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CONTENTS

FOREWORD

This RECORD contains 5 papers that examine various aspects of transportation needs of the poor, disadvantaged, and elderly and the use of public transportation in meeting those needs.

Schnell reports on a series of interviews concerning the most efficient and economical means of ensuring the availability of public transportation that the elderly and the handicapped can effectively use. He discusses the characteristics of those citizens, defines the dimensions of the problem, and focuses on the major measures already in existence or proposed for facilitating their use of urban transit. The measures include modification of the types of vehicles currently in service, use of taxis, the TRANSBUS Program, the Small Bus Program, and demand-responsive service.

Paaswell and Recker identify who and where the "carless" are and what transportation alternatives exist for them. Data from Buffalo indicate the relations among carlessness, median income, race, age, and accessibility of public transport. The authors also examine the extent of carlessness in the suburban areas and indicate that the problem of mobility among suburban households may be more severe than in the inner-city areas.

Kidder examines the ways in which social service agencies in a small city cope with the transportation problems of immobile clients. The study documents needs that are not met and capabilities that are not fully used. The author indicates that demand for services is poorly coordinated with the available supply of vehicles and suggests that consolidation of transportation services would eliminate the inefficiencies if legal and economic restraints can be removed. Interim solutions suggested by the author include exchanges among agencies of data on volunteers and vehicle availability and increased reliance on public transit modes.

Weaver and Herrin studied the transportation needs of elderly citizens residing in medium-sized cities. Basic data were collected by sampling the elderly in a city of 125,000 population. Demographic characteristics of those interviewed and the present transportation mode used (bus, taxi, or private automobile) were determined. One special phase of the study was related to the determinates of their transit system usage. Based on the findings, several recommendations are made for improving the mobility of the elderly.

Dajani and Egan report on a pilot study to evaluate the income-distribution effects of the proposed Atlanta transit system. Benefits and costs to each of 8 traffic zones are estimated. Benefits accruing to each zone as a result of savings in time, vehicle ownership and operating costs, transit fares, parking, and accidents are estimated and compared to transit fares and additional sales taxes that have to be paid by the residents of that zone. Other factors affecting the distribution of income in the Atlanta metropolitan area are also discussed.

PUBLIC TRANSPORTATION AND TRANSPORTATION NEEDS OF THE ELDERLY AND HANDICAPPED

John B. Schnell, American Public Transit Association

Section 16(a) of the Urban Mass Transportation Act of 1964, as amended, declares as national policy that urban public transportation shall be available to the elderly and handicapped and that this shall be transportation that they can effectively use. This paper reports on a series of interviews concerning the most efficient and economical means of ensuring the availability of transportation that meets that requirement. The paper discusses the characteristics of these citizens, defines the dimensions of the problem, and focuses on the major measures already in existence or proposed for facilitating their use of urban transit. Measures include modification of the types of vehicles currently in service, use of taxis, development of new vehicles in the TRANSBUS and Small Bus Programs, and demand-responsive service. In the opinions of those interviewed, the most efficient and economical means of providing transportation that the elderly and handicapped can effectively use is to centralize, and support by public subsidy, transportation in the principal urban transit systems: TRANSBUS and small bus for the ambulatory and semiambulatory and demand-responsive vehicles with attendants who would assist invalids and nonambulatory through the doors of their homes and through the doors of their destinations. Interviewees agreed that, regardless of the solution, a sustained program of education is essential to convince and remind the public and the typical rider that the needs of the elderly and handicapped deserve special attention.

•SECTION 16(a) of the Urban Mass Transportation Act of 1964, as amended, declares,

> It is . . . to be the national policy that elderly and handicapped persons have the same right as other persons to utilize mass transportation facilities and services; that special efforts shall be made in the planning and design of mass transportation facilities and services so that the availability to elderly and handicapped persons of mass transportation which they can effectively utilize will be assured; and that all federal programs offering assistance in the field of mass transportation (including the programs under this Act) should contain provisions implementing this policy.

Section 16(b) of the Act states that 1½ percent of the total funding of Urban Mass Transportation Administration programs may be set aside to assist state and local public bodies and agencies in providing public transportation facilities and services for elderly and handicapped passengers. The full text is as follows:

> In addition to the grants and loans otherwise provided for under this Act, the Secretary is authorized to make grants or loans for the specific purpose of assisting states and local public bodies and agencies thereof in providing mass transportation services which are planned, designed, and carried out so as to meet the special needs of elderly and handicapped persons. Grants and loans made under the preceding sentence shall be subject to all of the terms, conditions, requirements, and provisions applicable to grants and loans made under Section 3(a), and shall be considered for the purposes of all other laws to have been made under such section. Of the total amount of the obligations which the Secretary is authorized to incur on behalf of the United States under the first sentence of Section 4(c), 1½ per centum may be set aside and used exclusively to finance the programs and activities authorized by this subsection (including administrative costs).

The words "effectively utilize" in Section 16(a) are of particular importance. The Congress has clearly stated its intent not only that urban public transportation shall be available to the elderly and handicapped but that this shall be transportation that they can effectively use. This paper addresses the problem of planning and designing transportation facilities and services in such fashion that the elderly and handicapped can effectively use them.

CHARACTERISTICS OF THE ELDERLY AND HANDICAPPED

As defined by Section 16(d) of the Act,

> The term "handicapped person" means any individual who, by reason of illness, injury, age, congenital malfunction, or other permanent or temporary incapacity or disability, is unable without special facilities or special planning or design to utilize mass transportation facilities as effectively as persons who are not so affected.

According to a study by the Transportation Systems Center (1), an elderly person is an individual 65 years of age or older. The definition of the Act in effect establishes 2 groups: those who can effectively use public transportation and those who cannot use it so effectively as the first group without special facilities or special planning or design. Just as there are gradations within the group of the ablebodied, so there are gradations within the group of the handicapped, and any solution to the problem of providing the most effective transportation must take these gradations into account. Therefore, this paper will use the following classifications as aids to discussion:

1. Invalids—persons who are disabled for active service or movement and are virtually confined to bed;
2. Nonambulatory—persons who, for all practical purposes, are confined to wheelchairs;
3. Semiambulatory—persons who, although handicapped to some extent, can walk with difficulty and generally use crutches or canes;
4. Ambulatory—persons who, although handicapped by age or infirmity, can walk without serious difficulty; and
5. Able-bodied.

DIMENSIONS OF THE PROBLEM

The Transportation Systems Center study (1) estimates that the elderly and handicapped population in the United States in 1970 was as follows:

Category	Number
Elderly who are not handicapped	13,110,000
Elderly who are handicapped	6,990,000
Nonelderly who are handicapped	6,400,000
Total	26,500,000

Of this total number, 11,700,000 are estimated to live in nonurbanized areas and 14,800,000 in urbanized areas. This paper is concerned only with the latter group. An estimated 4,400,000 of the 14,800,000 are able to drive their own cars. The remaining 10.4 million are divided into the following groups (1):

Category	Number
Have no transit available	4,200,000
Are able to use transit	3,000,000
Are not able to use transit	1,200,000
Can go out	500,000
Cannot go out	700,000

Category	Number
Have transit available	6,200,000
Are able to use transit	4,600,000
Are not able to use transit	1,600,000
Can go out	600,000
Cannot go out	1,000,000
Total	10,400,000

Thus, the number of elderly and handicapped for whom urban transportation must be provided is approximately 8.7 million, an undetermined number from the 1.7 million who cannot go out but must occasionally be taken to a hospital or other medical facility, and an undetermined number from the 4.4 million who can drive themselves but might prefer to use transit either regularly or occasionally. The number of elderly is projected to increase by some 40 percent during the next 3 decades, and presumably the numbers in all of the categories above will increase. However, this paper discusses only the estimates for 1970.

SERVICES FOR THE ELDERLY AND HANDICAPPED

Existing and proposed services for the elderly and handicapped are of 2 main types: those directed at alleviating the costs of transportation and those directed at compensating for physical disabilities. In the first group are services such as reduced fares, transit stamps for those with incomes below a designated level, coupons for taxis, volunteer services arranged by social and welfare agencies, and transit system buses leased by social and welfare agencies. Services in the second group include modification of the types of vehicles currently in service, taxis, TRANSBUS and Small Bus Program vehicles, and demand-responsive vehicles. This study is primarily concerned with the second group. The merits and drawbacks of these approaches to the problem will be discussed in succeeding sections. First, the research procedures that were followed are explained.

RESEARCH PROCEDURES

Initially it was planned to interview individuals at institutions in selected U.S. cities to ascertain their views concerning transit services available and the modifications needed to effect improvements. A questionnaire was prepared but attempts to conduct interviews in Dade County, Florida, and in Oakland, California, disclosed serious inadequacies in the procedure.

The interviews revealed that the mental and physical characteristics of the interviewees were so intertwined that it was impossible to categorize any one individual by his or her specific disability. Thus, any attempt to summarize the results of the interviews would have been meaningless because of the mixed characteristics of those interviewed. Medical and administrative personnel who tend to the needs of the elderly and handicapped on a daily basis agreed that individuals having an identical physical disability might be totally dissimilar in inherent mobility. Such dissimilarity is attributable to the great number of possible variables, a few of which are listed below:

- Age
  - Chronological age
  - Age at which physical or mental disability occurred
  - Degree of senility
- Experience
  - General experiences prior to disability
  - Work experiences prior to disability
- Family and friends available to help
- Financial status
  - Eligible for veterans, welfare, or other financial programs

- Nature of physical handicap
  - Permanence of handicap
  - Dependence and degree of dependence on others for mobility
  - Degree of mobility
  - Types of travel barriers involved
- Nature of mental handicap
  - Permanence
  - Dependence on others for decisions and thinking
  - Degree of incapacity
- Attitude (assuming no mental handicap)
  - Depression or enthusiasm
  - Degree of resentment of handicap
- Local, municipal, and state programs for the handicapped
  - Financial
  - Transportation
  - Welfare, social, medical aid, rehabilitation
- Local transportation facilities available
  - Taxi
    - Hours of operation
    - Willingness or ability of dispatchers to supply cabs to all neighborhoods
    - Willingness of drivers to assist the handicapped
  - Handicabs, Medicabs, or others
  - Welfare agency transportation
- Residence
  - Location in relation to medical and other destinations
  - House or apartment
  - Ground floor or upper floor
  - Other travel barriers imposed by housing

In addition, administrative objections were encountered. Those in charge of the institutions pointed out that their patients were reluctant to discuss physical disabilities with strangers and that they did not wish to place the patients in potentially embarrassing situations. The administrative and medical officials, on the other hand, welcomed the opportunity to discuss the mobility problems of their patients and residents and indeed were delighted that the transit industry was taking an active interest in improving transportation for those under their care. Accordingly, the personnel who were attending to medical, administrative, and transportation needs of the elderly and handicapped were interviewed for their opinions concerning the most effective means of making public transportation available.

Summaries of the interviews were sent to the interviewees for review, corrections, and comments. In many instances, expressions of encouragement were returned plus requests for information on the progress of the search for the most effective means of providing mobility for the elderly and handicapped.

MODIFICATION OF EXISTING VEHICLES ON REGULAR ROUTES

One approach is to modify vehicles already in service or to modify the designs for new vehicles to accommodate the elderly and handicapped. Inasmuch as the ambulatory and the semiambulatory are able to ride on the vehicles as they are, the modifications should meet the needs of the nonambulatory. The reaction of most interviewees to this proposition was that this is only partly true. (Although the proposal for modification applies equally to rapid transit vehicles and to buses, the following discusses mainly buses.)

The usual modification to a bus to accommodate the nonambulatory is adding a hydraulic lift or equivalent device that will raise a wheelchair and occupant from the curb into the bus and lower the wheelchair and occupant from the bus to the curb. Space for wheelchairs within the bus is provided by removing seats or using foldup seats. Other assists include anchoring points for the wheelchairs and handholds for wheelchair occupants while riding.

Interviewees commented that modifying standard vehicles is not the most efficient and cost-effective way to enable the elderly and handicapped to effectively use transit. Some interviewees even asked whether modifying standard buses actually would enable the elderly and handicapped to effectively use transit. Discussion centered on whether all or only some of the vehicles in the transit company's fleet should be modified and whether such modification truly fulfills the company's obligation under Section 16(a).

In the opinion of most interviewees, modifying only part of the fleet would observe the letter but not the spirit of the requirement that "the availability to elderly and handicapped persons of mass transportation which they can effectively utilize will be assured." Wheelchair users would have difficulty knowing when and where to find the specially equipped buses if only a few were in service. Even if run on regular, published schedules, the special buses would be of little use to wheelchair users who, after getting to the bus stop on time, found all available wheelchair spaces taken and had to wait for the next bus. Confidence in the dependability of service could be developed only if every bus were equipped to accommodate wheelchairs. Otherwise, the nonambulatory would not try to make use of the service, and the high-priced special equipment would run unused.

Even if costs could be ignored, equipping every bus with hydraulic lifts would not necessarily enable the nonambulatory to effectively use transit. In many areas, wheelchair users could not board and alight from a bus unaided regardless of hydraulic lifts.

A thoroughfare in Washington, D.C., traveled by perhaps a dozen bus routes, is lined with brick islands at which approximately 50 percent of the buses load and discharge. For a wheelchair user to descend the curb at the sidewalk, push out into the street, mount the island curb, and then get on the bus would be difficult even under ideal conditions. Rush-hour crowds, construction sites, cars parked double, traffic circles, busy intersections, and other hazards would add to the difficulties. There is also weather. Few wheelchair users can handle the problem of alighting into or beside a snowbank or on icy pavement. Merely waiting in rain or snow is more of a problem for people sitting in wheelchairs than for those standing.

Interviewees criticized the assumption, implicit in the plans to equip regular buses with hydraulic lifts, that wheelchair users are capable of doing virtually everything for themselves except get on and off the bus. That a nonambulatory person can wheel 2 blocks to a bus stop does not signify that he or she can secure the chair once it is aboard a bus, can use hand grips to keep braced against the bus movements, can unfasten the chair to get off, and once off can maneuver through a crowd of commuters to his or her destination. The wheelchair user who is capable of doing these things is definitely not typical. Interviewees felt strongly that buses for the nonambulatory would have to carry not only special equipment but personnel willing and able to extend assistance.

For these and other reasons, respondents were generally of the opinion that modifying regular buses is not a satisfactory solution to the problem of providing public transportation for the nonambulatory. Several of those interviewed commented on the inadvisability of holding out to the handicapped the hope of riding like everybody else. All persons interviewed agreed that the nonambulatory are unavoidably different from regular transit system patrons, notwithstanding the assertions of some spokesmen that the handicapped do not wish to be treated differently or transported separately from the able-bodied. Although modification of existing equipment will enable some nonambulatory to ride who cannot now ride, at best it is a partial solution even for these few. Accordingly, some interviewees inclined to the view that modifying standard vehicles does not truly satisfy the obligation to ensure "availability to elderly and handicapped persons of mass transportation which they can effectively utilize." Interviewees also noted that modifying standard vehicles will do nothing whatever for invalids.

TAXIS

At present the best means of transportation for the elderly and handicapped in many cities is a taxicab with a helpful and friendly driver. A physically sturdy driver who

is willing to help a handicapped person move from wheelchair to cab seat, fold and store the wheelchair, unfold it at destination, and assist the passenger from the taxi into the chair provides as good a means of transportation for the elderly and handicapped (except the invalids) as can be found. But questions of expense aside, there are many conditions that prevent the use of taxicab service by the nonambulatory.

Not all cab drivers are young enough and strong enough to help a handicapped person from the wheelchair and into the cab. Not all are good-natured enough. Not all are willing to accept the responsibility. Some taxicab companies even instruct their employees to accept wheelchair users as passengers only if they can climb into the cab without assistance and pull their wheelchairs in after them. Some require handicapped persons telephoning for a cab to indicate the nature of their handicaps and direct drivers to refuse the handicapped as passengers if they have not done so. Furthermore, in many cities cabs cannot be depended on to go to certain sections of the city, especially during peak hours or night hours.

This is not to write off the taxicab as a means of transporting the nonambulatory. Indeed, there may be opportunity for the taxi industry to combine with the transit industry to provide satisfactory service with special vehicles.

