MODAL CHOICES AND TRAVEL ATTRIBUTES OF INNER-CITY POOR

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This paper examines the transportation problems of the inner-city poor. The paper is based on a study of the transportation needs of Model Cities residents in one of the largest poverty concentrations in the nation. The scope of the study was to identify the transportation constraints that inhibit mobility. Discussed is the need for transportation to jobs, shopping, medical facilities, and recreation. The effect of transportation (or lack of it) on the mobility of the poor is investigated, and recommendations are developed to satisfy the needs of each population group that is transit-dependent.

•THIS PAPER is based on a study that analyzed the transportation needs of residents of the Central Brooklyn Model Cities (CBMC) area.

The study area is made up of 3 communities: Bedford-Stuyvesant, Brownsville, and a part of East New York. At the time of the study in 1969, it contained more than 404,000 people, 40 percent of whom lived in households earning less than $4,000 per year. The unemployment rate in the area was 14 percent of the total labor force of 121,000 persons. The amount of underemployment in the area was also reported to be quite high. The population in the area was 78 percent black, 19 percent Spanish-speaking, and 3 percent white.

In the past 20 years there has been a significant reduction of the white population accompanied by an even larger increase of the Spanish-speaking and black populations. This change has brought about a radical rearrangement of the entire economic and social structure.

The exodus of the more affluent Whites, who left in large numbers, created a new set of conditions in the area, requiring a careful review of the efficiency of the public transportation system in serving the needs of the new residents.

The Whites who left consisted largely of middle- and upper-income groups, holding jobs primarily located in the Manhattan business districts or downtown Brooklyn. The rapid transit lines are generally oriented from the CBMC area to these points, providing fast and direct service between central Brooklyn and those places of employment. The rapid transit lines are complemented by an extensive system of feeder bus routes crisscrossing the CBMC area, with connections to the subway stations.

This public transportation system, laid out many years ago, remains the same today. No significant changes have been made to reflect new needs for public transportation in the area. And today's transportation needs for central Brooklyn are different from the needs of the past. For example, manufacturing and wholesaling jobs have moved away from the traditional center-city locations to the less congested areas of the metropolis, where access by public transportation is either costly or excessively time-consuming.

Sponsored by Committee on Passenger and Freight Transportation Characteristics.

CAR OWNERSHIP

The degree of dependence on public transportation for the CBMC area resident population can be measured by an analysis of car ownership per household.

The members of a household that does not own a car will depend completely on public transportation for their travel. Even if, from time to time, occasional trips can be made in a neighbor's or a friend's automobile, non-car-owning household members are basically dependent on a bus, subway, taxicab, or train for a trip that cannot be made on foot. Approximately 73 percent of the households in the CBMC area owned no car.

The distribution of non-car-owning households, with respect to households, is shown in Figure 1, for the purpose of identifying the groups of families with greatest dependence on public transportation for their mobility. The low-income group, which makes up 40 percent of all households in the area, contains the largest proportion of households (91 percent) that own no cars.

TRIPS PER HOUSEHOLD

In the home interview travel survey, trips made by CBMC area residents were recorded by purpose and mode of travel. The types of trips reported include trips made by all modes, including walking. However, only walking trips of 15 min or longer were included in the travel survey.

The average number of daily trips (walking trips are not included in rate calculations) made by members of CBMC area households was found to vary as a function of the following variables: income, car ownership, size of household, race, and the distance of the household to the nearest subway station. These trip rates are shown in Figures 2 through 6.

Figure 2 may be viewed as the constraint of income on travel. For every household size, the number of trips made by the members of a household increases with increasing income. This finding is not at all surprising. What is important is the magnitude of differences in trip-making among various income groups. When these differences are compared among households of adjacent income groups, they can be regarded as the marginal effect of income on trip-making.

The largest loss in trip-making, due to income constraint, occurs in the low-income households, where a marginal loss of more than 2 trips per day was found. As household income increased, however, the effect of income on the marginal loss in trip-making diminishes considerably. This loss due to income varies also with household size. Households in the low-income category having 1 and 2 members and 7 or more members exhibit higher losses in trip-making. These are households containing the highest proportion of the elderly and the young. These are the people whose mobility is affected most by income constraints. By comparison, losses in trip-making due to income differentials are least for households having above-moderate incomes.

The income constraint on the travel of 3- to 6-member households is not very different among households in the low- or moderate-income category. The differences in the distribution of marginal trip losses for this group of households are related to the fact that they include a higher representation of adult members whose travel habits are more uniformly susceptible to income differentials.

The travel characteristics of household members were also found to vary with their ethnic characteristics (Fig. 3). The Blacks who live in low-income households are more mobile than their Spanish-speaking counterparts (2.7 versus 1.8 trips per household). This relation is reversed, however, when household incomes exceed $4,000 per year. In the higher income range, the Spanish-speaking households are considerably more mobile than black households.

