Life-Styles and Transportation Patterns of the Elderly in Los Angeles

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The diversity of the elderly population in Los Angeles County is studied by using the concept of life-style. Life-style is defined by a set of socioeconomic, demographic, and behavioral characteristics. A methodology is presented that uses factorial ecology techniques; the data required are commonly available from census and administrative sources in metropolitan areas. Factor analysis is applied to census tracts to define dimensions of life-style that represent the major differentiating characteristics of elderly populations. Homogeneous life-style groups among the elderly are then identified by clustering tracts that show similar life-style dimensions. Finally, analysis of variance is used to identify differences in the travel characteristics of life-style groups. An investigation of the elderly population of Los Angeles County was conducted as a case study. Seven dimensions were defined that provided a basis for the identification of seven elderly life-style groups. Each group was found to be unique in terms of travel demands and socioeconomic composition. Life-style groups were also found to reside in specific areas of the county, a necessary condition for meeting their transportation needs.

Since 1970, considerable effort has been devoted to identifying the special transportation needs of the elderly. Federal, state, and local funds have been used for accessibility and mobility studies and for improvements in public transportation services for older Americans. Although significant advances have been made in these areas, senior citizens still seem to be viewed by transportation planners as a homogeneous group with common problems and needs. They are often stereotyped as central city residents who are relatively nonmobile, poor, and dependent on social security and public transportation. This is true of many of the elderly, but many studies have demonstrated that the elderly are actually a very diverse group. For example, census data for 1970 show that, although half of the elderly of Los Angeles County, California, resided on the most densely populated 5 percent of the land, the other half was scattered at much lower densities on the remaining 95 percent (1). Socioeconomic and demographic characteristics and travel demands of the elderly have also been shown to vary considerably with location in urban areas. These variations in travel behavior have important implications for the provision of transportation services for the elderly, but they have generally not been taken into account in transportation planning.

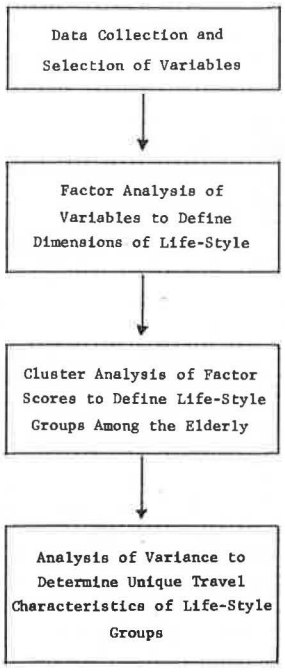
The concept of life-style is a potentially powerful tool for studying the residential location and travel patterns of the elderly (2). In this paper, life-style is taken to mean particular combinations of socioeconomic and demographic variables that represent the situations in which people live. Among these variables are income, family status, educational attainment, and residential density. In the elderly population, one life-style group of single persons may live alone in high-density, low-income, ethnically diverse areas characterized by relatively poor health. This life-style group would have very different travel needs and behavior than one consisting largely of husband and wife families who are in good health and live independently on moderate to high incomes in ethnically homogeneous areas. Because members of a life-style group are likely to live in close proximity to other members of the same group, it should be possible to distinguish between residential communities of the elderly on the basis of the life-styles of their residents.

This paper presents a methodology for using the concept of life-style in analysis and for identifying life-style groups among the elderly. The hypothesis that residential location and travel patterns differ significantly betwen life-style groups is also investigated. The methods are based on the factor analysis and cluster analysis techniques of factorial ecology and require age-specific data that describe the elderly population at a census-tract level. The methodology and the results of an application of the methods in a case study of the elderly population of Los Angeles County are described. Also discussed are the implications of the findings for the provision of transportation services for today's elderly population and for future generations of the elderly.

METHODOLOGY

The methodology consisted of four steps (Figure 1). First, socioeconomic and demographic variables describing the elderly population were obtained. These variables documented such attributes as automobile ownership, economic resources, social living arrangements, ethnicity, sex, physical living arrangements, educational attainment, and health (3). The primary data source was the 1970 files of the U.S. Bureau of the Census. Detailed age-specific data describing automobile ownership, income, household composition, and

Figure 1. Flow chart of research methodology.



employment were not available from regular census tabulations and were obtained as a special tabulation by the Bureau of the Census. Data describing the health of the elderly—including morbidity, mortality, and mental health care admission rates—were obtained at the census-tract level from the Los Angeles County Department of Health Services. All variables were expressed as relative frequencies. For example, the number of elderly females in a zone was expressed as the percentage of the elderly in the zone who were female.

The second step was to use principal components factor analysis to reduce the set of descriptive variables for the elderly population into a smaller number of life-style dimensions. The factors extracted through principal components analysis were rotated to varimax position, which resulted in a solution of "simple structure" in which each variable tended to associate, or load highly, with only one factor. This property of the solution made it possible to describe and interpret the factors more easily in terms of the variables with which they were most closely associated.