TRANSBUS PROGRAM

TRANSBUS is the name given to a bus currently being designed and tested under a program financed by the Urban Mass Transportation Administration. Subcontracts were let in 1971 to 3 manufacturers to develop their own designs and produce 3 prototype buses by 1973. Evaluation tests will be conducted on all 3 designs, and in 1974 UMTA plans to select the best design. This design will be made available to all manufacturers bidding to build future fleets for city transit operators.

Although TRANSBUS is not being designed specifically for the handicapped, they will be benefited by many of its features. Illumination of bus steps will be better than that in present vehicles. The first step will be only 6 inches up from the curb, and each subsequent riser will be no more than 7 inches high. Front doors will be 25 percent wider, seats will be wider and spaced farther apart, and loudspeakers will enable the driver to assist passengers with route and stop information.

One prototype of each manufacturer's design is being fitted with experimental devices such as electrically controlled ramps and lifts that will enable passengers in wheelchairs to board. The purpose of building these prototypes is to assess a possible means of complying with Section 16(a) of the Urban Mass Transportation Act. Whether these specially equipped models will become standard production remains to be determined.

Interviewees noted a fundamental conflict between the goals of the TRANSBUS Program and the experimental equipping of prototypes with special equipment for the nonambulatory. One of the reasons for producing TRANSBUS is to provide the passenger with such efficient transportation as to wean him away from using the automobile in urban environments. To this end TRANSBUS will move commuters more rapidly than present buses; it will have faster acceleration and deceleration rates and power to maintain speed on hills. Lower steps, wider doors, and better illumination will reduce passenger loading and discharging time from the current 3 seconds per passenger to $1\frac{1}{2}$ seconds per passenger. This goal, however, clashes with the objective, inherent in the installation of special equipment, to safely load, secure, and discharge wheelchair users.

To stress the incongruity of designing a bus for high speed and then equipping it with features to delay it, an interviewee recounted an incident that occurred with some retirement home residents who from time to time were transported to social functions by bus. On one occasion the bus stopped at another retirement home to take on passengers who were even more elderly and enfeebled than those from the first home. The members of the first home were quite critical and exasperated at the time necessary to safely load the members of the second. Similarly, regular patrons of a high-speed bus could be expected to be exasperated at the time that would be required to load, secure, unsecure, and discharge wheelchair users.

In addition to the foregoing conflict of goals, specially equipped TRANSBUSES would be an inadequate solution to the problem of providing efficient and economic transportation for the nonambulatory because all of the shortcomings applicable to modification of existing vehicles would also apply to TRANSBUS. Moreover, TRANSBUS would do nothing to ease the plight of the invalids.

Our conversation with Harold Willson of Alamo, California, was informative with regard to present and future buses and the needs of the elderly and handicapped. Mr. Willson is employed by the Kaiser Foundation Health Plan, Inc., of San Francisco and has devoted years to obtaining public recognition for the needs of the handicapped. He was instrumental in persuading BART to consider many of the design features for vehicles and stationary sites that would improve the mobility of the handicapped.

He concurred with the observation that only few of the nonambulatory are sufficiently aggressive and determined to function like normal persons to want to get themselves lifted aboard a bus in a wheelchair on a daily basis. The importance of weather as an influencing factor was also acknowledged. Finally, he agreed that an overcommitment to one segment of the handicapped population (such as those nonambulatory who have the will and initiative to get themselves to work every day) might have an adverse effect on programs for aid to the nonambulatory who have other degrees of disability. Insistence on converting all transit vehicles in a fleet to the needs of selected nonambulatory persons could stimulate a negative reaction for future programs to help the handicapped in general. Mr. Willson recognized the validity of all these arguments but also indicated that he would like to see provisions for wheelchairs on all main-line bus commuter routes and in subway systems to provide sufficient mobility for the competent wheelchair users so that they might accept gainful occupation in employment centers.

SMALL BUS PROGRAM

UMTA has announced its intention of developing a general and performance specification for an advanced small urban transit bus. This specification will be similar to the general and performance specification for the TRANSBUS but specialized to reflect small bus requirements. Under the Small Bus Program, the kinds of services that small buses now provide and might provide in the future will be examined, and investigations will be made to establish the detailed nature of these services and specialty bus design features needed to accommodate them. For example, investigations will be made of downtown circulation, demand-responsive service, and other operations to accommodate the general public and the elderly and the handicapped. Certain of these investigations will be extended to evaluate and appraise other existing modes of transportation and vehicles in meeting the urban transportation needs of the elderly and handicapped, and recommendations will emphasize new equipment designs and operations.

Thus, the scope of the project will cover the transit industry's needs for small buses to accommodate 25 passengers or fewer and for demand-responsive vehicles with special equipment to provide transportation for the elderly and handicapped. These would probably be a van type of vehicles that handle as few as 8 passengers. The American Transit Association has recommended to UMTA that the Small Bus Program be started as soon as possible and that the study of needs of the elderly and handicapped be finished as early as possible so that the findings are available prior to the decision-making point in the TRANSBUS Program

DOOR-THROUGH-DOOR DEMAND-RESPONSIVE TRANSPORTATION

The word "through" differentiates door-through-door service from other types of demand-responsive transportation service in that the transit system supplies one or more persons who extend individual help to those using the service. Those persons enter the residences, assist the handicapped persons out of their houses and into the vehicle, and assist them from the vehicle and through the doors at their destinations.

HANDICABS, Inc., is an example of a private enterprise door-through-door transit system. We interviewed the founder John Leonard Lovdahl of Milwaukee, Wisconsin (himself a paraplegic).

HANDICABS has (as of February 1973) 120 small buses and vans equipped with special loading doors and ramps. Approximately 50 percent of each bus provides regular seating, and the remainder provides space for persons in wheelchairs and for persons who must be transported prone. All buses and most vans are equipped with first aid kits, a spare wheelchair, and seat belts that are used to secure the wheelchair.

Each van is equipped with a "handiramp" that is hooked to the inside of the loading door and stands to one side, out of the way, but pulls down to meet the sidewalk, curb, or street when in use. Although the lowered ramp has a fairly steep grade, wheelchairs may be pushed up relatively easily because there are steps in the center of the ramp, and the employee pushing the chair stands on a horizontal surface while pushing up the incline. The edges of the ramp are raised to prevent the wheelchair from slipping off either side.

Most of the company's business is derived from contracts for transporting handicapped children in the local schools, but 10 of the vans are used entirely to provide demand-responsive service to the handicapped. In this operation, a telephone operator relays incoming requests for service to a dispatcher who routes the vans by radio to obtain maximum productivity (passengers per trip) in the minimum time. A van that has delivered all of its passengers and has no immediate instructions does not cruise but stops at a major crossroads or center to wait for further directions from the dispatcher. Typically between 35 and 40 dispatches per hour are made with the 10 vans.

At the time Mr. Lovdahl was interviewed the rates were $3 minimum for the first 30 blocks and an additional $3 for each additional 30 blocks. The rate was $7 minimum for a round trip to nursing home or hospital or to airports. In many instances trips for medical purposes were paid for by Medicaid. Not a single customer, however, was using HANDICABS for daily transportation to and from work. Mr. Lovdahl remarked that his service was too expensive for the usual regularly employed handicapped person and said that a taxi would be a more desirable and economical service for persons sufficiently mobile to use taxicabs. HANDICABS provides not only door-to-door transportation but physical assistance to the passenger door through door. Its employees do not have medical training but receive training in assisting handicapped people and in supplying first aid.

The consensus of most persons interviewed was that the nonambulatory must have public transportation that is different from that of the general public because they themselves are different from the general public. Door-through-door transportation accommodates all capability gradations of the nonambulatory and is the best solution to the problem of ensuring the availability to elderly and handicapped persons of public transportation that they can effectively use. But there is the problem that door-through-door transportation is too expensive for most nonambulatory. An important question, then, is whether financing can be arranged to bring door-through-door demand-responsive transportation within the means of the handicapped who have to get by on limited resources.

FINANCING TRANSPORTATION FOR THE ELDERLY AND HANDICAPPED

Few urban public transportation systems in the United States operate without public assistance as a subsidy or some other form. Given the fact that the transportation needs of the elderly and handicapped are different from those of the able-bodied, the costs of supplying special transportation must inevitably be higher. Thus, funds supporting transportation for the elderly and handicapped must come either directly from general revenues in the form of subsidies for a transportation authority, from funds provided by separate acts of city or state legislative bodies, from medical, social, and welfare agencies, or from other public sources.

Interviewees indicated that a number of social and welfare agencies of Milwaukee resisted transferring their requirements to HANDICABS and tried to meet their needs themselves. They soon found, however, that to use HANDICABS was less costly than to supply equally reliable and safe service individually and to stick to their own lines

of endeavor was more efficient. Although HANDICABS is now self-sustaining, it had a long struggle to become so. The more common experience is for small enterprises to fail for lack of funds. HANDICABS operates with nonunion drivers, some of whom are part time, as befits the peak-hour nature of a portion of their business.

Most interviewees favored centralizing transportation for the elderly and handicapped in the principal urban transportation system—TRANSBUS and small bus for the ambulatory and semiambulatory door-through-door demand-responsive transportation for the invalids and nonambulatory.

An operation in Cincinnati is an example of how financing of demand-responsive transportation for the elderly and handicapped might be accomplished. Sandra Willingham, director of the Model Cities Agency's On Call, reported that 5 of the original demand-responsive vehicles being used by On Call were donated by other Cincinnati social and welfare agencies who were happy to have On Call take over the responsibilities and costs of this transportation service. Now that Model Cities funds for On Call are to be terminated on June 30, 1974, Cincinnati agencies are beginning to consider whether some of the social and welfare costs that used to be spent on individual station wagon or van transportation of the elderly and handicapped might best be turned over to On Call so that one agency could perform the work more efficiently. Indeed, one of the city's churches has volunteered to provide $2,500 to have On Call's services extended into a neighboring area.

Interviewees felt that transportation for the elderly and handicapped can best be provided by consolidating welfare and social transportation means and funding so that (a) an efficient transportation operation is established with safe, reliable, properly maintained, and efficiently dispatched vehicles and (b) welfare and social aspects are taken care of through social and welfare funds, with local transportation funds added to provide a viable level of service.

Do major transit systems want to take on the responsibilities of demand-responsive transportation? Foremost among the advantages are the fulfillment of the obligation under Section 16(a) in a manner that would enable the elderly and handicapped to effectively use urban transit. A program combining TRANSBUS (standard version, without special equipment), small bus, and demand-responsive door-through-door would preserve the objective of TRANSBUS to provide high-speed service and at the same time provide public transportation for all categories of the elderly and handicapped, including the nonambulatory and invalids. There would be other advantages, too:

1. Satisfaction from meeting the needs and desires of the elderly and handicapped;
2. Public relations benefits from supplying essential services to the handicapped;
3. Avoidance of having to purchase and maintain specially equipped buses for use on regular runs; and
4. Potential for effectively using some employees who are idle during the nonpeak hours.

There would, of course, be problems facing a transit system that provides demand-reponsive service. In particular, there would be the labor problems of training bus drivers to provide the personal attentions demanded by door-through-door service. Assignment of drivers to such duties would have to be on a purely voluntary basis. From the drivers' viewpoint, the responsibilities of helping the nonambulatory would be offset by the advantages of driving small vehicles, following relaxed schedules, and having freedom from crowds and heavy traffic conditions throughout the day. Through the union seniority system of choosing assignments every 3 or 6 months, some bus drivers in several cities have already indicated their preference for driving demand-responsive vehicles.

PUBLIC EDUCATION AND ACCEPTANCE

A steadily sustained program of public education is essential to achieve public acceptance of the concept of public transportation for the elderly and handicapped. Such a program is required regardless of whether needs are met with regular buses or demand-responsive vehicles, for the public will ultimately bear the costs.

News media, government officials, and citizens must be acquainted with the plight of the elderly and handicapped and the benefits of providing them with transportation to help them obtain employment and have improved access to medical, recreational, educational, religious, and other institutions. They must be acquainted with the costs of alternative means of providing such transportation. Whatever mode of transportation is decided on, they must be given the reasons for selecting that mode to retain their support.

In the opinions of those interviewed, the most convincing case can be made for demand-responsive transportation for meeting the needs of the elderly and the handicapped. No matter what solution may best meet local conditions, a continuing educational campaign is needed to remind the typical rider that the needs of the elderly and handicapped merit special attention.

SUMMARY AND CONCLUSIONS

This paper reports on a series of interviews concerning the most efficient and economical means of ensuring the availability of urban public transportation that elderly and handicapped persons can effectively use. The consensus among those interviewed was that modifying regular commuter transit service will not fully meet the needs of invalids and the nonambulatory and that the preferred means of achieving the objective is through use of a combination of standard transit vehicles, specialized small vehicles, and demand-responsive service.

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LOCATION OF THE CARLESS

R. E. Paaswell and W. W. Recker, State University of New York at Buffalo

This paper identifies the "carless" and shows where they are and what transportation alternatives exist for them. More than 65 percent of the U.S. population are carless. Data from Buffalo, New York, serve to indicate the relations among carlessness, median income, race, age, and accessibility of public transport. For the study area, the public transport system, which has a development consistent with the traditional pattern of urban growth, no longer adequately serves the needs of those who rely on it most. Examination of the extent of carlessness in the suburbs shows that the problem of mobility among suburban households may be more severe than that in the inner city.

•THE TRANSPORTATION planning process traditionally has been oriented to establishing travel demand on the basis of vehicular trips. Travel is usually considered as taking place by car, public transportation, taxi, and other modes. Because of the overwhelming number of passenger trips in the United States by car, problems relating to lack of having access to a car have been minimized. (Trips by private car in 1967 represented 79 percent of total trips, and 82 percent of work trips were by car as driver or rider.) This paper illustrates that the problem of access to a car is actually a significant one for a major portion of the U.S. population.

Those without access to a car do not represent a homogeneous set of the population. In recent years various subgroups of the population, for example the poor (1) or the elderly (2), have been singled out as being among the transportation disadvantaged. The term disadvantaged is used because real penalties are assessed in time, cost, or simply ability to pursue an activity desired when a car is not available.

Figures 1 and 2 show how the carless are defined, how car availability affects their decisions to pursue activities, and how these decisions are finally reflected in the choice of mode for the specific journey.

The first step in identification of the carless is to determine car availability either through household ownership or other sources of availability outside the household. The latter may be important, for example, to a teenager who, while not having a car available in his household, relies on friends for rides to locations where the majority of his or her nonschool activities take place. Figure 1 shows that the carless are a diverse group that includes the young (less than license age), the elderly, the handicapped, those with no insurance (where required), and those who specifically choose not to drive.

A preliminary estimate of the extent of these problems can be determined from household and personal data. Eighty percent of U.S. households own 1 or more cars. The 20 percent who do not represent more than 40 million people. In the households that own cars, 35 percent of the people are 18 or younger and 14 percent are 59 or older. Sixty percent of the households have only 1 car. In 1970, 50.6 million workers indicated that they traveled to work as a driver (3). Thus, even if the second and third cars are used exclusively for work trips, a high proportion of first cars are used for the journey to work leaving many households carless while the family car is parked at the workplace parking lot. Estimates of persons without immediate access to a car in 1970 are as follows:

Figure 1. Definition of carless.