These characteristics do not appear to be consistent among households of different sizes (Fig. 4). For small households (1 or 2 members), black household members who live in households earning less than $7,500 are more mobile than those in Spanish-speaking households. This characteristic does not hold for 3- to 6-member households earning less than $4,000. In these households the Blacks are less mobile than their Spanish-speaking counterparts.

Figure 1. Relation of non-car-owning households and income.

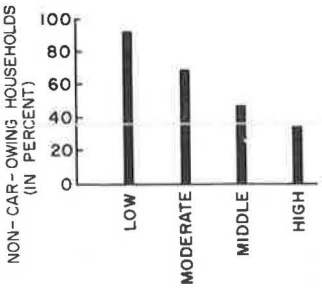


Figure 2. Effect of income on trip-making.

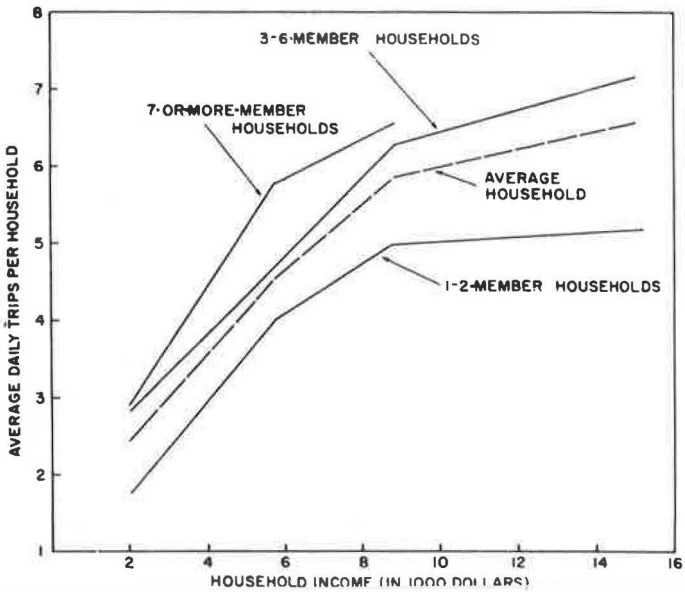


Figure 3. Effect of race and income on trip-making.

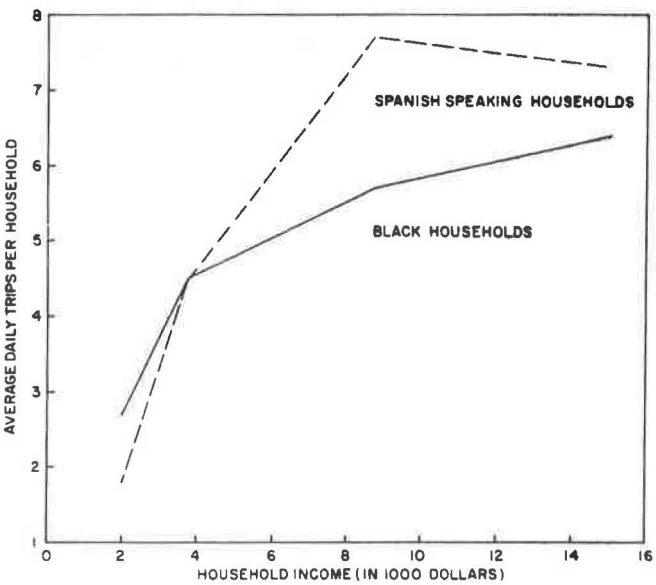


Figure 4. Effect of race, size of household, and income on trip-making.

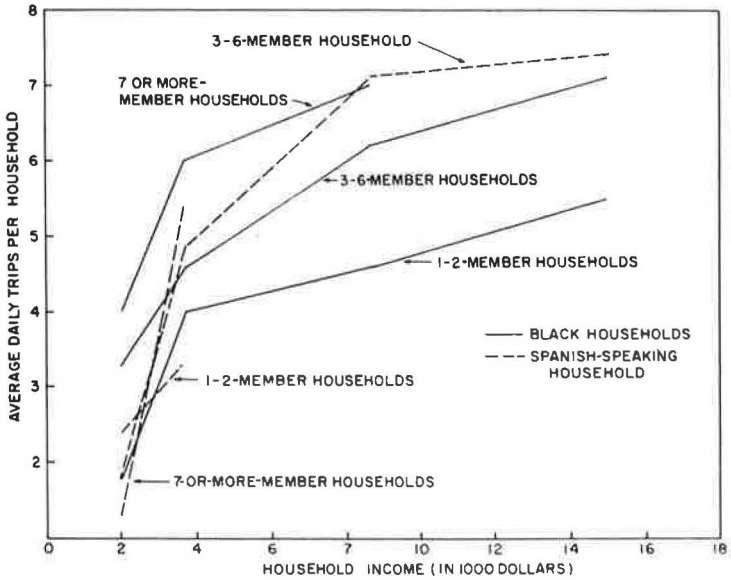


Figure 5. Effect of car ownership and income on trip-making.