The number of factors retained and rotated was determined by examining the eigenvalues of the unrotated factors and the interpretability of the rotated factors. The procedure for accomplishing this involved the following steps. Initially, all factors with eigenvalues greater than 1.0 were rotated. These factors were then examined for their interpretability in the context of this study. If a factor could not be interpreted, the unrotated factor with the smallest eigenvalue was eliminated and the remaining factors were rotated and examined. These steps were repeated until it was determined that all rotated factors were interpretable. Factor scores that measured the positions of the zones with respect to the factor dimensions were then computed.

After the variable set was reduced to a smaller number of dimensions, cluster analysis was applied to identify homogeneous life-style groups. Zones with similar factor scores on the dimensions were clustered by using the K-means algorithm developed by MacQueen (5,6). The distance between a pair of zones was measured as the Euclidean distance in the factor space. That is, D_{xy}, the distance between zones x and y, was defined as follows:

$$D_{xy} = \sqrt{\sum_{i=1}^{p} (x_i - y_i)^2} \qquad (1)$$

where x_i and y_i are the factor scores corresponding to zones x and y respectively for the ith dimension and p is the number of factors defined in the principal components analysis.

The number of clusters in the final solution was determined by examining solutions with from 5 to 20 clusters and choosing the one in which the clusters were most easily identified and interpreted. Each cluster represented an area within the county in which the elderly residents tended to share common socioeconomic and demographic characteristics.

Finally, aggregate patterns of travel behavior of the life-style groups were identified, and analysis-of-variance (ANOVA) was applied to test for the presence of significant differences in those patterns among the groups. Data describing the travel patterns of the elderly were obtained from the 1967 Los Angeles Regional Transportation Study (LARTS), which consisted of an origin-destination survey of a 1 percent sample of the households in the Los Angeles area (7). The following travel variables were created from these data: possession of a driver's license (yes or no); vehicular travel on the survey day (yes or no); number of automobile driver trips on the survey day; number of automobile passenger trips; number of bus passenger trips; and number of trips for each of four purposes—personal business, leisure, work, and shopping.

One-way ANOVA was then applied to test for significant overall differences between group means for the travel variables. A value of the F-statistic of ANOVA was computed for each variable. The overall differences for each travel variable were considered to be significant if the value of F exceeded the value indicating statistical significance at the 0.01 level.

RESULTS OF FACTOR ANALYSIS

Fifty-one variables describing life-style were created from the available data (Table 1). The application of principal components analysis resulted in a seven-factor solution in which each factor was logically interpretable. The seven factors accounted for 57.0 percent of the variance in the original data matrix. The factor-loading matrix for the seven-factor solution is given in Table 2. The percentage of variance explained by each rotated factor is tallied under the corresponding column of factor loadings. By examining the factor-loading matrix, it was possible to label and interpret each life-style dimension as follows:

1. Proximity to services—The first dimension was strongly associated with variables describing social living arrangements, economic resources, and automobile ownership and appeared to be an index of the need to reside in close proximity to services, including public transportation. Many elderly residents of zones with positive factor scores probably had a significant need for such services. They tended to live alone, in densely populated areas of the county, on low incomes, and in older apartment structures. The rate of automobile ownership among the residents was also relatively low.

2. Financial security—Several variables that reflected wealth, occupational status, and income were correlated with this dimension of life-style. In portions of the county with positive factor scores, the elderly tended to live in expensive housing and apartments on moderate to high incomes; apartment living was a common physical living arrangement. A large proportion of the elderly residents owned automobiles and had college educations, and those who worked generally had white-collar jobs.

3. Isolation—Like the first two dimensions, the third dimension was closely associated with income variables. Descriptors of employment status, automobile ownership, and sex of the elderly population were also correlated with this factor. It is likely that many of the senior residents of the zones with positive scores were socially isolated and nonmobile. They were characterized by low automobile-ownership rates, employment levels, and incomes. A relatively high proportion of the households received social security or railroad retirement benefits as their principal source of income. Elderly females far outnumbered males of retirement age, which suggests that a relatively high percentage of the elderly females were widows.

4. Long-term residence—The fourth factor was almost exclusively related to physical living arrangements and included variables descriptive of the age of housing and the year of occupancy. Zones with positive scores were among the most stable residential areas in the county. Many elderly residents moved into their homes before 1950, and a large proportion occupied single-family dwellings. Despite the social and economic pressures that often force those in retirement to move to apartments or smaller homes, many of the

elderly had remained in residences they had occupied since they were much younger.

5. Race and occupation—The fifth life-style dimension reflected the ethnic composition of the elderly population and the occupations of those who worked. Elderly blacks and persons with service-related occupations tended to live in zones with positive factor scores. Although a small proportion of the elderly population was white, these elderly whites constituted a relatively large proportion of the total white population of the zones. The value of homes in these areas was relatively low—evidence of the fact that service employment is associated with low income.

6. Spanish American ethnicity—This dimension was also associated with variables descriptive of ethnicity and occupational status and was strongly related to measures of educational attainment. Positive scores identified areas in which both the Anglo and Spanish American cultures were represented. Elderly persons of Spanish American background who had low levels of formal education and blue-collar occupations were concentrated in these areas. Home values, rents, and the level of automobile ownership were relatively low, and a significant proportion of the elderly families were classified as living in poverty.