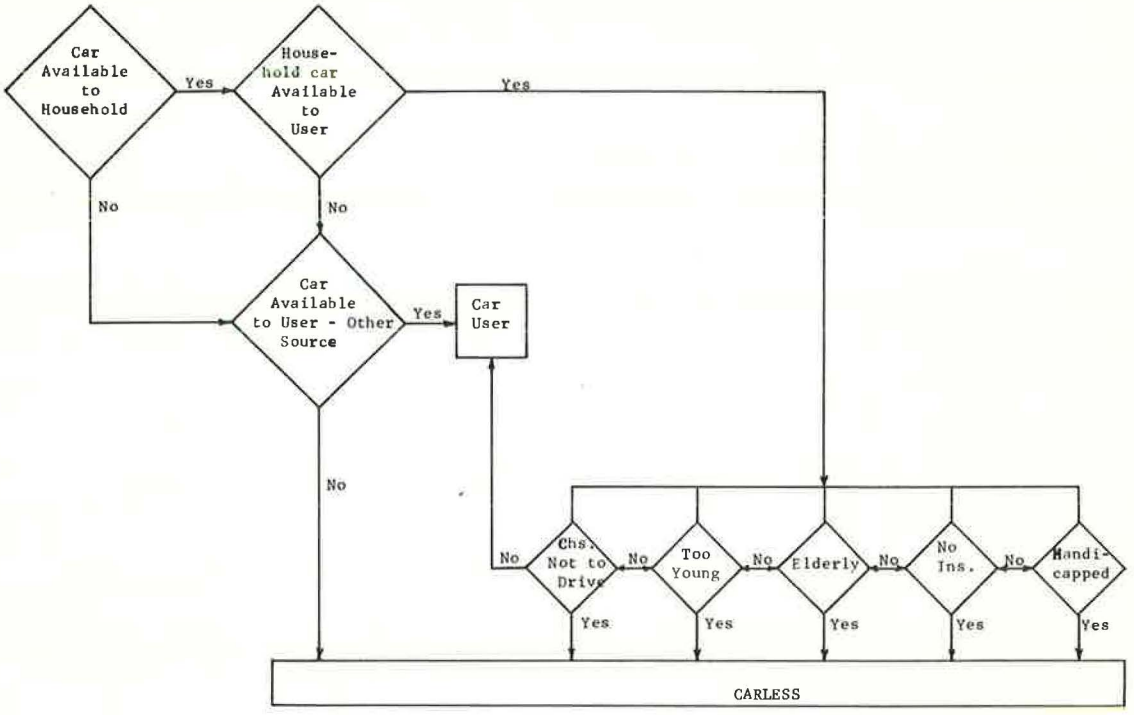
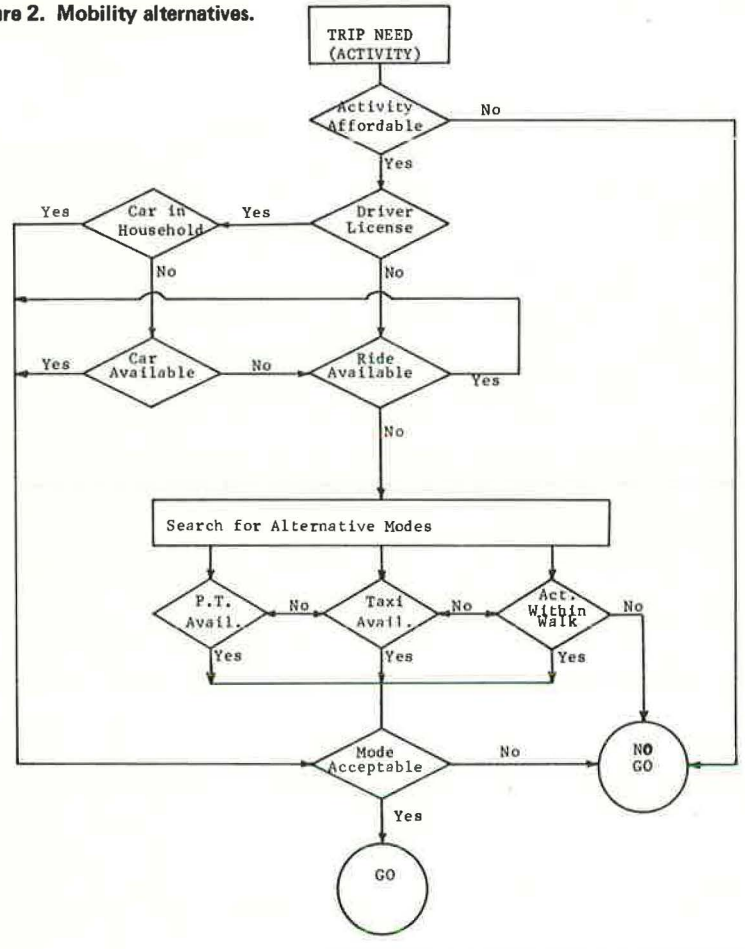


Figure 2. Mobility alternatives.



Category	Number
Persons in households with no car	41,280,000
Persons in households with 1 car, which is used for journey to work	40,000,000
Persons under 18 in households with car available	42,940,000
Persons over 59 and not licensed to drive in households with car available	8,580,000
Total	132,800,000

More than 65 percent of the people in the United States (population of 203 million in 1970) have no immediate access to a car. This number can be enlarged by including the physically handicapped and those with cars who choose not to drive (restricted license, lost insurance). This leads to the following observations.

1. A significant number of people have no car either at all or during a large part of the day. Since car ownership is related to income, these are probably the poor, and especially the urban poor.
2. A sizable number of people in car-owning households may not drive; this includes the elderly and those under 18. The group between 5 and 18 are particularly cited, for they are in an age group where a major proportion of their activities may not be household centered. In a household with 1 car that is used primarily for the work trip and remains at the place of work, the remaining members of the household must respond essentially as members of no-car households during work hours.

The large investment in the highway program since 1956, without concurrent investment in alternative transportation programs during the same period, has created polarity between those with and those without access to a car. That is further widened by

1. The shift of predominantly middle-income families from central cities of metropolitan areas to suburban rings;
2. The well-documented decline in public transportation coupled with increasing fares to the rider;
3. The inability of public transportation to service the needs of the dispersed suburban population;
4. Shifts of places of employment and markets from inner areas to the suburbs;
5. Declining blue-collar and low-income jobs in the central cities coupled with increasing jobs in the suburbs; and
6. Inadequate supply of low-income housing in suburbs to facilitate the journey to work to potential new places of employment.

LOCATION

Although age statistics are fairly consistent, car ownership statistics are not. As size of urban area increases, the percentage of 0-car households increases. In U.S. cities having a population greater than 3 million, 47 percent of the households have no car; in cities having a population of 250,000 or less, 20 percent of the household have no car; and in suburban areas 12 percent have no car. A general inference is that, as density (or size) of an urban area increases, there is less need for a car. Although there is an element of truth in this (expectation of well-developed public transportation systems), it is also true that larger urban areas have high proportions of low-income families. Although the need for a car per se does not necessarily exist, the need for reliable transportation to satisfy a wide variety of travel needs does.

To gain a clearer perspective on the location of the carless and to tie location to need, a study was made in Buffalo, New York, and its inner-ring suburbs. The population of the study area is 1,085,000, of which 463,000 live within the city proper. Median income is $8,800 in the city and $11,600 in the suburban areas. Thirty-four percent of the households in the city and 7 percent of those in the suburban area own no car. Multicar ownership, a factor important in establishing access when 1 car is used but

travel is still decreased within the household, is only 7 percent in the city and 38 percent in the suburban areas.

Physical location of the groups mentioned above is by itself meaningless, but gains meaning when set in a framework of desired activities and available transportation. The major forms of public transportation in Buffalo are buses (fare 45 cents within the city), taxis, and a demand-activated bus service for the elderly within the Model Neighborhood area. The latter is a free transportation service available to persons 59 and over and, on occasion, to special organizational groups whose members reside within a defined area of the city. The population in this area is predominantly nonwhite and below median income.

Figure 3 shows bus availability by frequency and number of lines within census tracts. The information is displayed in this way to make data from census evaluations comparable. The figure was developed from frequency plots of bus routes on a street map for the specified time periods: day, peak; day, off-peak; night; and Sunday. The frequency of service changes, of course, with the service period. It also changes substantially as urban density changes. The most significant off-peak demand change occurs in the southern part of the city. However, for most census tracts, off-peak frequency is as high or nearly as high as peak frequency. The night frequencies show substantial decay from the day frequencies, except in the dense inner areas. The western portion of the city shows the most substantial decline and is somewhat cut off from the inner areas of the city by public transit, even though the distances are not great. The most substantial changes occur on Sunday, when large areas of the city, with the exception of the inner area, have very infrequent service.

The weighted averages refer to all bus routes through a given tract. These figures do not show accessibility to bus lines within the tract (i.e., walking distances to line), but these would be reflected in further weights on availability of bus service.

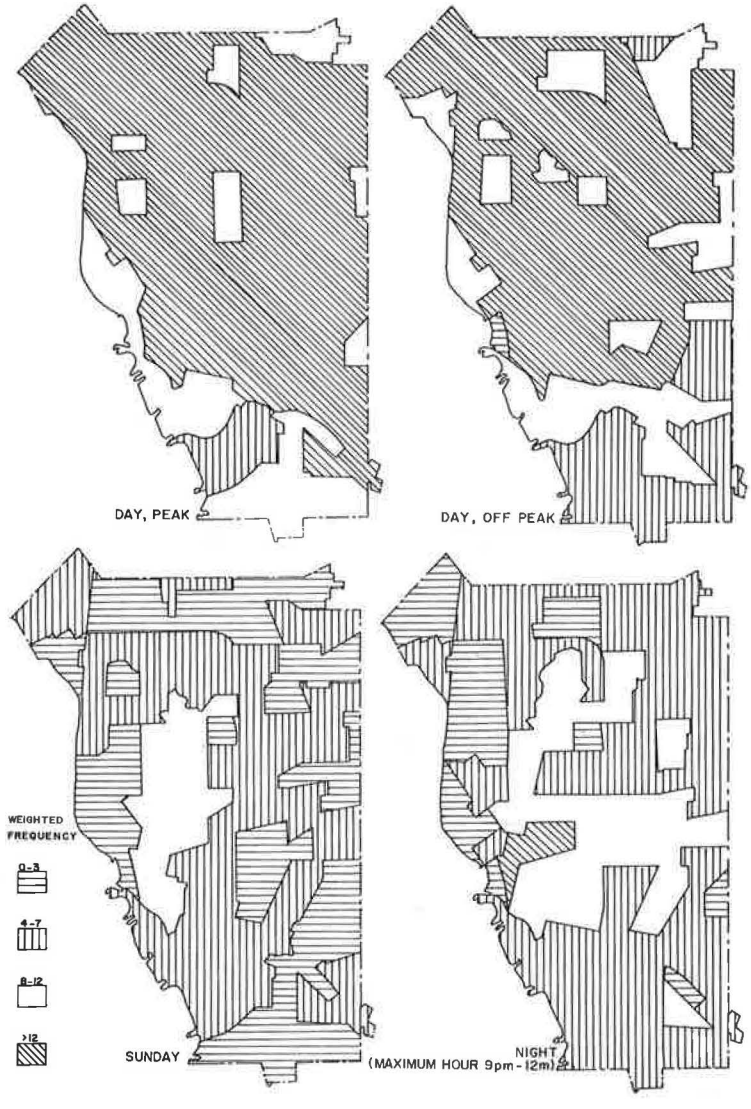
Figure 4 shows the percentage of households that have no cars. The concentric rings of decreasing percentage that extend from the city center are consistent with the traditional patterns of urban growth. The core, once thriving, is now attempting a renaissance. Yet the innermost core is the area of high transient residency and commercial buildings and also serves as a large component of the regional market. Median income is lowest in the core; unlike many other cities of similar size, there are no pockets of rich in this area.

Leading from the center of the CBD, a major arterial road divides the city. On the east side of this road, immediately surrounding the core, the population is almost exclusively nonwhite and has much lower than median income. On the lower west side of the artery the area is becoming a mix of transient and Spanish-speaking population. These areas also have the greatest population densities within the city. The high densities are not achieved through use of apartments, but through closely spaced multiple-family houses. It is not uncommon to find houses behind houses on lots originally developed for single-family dwellings.

The intense concentration of no-car ownership (greater than 50 percent of households) is readily seen in this area, which is small but represents a significant number of the population (18 percent). The number of households without cars in this area alone represents more than 10 percent of the total number of households in the city. Lower car ownership is more predominant among the nonwhite population than among the white population having similar income brackets. (No-car ownership in the nonwhite population is slightly higher than 50 percent of households.) The concentration in one area would normally cause one to expect a similar concentration of services and employment within the same area. But, as documented elsewhere (4), employment is decreasing in the city center, especially blue-collar employment, and the most basic of services, grocery shops, are closing, limiting the choices to markets more inaccessible and generally more expensive. (A recent news article noted the closing of a major chain supermarket in this zone. It specifically cited increasing difficulty for the elderly and poor, the largest carless groups, to find other food stores in an accessible location.)

The areas of lowest no-car ownership are those at the most northern and southern areas of the city. The most southern portion corresponds to an area of the city where

Figure 3. Bus frequency.



the bus service is least frequent. The northern area is predominantly a white middle-class area, a proportion of which also has a high percentage of households owning more than 1 car. This area also has good bus service on radial routes into the CBD, but circumferential routes are almost nonexistent. The characteristics of this area are more similar to the suburban ring surrounding the area than to the inner city, where less than 20 percent of the households do not own cars.

Figure 5 shows the location of employment in the city and the suburbs. Because actual work location is shown, the influence of unemployment in any zone is not noted. The predominant place of work (more than 50 percent) of all workers in the area is the city. A significantly higher percentage of workers on the west side (predominantly white population) work in the city; of this proportion, a higher percentage work within the CBD, where a greater number of white-collar jobs are available. A high number of black males work in suburban locations (one major employer is located south of the city, a second north of the city), and the principal mode of travel to these locations is by car (4). Figure 5 shows that the city boundary acts as a dividing line for work locations.

Figure 6 shows the number of workers who do not drive to work (i.e., they travel as passengers, walk, go by transit, or take a taxi, but they do not work at home). Figure 6 also shows the impact of carlessness on the nonwhite population. This population in the east central portion of the city represents a higher percentage of those who work outside the city and a higher proportion of those who do not drive. Figure 3 shows that bus frequencies are generally good at all times in this area. What is not shown in these figures is that the bus lines are traditionally CBD-oriented and do not provide good access to the suburban jobs and markets. (However, a corridor rail rapid route and redesign of the bus system are currently under way to provide greater access to the whole metropolitan area for the inner-city residents.) For those who live in the suburbs, the most common mode of travel to work is as car drivers.

When the family car is used for work, the 1-car household is carless for essentially 8 to 10 hours a day. Members of the family must use other modes of transportation for any non-home-based activities during this period. Figure 7 shows an estimate of the percentage of 1-car households that have the car at home during the day. The estimate is based on the percentage of households within a tract with 1 and more cars and the number of workers who cite their principal work-trip mode as driver. The lowest percentages are in the suburbs, which are also the areas with poorest bus frequencies. The inner-city areas, where a high percentage of cars are left at home, are also the areas of lowest car ownership. This makes it possible to put a value on car availability. In the inner-city areas, especially in the poorest areas, car ownership does not always signify car use. The cost of operation, insurance, or the car's unreliability might prohibit its use as the normal mode for the journey to work. The northwest area and the southern areas of the city, already noted for relative lack of bus service compared to other areas of the city, also have fewer multicar households. In these areas particularly, the availability of services within walking distance is critical, for transit service is infrequent.

Figures 8 and 9 show the distribution of the young and the elderly throughout the city. A high concentration of the elderly occurs immediately along the major artery near the city center; another concentration is in older neighborhoods, from which their children have moved to the suburbs. More than half of the elderly (most frequently women) are not licensed to drive. The availability of bus service and nearby markets is essential to this group. However, bus regulations against shopping carts make bus travel for marketing difficult. This is heightened by a special bus fare for the elderly of 35 cents, which, although lower than the national average, represents a barrier to active travel. Free service for the elderly is available only to a small group, who take great advantage of the service. The elderly most severely hurt are those who live in the suburbs where bus service during nonpeak hours is virtually nonexistent. A comparison of city and suburban distribution shows the strong pull of the city, and it can be surmised that both familiarity with the area and availability of services must be among the reasons for the lack of migration to the suburbs. However, markets and services (group medical practice, for example) are increasingly locating in the suburbs

Figure 4. Percentage of households with no car.

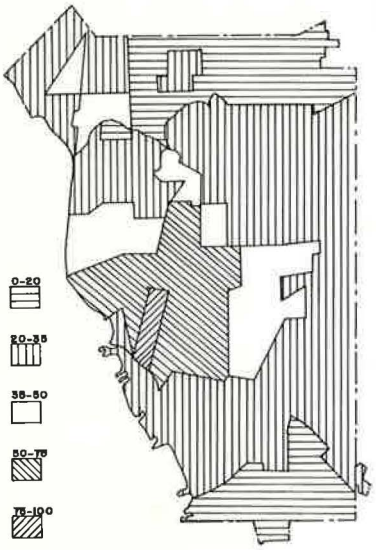


Figure 5. Percentage of employment locations.