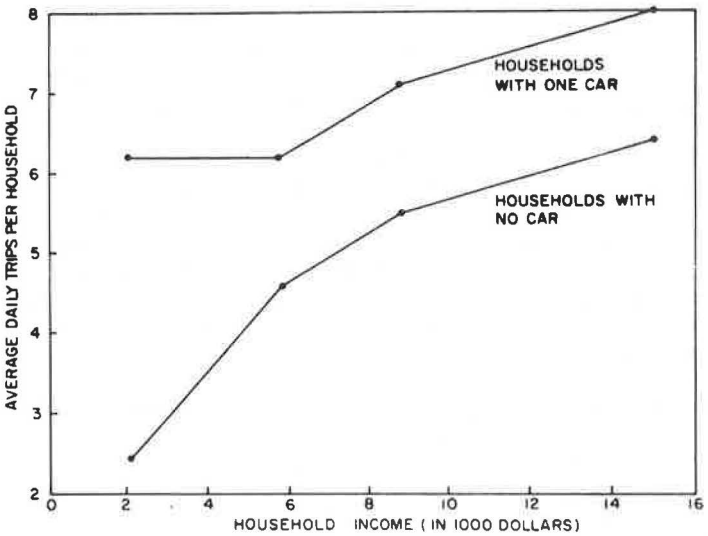
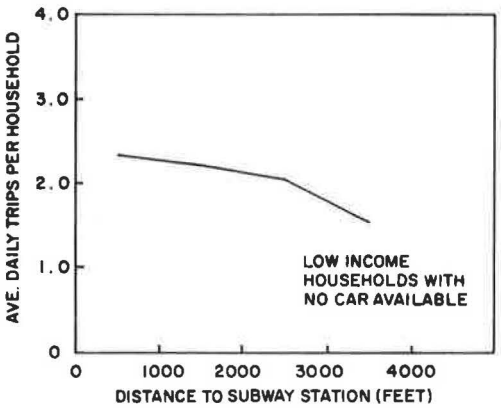


Figure 6. Effect of rapid transit accessibility on trip-making.



Whether a household has an automobile available was found to affect the rate of trips generated by members of the household. This was true among households of every income level, and, as Figure 5 shows, the low-income level was affected most by the presence of an automobile. For higher incomes, the impact of car ownership was found to be relatively constant in magnitude.

Household income, car ownership, household size, and race are the 4 endogenous variables that were found to influence the travel of CBMC area residents. The findings derived from the analysis of these variables do not suggest recommendations that, if implemented, could lead to an increase in the mobility of the population. Certainly, giving money or cars to the poor would render them more mobile. For various reasons, this would not be a viable solution.

The underlying goal of the study was to remove or minimize those constraints on travel that are related to the transportation system serving the CBMC area resident. The constraints on travel imposed by the transportation system are external in nature and have been referred to as exogenous variables. The cost of travel, the time required in making a trip, the quality of public transportation service, the reliability of time schedules, and so on are the kinds of measures that were investigated.

The impact of public transportation service on the trip-making characteristics of the CBMC area resident was measured with respect to the household's proximity to the nearest subway station. The use of walking distance to subway stations as a measure of constraint on travel was found to be significant only for low-income households. As shown in Figure 6, those households located within 1,000 ft of subway stations produce an average of 2.35 trips per household, while other households located 3,000 ft or more from subway stations generate an average of 1.55 trips per household. These differences in trip-making due to the varying proximity of a household to a subway station indicate the marginal loss of travel due to subway accessibility distances.

Thus, the amount of travel not made by members of low-income households because of distance accessibility differentials may be readily estimated by multiplying the number of households affected by the marginal trip loss.

As was stated earlier, the CBMC area is served by a very dense network of buses. It is very rare to find a location where one cannot walk to a bus in less than 500 ft, and in all cases everyone can reach a subway-bound bus by walking less than 1,000 ft. Taking a bus to reach a subway station, however, requires the payment of a double fare. It is reasoned, therefore, that low-income household members find this double-fare structure a constraint to travel and are, therefore, affected in their trip-making.

It is estimated that, if there were free transfers for low-income riders, they would increase their mobility from 40,485 to 43,700 trips per day, based on comparison of 1-fare and 2-fare zones.

At the time this study was made the transit fare was 20 cents; the present fare of 35 cents should be even more detrimental to the low-income traveler, and his trip-making might be reduced by amounts even greater than those reported here.

TRIP PURPOSE, MODE UTILIZATION, AND DISTRIBUTION OF TRAVEL

The travel activities of CBMC area residents were classified into 2 groups: work and nonwork oriented. The proportion of work travel amounted to approximately 18.5 percent of all trips made by the residents. Low-income households, however, were estimated to contain fewer work trips than households not in the low-income group (11 versus 20 percent). This difference was primarily attributable to the higher unemployment found in low-income households.