7. Poor health—The seventh dimension was an index of the health-related status of the elderly and was closely related to mortality and morbidity rates. Variables describing the proportion of the elderly population who had participated in World War I and the proportion who lived in homes for the aged and dependent were also correlated with this dimension, and these variables appeared to be indirectly related to health status. Zones with positive scores showed high morbidity and mortality rates, relatively high proportions of married elderly, and significant numbers of the elderly living in homes for the aged.

RESULTS OF CLUSTER ANALYSIS

The seven life-style dimensions represented the major sources of variation in the original set of 51 variables, and each dimension represented an important characteristic on the basis of which the elderly populations of the zones in Los Angeles County could be distinguished from one another. Cluster analysis was then applied to the matrix of factor scores in order to identify homogeneous life-style groups among the elderly. After solutions with from 5 to 20 clusters were examined, the 7-cluster solution was chosen because of the high degree of geographic contiguity among the zones within the clusters and because the areas represented by the clusters could be easily identified and described.

The seven life-style groups were given the following descriptive titles: (a) central city dwellers, (b) the financially secure, (c) the institutionalized, (d) new sub-

Table 1. Glossary of census and administrative variables.

Variable	Definition
AUTOF0	Percentage of elderly husband-wife and other families with no automobiles available
AUTOF2	Percentage of elderly husband-wife and other families with two or more automobiles available
AUTOP0	Percentage of elderly primary-individual families with no automobiles available
AUTOP2	Percentage of elderly primary-individual families with two or more automobiles available
BENFIT	Percentage of elderly persons receiving social security or railroad retirement payments
B1949	Percentage of elderly-occupied units built in 1949 or earlier
B6064	Percentage of elderly-occupied units built from 1960 to 1964
B6570	Percentage of elderly-occupied units built from 1965 to 1970
CNEGRO	Percentage of the elderly who are black
CSPAN	Percentage of the elderly who are Spanish American
CWHITE	Percentage of the elderly who are white
DENPOP	Density of elderly population
EDLT5	Percentage of the elderly with less than 5 years of education
ED912	Percentage of the elderly with 9 to 12 years of education
EDCOLL	Percentage of the elderly with 1 or more years of college education
EMPL52	Percentage of the elderly employed 50 to 52 weeks in 1969
FAMILY	Percentage of the elderly residing in homes for the aged or other dependent situations
FEMALE	Percentage of the elderly who are female
HUSWFE	Percentage of elderly households classified as husband-wife households
ILT3K	Percentage of elderly-occupied units with a household income of less than $3000/year
I7K15K	Percentage of elderly-occupied units with a household income of from $7000 to $15 000/year
IGT15K	Percentage of elderly-occupied units with a household income of $15 000 or more/year
MARRY	Percentage of the elderly who are married
MENTAL	Annual visitation rate among the elderly at county mental health facilities
MOBLE	Percentage of the elderly occupying mobile homes or trailer units
MORBID	Annual morbidity rate of communicable diseases among the elderly reported at county health facilities
MORTAL	Annual mortality rate among the elderly per 100 persons
NEGROC	Percentage of the black population who are elderly
NOTEMP	Percentage of the elderly not employed in 1969
01949	Percentage of elderly-occupied units occupied by head before 1949
06064	Percentage of elderly-occupied units occupied by head from 1960 to 1964
06570	Percentage of elderly-occupied units occupied by head from 1965 to 1970
OCCBC	Percentage of members of the elderly labor force classified as blue-collar workers
OCCSER	Percentage of members of the elderly labor force classified as service workers
OCCWC	Percentage of members of the elderly labor force classified as white-collar workers
OWNOCC	Percentage of elderly-occupied units that are owner occupied
POOR	Percentage of the elderly classified as being below the poverty level
POP	Percentage of the total population who are elderly
PRMIND	Percentage of elderly households classified as primary-individual households
RELATV	Percentage of families with elderly family members in residence (other than the head of household or spouse)
RTLT60	Percentage of housing units occupied by elderly renters that rent for less than $60
RT6099	Percentage of housing units occupied by elderly renters that rent for from $60 to $99
RGT150	Percentage of housing units occupied by elderly renters that rent for $150 or more
SPANC	Percentage of the Spanish American population who are elderly
UNITS1	Percentage of housing units occupied by elderly renters in one-unit structures
UNITS3	Percentage of housing units occupied by elderly renters in structures of three or more units
VLLT15	Percentage of housing units valued at $15 000 or less that are occupied by elderly owners
VL1520	Percentage of housing units valued at $15 000 to $19 000 that are occupied by elderly owners
VLGT25	Percentage of housing units valued at $25 000 or more that are occupied by elderly owners
WHITEC	Percentage of the white population who are elderly
WWIVET	Percentage of elderly persons classified as World War I veterans

urbanites, (e) the black community, (f) the Spanish American community, and (g) early suburbanites. The travel-variable means and the ANOVA results are given in Table 3. Because the cluster of zones in which the institutionalized resided consisted of only 14 zones and because only 23 persons in the LARTS sample resided in this area, travel data for the institutionalized group were not listed in Table 3 and were not incorporated in the ANOVA.

