	1.61	2.34	2.21	1.97	1.91	1.74	1.30	1.37	1.75	1.38	1.93	1.94	2.39	1.59	1.98	1.13
size=	288	241	233	233	259	239	241	270	280	304	287	264	290	243	251	244	295	281	216
	720.5	521.037	409.97	372.852	604.357	525.598	473.311	514.575	485.799	392.493	393.2	450.995	393.517	468.074	484.223	581.066	458.627	554.258	242.958
GENERAL OVERALL																			
sp^2=	1.83551	df=	4,940																
sum	1,056	531	513	457	833	566	588	1,049	1,163	1,310	988	815	1,260	582	639	554	1,228	950	411
count	288	241	233	233	259	239	241	270	280	304	287	264	290	243	251	244	295	281	216
mean(Y)=		3.13491																	
n*(Y1-Y)^2																			
	81.4375	209.153	203.841	320.883	1.83199	140.493	145.895	151.239	289.532	418.04	15.0778	0.50282	424.534	133.011	87.1038	50.4205	307.536	18.988	327.918
sb^2=	184.741	df=	18																
f=	100.85																		
p=	0.0000																		
F-MEDIA										F-Training Format									
sp^2=	2.0342	df=	2,275							sp^2=	1.71343	df=	2,382						
sb^2=	171.567	df=	9							sb^2=	151.488	df=	9						
f=	84.34									f=	88.40								
p=	.0000									p=	0.00								

There is a significant difference between at least one of the means.

There is a significant difference between at least one of the means.

THE VALUES BELOW ARE THE THE PROBABILITY ASSOCIATED WITH A STUDENTS' T-TEST FOR TWO SAMPLES.

Overall Media	C	D	E	F	G	H	I	J	Training	L	M	N	O	P	Q	R	S	T
B	2.7E-28	4.1E-29	7.7E-39	0.00028	2.5E-21	5.4E-23	0.0319	2.9E-05	K	9.4E-22	8.7E-29	0.34654	4.1E-53	7.3E-48	1.9E-36	0.06098	1E-17	8.2E-91
C		0.48161	0.02272	5.1E-14	0.10212	0.11499	1.8E-35	1.2E-47	L		0.00475	3.1E-22	9.2E-18	2.3E-13	5.7E-09	1.2E-14	0.4848	2E-47
D			0.02282	3.8E-15	0.07805	0.08882	1.3E-39	3.1E-52	M			3E-29	1.5E-09	2.2E-08	0.00053	2.3E-21	0.00874	3.5E-31
E				2E-22	0.0004	0.00041	2.2E-50	8.4E-65	N				2.3E-53	3.4E-48	1.3E-37	0.02965	2.5E-18	2.9E-92
F					1.9E-10	3.4E-11	3.3E-08	1.9E-14	O					0.10827	0.01473	1.3E-44	6.1E-16	1.8E-08
G						0.24238	1.2E-22	2.1E-47	P						0.14775	5.8E-39	5.7E-12	2.8E-10
H							1.4E-32	1.5E-43	Q							4.8E-30	2.8E-08	4.6E-12
I								0.01097	R								3.8E-12	6.9E-83
J									S									5.5E-33

WHEN P≤0.05 WE ARE AT LEAST 95% CONFIDENT THAT THERE IS A SIGNIFICANT DIFFERENCE IN THE MEANS

APPENDIX D

Interview List

Interview List

Jan Campbell
Disability Project Coordinator
City of Portland
Rm #516, 1120 SW 5th
Portland, OR 97204-1989

Kathe Colemen
Independent Living Services Coordinator
Suite A
2600 SE Belmont
Portland, OR 97214

Lisa Davis
Transportation Assistant
Multnomah County
Developmental Disability Program
Portland, OR 97204

Susan Gries
Case Coordinator Assistant
Pearl Buck Productive Services
4232 West 5th
Eugene, OR 97402
(503) 484-4666
Full Range of Disabilities

Sandra McCourry
Case Coordinator
Pearl Buck Productive Services
4232 West 5th
Eugene, OR 97402
(503) 484-4666
Full Range of Disabilities

Patricia Nielsen
TriMet
4012 SE 17th
Portland, OR

Mary Ann Pape
Heart of the Valley Center
Corvallis, OR 97330
Brain Injured Transit User

Karol Rourke
Instruction Aid
Specialized Employment
Lane Community College
1645 Oak
Eugene, OR 97401
(503) 726-3959
Full Range

Brian Zinsheim
Trainer
Specialized Employment
Lane Community College
30th Ave.
Eugene, OR 97405
(503) 726-3959
Mental and Physically Disabled

Greg Zwettler
Life Skills
Sheldon High School
2455 Willakenzie Rd.
Eugene, OR 97401
(503), 287-3522
EMR, Severely Learning Disabled

* U.S. G.P.O.:1994-301-717:80477

NOTICE

This document is disseminated under the sponsorship of the U.S. Department of Transportation in the interest of information exchange. The United States Government assumes no liability for its contents or use thereof.

The United States Government does not endorse manufacturers or products. Trade names appear in the document only because they are essential to the content of the report.

This report is being distributed through the U.S. Department of Transportation's Technology Sharing Program.

DOT-T-94-04

TECHNOLOGY SHARING

A Program of the U.S. Department of Transportation