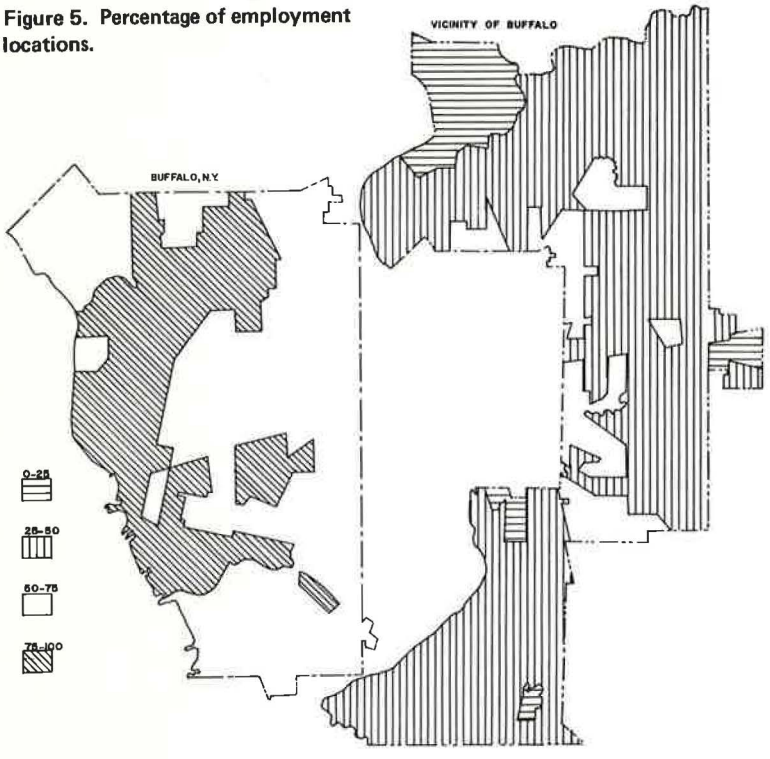


Figure 6. Workers who travel to work not as automobile driver.

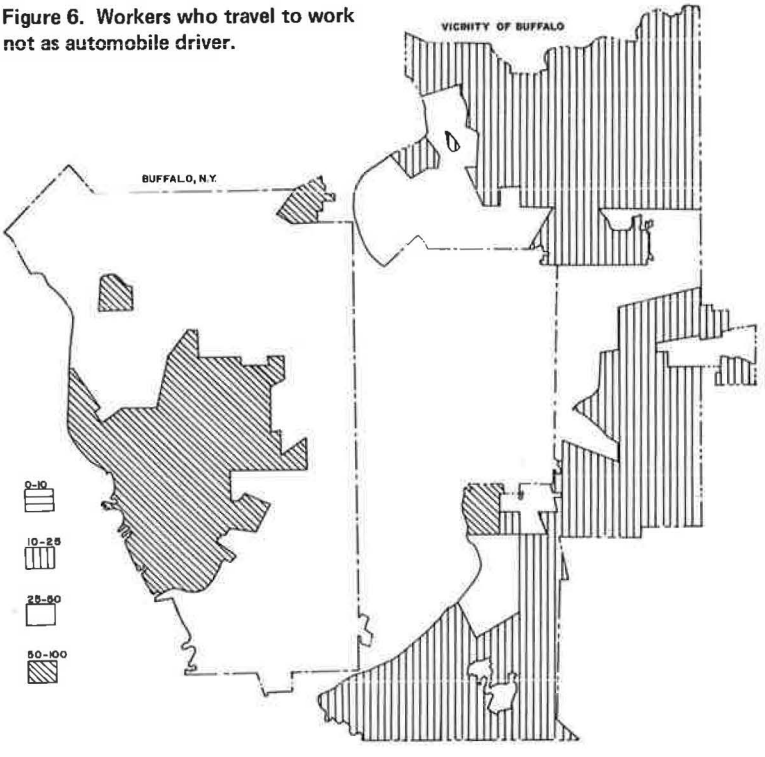


Figure 7. Percentage of 1-car households that have the car at home during the day.

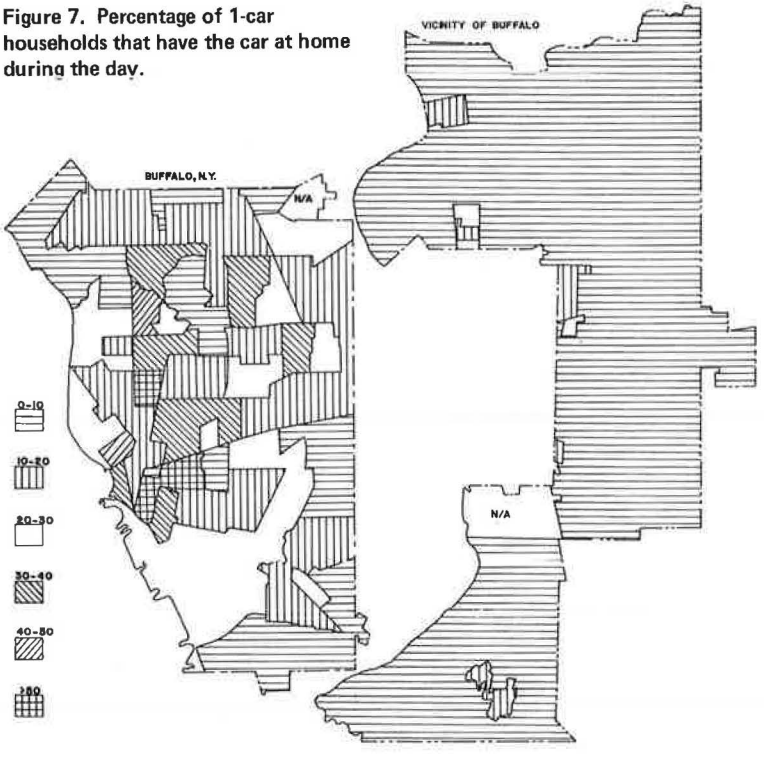


Figure 8. Population aged 59 and older.

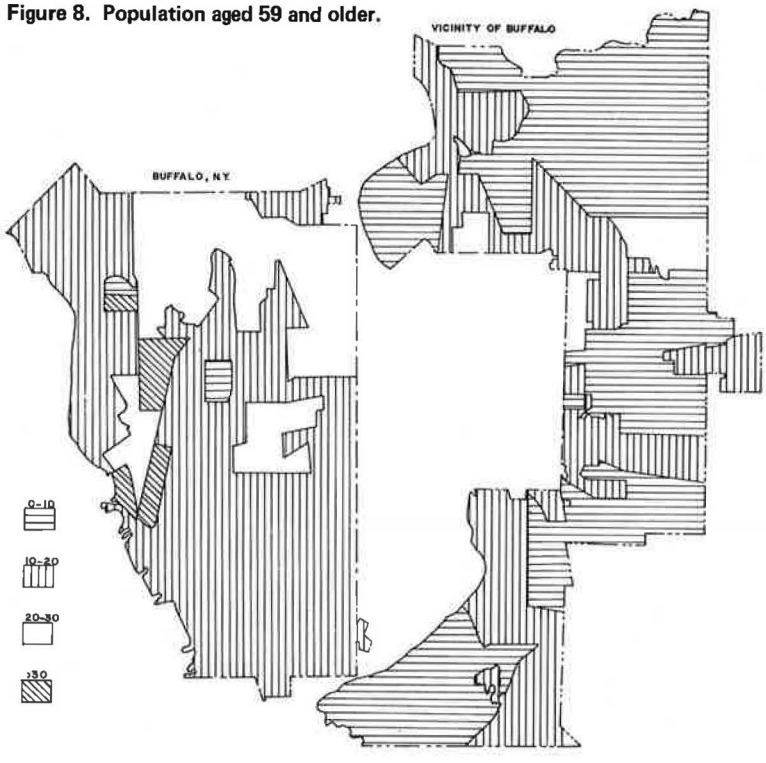
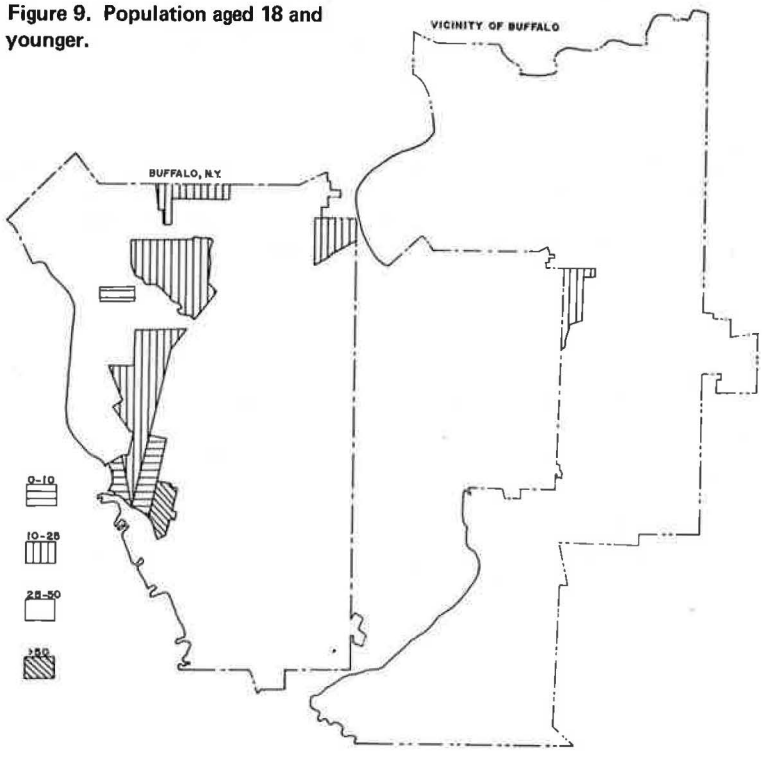


Figure 9. Population aged 18 and younger.



and will be more difficult to reach for those who have no car.

The overwhelming presence of youth is shown in Figure 7. Those under 18 (the legal age for full driving privileges in New York) are not found in force along the west side of the most accessible (by public transit) area of the city. In many cases, the travel needs of youth are met by bicycling and hitchhiking. Hitchhiking, of course, relies on cars, and biking, in cities where bikes are not formally recognized, is in direct conflict with the car. Travel needs can also be met by use of public transportation or by the scheduled ride (or car pool). Reduced fare for students (or free fare) is available only for the school trip. Those too young to work or the older teen workers, who generally work for minimum wages, must pay full fare (45 cents plus 5 cents for each transfer). The younger group (5 years to early teens) usually must rely on a relative for a ride. Figure 7 shows that the family car is often not available during the day for these rides. This often means that the young person must pursue his or her activities within a relatively small area. In areas with poor transit service, such as the suburban rings, it also means that much of the life of the city, frequently available in the more densely populated areas, is not available except on a formally scheduled basis. Thus, the seeming freedom associated with car ownership is nonexistent for this group and underlines the difficulties associated with being carless.

CONCLUSIONS

The common practice in recent years has been to single out specific groups as being the travel disadvantaged. The most common denominator for this group is the carless—those without access to a car at the time of need. In recent years, car ownership per household has increased only slightly, and the increase has taken place in the lower income ranges. But the dynamics of urban areas increase the polarity between those with and without access to cars. Zones of high densities within the cores of urban areas can no longer support markets and employment for the residents of the areas. Public transportation service is poor and is costly to the user (in time as well as money). Monitoring of the trip-making over time must be made among the carless to determine whether travel increases or decreases and whether travel becomes more difficult. In planning for the car, we have, as noted at the outset of this paper, planned for the minority.

ACKNOWLEDGMENT

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TRANSPORTATION POLICY AND THE DELIVERY OF SOCIAL SERVICES IN A SMALL CITY

Alice E. Kidder, North Carolina Agricultural and Technical State University

The study examined the ways in which social service agencies in a small city cope with the transportation problems of immobile clients. The study documents unmet needs as well as underused capacity. Inefficiency stems from the tendency for many agencies to operate 1 or 2 vehicles only a brief time during the day. Low-vehicle utilization combines with high driver cost to produce per client trip costs as high as $7.60. Demand for services appears to be poorly coordinated with the available supply of vehicles. Consolidation of transportation services would eliminate this inefficiency, but economic, institutional, and legal barriers stand in the way of effective merger of transportation programs. Interim solutions include exchanges among agencies of data on volunteers and vehicle availability and increased reliance on public transit modes. Longer range solutions involve application for federal funds through local governmental channels for service development and capital improvement programs.

•PREVIOUS studies of the transportation needs of residents in small cities and their hinterlands indicate that those who have low incomes and no automobiles are dependent for their mobility on other drivers and on public transportation. Where bus service is unavailable and where there is no one with whom to catch a ride, serious problems may arise. Studies of persons without access to cars reveal the difficulties they have in getting to medical facilities for routine appointments, getting to job-training programs located in adjacent towns, and in transporting children across town to recreation programs (1).

Social service agencies have identified the needs of low-income residents or other transportation disadvantaged, and each agency tends to develop its own program to solve the problem of immobility among its clients. Conversations with antipoverty agency directors, social service workers, and job-training staffs indicate a proliferation of ad hoc solutions: Volunteers driving their own cars may be asked to aid in emergencies or with the monthly schedule of client visits; vehicles such as cars or vans may be purchased or leased by the agencies and driven by the staff; or the agency may reimburse clients for the transportation expenses incurred. An agency director may even be called from his or her home at 6 o'clock in the morning to bring taxi fare to a trainee whose car broke down on the way to start a new job.

In large cities, social service agencies can extend the outreach of their services by opening new neighborhood centers in low-income areas (2) or in housing projects designed for the elderly (3). Other transportation disadvantaged may be reached through development of special vehicles for the physically handicapped or the disabled (4).

In smaller cities, however, the cost of multiple centers is prohibitive, and few agencies can with their own funds purchase the expensive, specially equipped vehicles for transporting the handicapped. To extend the delivery of social services, various programs have been devised.

1. Individual agencies have purchased one or more vehicles that are driven by professional or paraprofessional staff. For example, in Belvidere, New Jersey, Progress on Wheels, a nonprofit organization, uses volunteers and vehicles acquired through OEO auspices from the General Services Administration of the federal government.

2. New transportation operations are occasionally funded out of antipoverty funds to provide specialized transportation services for the disadvantaged (3):

> In Inkster, a racially mixed, low-income suburb of Detroit with a population of about forty thousand, . . . five station wagons were leased inexpensively from the state highway department to provide on-call, door-to-door transportation to medical services, social services, cultural affairs and shopping. There is no public transportation in the area. The wagons are driven by volunteers who are paid only out-of-pocket expenses. In emergencies and in other than business hours, volunteers drive their own cars. In two of the less populated service areas, volunteers are unavailable. Therefore, part-time elderly drivers are employed by the project.

3. An agency acts as the coordinator to get rides for clients from a pool of volunteers. In Greensboro, North Carolina, the Voluntary Action Center of the United Community Service has a list of volunteers who are called on to provide rides to social service agencies for clients who request transportation.

The research reported on in this paper is an attempt to evaluate the effectiveness of agency transportation services in the context of a small city. Our data collection site is Greensboro, North Carolina, that has a population of 150,000. Greensboro enjoys a fairly widespread network of radially oriented bus service to the downtown area, but public transportation from low-income neighborhoods to outlying medical facilities, special clinics, and job-training sites is often lacking.

The study inventoried the transportation resources (both physical and financial) that were at the disposal of these agencies, and attempted to find answers to the following questions:

1. What is the total expenditure by social service agencies for transportation for clients?
2. What is the extent of utilization of the cars, vans, and buses owned by the agencies?
3. Do agencies find there are unmet calls for transportation from clients or other persons transportation disadvantaged by low income, age, physical handicap, or inability to drive?
4. Can the transportation resources of the community and of the social service agencies be drawn together into a consolidated system?
5. What budgetary or jurisdictional restrictions inhibit the development of a centralized transportation system to serve the transportation needs of all social service agencies?