The ANOVA results showed that there were statistically significant differences between the life-style groups for eight of the nine travel variables. The groups were not found to be significantly different from one another in terms of the number of trips made for the work purpose. Table 3 shows that the range of mean values for this variable varied only slightly—from a low value of 0.13 trips/person for the Spanish American community and central city life-style groups to a high value of 0.23 trips/person for the new suburbanite and the financially secure life-style groups. The lack of variation could be attributed to the fact that very few trips were made for the work purpose, which leaves little room for variation. But it may also be explained by the fact that the distribution of employment rates was relatively uniform across life-style groups.

Three elements of the data base were used in the description of life-style groups:

1. Detailed census data were aggregated to the cluster level to provide socioeconomic and demographic profiles of the life-style groups.
2. The nine travel variables defined previously were computed for each group to describe characteristics of travel behavior.
3. Maps of the clusters were produced so that the residential locations of life-style groups could be identified.

Central City Dwellers

The first life-style group represented about 26 percent of the county's elderly population and included many

Table 2. Factor-loading matrix.

	Factor						
Variable	Proximity to Service	Financial Security	Isolation	Long-Term Residence	Race and Occupation	Spanish American Ethnicity	Poor Health
PRMIND	0.827						
HUSWFE	-0.822						
OWNOCC	-0.812						
POP	0.757						
DENPOP	0.738						
WHITEC	0.653				0.315		
B1949	0.547			0.629			
UNITS3	0.527	0.373					
AUTOF0	0.524					0.322	
ILT3K	0.512	-0.526	0.330				
I7K15K	-0.512	0.427					
AUTOP0	0.509		0.390				
FAMILY	-0.467						0.421
POOR	0.437	-0.369				0.397	
AUTOF2	-0.362	0.307	-0.546				
SPANC	0.357						
06570	0.357			-0.660			
RT6099	0.349	-0.533					
UNITS1	-0.336						
RELATV	0.321	0.307					0.474
01949				0.794			
VLGT25		0.820					
OCCWC		0.739			-0.307	-0.384	
EDCOLL		0.719					
RGT150		0.679					
VL1520		-0.628					
OCCBC		-0.607				0.344	
VLLT15		-0.486			0.376	0.342	
IGT15K		0.434	-0.723				
EMPL52		0.425					
OCCSER		-0.381			0.699		
NOTEMP			0.689				
ED912						-0.627	
EDLT5						0.749	
FEMALE			0.705			-0.349	
AUTOP2			-0.667				
BENFIT			0.592				
B6570				-0.605			
B6064				-0.661			
06064				-0.417			
CNEGRO					0.891		
CWHITE					-0.865		
NEGROC							
CSPAN						0.783	
RTLT60						0.428	
WWIVET							0.749
MORTAL							0.695
MARRY							0.634
MORBID							0.418
MOBLE							
MENTAL							
Percentage variance explained	13.34	11.60	7.45	6.54	6.37	6.82	4.89

Note: Only factor loadings greater than 0.3 in absolute value are listed.

persons who resided in and near its major urban centers (Figure 2). The mean value for the zones for the dimension of proximity to services was especially high, indicating that this life-style group was unique in terms of home- and automobile-ownership rates, the percentage of single-person households, the average income, and the age of the structures occupied. Although nearly 50 percent of the residences in the county occupied by elderly households were owned, only about 26 percent of central city dwellers owned homes. Almost 47 percent of elderly households had moved into their residences since 1965, a percentage considerably higher than the county average of about 36 percent. But most of the structures were quite old; more than 69 percent were built before 1950.

Almost 47 percent of the households were composed of single persons compared with the country average of 34 percent. In addition, because about 71 percent of the persons living alone did not own an automobile, an especially high dependence on friends and relatives who drive and on public transportation could be expected in this area. The low level of automobile ownership was probably related to the inability of many residents to afford automobiles. Incomes of less than $3000/year were reported by almost half of the households. Although it is commonly believed that central city areas are the location of the least mobile elderly subpopulation, the LARTS data showed that this is not the case. The average number of trips reported by members of this life-style group was below the average for the county's elderly population, but it was much higher than rates for the Spanish American and black community life-style groups. This group had the highest rate of bus travel and relatively high rates of automobile driver and automobile passenger trip making. Central city dwellers nonetheless tended to make fewer vehicle trips than the average elderly person in the county.