The modes of travel used for work purposes by CBMC area residents of varying economic states were analyzed. Although on the average more than 71 percent of all workers travel to work in either a subway or a bus, the low-income workers use these 2 modes more than any other group (78.2 versus 55.4 percent for the high-income worker). The use of an automobile for work purposes is much less likely for the low-income worker than for the high-income worker (12.8 versus 37.8 percent). Most automobile work trips are made by persons who drive their own automobiles, and a very

small proportion are passengers or join a car pool. Car-pool utilization, in fact, is negligible among low-income households.

The use of taxis for work travel is minimal among all income levels. Approximately 7 percent of the low-income workers walked to work. This proportion was lowest for the moderate- and middle-income catergories, but then it appears to rise to about 6 percent for people in the high-income level.

Mode utilization for work travel was found to be related not only to income levels (and consequently car ownership) but also to the location of a work site. Thus, the utilization of a car to reach work sites in areas well served by transit is considerably less than for those areas where transit is not so efficient.

Nonwork trips were analyzed to identify the nature of nonwork activities, which generate the travel of CBMC area residents.

If the trip purposes are interpreted to represent the importance of one activity relative to another, then one may rank the trip purposes in order of importance to the trip-maker in a manner that is proportional to their frequency. On this basis one may logically relate nonwork travel needs among travelers of different economic status. Thus, it was noted that the trip-making priorities among the low-income groups are rather similar to those of high-income groups. Trips made for social-recreational, shopping, and personal business reasons are the top 3 activities demanded by CBMC area residents. School trips made by residents are the next most common activity, and trips made for health reasons are fifth in order of importance. In this latter trip category, however, it should be noted that the medical-dental trip becomes less important as household income increases (8.4 percent for low-income versus 2.0 percent for high-income households). The least frequent trips were those for adult education and for seeking employment.

Nonwork trip purposes were further stratified by sex of traveler. Again it is seen that social-recreational, shopping, and personal business are the most frequently made trips by both sexes, and, in general, the traveler's sex does not seem to indicate any radical differences in travel behavior. It does appear, however, that males go more often for adult education, less often to shop, and more often to activities that are of a personal-business nature.

The transportation modes used to satisfy the nonwork travel needs were found to be largely dependent on the economic status of a traveler. The persons most dependent on public transit were those living in low-income and moderate-income households, and as household income increased a larger proportion of nonwork travel took place in automobiles.

Modes of travel used by persons living in households of different economic levels were determined for 3 major activities of concern to the CBMC area residents: shopping, social-recreational, and medical-dental activities. Definite patterns of mode usage emerge. For example, although the low-income households make the least use of automobiles, simply because they do not own them, nevertheless they manage to use automobiles more often for some purposes than others. For travel to a doctor or to a dentist, they make 17.5 percent of their trips by automobile, whereas for shopping less than 11 percent of their trips are by this mode. The middle- and high-income households use the automobile most often for social-recreational travel. Trips by subway or bus are most abundantly made by low-income and moderate-income household members. These 2 modes are used 70 percent of the time by the low-income resident to travel to social-recreational activities, 58 percent of the time to go to a doctor or a dentist, and 53 percent of the time to go shopping.

Members of low- and moderate-income households walk to shopping more than 10 times as often as those of higher income groups. This characteristic may be indicative of the fact that local shops are most heavily patronized by the low- and moderate-income families. The low-income households also walk most often to see a doctor or a dentist, and they also use taxis most often for this purpose.

The importance of each mode to people of different economic status is given in Table 1 for 4 major trip purposes: work, shopping, social-recreational, and medical-dental trips. The numbers shown are to be interpreted as the ranking of a specific mode compared to the other modes considered. The modes have been grouped into 4

functional groups: automobile, including automobile driver, automobile passenger, and car pool; taxi (medallion and nonmedallion); transit, including subway and bus; and walking.

Thus, for work purposes there is no switch of mode ranking because of household income differentials. For shopping purposes, transit remains the most used mode across all incomes. For the low- and moderate-income households, walking is the next most common way of traveling, and automobile and then taxi are the next most common.

Low-income households exhibit the same mode-usage pattern for social-recreational trips as for shopping. For middle- and high-income households, the automobile replaces transit as the most frequently used mode.

The medical-dentist trip made by the low-income group ranks transit as still the most frequently used mode; the automobile is the next highest. This combination is the same as that found for the work trip. Unlike the work trip, however, for medical-dentist travel, the taxi mode is ranked third and walking last. Thus, the importance of the taxi mode to the low-income traveler is related to the purpose of the trip and the need associated with it. He finds it an expensive mode and uses it in a rational manner.