METHODOLOGY OF THE STUDY

The universe of social service agencies in Greensboro, both public and private, were included in the study. The functions of the agency may include any of the fields of health care, counseling, training, income transfer, employment placement, youth, recreation, and day care. Lists of agencies were supplied by the United Community Services, the Center for Manpower Research and Training of North Carolina A&T State University, and by the Guilford County Economic Opportunity Council. Interviews were conducted both with agency directors and with transportation specialists within the agencies where such positions existed.

We are pleased to report complete support from the designated agencies. All of the 24 agencies responded to the request for data. At the start of the project the agencies were invited to a conference held at the university where the special service agency representatives and the students and faculty of the university Transportation Institute developed the survey instrument and provided useful guidance and insights to the researchers.

Existing Transportation Resources of Social Service Agencies

The social service agencies of Greensboro report the availability in one agency or another of 26 vehicles with a total seating capacity of 481 seats. These transportation

resources are not evenly distributed among the agencies. Of the 24 agencies interviewed, 10 have no vehicle whatsoever and the remaining 14 have one or more vehicles. Table 1 gives the characteristics of the agencies interviewed. The vehicles inventoried were 2 sedans, 4 station wagons, 13 vans and minibuses, 6 buses, and 1 utility truck.

Table 2 gives the breakdown of total transportation costs by agency and by type of expenditure. In many cases, the agency directors did not know how much they were spending on transportation or how many client trips were made during the year. Thus, nonresponses (na) are given in many categories; if the cost category contains an na, it was not included in the budget totals for the agency. If it was possible to estimate expenses for any category, for example, on the basis of the mileage driven per year, the estimated figure is given and included in the total.

The social service agencies are implicitly spending $50,468 yearly at an average cost per client trip varying between 69 cents and $7.60. This extraordinarily large sum for transportation expenditure is possible because many separate budgets, from a host of funding sources, include line items for transportation. The duplication of expenditure is striking in view of the low level of utilization of most of the vehicles and drivers. Let us consider some of the inefficiencies of the system.

Low Vehicle Utilization

The average vehicle is in use only 3.6 hours out of the 24-hour period of a weekday and almost not at all on weekends. Only 5 agencies out of the 10 with vehicles use the cars more than 1 hour per day.

Data are not available on the complete distribution of trips by time of day; however, the authors estimated these figures based on interview responses about the agency's program. These estimates are given in Table 3.

Capacity utilization appears to be quite low. Utilization of capacity should be measured along 2 dimensions: seat utilization at a given point in time and during the day that the vehicle is carrying passengers. For example, some of the agencies run large buses to schools for the handicapped. These vehicles used most of the seats when in operation, but the buses make only 2 runs a day and stand idle otherwise. Other vehicles may make frequent trips (such as vehicles operated by the social service division of the county), but carry only 1 passenger to a specific destination.

With respect to the agencies under study, we may conclude that at no time of the day is more than 65 per cent of seat capacity used, including peak traffic hours (Table 4). Use drops to 26 per cent of capacity during midmorning and may amount to no more than 5 percent of capacity over time. Almost no use is made of the seats in the evenings, during the night, or on weekends.

Labor Costs

Many agencies cannot afford to hire a paraprofessional driver and hence press into service the existing professional staff, including in selected cases the director of the agency. The agencies that have paid drivers had a total annual wage bill of $29,000 for their time actually spent in driving (Table 2). Since some of the drivers' time is spent on other activities in the agency, the total costs of drivers' salaries may run considerably higher.

If data were not available from the agency, wages for drivers were estimated from the hourly wage rate supplied by the agency and the mileage divided by 20 mph, which we assumed to be an average speed. This approach understates wage costs, for it does not include waiting time, nor does it allow for the fact that some agencies pay for the entire salary of paraprofessional drivers, irrespective of whether they are driving all during the day. Since we did not know whether the paraprofessional drivers were gainfully employed in other pursuits within the agency when not driving, we decided to impute to the transportation costs not their total hours worked in the agency but only the hours they spent driving.

Table 1. Characteristics of agencies interviewed.

Characteristic	Number	Percent
Clients served per year		
1 to 100	3	12.5
101 to 1,000	11	45.8
Over 1,000	10	41.7
Total	24	100.0
Function		
Counseling	3	12.5
Health	5	20.8
Manpower and employment	10	41.7
Youth recreation and day care	4	16.7
Other	2	8.3
Total	24	100.0
Clientele in poverty bracket		
Less than 25 percent	7	29.2
25 to 50 percent	5	20.8
51 to 90 percent	8	33.3
Over 90 percent	4	16.7
Total	24	100.0

Characteristic	Number	Percent
Source of funds		
Federal government	7	29.1
State government	5	20.8
Local government	2	8.3
Charitable contributions	5	20.8
Public and private	5	20.8
Total	24	100.0
Major source of transportation		
Own vehicles and drivers	10	41.7
Use volunteer drivers	10	41.7
No program	4	16.6
Total	24	100.0
Other transportation programs		
Pay bus fare	6	25.0
Do not pay bus fare	18	75.0
Pay taxi fare	5	20.8
Do not pay taxi fare	19	79.2
Reimburse staff	9	37.5
Do not reimburse staff	15	62.5
Reimbursed staff drivers	8	33.3
Do not reimburse staff drivers	16	66.7
Use volunteers	10	41.7

Table 2. Agency expenditures for client-related transportation.

Agency	Expenditures (dollars)							Annual Trips	Cost per Passenger (dollars)
	Vehicle Depreciation	Driver Wages	Gas and Oil	Repairs	Insurance	Other	Total[a]		
1									
2	315	2,800[b]	560	150	220		4,045	5,200	0.78
3						2,150	2,150	na	na
4						100+	100+	20	5.00
5	na		na	na	na	na	na	na	na
6	na		na	na	na	na	500	na	na
7	380	1,500[b]	300	100	na		2,280	300[c]	7.60
	283	1,800[b]	360	100	na		2,543	400[c]	6.35
	233	1,800[b]	360	100	na		2,493	400[c]	6.23
8									
9	191	1,500[b]	na	na	na	na	na	na	na
10	539	2,750	825	na	150[c]	1,250	5,514	8,000	0.69
11	532	3,500	1,050	250	150[c]	na	5,482	1,000+	5.48
12	858	na	na	na	na	na	na	1,250	na
13	463	1,800	1,080	1,668	750		5,761	na	na
14						100[c]	100[c]	na	na
15	na	5,000	na	na	na	na	16,000	2,550	6.27
16	400	3,400	663	na	na	na	na	na	na
17	400	3,368	663	na	na	na	na	na	na
18	na						3,500		
19									
20									
21									
22									
23									
24	na	na	na	na	na	na	na	na	na
Total	4,594	29,218	5,861	2,218	na	na	50,468		

Note: na = not answered, i.e., no information was supplied by agency.

[a]Does not reflect total expenditures for the items, rather total reported expenditures. The costs, therefore, represent a minimum estimate.
[b]Imputed expenditure.
[c]Estimated.

Table 3. Trips by time of day.

Agency	7:01 a.m. to 9:30 a.m.	9:31 a.m. to 11:30 a.m.	11:31 a.m. to 1:00 p.m.	1:01 p.m. to 4:30 p.m.	4:31 p.m. to 6:30 p.m.	6:31 p.m. to 10:00 p.m.	10:01 p.m. to 7:00 a.m.
1	0	0	0	0	0	0	
2	20	0	0	20	0	0	
3	0	0	0	0	0	0	
4	0		0	0	0	0	
5	0		0	0	0	0	
6	0		0	0	0	0	
7	0		0	0	0	0	
8	0		0	0	0	0	
9	65		na	65	0	0	
10	12		0	0	12	0	
11	5	15	15	15	15	5	5
12	0	3	0	3	0	0	0
13	0	0	0	100	100	0	0
14	0	1	0	1	0	0	0
15	0	5	0	5	0	0	0
16	100	50	50	0	100	0	0
17	50	50	0	0	50	0	0
18	40	0	0	0	40	0	0
19	0	0	0	0	0	0	0
20							
21							
22							
23	5	2	0	5	0	0	0
24	10	10	10	10	10	10	10
Total	230	126	65	223	315	15	15

Table 4. Seat capacity used on weekdays.

Time	Client Trips	Seat Capacity	Trips as a Percentage of Capacity
7:00 a.m. to 9:30 a.m.	230	481	47.8
9:31 a.m. to 11:30 a.m.	126	481	26.2
11:31 a.m. to 1:00 p.m.	65	481	13.5
1:01 p.m. to 4:30 p.m.	223	481	46.3
4:31 p.m. to 6:30 p.m.	315	481	65.5
6:31 p.m. to 10:00 p.m.	15	481	3.1
10:01 p.m. to 7:00 a.m.	15	481	3.1

Poor Coordination of Demand for Services With Available Supply of Vehicles

The agencies that are likely to receive calls from persons needing transportation are not the agencies that have vehicles at their disposal. The Voluntary Action Center maintains a list of volunteer drivers, but there is no guarantee that the volunteers will be available with a functioning car when calls come in from the elderly needing to get to clinics, from low-income families needing to collect food, from children going to special instructional programs, or from the physically handicapped needing help to get around in the city. The Crisis Control Center can be reached by phone 24 hours a day. Its staff report getting requests for transportation in the middle of the night for medical emergencies among low-income persons who feel they cannot afford the $25 for an ambulance, but they have no way of dispatching vehicles to meet those needs. Closer cooperation between these agencies and the ones with vehicles and drivers could greatly improve the efficiency of the system.

BARRIERS TO CONSOLIDATION OF SERVICES

Given the evidence of unmet needs in the face of underused capacity, one suspects the system as a whole could benefit from consolidation. Older, less reliable vehicles could be disposed of; telephone requests now coming in to the Voluntary Action Center

could be answered by vehicles in another agency; and a pooling of the various sets of volunteers used as drivers by the several agencies could provide a larger backup to the whole system.

Despite these advantages, many barriers stand in the way of effecting these changes. Economic barriers are immediate: There is a high initial outlay required by the agency that assumed responsibility for coordination of the program. These costs include managerial time, recruitment of volunteers to operate telephones, red tape involving interagency transactions, and increased liability.

Institutional barriers in some cases prevent transfer of assets from one agency to another. The various funding sources for the agencies include federal government grants, state grants, city or county budgets, foundation support for special programs, support by the United Campaign, other charitable contributions, or some combinations of these sources. Each funding source carries its own hierarchy of accountability and cannot easily permit transfer of vehicles to another agency. Furthermore, vehicles used by a social service agency may more frequently be used to send staff to nearby conferences; therefore, the agency wants to maintain dispatching authority.

INTERIM SOLUTIONS

Using a single agency to collect the requests for service, the agencies can retain their own vehicles but at the same time offer the probable use of the vehicle where no conflicting demands made by that agency have arisen. The approach involves the pooling of lists of vehicles, lists of functioning volunteers, and information on alternative modes (such as taxi rates).

Volunteers appear to be the key ingredient. It is no longer any problem to insure volunteer drivers of agency vehicles. The National Center for Voluntary Action published a pamphlet that describes a blanket policy that covers all volunteers for an annual premium of $2 per volunteer ($40 minimum premium per policy).

It is difficult to recruit volunteer drivers who have the physical stamina to lift handicapped individuals into cars. From experience, most volunteers are either housewives or retired persons, for whom the lifting is difficult. None of the social service agencies interviewed had acquired the specially equipped vehicles to make access and egress easier for the physically handicapped.

Some of the social service agency personnel interviewed were unfamiliar with alternative transportation modes available to the carless. Another interim solution includes a compilation of information on existing public transportation routes, fare structure, and schedules; conventional taxi rates; contract rates offered by taxi companies; and information on rates charged by emergency squads for ambulance pickup in low-income areas. If a central dispatch office has this information, it can be passed on to clients and agency personnel to answer immediate problems.

LONG-RANGE SOLUTIONS

Much transit planning is now occurring in city and regional governments. Transit planners typically depend on aggregate data sources such as origin-destination studies, census data, and traffic surveys. Perhaps new discussions should take place between planners and heads of social service agencies to identify specialized transportation needs, which may occur monthly, such as a need to distribute surplus food, or unpredictably, a need to get a client to a medical specialist in an adjacent town.

Such discussions may lead to exploration of demand-responsive, flexibly routed public transportation services. This approach to bus service is under experimentation in many cities (5) and could prove a great benefit to social service agencies. Low-income residents of Model Cities neighborhoods in Detroit, Michigan, and Columbus, Ohio, have increased access to local agencies as a result of demand-responsive systems that provide door-to-door pickup and delivery.

Cities that have evaluated their needs and have fulfilled the federal transportation planning requirements may apply for capital grants and service development grants from the Urban Mass Transit Administration, provided the local municipality contributes. However, few cities have a transit system that provides ubiquitous service to

social service agencies. In an era of increasing deficits for transit operators, most are reluctant to provide these services, which are unlikely to pay for themselves.

An issue worthy of further research is that of other federally funded approaches to the transportation problems of social service agencies. One suggestion broached by volunteer organizations is that the current rate of income tax credit for volunteers who drive for charitable organizations be raised. At present the rate is 8 cents per mile, 3 cents less than business corporations can deduct for business mileage. Equalization of the income tax advantage bringing the volunteers up to 11 cents per mile would be instrumental in promoting the expansion of volunteer programs.

Another suggestion involves federal support for capital acquisition as agencies band together to provide better transportation services. Several important questions should be explored with respect to this proposal: What would be the basis for local matching grants? Would the consortium of agencies include both public and privately funded organizations? In a consortium, would the agencies participating be charged on a per client basis or on a flat yearly fee? If the latter, how would assigning of transportation priorities take place?

There is only a modest amount of literature available describing how agency transportation programs are set up, and none analyzes in depth the costs and benefits of these experimental programs. These matters were discussed at length at the UMTA-sponsored Spring Meeting of the University Research and Training Grant Program in 1973. Therefore, it is premature to discuss solutions to a problem of client immobility that has not been completely documented. What does appear clear is that there is widespread recognition among social workers that carless clients, or otherwise handicapped individuals, are denied needed social services because of transportation difficulties.

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TRANSPORTATION NEEDS AND DESIRES OF THE ELDERLY RESIDING IN A MEDIUM-SIZED CITY

V. Clayton Weaver, Barton-Aschman Associates, Inc.; and
Moreland Herrin, University of Illinois at Urbana-Champaign

Large numbers of elderly live in medium- and small-sized cities where the sole form of public transportation is the bus, which is infrequently used and has limited route coverage. This paper reports a study of the transportation needs of those citizens and their reasons for using the modes that they do. Basic data were collected by sampling the elderly in a city of 125,000 population. In a special phase of the study to determine why they used transit, 2 conclusions were reached: Cost plays a minor role in the decision to use or not use the bus, and physical problems significantly limit ridership. Based on the findings, several recommendations are made for improving the mobility of the elderly.

•SEVERAL studies (2, 3, 6) have investigated transportation needs of the elderly in general, but few have dealt with the problem of the mobility constraints facing the elderly in a medium-sized city (50,000 to 250,000 population) where the sole form of public transportation is the bus, which is infrequently used and has limited route coverage. Therefore, this study was conducted in Champaign-Urbana, Illinois (population approximately 125,000) and was directed toward answering the following questions:

1. What determines the transportation mode choices the elderly make?
2. How does the public bus transit system meet the needs of the elderly, and what are their views about it?
3. What possible changes could be made in the available transportation modes to better serve the elderly?

SURVEY METHODOLOGY

Selection of Size and Type of Sample

The term "elderly" can be defined in several ways. It can identify that segment of the population who have difficulty caring for themselves or whose family and life cycles have changed or who have retired from full-time gainful employment. This paper uses the last definition and considers the elderly to be those 65 or older, the most frequent age of retirement.

Lists of elderly citizens who could potentially be interviewed were obtained from 3 main sources: township tax assessor, Champaign County Housing Authority, and community action groups. Names were obtained of slightly more than 3,000 people, representing approximately 50 percent of the 6,156 elderly residents of Champaign-Urbana. The final sample was randomly drawn from this list of 3,000 names. Those over 65 represent only 6.9 percent of the total Champaign-Urbana population. This relatively low proportion of the elderly in the twin cities is due to the high student population of the University of Illinois. The average age of those sampled was 73 years.