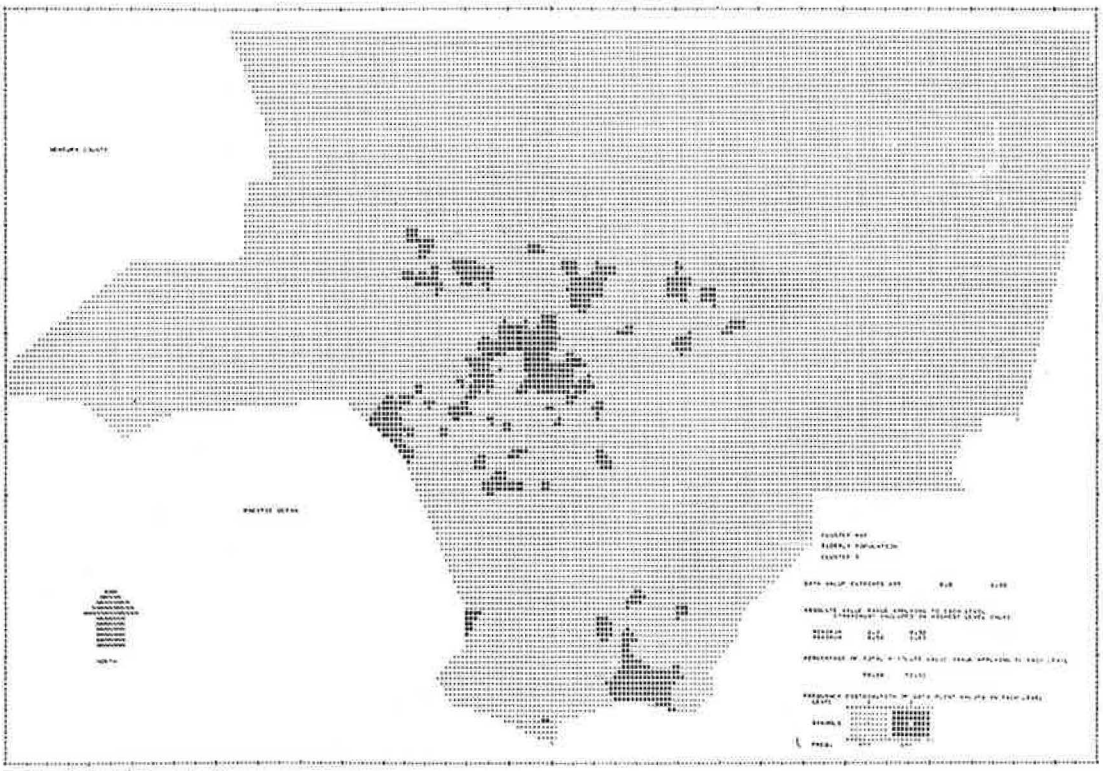
The average number of trips reported by the mem-

Table 3. Travel-variable means and results of analysis of variance.

Travel Variable	Life-Style Group							
	Central City Dwellers	Financially Secure	New Suburbanites	Black Community	Spanish American Community	Early Suburbanites	County	F-Statistic
Percent with drivers' licenses	34.55	58.64	48.14	32.89	23.43	45.61	42.49	39.24[a]
Percent reporting vehicle travel	40.82	55.95	47.84	33.68	31.35	47.11	44.79	19.19[a]
Automobile driver trips	0.66	1.38	1.04	0.56	0.40	1.02	0.91	23.86[a]
Automobile passenger trips	0.35	0.52	0.43	0.21	0.23	0.49	0.42	8.58[a]
Public bus passenger trips	0.21	0.09	0.04	0.16	0.19	0.05	0.11	26.06[a]
Personal business trips	0.59	0.92	0.62	0.53	0.44	0.70	0.66	12.05[a]
Leisure trips	0.23	0.43	0.30	0.13	0.09	0.29	0.27	11.99[a]
Work trips	0.13	0.23	0.23	0.16	0.13	0.19	0.18	2.36
Shopping trips	0.31	0.46	0.39	0.16	0.21	0.43	0.36	13.03[a]
Total trips	1.26	2.04	1.54	0.98	0.87	1.61	1.47	
Sample size	1528	736	706	387	308	2080	5768[b]	

[a] Statistically significant at the 0.01 level.
[b] Includes 23 persons who resided in the institutionalized life-style area

Figure 2. Life-style area of central city dwellers.



bers of this group on the survey day was 1.26/person, or about 85 percent of the county average. Forty percent reported at least 1 trip, only 4 percentage points lower than the county figure, and 7 and 9 percentage points higher than for the black and Spanish American communities respectively. The rate of driving was much lower than the countywide rate, which reflected the low level of automobile ownership among the residents. However, the average number of automobile passenger trips was 0.35, only slightly lower than the county average of 0.42. Bus ridership was nearly double the county average of 0.11 trips/person/d. Trip-making rates for the four trip purposes were all fractionally lower than the county rates.