Approximately 91.4 percent of all trips made by CBMC area residents either began or ended at home. The remaining 8.6 percent were made from and to nonhome locations. The most frequent nonhome to nonhome travel, however, involved either changing modes of travel or transferring within modes (31 percent). It would appear, therefore, that the CBMC residents' travel is almost exclusively home-oriented.

TIME DISTRIBUTION OF TRAVEL

The distribution of travel by time of day is shown in Figure 7; 48.1 percent of all trips made occurred during the morning and evening rush periods (24.1 and 24.0 percent respectively). During those hours, transit operations provide for the greatest number of vehicles to serve the concentrated demands for travel. During the remainder of the day, however, when the remaining 51.9 percent of the people travel for reasons other than work, headway of transit vehicles almost doubles, according to schedules published by the NYC Transit Authority. This is a normal procedure for non-response-actuated transit systems and is a consequent outcome dictated by sound economic principles. Also, a 15-min scheduled waiting period for a transit vehicle would certainly not seem unreasonable, especially when the expected wait for a passenger is reduced to 7.5 min. If this were the situation for off-peak service, it would appear that transit service quality, viewed from the headway criterion, should be considered satisfactory. A field check on these headways, however, disclosed that buses and subways do not run according to scheduled performance and that headways deviate considerably. As a result the traveler must, in many cases, wait twice as long or longer in some cases every time he takes a subway or a bus during off-peak hours. Although for bus service a large part of this problem is attributable to street congestion, which creates bunching of buses, for subways it must be attributed to the operational deficiencies of the system.

Figure 8 shows the daily distribution of travel for 5 selected trip purposes. As one would expect, work and homebound travel peak during the normal daily rush hours. Shopping, social-recreational, and medical-dentist trips are more evenly distributed, and their peaks occur during the off-peak hours. These types of trips, therefore, are most affected by the transit system's operational delays occurring during off-peak hours.

GEOGRAPHIC DISTRIBUTION OF TRAVEL

One fundamental objective of this study was to investigate the problem faced by the poor in connection with their travel needs. Do the poor travel to less distant points than the nonpoor? Do they spend more time traveling the same distance than the nonpoor? Do they pay higher fares? These and similar questions are answered here. The types of trips analyzed for this purpose were work, shopping, social-recreational, and medical-dentist.

In general, regardless of trip purpose, most of the trips made by the CBMC area residents terminate within the boundaries of New York City; very few go to the adja-

Table 1. Importance of travel mode for selected trip purposes by household income.

Trip Purpose	Household Income	Automobile	Taxi	Transit	Walk
Work	Low	2	4	1	3
	Moderate	2	4	1	3
	Middle	2	4	1	3
	High	2	4	1	3
Shop	Low	3	4	1	2
	Moderate	3	4	1	2
	Middle	2	3	1	4
	High	—	—	—	—
Social-recreation	Low	3	4	1	2
	Moderate	2	4	1	3
	Middle	1	4	2	3
	High	1	—	2	3
Medical-dentist	Low	2	3	1	4
	Moderate	2	4	1	3
	Middle	—	—	—	—
	High	—	—	—	—

Figure 7. Distribution of trips by time of day.

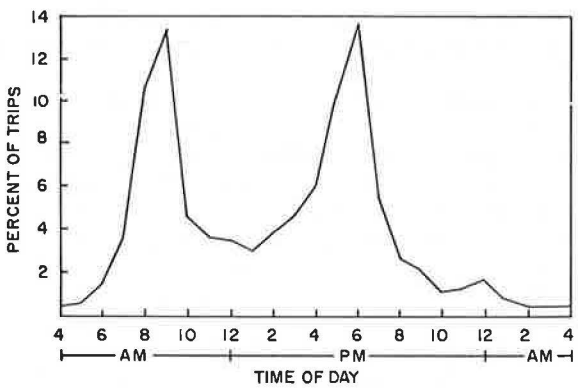
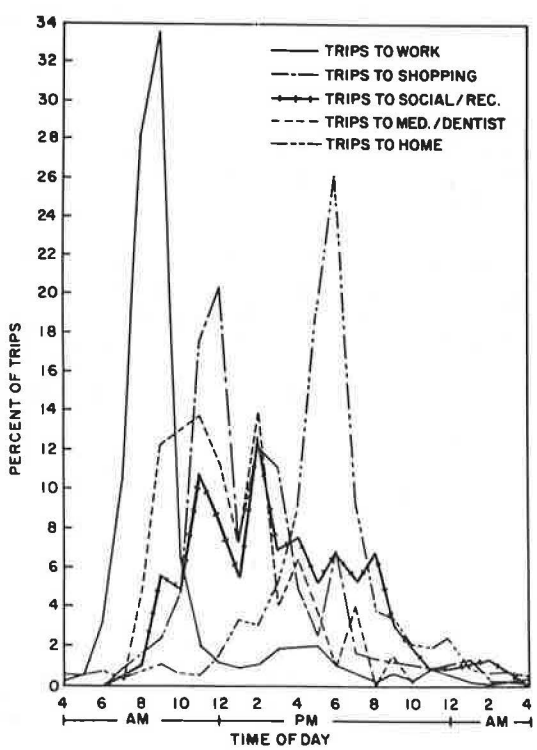


Figure 8. Distribution of trips by purpose and time of day.



cent suburbs. Also, most of the trips made in New York City terminate in Brooklyn and Manhattan.