The Survey Research Laboratory at the University of Illinois advised that the sample should be at least 3 percent of the total population over 65, and 207 elderly citizens, a 3.25 percent sample, were interviewed.

Design of the Questionnaire

A telephone interview method was used because it provides a quick way to gather data at low cost and is more personal than a mail survey. It also permitted elderly volunteers to assist in taking the data.

Three types of information were obtained in the interviews: demographic characteristics of those interviewed, such as age, sex, income, and possession of driver's license; travel habits and transit usage; and attitudes about the effectiveness of the present public transportation system and possible improved service in the future. The questionnaire could be completed in about 5 minutes by the elderly persons who could easily check off answers while they conducted the interviews.

Collection of the Data

Data were collected from the 207 elderly citizens between October 10 and October 24, 1972. The elderly volunteers used as some of the interviewers were from 2 community action groups: Tele-Care and Retired Senior Volunteer Program. In general, the elderly citizens interviewed were much more willing to talk with an elderly interviewer than a nonelderly interviewer.

ANALYSIS OF THE TRANSPORTATION SURVEY

The data were analyzed to obtain 4 types of information: demographic characteristics, present transit system usage, determinates of modes used, and travel desires.

Demographic Characteristics

Table 1 gives a summary of the demographic characteristics. A point should be noted with respect to income. First, the sex of the respondent appeared to have a great deal of effect on income. Although males had a higher income than females, a female is much more likely to live alone and therefore have an income for only one person while a male may have an income for 2 people. In future research, it might be valuable to gather information about the number of people in the household unit.

Bus Usage

The Champaign-Urbana Mass Transit District provides bus service to the twin cities. The district operates 13 buses on 7 routes during the peak periods from 6:00 to 9:00 a.m. and 3:00 to 6:00 p.m., Monday through Friday. During the rest of the day, only 10 buses are operated on the same 7 routes. The other 3 buses used for peak periods are available during the off-peak hours for charter service. The district offers reduced service on Saturday and no service on Sunday.

Table 2 gives a summary of the use of the bus system by the elderly. Analysis of bus system usage by income class revealed an interesting fact. Bus ridership declined as incomes increased for the first 3 income classes, but then rose sharply when incomes increased to over $15,000. The decline in bus ridership with an increase in income was expected because automobile ownership and driver's license possession were found to be directly related to income. The increase in bus ridership for the highest income class is a surprise and can possibly be explained by factors such as educational levels and increased mobility patterns of the more affluent. Another factor may be that those in the middle-income brackets may feel that there is a social stigma associated with the use of public transportation.

Table 2 gives a summary of the relation between demographic characteristics and the number of bus trips per week. That retired persons took twice as many bus trips as working persons may mean that the bus does not serve the working person effectively or simply that working people have a greater likelihood of owning automobiles and having higher incomes, either of which would mean fewer bus trips. The 2 variables were found statistically related to the 90 percent level.

Taxi Usage

Five taxicab companies provide service 7 days a week and 24 hours a day in Champaign-Urbana. Table 3 gives a summary of taxicab use by the elderly. Those in the middle-income classes made the greatest use of taxicabs. This fact might further reinforce the point made earlier about there being some type of stigma associated with

Table 1. Demographic characteristics.

Characteristic	Survey (percent)	Comparative Data (percent)
Sex		
Male	20.3	35[a]
Female	79.7	65[a]
Automobile ownership		
0	41	56[b]
1	48	44[b]
2 or more	11	
Driver's license		
Have	46.4	
Do not have	53.6	
Employment		
All		
Employed	9.8	
Retired	90.2	
Female		
Employed	8.6	11.5[a]
Retired	91.4	88.5[a]
Male		
Employed	14.3	27.9[a]
Retired	85.7	72.1[a]
Income		
< $5,000	59	68[c]
$5,000 to $10,000	20	
> $10,000	21	32[c]
Home ownership		
Own	80.1	69[d]
Rent	19.9	31[d]

[a]1970 Census of Champaign-Urbana.
[b]Data reported by Riley (8).
[c]1970 Census of Chicago.
[d]Data reported by Markowitz (6).

Table 2. Percentage of elderly who use buses and number of trips per week.

Characteristic	Use	Do Not Use	Trips per Week
All	41.5	58.5	1.0
Sex			
Male	22.0	78.0	0.5
Female	46.3	53.7	1.1
Automobile ownership			
0	64.7	35.3	2.0
1	26.0	74.0	0.2
2 or more	15.8	84.2	0.1
Driver's license			
Have	16.7	83.3	0.2
Do not have	63.3	36.7	1.5
Employment			
Employed	40.0	60.0	0.5
Retired	41.2	58.8	1.0
Income			
< $5,000	46.7	53.3	1.3
$5,000 to $10,000	33.3	66.7	0.9
$10,000 to $15,000	25.0	75.0	0.1
> $15,000	42.9	57.1	1.1
Home ownership			
Own	36.9	63.1	0.8
Rent	56.4	43.6	1.6

Table 3. Percentage of elderly who use taxicabs and number of trips per week.

Characteristic	Use	Do Not Use	Trips per Week
All	51.2	48.8	0.5
Sex			
Male	38.1	61.9	0.3
Female	54.6	45.4	0.5
Automobile ownership			
0	60.0	40.0	0.8
1	46.0	54.0	0.2
2 or more	42.1	57.9	0.1
Driver's license			
Have	40.6	59.4	0.4
Do not have	60.4	39.6	0.7
Employment			
Employed	60.0	40.0	2.1
Retired	50.0	50.0	0.4
Income			
< $5,000	43.0	56.1	0.5
$5,000 to $10,000	72.2	27.8	0.6
$10,000 to $15,000	45.8	54.2	0.9
> $15,000	35.7	64.3	1.1
Home ownership			
Own	51.6	48.4	0.4
Rent	50.0	54.0	0.6

riding the bus. Those with incomes under $5,000 can least afford to use taxicabs, and those with incomes higher than $15,000 who do use the taxicabs make many trips, accounting for the higher average trips per week for this income class.

Reasons for Using Buses or Taxis

Table 4 gives the reasons for riding buses; the most frequently mentioned reasons were automobile related. A preference for the automobile was the major reason given for not riding the bus, although having physical problems was a significant one and will receive special attention in this paper.

Cost of riding the bus (30-cent fare) was not mentioned by any of the respondents as a reason for not using it. This fact should lend support to the argument that a reduced-fare program would not increase elderly ridership significantly in Champaign-Urbana. A reduced-fare program is not to be ruled out completely though because of the elderly who must use public transit and have financial difficulties. Route and time inconveniences indicate a desire for a high level of service, and increasing the level of service may increase ridership much more than reducing the fare.

Taxis are used mostly when an automobile is not available. One might expect convenience to be mentioned frequently as a reason for using taxicabs, but about 10.7 percent of those interviewed said they used cabs because no bus was available (Table 5). The frequent mentioning of comfort and safety might indicate a preference for smaller vehicles by the elderly. Cost was an important reason for not using taxis.

The responses given in Table 5 indicate that competition for elderly riders occurs between the taxi and bus systems and that public transportation serves a captive market. Those individuals who have an automobile and can drive seem perfectly happy doing so. Therefore, the thrust of any future improvement in transit service for the elderly must be aimed at those without automobiles or driver's licenses.

As stated earlier, 12.7 percent of those interviewed who did not ride the bus gave a physical restriction as the reason. Later the respondents were asked whether they had any physical restriction that made bus riding difficult, and 21.7 percent responded that they did have such a restriction. Walking difficulty was cited by 16 percent, vision by 2 percent, hearing by 1 percent, and other miscellaneous problems by 3 percent. In the nation, some 10 percent are reported to have a significant vision loss, approximately that many have a significant hearing loss, and 1.9 percent of the aged are blind. Since only 2 percent of the respondents reported significant vision problems, it may be that the elderly consider only near blindness or actual blindness as significant vision losses. One possible explanation for the low number reporting a hearing problem is that the question was worded in such a way that people did not feel that a hearing loss made the use of the bus difficult and indeed it may not. Those that have walking difficulties that restrict their bus usage may require door-to-door transit service and specially designed equipment.

Travel Desires of the Elderly

Two questions were asked to determine the travel desires of the elderly: Are there any areas of town that they would like to travel to that they now have difficulty in reaching? Would they make more trips around town than they now make if better public transportation were available?

Of those interviewed, 15.3 percent stated that there were areas of towns that they would like to travel to that they have difficulty in reaching. The areas listed are served well by the present Champaign-Urbana Mass Transit District. What the responses may indicate is that there are some 15.3 percent of the elderly that have problems getting around, regardless of the destination. This percentage is close to the 22 percent who indicated that physical problems limited their use of the bus. The problem apparently lies not at the destination end of the trip but rather at the origin or home end, where some distance must be walked to catch the bus. This problem could be rectified only by door-to-door service.

Of those interviewed, 27 percent said that they would make more trips around town than they do now if better public transportation were available. Two areas, downtown

Table 4. Reasons for using and not using buses.

Reason	Respondents (percent)
For using	
Automobile not available	35.6
Convenient route	22.8
No driver's license	17.5
Convenient time	9.4
Cost	5.4
Comfort	4.7
Safety	2.0
Other reasons	2.7
For not using	
Prefer automobile	47.3
Prefer friend's or relative's automobile	15.3
Physical problems	12.7
Route inconvenient	11.3
Time inconvenient	8.0
Prefer taxi	2.0
Cost	0.0
Other reasons	3.3

Table 5. Reasons for using and not using taxicabs.

Reason	Respondents (percent)
For using	
Automobile not available	30.6
Convenient route	15.7
Bus not available	10.7
Convenient time	9.1
No driver's license	8.3
Comfort	7.4
Safety	7.4
Cost	0.0
Other reasons	10.7
For not using	
Prefer automobile	50.0
Prefer friend's or relative's automobile	18.1
Cost	13.0
Prefer bus	12.3
Unsafe	2.2
Uncomfortable	1.5
Inconvenient time	1.5
Inconvenient route	0.0
Other reasons	1.5

Table 6. Future trip purposes.

Purpose	Respondents (percent)
Shopping	55.4
Church	17.9
Visiting friends	12.5
Visiting relatives	3.6
Doctor	3.6
Recreation	3.6
Meetings	1.8

Urbana and downtown Champaign, accounted for the destinations of more than 62 percent of the future trips. Those 2 areas are served well by the Mass Transit District, and again the conclusion is that improvements in transportation services for the elderly need to take place at the origin end of the trip rather than at the destination end.

Table 6 gives the purposes of future trips. Almost 18 percent of the trips are to church and no buses operate on Sunday. The need for Sunday service is likely higher for the elderly than for any other population group, and this should be considered when any transit system for the elderly is being planned.

SUMMARY AND RECOMMENDATIONS FOR MOBILITY IMPROVEMENTS

Summary

The results of the transportation survey of the travel habits and desires of the elderly in Champaign-Urbana revealed the following statistically significant relations among 4 variables and bus ridership (although less than 26 percent of the variation in bus usage could be explained):

1. Bus usage declined as the number of automobiles available increased;
2. Those without driver's licenses were 4 times as likely to use the bus as those with driver's licenses;
3. Females were twice as likely to use the bus as males; and
4. Bus usage declined as income increased for incomes less than $15,000, and usage rose sharply for incomes more than $15,000.

Cost seemed to play a minor role in the decision to use or not to use the bus, and physical problems significantly limited bus ridership by the elderly.

These facts may be important in deciding what improvements should be made in the present system.

Taxi ridership was found to be significantly related to driver's license possession, employment status, automobile ownership, and sex. Relations among these variables and taxi usage did exist; however, they were weak and would prove of little value in explaining the variation in taxi usage. The respondents indicated that cost was an important factor in taxi use.

Some 15 to 25 percent of the elderly have unsatisfied travel desires, most frequently related to shopping needs. Because shopping areas have frequent bus service, the difficulty may be at the origins of the trips.

About 18 percent of the elderly said that they would make more trips to church on Sunday if better public transportation service were available.

Recommendations

The fact that cost was not stated as a reason for not using the bus indicates that a reduced-fare program would not significantly increase ridership by the elderly even though it may prove to be of some assistance to those who are currently using the system.

The present transit system can do little to better serve individuals with physical difficulties. They require door-to-door service in some type of specially designed equipment.

The taxi was convenient for those who used it, but its use was restricted by its relatively high cost. The elderly need this kind of convenient service, i.e., a demand-responsive door-to-door service but at low cost.

To provide Sunday service for the entire city would not be financially feasible for the Mass Transit District. Therefore, individual churches should investigate the transportation needs of their elderly members and see whether they could meet them on a charter or cooperative basis.

Some of the things the Mass Transit District can do to better serve the elderly include the following: programs to make the elderly more aware of the present services available; installation of easy-to-read maps and timetables in areas frequently used by the elderly; installation of benches and shelters; and development of programs during the off-peak hours between 9:00 a.m. and 3:00 p.m.

The Champaign Chamber of Commerce has been investigating the possibility of a reduced bus fare program for the elderly. It might also explore a reduced-fare program for the elderly on the taxicab system, which is suited to the needs of the elderly.

The possibility of obtaining a specially designed vehicle for use by the elderly is currently being investigated by several agencies. The planners of such a system should complement and not duplicate the services offered by the present Mass Transit District.

Community action groups should receive public support for the roles that they are playing in helping to find solutions to the transportation needs of the elderly.

Transportation cooperatives, owned and operated by older people, can provide the specialized type of transit services that many older people require. Cooperatives have been quite successful in Raleigh and Wake County, North Carolina, and in 9 counties in the Green Hills region of central Missouri.

In summary, activities that may result in improvements in transportation services for the elderly in a bus-oriented community like Champaigh-Urbana include bus system improvements (as indicated), study of a reduced-fare taxi program, operation of a specially designed vehicle to complement the present Mass Transit District, and public support of community action programs.

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INCOME DISTRIBUTION EFFECTS OF THE ATLANTA TRANSIT SYSTEM

Jarir S. Dajani and M. Michael Egan, Duke University

This paper reports on a pilot study to evaluate the income-distribution effects of the proposed Atlanta transit system. The incidence of benefits and costs to each of 8 traffic zones is estimated. The zones have annual incomes per family varying between $5,000 and $18,000. Benefits accruing to each zone as a result of savings in time, vehicle ownership and operating costs, transit fares, parking, and accidents are estimated and compared to transit fares and additional sales taxes that must be paid by the residents of that zone. The net benefits accruing to each zone seem to be more, both per family and per trip, in zones where family incomes are lower. This pattern, however, is strongly influenced by both the location of the zone relative to the closest transit station and the level of interaction between the zone and the central business district. Other factors affecting the distribution of income in the Atlanta metropolitan area are also discussed.

•DURING the last 10 years public investment in urban transit systems has increased considerably and has evoked charges that transit systems favor white middle-class suburbanites over central city, blue-collar workers. In November 1971, the voters of Atlanta approved a $1.4-billion transit system. This new system has also been criticized on the grounds that it favors the nonpoor and thus does not help to compensate for the income distribution biases of public highway investments. The system is supposedly biased to favor the central business district worker who is predominantly white and in the middle-income bracket. In addition, the system is being paid for by a 1 percent sales tax in the 2 counties that are building the transit system, and the use of this regressive tax has heightened the controversy over the possible income biases of the Atlanta system.

The Urban Mass Transportation Act of 1970 provides a federal grant of two-thirds of the capital cost. The 1 percent sales tax covers the remaining one-third of the capital cost and will heavily subsidize the operating cost of the system. Because the fares will be subsidized and because the rail and bus lines will not serve all areas of Atlanta equally, the new system could indeed have a considerable distributive effect on incomes in Atlanta.

This paper examines the possible distributive effects of the Atlanta system in a particular year after the system is completed to determine whether there is an income-group bias. It reports on a pilot study in 8 of the 399 traffic zones into which the metropolitan area is subdivided. The 8 zones were chosen primarily because data were readily available for them and because they represent a wide range of family incomes, residential densities, and automobile ownership characteristics (Tables 1 and 2). Figure 1 shows the relative location of the study zones with respect to the proposed rapid transit system.