The Financially Secure

Figure 3 shows the second life-style area, that in which the most affluent portion of the elderly population is located. On the average, members of the financially secure life-style group earned high incomes, lived in expensive homes and apartments, and were high school or college educated. They appeared to be unburdened by the economic constraints that often accompany retirement and that tend to limit travel and the ability to engage in activities. About 14 percent of the county's elderly were members of this group. The life-style dimension most strongly represented in this cluster was financial security; the mean value of the long-term residence dimension was also relatively high. Many of the residents therefore lived on high incomes, had lived in their homes for a long period of time, and had grown old with their neighborhoods and communities. About 60 percent of the housing units occupied by members of this group were owned, and more than 70 percent of the homes were valued at over $25 000. Among those who rented, about 40 percent paid ≥ $150/month. This percentage was substantially higher than the county figure of 12 percent. About 25 percent of the elderly had lived in their homes for 20 years or more, and approximately the same proportion had moved into their residences since 1965.

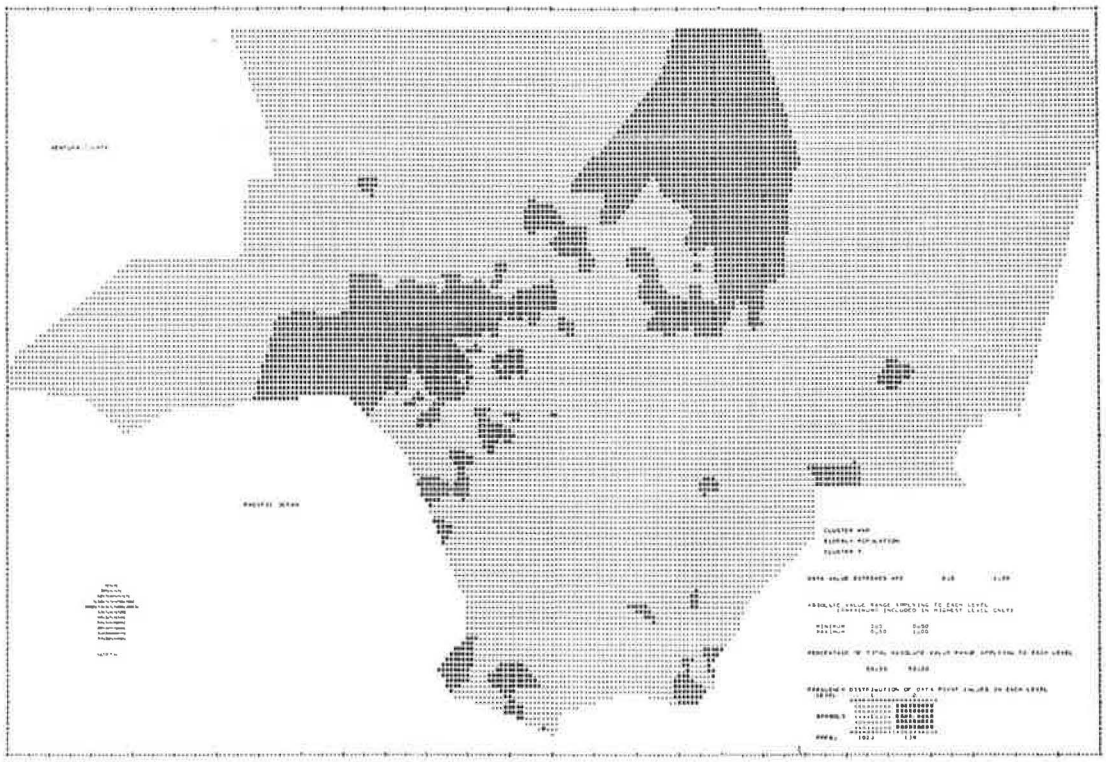
Education and employment levels were also quite high. More than 32 percent of the group were college educated compared with a countywide figure for the elderly of about 17 percent. Forty-five percent of the residents continued to work past retirement age in some capacity, primarily in white-collar occupations.

The average number of trips reported by members of this life-style group was 2.04 trips/person, over one-third higher than the countywide rate and the highest among the life-style groups. The proportion of licensed drivers—59 percent—and the proportion that reported at least one vehicular trip—56 percent—were much larger than the corresponding proportions for the elderly of the county. The average number of work trips was relatively high, and the frequencies of travel for the other trip purposes were much greater than in any other life-style area. The daily number of personal business trips was 0.92 trip/person—approximately as high as the average rates of trip making for the Spanish American and black community groups for all trip purposes and significantly higher than the county average of 0.66 trips/person. Automobile passenger trips were also made more frequently in this area than in any other life-style area.

The Institutionalized

The third life-style area was unique in that it consisted of only fourteen zones (Figure 4). A large positive mean value in the dimension of poor health indicated that this area was the location of elderly who frequently experienced health problems and visited county medical facilties. An examination of census data on a zone-by-zone basis revealed that this life-style group included less than 1 percent of the county's elderly population

Figure 3. Life-style area of the financially secure.



and that a large proportion resided in health care centers such as hospitals, convalescent homes, or other group quarters for the aged. Because the LARTS sampling rate was low, the institutionalized group was not considered in the analysis of travel data. The sample size of 23 was considered to be too small to give an accurate description of the travel patterns of the group members.

New Suburbanites

The new suburbanites lived in the most recently populated areas of the county and represented 12 percent of the county's elderly population (Figure 5). They had suf-

Figure 4. Life-style area of the institutionalized.