The central business districts of Brooklyn and Manhattan are the largest attractors of work trips for all occupational groups. Also, there appears to be no fundamental difference in the distribution of work destinations among the occupational groups.

The relation between the distance traveled and the travel time required to cover this distance was analyzed for each of the 4 trip purposes. Figure 9 shows the distribution of work trips for each occupational category. No startling difference in work travel distribution exists among the occupational groups, and it appears that the amount of time spent in traveling is also similar among types of work (Fig. 10). Since most of the work trips take place during peak hours, most of them are made via transit, and most of them are destined to job sites well served by transit. This finding may not be at all surprising for New York City.

Analysis of the shopping trip distribution gives a different situation (Fig. 11). The low-income travelers make shorter trips than high-income travelers and, therefore, exhibit a stronger orientation toward local neighborhood stores. Trips to a medical doctor or a dentist are also shorter for low-income household members (Fig. 12), but trips made for social-recreational activities are similar for both economic groups (Fig. 13).

The time spent on traveling to these non-work-oriented activities is shown in Figure 14. Contrary to the findings of the work trip analysis, where no differences in travel times were found among different economic groups, for non-work-oriented travel, the poor travel longer to cover the same distance traveled by the high-income traveler. This finding may be attributable to the fact that the low-income traveler, who depends primarily on transit, experiences more than any other group the increase in travel time required to use transit vehicles during off-peak hours; the higher income groups are less affected because they use their automobiles more often during the off-peak hours. As shown in Figure 13, the average travel time differentials, for trips longer than 7 miles, vary between 15 and 20 min. It may be due to this factor that low-income groups tend to keep their nonwork travel to areas closer to home than do those of higher incomes.

Thus, the distance traveled by a typical CBMC area resident is a function of trip purpose and the resident's income level. If the distances traveled by the 85th percentile group are used as standards of reference, it may then be possible to compare the "life space" of a typical low-income resident with that of a resident in a higher income bracket.

Figures 15 and 16 show work and nonwork life spaces; work life space is the most extensive, with 85 percent of the professional-technical workers traveling as many as 7.9 miles. The unskilled worker travels 7.3 miles, and the skilled and semiskilled travel 6 to 8 miles. Thus, as was mentioned earlier, there are no radical differences in the work life spaces of groups of different skill levels. In the shopping activity, the higher income groups have a life space radius 50 percent greater (5.9 versus 3.9 miles) than that of low-income groups. For the medical-dentist trip, these differences increase to 100 percent (4.9 versus 2.5 miles); for the social-recreational activity, no significant difference was found, with both economic groups traveling 7.7 miles.

THOSE WHO DO NOT TRAVEL

Heretofore, the discussion of travel characteristics has been confined to those CBMC area residents who travel, and their trip rates were calculated on the basis of all household members, irrespective of whether they made any trips.

CONCLUSIONS AND RECOMMENDATIONS

It is apparent that the travel desires of the poor are not different from those of the more well-to-do public. Indeed, the poor exhibit the same preferences for shopping, recreation, health, and work. How they achieve these objectives, however, is quite different from the pattern observed for the nonpoor. The poor are constrained in their mobility by both their economic predicament and the physical characteristics of the transit system.

Figure 9. Distribution of work trips by distance.

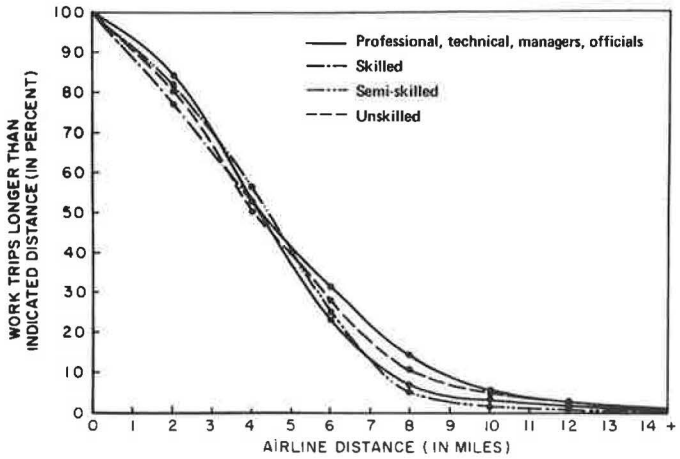


Figure 10. Relation of time and distance for work trips.