1983 was chosen as the year in which to predict the system's distributive effects primarily because of data availability. Many of the computer programs that have been used in planning the Atlanta system are simulations of the transportation network that is supposed to exist in 1983. Many of the data necessary for this study have come from these programs. Throughout this paper the rapid transit system is compared with a 1983 expressway transportation network that would include only the present Atlanta bus system for public transit. The incremental investment in transit above the amount invested in expressways will give rise to incremental cost and benefits for

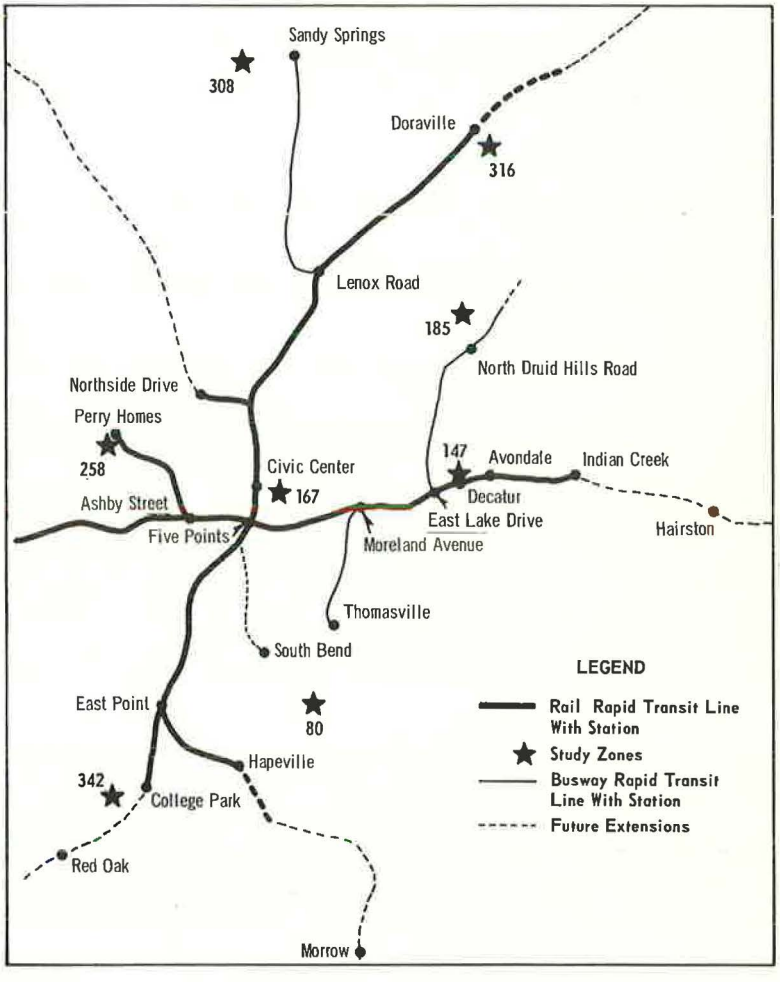
Table 1. 1983 socioeconomic data.

Zone	Average Family Income (dollars)	Persons in Labor Force	Families	Passenger Cars	Land Area (acres)
80	11,683	404	240	381	5,462
147	8,771	1,468	771	982	1,755
167	6,353	1,812	996	692	1,397
185	18,595	703	453	951	4,306
258	5,396	2,580	1,037	895	3,218
308	18,173	4,091	4,021	8,424	89,780
316	10,308	1,175	1,063	2,026	61,370
342	8,838	2,539	1,432	2,358	22,820

Table 2. 1983 transportation data.

Zone	Daily Trips	Distance to Transit Station (miles)	Automobiles per Family	Distance From CBD (miles)	Percentage of Trips to CBD
80	2,163	2.7	1.58	5.4	24.9
147	6,623	0.3	1.27	5.2	21.8
167	5,799	0.9	0.69	1.4	67.7
185	4,748	0.8	2.09	6.7	17.1
258	7,292	0.5	0.86	4.3	48.2
308	42,723	1.4	2.09	11.3	12.9
316	10,646	0.9	1.90	13.7	13.0
342	13,006	1.4	1.64	8.5	19.4

Figure 1. Atlanta rapid transit system.



the city. Furthermore, it is assumed that approximately the same total investment in highway facilities will occur in the study area, with or without rapid transit. This assumption will be justified later in the discussion of transportation networks and the effects networks have on land use development patterns.

The incremental costs and benefits that will accrue to each of the 8 study zones are measured, and the distributive nature of the rapid transit system is examined. The procedures outlined in this paper could be extended to the entire area and could thus provide policy-makers and voters with more evidence on which to base decisions pertaining to choices among alternative transportation systems.

COMPARISON OF ALTERNATE SYSTEMS

A comparison of the costs and benefits of a certain transportation strategy requires that the transportation planning process be carried out for 2 transportation systems: the highway system only and the mixed highway-rapid transit system. The following notation is used to identify the 2 systems:

S1983* = 1983 transportation network with rapid transit (dual-mode system), and
S1983 = 1983 highway transportation network without rapid transit (single-mode system).

The complete transportation planning process was carried out for system S1983*, but not for S1983.

Different systems obviously induce different urban growth patterns; therefore, only a new forecast can adequately reflect the dispersed pattern of urban development that will arise from an all-highway system. In addition, new trip generation predictions are necessary for each transportation zone because all zones will display different development densities if they are served by a highway network rather than a highway-transit network. Likewise, new trip-distribution predictions are necessary for S1983.

For example, a zone in Atlanta's CBD would attract more trips under a rapid transit-highway system than an all-highway system because of the accessibility the rapid transit system would provide to central business district zones. Levels of traffic congestion and travel times would vary considerably on portions of the highways that might be common to both transportation alternatives. Expressways in the CBD might, for example, be less congested in the all-highway network than in the highway-public transit network because the CBD would have a considerably higher employment density and would thus have more trips both by rail and by car attracted to it with a rapid transit system than with an all-highway system.

Since the planners have not analyzed an all-highway system for 1983, some assumptions had to be made in order to derive the necessary data for S1983 from the 1970 Atlanta highway system (S1970). It was assumed that 1970 automobile travel times would continue to prevail in 1983 in the central area of Atlanta for the S1983 system. If public investment in transportation continued only in highways, these new roads would be built almost exclusively in the periphery of Atlanta. This would cause Atlanta to continue to grow in a dispersed, low-density land development pattern similar to that of other automobile-oriented cities such as Los Angeles. This dispersed growth pattern has already revealed itself along Atlanta's recently completed perimeter expressway, where at a great distance from the CBD suburban office parks, apartments, and shopping centers are springing up in response to this form of transportation investment. Consequently, if no rapid transit system were built to redensify the central portions of Atlanta, most of the growth between 1970 and 1983 would occur in the outer suburbs of Atlanta and the CBD would remain approximately the same size.

The assumption that 1970 travel times will persist in 1983 is supported by the fact that only 2 major new expressways are planned for 1983 to serve the downtown area. Therefore, whether the downtown can continue to grow is doubtful. Hence, with only slow growth in the CBD and with the accessibility provided by the 2 new expressways, the assumption that the 1983 CBD will attract approximately the same number of trips as it did in 1970 and travel times will be approximately the same is not unreasonable. In addition, in an all-highway system, many of the trips that originate at the periphery

and are generated by either system would be bound for destinations in the outer ring of new development rather than for the CBD, which would be their probable destination if rapid transit were built.

BENEFITS OF THE RAPID TRANSIT SYSTEM

The proposed system will yield 3 main benefits to individuals in the Atlanta area: (a) savings in net travel times; (b) savings in vehicle operating and capital costs, including parking, accidents, and insurance costs; and (c) increases in trips. Although the first 2 benefits are dealt with extensively, the third benefit is not accounted for in the urban transportation planning process, which assumes that the same number of trips will be generated by a zone regardless of the system that serves it. Total annual benefits are given in Table 3.

Time Savings Benefits

Travel times from each of the 8 study zones to each of the other 399 zones in the Atlanta area for S1983 were derived by using actual measured 1970 automobile travel data (1). As discussed earlier, the underlying assumption is that, without a rapid transit system, 1970 automobile travel times will persist until 1983 in the central portion of Atlanta.

The available sample of 1970 automobile travel times, however, is not large enough to cover all possible trip routes in the all-highway system of 1983. To extend the 1970 automobile travel times to that system, adjustment factors were developed that converted the 1983 highway travel times for S1983* to the 1983 highway travel times for S1983.

$$(T^*_{ijk})(F_{i\ell}) = T_{ijk} \quad (1)$$

where

T_{ijk} = travel time in both 1970 and 1983 on the Atlanta highway system from origin i to destination j (i = 1, ..., 8 and j = 1, ..., 399) by mode k (k = 1 for automobile and 2 for transit);
T^*_{ijk} = travel times on S1983*;
$F_{i\ell}$ = adjustment factor that converts T^*_{ijk} to T_{ijk} (i = 1, ..., 8) and (ℓ = 1, ..., 5).

For each of the 8 study zones, 5 adjustment factors were developed, 1 to each quadrant and 1 to the CBD. Thus, a trip originating in a study zone would have its 1983 highway travel time in S1983* converted according to the location of its eventual destination. There were 40 factors developed in all, 5 for each of the 8 zones.

To compute the factors, we compared 1970 travel times on the highway system and travel times on S1983* for each of 40 origin-destination pairs representing all 4 quadrants and the CBD. The former travel times had to be derived from 1970 data, which were obtained by the Georgia State Highway Department. These data were in the form of measured speeds on selected roads and expressways. The speeds were measured by test vehicles traveling on 57 subsections of 6 major freeways and 6 major arterials surrounding Atlanta. The freeway subsections totaled 86 miles (138 km) in length and had an average daily traffic volume of 76,962 vehicles. The arterial subsections totaled 24 miles (39 km) in length and had an average daily volume of 20,230 vehicles. Travel speeds were measured on the subsections at 3 or 4 times during each of the 2 peak periods and were measured either once or twice during the off-peak period. Figure 2 shows the location of the expressways. Corresponding 1983 highway travel times from 1 zone to another for the highway-transit system were based on the least time path between a pair of zones.

Whenever a 1970 subsection did not have a corresponding 1983 link, a 1970 travel time was assigned to a 1983 link on the basis of the link's location in the city and its classification as either a freeway or an arterial link. For example, a trip originating in origin zone 80 and bound for a destination zone in quadrant 2 of the city would take

Table 3. Total annual benefits.

Zone	Amount (dollars)	Zone	Amount (dollars)
80	57,215	258	1,084,409
147	903,386	308	1,262,062
167	875,311	316	461,885
185	307,163	342	210,905

Figure 2. 1970 Atlanta expressway system.

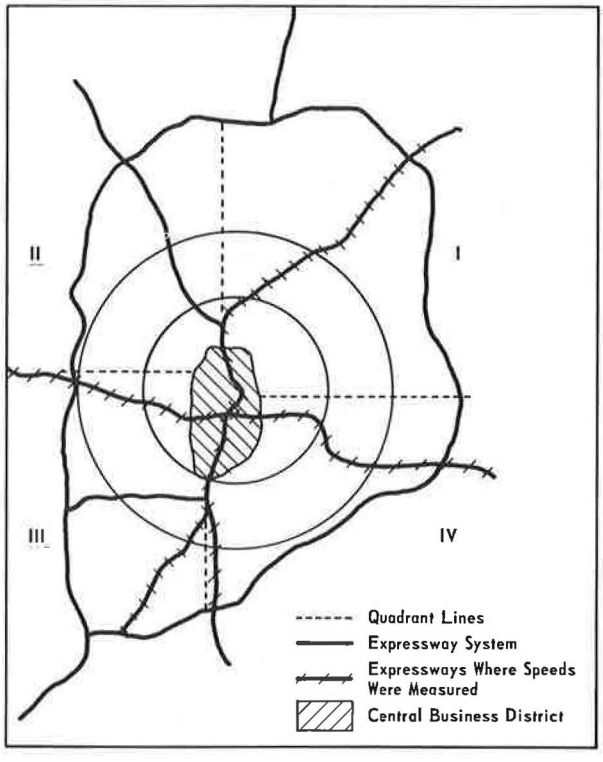


Table 4. Annual benefits from time saved.

Zone	Time Saved (min/trip/day)	Average Increment of Time Saved	SRI Time Value (dollars/hour)	Annual Time Saving (hours/year)	1983 Value of Time Saved (dollars/year)
80	2,059.9	1.06	0.95	17,809	16,918
147	56,711.9	10.23	1.45	491,503	712,679
167	21,683.6	4.16	0.65	187,924	122,150
185	16,510.5	3.83	1.36	143,086	194,596
258	48,433.1	7.48	0.63	419,753	264,444
308	35,626.3	0.94	1.36	308,761	419,904
316	20,377.8	2.12	0.95	176,607	167,776
342	-7,690.5	-0.66	0.79	-66,651	-52,654

Table 5. Annual benefits from private vehicle operating and capital costs.

	Operating Cost		Capital Cost		
	Daily Vehicle-Miles Not	Annual Saving	Cars No Longer Needed		Annual Saving
Zone	Traveled	(dollars)	Number[a]	Percent	(dollars)
80	138.6	3,834	33	43	16,644
147	442.6	12,244	154	48	86,708
167	1,003.0	27,748	753	49	432,978
185	847.4	23,444	143	33	55,353
258	2,418.8	66,914	619	50	363,043
308	9,840.5	272,229	900	33	348,381
316	3,316.3	91,742	275	45	145,158
342	1,655.8	45,807	218	48	122,742

[a](S1983* trips - S1983 trips)/1.38, where 1.38 = avg automobile occupancy.

an expressway in the 1983 highway network on which no 1970 travel times were measured. To assign a 1970 travel time to the links on that expressway, we grouped the links into 3 categories, which were determined by their location within 1 of 3 concentric rings centering on the CBD. The average 1970 travel times on the 2 nearest expressway links by both quadrant and concentric ring were applied. The concentric rings were used because travel times generally increase on expressways and arterials as distance to the CBD decreases. Travel time comparisons were made only for links that were of the same street classification.

Once the necessary factors, F_{iq}, were obtained for each of the 40 origin-destination pairs, they were used to provide a trip-time matrix (8 × 399) for S1983. Similar trip-time matrices for S1983* were provided by the Georgia Department of Transportation. A transit travel-time matrix was provided by the Metropolitan Atlanta Rapid Transit Authority (2, 3). The Georgia Department of Transportation also provided a total person-trip interchange matrix. A modal-split analysis was performed on this matrix. In the case of S1983, this was simply a matter of subtracting the old bus system patronage estimates from total person trips made by automobile. A modal-split analysis was performed for S1983* on the basis of the diversion curves used by the consultants.

Net time savings for trip-makers in zone i due to the proposed system can now be readily computed from the equation

$$X_i = \sum_{k=1}^{2} \sum_{j=1}^{399} (T_{ijk} - T^*_{ijk}) N_{ijk} \qquad (2)$$

where

X_i = net time savings for trip-makers in zone i resulting from the investment in transit, in minutes per trip per day; and

N_{ijk} = total number of trip-makers using mode k between origin zone i and destination zone j.

The values obtained are given in Table 4. These values are converted to annual time savings by multiplying by the number of working days per year and by doubling the figures to allow for 2-way trips. Only working days are considered because the origin-destination study on which the study was based does not consider weekend trip patterns. Time savings were in turn converted to dollar savings; monetary time values obtained by Thomas and Thompson (4) were used. A specific value of time was found for each of the 8 study zones on the basis of average zonal family income and the average length of zonal time savings per trip. These values were applied to the time savings of each zone, and monetary values of time saved by virtue of the proposed transit system were obtained.

Savings in Operating and Capital Costs

The next series of benefits to be estimated are savings in private vehicle capital and operating costs. These savings are based on the number of commuters who divert to rapid transit from the highway system. A person who diverts to the rapid transit system no longer incurs the automobile cost of the trip.