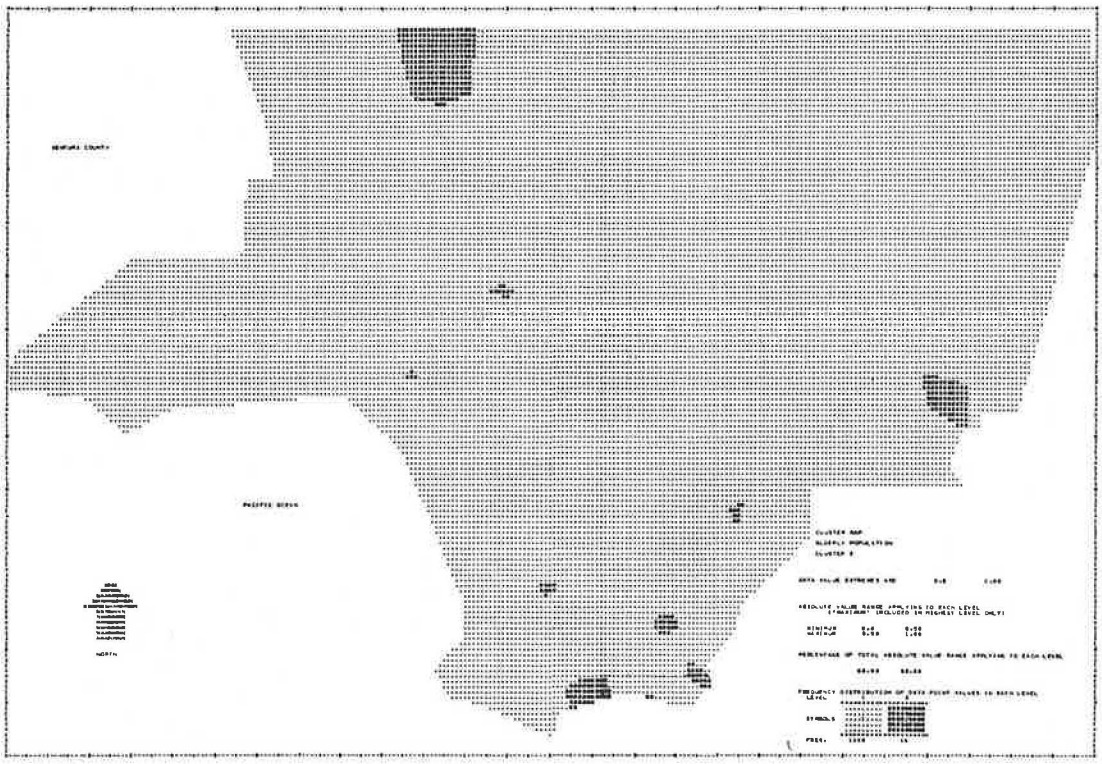
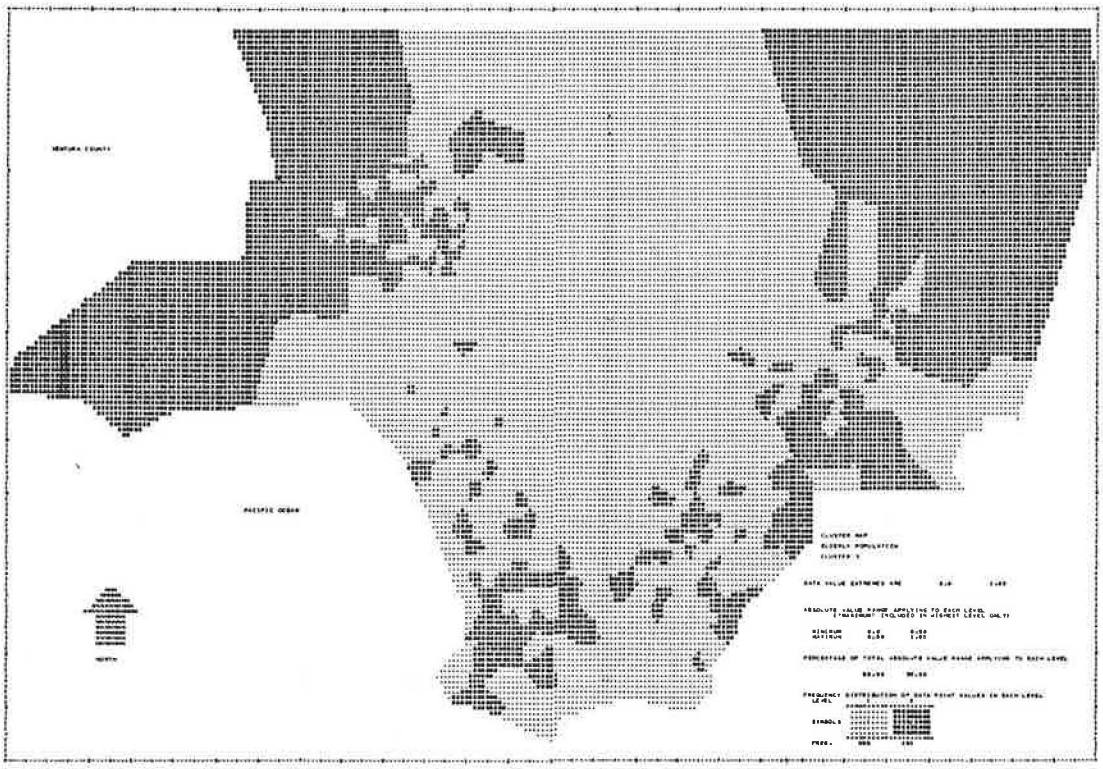