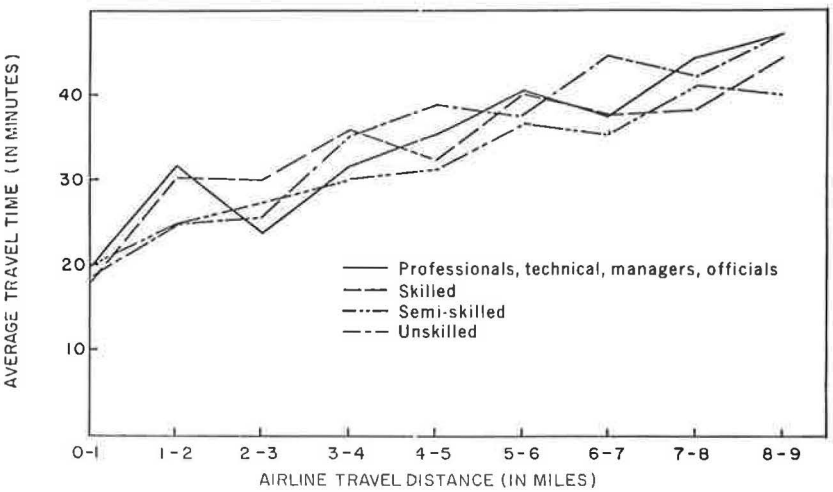


Figure 11. Distribution of shopping trips by distance.

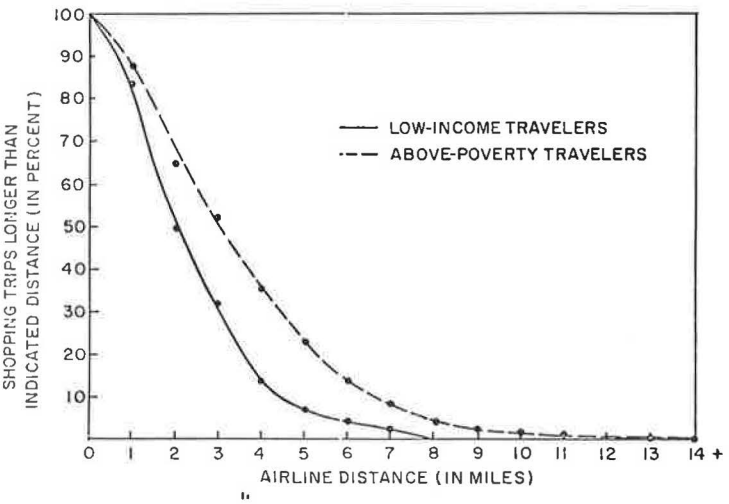


Figure 12. Distribution of medical-dentist trips by distance.

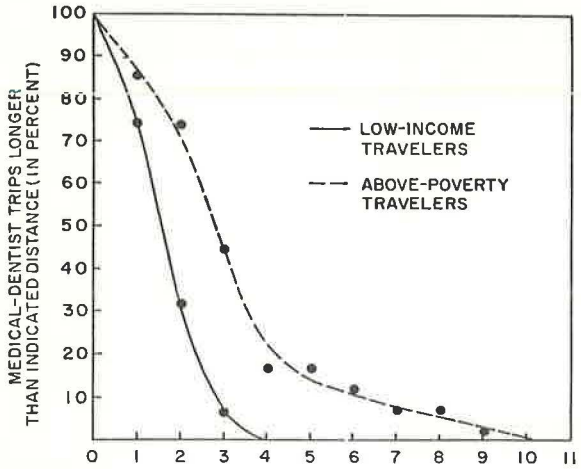


Figure 13. Distribution of social-recreation trips by distance.

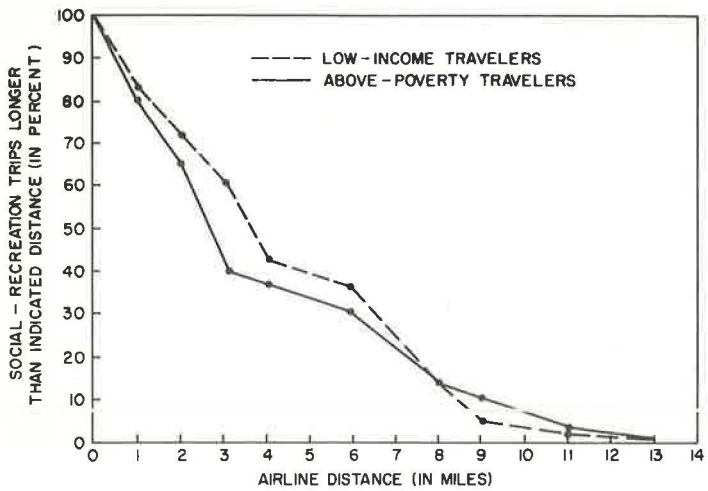


Figure 14. Relation of time and distance for nonwork trips.