Operating costs considered in this study are gas, oil, tires, and maintenance costs. Operating costs per mile, which were given by the Bureau of Public Roads and used by the consultant (5), have been used in the following equation:

$$OC_i = \sum_{i=1}^{399} \left(\frac{N_{ij1} - N^*_{ij1}}{1.38} \right) (D_{ij})(C) \qquad (3)$$

where

OC_i = operating cost saving to origin zone i,
D_{ij} = distance in miles from origin i to destination j, and
C = cost of automobile operation per mile.

N_{ij1} and N^*_{ij1} were defined above; the subscript 1 indicates the automobile mode, and the denominator 1.38 refers to the average car occupancy in Atlanta.

Some of the trip-makers who divert to rapid transit will no longer need a second automobile because of the rapid transit system. Estimating the proportion of diverted trip-makers who will no longer need a second car in 1983 is at best a precarious task. Nonetheless, the consultant compared frequency of second car ownership in major cities both with and without transit to predict how many diverted trip-makers in Atlanta would no longer need a car. They decided that roughly 50 percent of diverted trip-makers would divest themselves of a car if a rapid transit system were built in Atlanta. The authors feel, however, that income would enter into a trip-maker's decision to keep a car, and that 50 percent was too high for high-income zones. Therefore, zone 258, which has the lowest family income, was assigned the 50 percent rate; but zone 185, which has the highest income, was assigned 33 percent. Linear interpolations between these 2 extremes yielded values for zones with intermediate incomes. Zonal capital cost savings were obtained from the use of a value of $1,173 as the annual capital cost of owning an automobile. Annual operating and capital cost savings are given in Table 5.

Savings in Parking and Accident Costs

Another benefit of the rapid transit system is the savings in parking fees that accrue to transit-diverted trip-makers who travel to the CBD, this being the only area where monthly parking fees are consistently charged. Based on an average monthly charge of $20, savings in parking costs that accrue to trip-makers in each of the 8 study zones were found. The diversion of vehicles from the highway to the transit mode is also expected to reduce the number of accidents on the road. The number of accidents is a function of the distance traveled and the type of road. Unfortunately no data exist on what types of roads diverted transit commuters would no longer travel on, so an accident cost per vehicle-mile had to be applied to all mileage not traveled regardless of road classification. Accident costs were estimated to be $1,987,700 per 100 million vehicle-miles of travel per year. Annual parking and accident cost savings are given in Table 6.

Insurance Cost Savings

Daily commuters pay an insurance premium, in addition to normal insurance costs, on the cars they travel to work in. According to the project consultants, this premium averages $27.50 per year for an automobile used for commuting in Atlanta (5).

The major difficulty in estimating this benefit is that no data exist on how many of the transit-diverted trip-makers would be making work trips because the automobile trips are not stratified by trip purpose for S1983. It was assumed that diverted ridership would be distributed among the trip purposes in the same proportion as all transit ridership by trip purpose. For example, 60 percent of all transit riders from zone 80 make work trips. Therefore, it was assumed that 60 percent of the former automobile users who diverted to rapid transit would be making work trips. This assumption probably yields a conservative work-trip estimate because typically transit systems attract mainly commuting rather than shopping or school trips. Nonetheless, this procedure was followed because it gives the probable minimum number of diverted home-based work trips. Table 6 gives the results of this benefit computation.

Fare Savings

Under the old bus system, the transit fare in Atlanta was 40 cents 1 way, plus 5 cents for a transfer. Consequently, a typical bus work trip in Atlanta in 1971 costs

Table 6. Annual benefits from parking, accident, and insurance costs and transit fare savings.

Zone	Parking Cost		Accident Cost		Insurance Cost		Transit Fare	
	CBD Diverted Cars	Annual Saving (dollars)	Daily Vehicle-Miles Not Traveled	Annual Saving (dollars)	Percentage of Transit Work Trips	Annual Saving (dollars)	Captive Transit Riders	Annual Saving (dollars)
80	30.5	7,315	138.6	145	0.60	546	53	11,713
147	97.0	23,286	442.6	455	0.77	3,261	293	64,753
167	725.6	174,144	1,003.0	1,034	0.55	11,389	479	105,859
185	111.4	26,732	847.4	879	0.75	2,949	10	2,210
258	378.2	90,778	2,418.8	2,532	0.63	10,724	1,294	285,974
308	801.3	192,310	9,840.5	10,171	0.73	18,067	0	0
316	198.2	47,576	3,316.3	3,432	0.82	6,201	0	0
342	192.4	46,162	1,655.8	1,716	0.67	4,017	195	43,095

Table 7. Annual costs.

Zone	Sales Tax				Transit		
	0.5 Percent Sales Tax on Gross Income	1983 Gross Income (dollars)	Tax Contribution per Family (dollars)	Annual Contribution (dollars)	Transit Patronage	Annual Fare Contribution (dollars)	Annual Cost (dollars)
80	0.344	11,683	40.18	9,643	94	14,664	24,307
147	0.366	8,771	29.47	22,720	48	75,036	97,756
167	0.379	6,353	24.10	24,000	1,436	224,016	248,016
185	0.230	18,595	42.76	19,270	207	32,292	51,566
258	0.432	5,396	23.31	24,172	1,927	300,612	324,784
308	0.280	18,173	41.79	168,037	1,241	193,596	361,633
316	0.333	10,308	34.32	36,482	380	59,280	95,762
342	0.384	8,838	33.93	48,647	480	74,880	123,527

Table 8. Net annual benefits.

Zone	Family Income (dollars)	Net Annual Benefits Less Costs (dollars)	Net Annual Benefits per Family (dollars)	Net Annual Benefits per Daily Trip-maker (dollars)	Distance to Transit Station (miles)
258	5,396	759,625	733	104	0.5
167	6,353	627,295	630	108	0.9
147	8,771	805,630	1,044	122	0.3
342	8,838	87,123	61	7	1.4
316	10,308	366,123	344	35	0.9
80	11,683	32,908	137	15	2.7
308	18,173	900,429	224	21	1.4
185	18,595	255,597	562	54	0.8

Table 9. Person trips between zones and quadrants.

Zone	CBD	Quadrant 1	Quadrant 2	Quadrant 3	Quadrant 4
80	539	162	105	432	925
147	1,448	3,852	255	143	925
167	3,931	976	405	202	285
185	812	3,489	246	72	129
258	3,520	782	2,179	544	267
308	5,525	18,422	16,966	1,013	797
316	1,385	8,098	632	172	359
342	2,529	724	1,207	6,168	2,378

80 to 90 cents a day. The bus system has now been sold to MARTA, whose board of directors decided on a uniform 1-way rate structure, regardless of the distance traveled, the number of transfers, or the time of day at which the trip was made. The fare was set at 15 cents for the first 7 years of operation and 30 cents in the tenth year; "thereafter the fare to be charged [is] maintained, in accordance with the policy of the Board, at as low a rate as is possible, considering all other relevant matters" (2). A captive bus or transit rider could thus save an average of 25 cents per day in fares if the old Atlanta bus fares were to persist in 1983. 1971 bus fares could rise before 1983. In view of estimation difficulties, however, the average daily fare of 85 cents was assumed to persist, with the understanding that this is a very conservative estimate, which reduces the benefits of low-income zones, in which most captive riders live.

The consumption of this benefit raises some accounting difficulties. Rather than subtract the MARTA 60-cent daily fare paid by captive ridership from the average 85-cent bus fare, we included the MARTA fares later as zonal costs. Fare savings are best viewed as fares no longer paid to the old bus system by captive transit riders. These savings are given in Table 6.

COSTS OF THE RAPID TRANSIT SYSTEM

The measurable cost to each zone of the rapid transit system is its sales tax contribution to MARTA and the fare revenues each zone generates through patronage. From estimates of these 2 values, a total zonal cost can be obtained and compared with the total zonal benefit estimated above. The incidence of costs on each of the 8 study zones is given in Table 7.

Sales Tax Contribution

In the land use forecast for 1983, average family income was estimated for each zone in the city by the Atlanta Regional Commission (7). This projected zonal average family income and Bureau of Labor Statistics data on the consumption habits of southern urban families were used to estimate a total sales tax contribution for each zone. In 1960 the Bureau of Labor Statistics performed an extensive survey of consumption habits of families stratified by income group, family size, race, and geographic location (8). Because all of these stratifications were part of the land use forecast for 1983, it was possible to impute specific consumption patterns to each of the study zones. From these patterns, a value for total taxable consumption was obtained for each zone, and the MARTA 1983 sales tax rate of 0.5 percent was applied to this value.

Total taxable consumption was obtained by subtracting from current expenditures (BLS data cross classified by average zonal income, family size, and race) the dollar amount spent on goods and services exempt from taxation under Georgia law. These exempt goods and services include tuition fees, water service, phone service, professional services, transit fares, and holy scriptures (9). Then the MARTA sales tax rate, which is set by law to be 0.5 percent in 1983, was applied to total taxable consumption to obtain the dollar sales tax contribution of an average family within the zone. Because zones were drawn to make the families as homogeneous as possible with respect to zonal socioeconomic characteristics, error introduced by using an "average" family as the unit for computing the zonal tax contribution is minimized.

A possible income distribution effect of the sales tax is the diversion of retail trade away from the counties that levy the MARTA tax over and above the regular Georgia Retailers' and Consumers' Sales and Use Tax. Counties in California in which additional 0.5 percent sales tax was levied experienced a loss of sales, and consumers residing in these counties often attempted to avoid the tax, no matter how small (10). Although no evidence is available on the possible magnitude of trade diversion, owners of commercial property involved in retail sales just inside the county line will likely lose trade and owners of retail establishments just outside the line will gain by more than the amount of trade that their geographic market area would normally warrant. This loss of trade could eventually transmit itself into shifting property values and

encourage the location of new suburban shopping centers outside the city limits (11). Persons living just inside the county line will easily avoid the tax on many items, thus making them better off than other residents within the 2 MARTA counties. No attempt is made in this paper to quantify all of these diversionary effects and to rigorously evaluate their income distribution implications.

Fare Contribution

The Atlanta modal-choice model predicts the total transit patronage for each zone in the study area. These patronage estimates for each of the 8 study zones and the MARTA fare structure described above (30 cents for 1-way trips, no transfer cost) were used to estimate the second component of cost incurred by each zone.

COSTS VERSUS BENEFITS

Table 8 gives the results of comparing each net zonal benefit with the average family income in that zone.

The 3 lowest income zones have the 3 highest net benefits. A more striking statistic is the zonal benefit per daily trip-maker, which illustrates how much zonal net benefit arising from transportation investment accrues to each trip-maker in a zone. The lower income trip-maker receives 2 to 4 times the benefit that the upper income trip-maker receives from transit system investment on an annual basis. The data also point out the increased mobility provided by the new system to the lower income zones. The lower costs per trip originating in these zones will invariably increase the number of trips generated in them. This is a fact that is not allowed for in the traditional transportation planning process, but does point to the potential increase in mobility for lower income groups.

Representativeness of 8 Study Zones

Before any general conclusions can be drawn about the income distribution effects of the entire system, the 8 study zones must be carefully analyzed to determine the extent of their being representative of other zones with similar income. Zones with the same family income may vary considerably in their geographic location and socioeconomic characteristics, and it is difficult to generalize on the basis of these 8 zones. The following observations, however, may help the reader to critically review the findings of this study.

All the zones except zone 80 are within 2 miles (3 km) of a transit station. Accordingly, zone 80 does not stand to benefit much from the system. It has the second lowest net benefit per family and net benefit per trip-maker. All the other zones enjoy considerable transit accessibility, and the 2 highest net family benefit zones are both located on a transit line. The net benefit of a zone is thus strongly correlated with its location relative to a transit line, regardless of its income. Of the 2 highest income zones, zone 185 has more than twice the zonal net benefits of zone 308 and is about half as far from a transit station. Both zones have about the same per family income. This suggests that net zonal benefits can be estimated as a function of both family income and distance to the closest transit station.

Zone 342 is probably an aberration relative to its income group because it is the only zone that had a negative net time savings benefit. The data given in Table 9 show that a large number of trips originating in zone 342 are bound for areas that are not readily accessibly by transit, notably in quadrant 4 of the city. The transit lines serve zone 342 trip-makers well if they are bound for the CBD; but to reach quadrant 4, they must first go to the CBD. The negative net time savings of zone 342 and the resulting low benefits per family and per trip show that net zonal benefits are strongly affected by the extent of the zone's interaction with the central business district, which is the focal point of the transit system.

Other Income Distribution Effects

This study was directed at a small sample of traffic zones in the Atlanta area and

concentrated on direct user private costs and benefits. There are, however, other factors that are related to the transit system and are expected to have income distribution effects in metropolitan Atlanta. The rapid transit system will provide increased accessibility, and highly concentrated growth will continue in Atlanta's CBD and benefit downtown business managers and property owners. Many downtown interests have given vigorous support to the rapid transit system throughout the 1960s primarily because they will gain a great deal from the proposed system. Atlanta would continue to grow rapidly with or without rapid transit, but the growth would occur in different areas altogether, depending on the nature of the transportation system. Because of the rapid transit system, land values will increase for property owners in the CBD at the expense of owners in the suburbs. The extent of this CBD gain at suburban expense will probably be massive. Estimating the magnitude of such shifts and identifying their recipients are not attempted in this paper.

Also, property values will likely rise significantly along the new rapid transit lines (12). Thus, everywhere within the city, property owners near the new transit lines will enjoy considerable increases in property values while owners with less strategically located property will be at a comparative disadvantage.

In a more general sense, the investment in rapid transit in Atlanta will raise nearly everyone's income above what it would have been without the system because of multiplier effects on the local economy of the massive federal expenditure. The two-thirds federal funding will inject approximately $1 billion into the local economy during a period of about 10 years, and Atlantans will have paid only a small portion of that two-thirds funding through their own federal tax contribution. Consequently, one would expect incomes to rise in Atlanta, especially for persons employed directly or indirectly in the building of the system.

The local sales tax could cause certain border effects that would alter personal incomes. The trade diversion effects of the sales tax could cause both property values and sales volumes to rise just outside the county lines where the tax is in effect and to fall just inside these lines.

CONCLUSIONS

This paper has attempted to present a pilot study of the income distribution effects of the proposed Atlanta transit system. The benefits and costs of the system have been calculated for 8 of the 399 geographic traffic zones. Although some trends have emerged, factors such as the distance of the zone from the nearest proposed transit station and the extent of its dependence on and interaction with the CBD have a significant determining influence on the magnitude of the benefits of the system accruing to that zone. The extent of these influences cannot be determined without the benefit of a larger sample of zones. Nevertheless, zones that have an average family income of less than $9,000 and a significant amount of interaction with the CBD seem to benefit most from the system. Distance from a transit station or lack of interaction with the CBD or both disrupt this pattern for low-income zones. A family living in zone 167 and receiving an average family income of $6,353 can expect to benefit almost twice as much as a family living in zone 316 and having an average family income of $10,308. Both zones are 0.9 miles away from a transit station and have about 90 percent of their trips destined to the CBD or some intermediate location. The benefits per trip-maker are 3 times higher in zone 167 than in zone 316. Net zonal benefits per family are considerably higher in zone 316, where average incomes are $10,318, than in zone 308, where average incomes are $18,173, but are are considerably lower in zone 258, where average incomes are $5,396. All 3 zones are comparable in terms of transit accessibility and orientation to the CBD. From this, one could surmise that, for comparable levels of transit accessibility and CBD orientation, a zone's net benefits from the system decrease as income increases.

These findings are based on a limited sample and only one type of costs and benefits with distributive implications. Similar studies, which cover all traffic zones in an urban area and which would consider the distributive impact of factors such as rising and falling land values, spatial redistribution of residential and employment centers,

and spatial redistribution of the demand for goods and services, could shed a very useful light on the problem of the income distribution effect of transportation investments.

An extended study that would cover all traffic zones could provide planners, policy-makers, and residents with an additional tool for the evaluation of alternative transportation systems. Future improvements in simulation models and refinements of the methods of analysis suggested in this paper could provide both voters and policy-makers with a clear, reasonably reliable picture of the costs and benefits of the system to small geographic subdivisions of an urban area. The weaknesses of aggregate benefit-cost studies can be avoided by an analysis of the impact of proposed public systems in a disaggregate fashion. The analysis of the income distribution effects of large public works investments should become a standard part of the design and evaluation phases of the planning process.

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