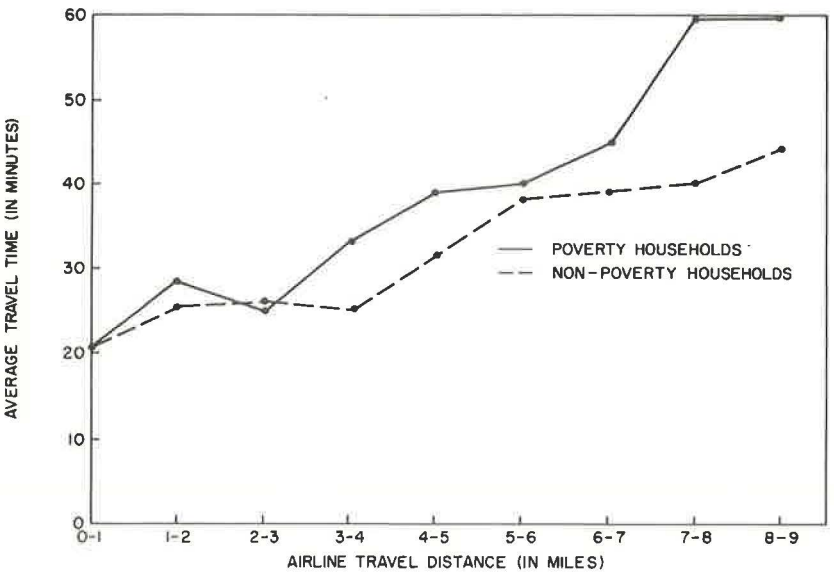


Figure 15. Work life space for 85th percentile travel distance.

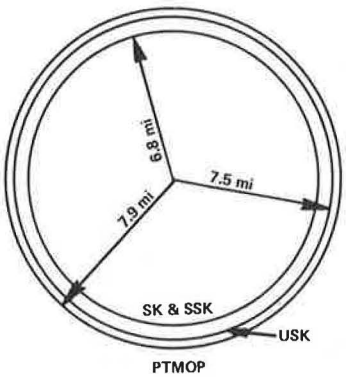
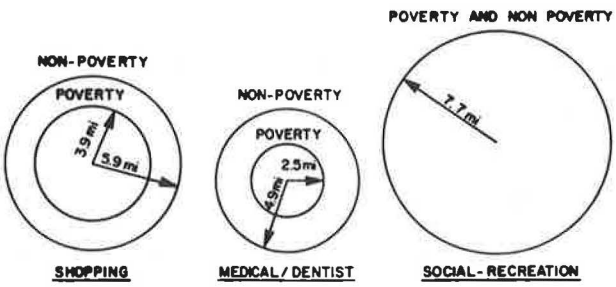


Figure 16. Nonwork life space for 85th percentile travel distance.



1. They travel less simply because they have less money to spend.
2. They are further constrained in mobility when they reside in areas requiring multiple fares to ride the transit system.
3. They rely almost exclusively on public transportation for mobility and are, therefore, dependent on a unimodal system of transportation.
4. Although they have exhibited work travel patterns similar to those of the nonpoor, this is a reflection more of the land use service characteristics of the transit system than of the choice of work destinations.
5. Trips made for shopping, medical reasons, or recreation involve, on the average, a longer travel time for the poor than for the nonpoor.
6. The poor travel to less distant places than the nonpoor when the trips are made for shopping or medical reasons.
7. The poor have a reduced choice of opportunities for shopping, health care, recreation, and jobs.

Based on these findings, it appears that several areas of improvement are possible to remove some of the barriers that inhibit the mobility of low-income persons who live in poverty such as the CBMC area.

Some recommendations that might produce immediate results are: (a) elimination of the multiple-fare system; (b) increasing off-peak operations for some important routes; (c) allowing group riding in taxis to reduce costs; (d) installing new transit routes from major transit terminals to points of industrial job concentrations, major shopping areas, hospitals and clinics, and regional recreational areas; and (e) improving the coordination of arrivals and departures of transit vehicles at major interchange points, especially during off-peak hours.

For the more distant future, however, more effective solutions should be implemented. Such solutions would not constitute the kind of patchwork remedies that were suggested above but instead should concentrate on the necessary attributes that a public transit system should have to serve the increasing dispersal of activities in metropolitan areas.

The use of the conventional bus in a transit operation is limited in applicability to corridors of higher densities, which are usually radial in character. The standard bus, moreover, is not suitable to serve nonradial travel, especially when it operates on a fixed-route pattern. In these cases what is needed is a transit vehicle that most nearly approaches the attributes of the private automobile. Thus, the development of a low-cost (to the user) door-to-door transit system, operated on the principle of dial-a-bus, might provide the appropriate solution to the mobility needs of low-income persons. Such a system should be coordinated with conventional transit vehicles at all major interchange points and should penetrate the low-density areas where significant job opportunities and other activities are located.