Figure 5. Life-style area of new suburbanites.



ficient economic resources to maintain homes in low-density areas, and many probably had little need for the public services available in more urbanized areas. A negative mean score on the dimension of long-term residence indicated that many of the members of this group had recently moved into new homes. About 48 percent of the elderly households had moved into their residences in 1965 or later compared with a countywide figure of <37 percent. Family living was the most common social living arrangement: Approximately 90 percent of the elderly lived with spouses or relatives. As would be expected in suburban areas, the level of home ownership was high. About 6 out of 10 units occupied by members of this subgroup were privately owned. Those who rented tended to choose large apartment complexes. About 24 percent of the units occupied by the elderly were located in structures with three or more units, a percentage slightly higher than the countywide figure of 17 percent. The average number of trips per elderly person was 1.54, only slightly higher than the countywide average of 1.47 trips/elderly person. The rate of automobile driver trip making was 1.04 trips/person, slightly higher than the county rate of 0.91; the average number of public bus passenger trips was only 0.04 trip/person. This was the lowest rate for the six life-style groups. Nearly 50 percent of the elderly had a driver's license, a proportion only fractionally higher than the proportion for the county's elderly population. For all other travel variables, the mean values for the new suburbanites were similar to the mean values for the elderly population of the county.

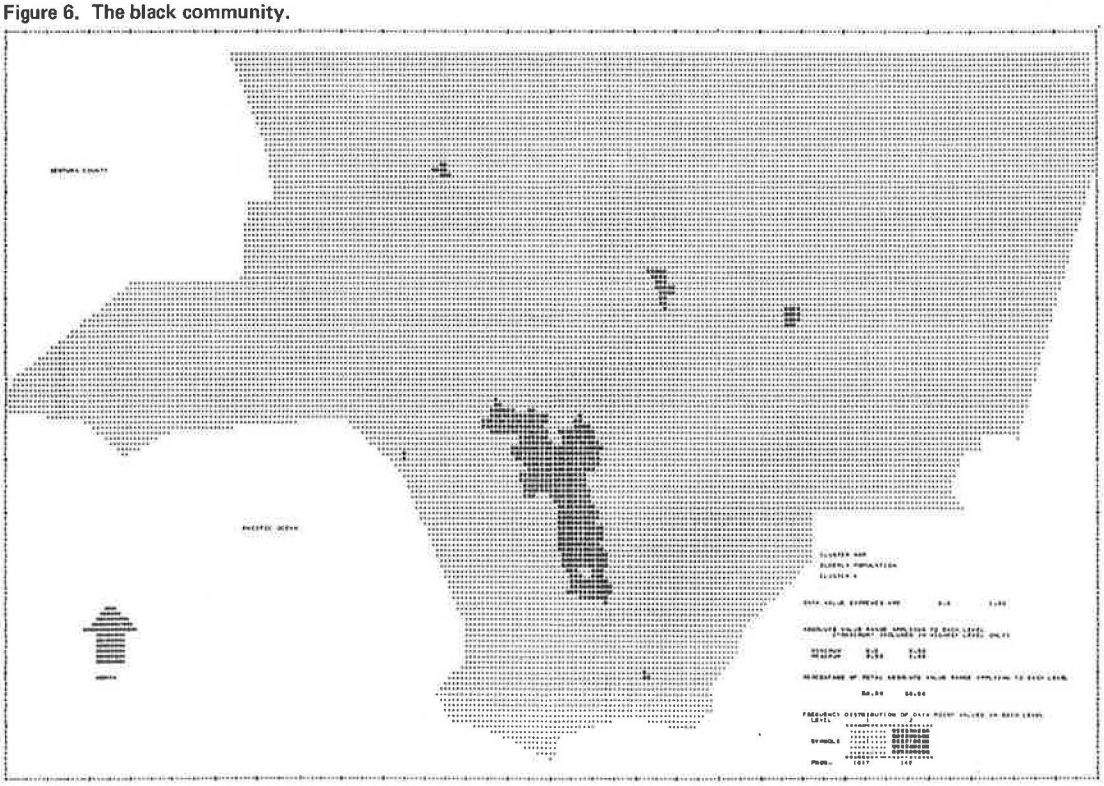
The Black Community

Figure 6 shows the fifth life-style area—the principal location of the elderly black population. The race and occupation dimension was strongly represented in the zones within the area. Of the 42 579 members of this life-style group, about two-thirds were black. Although this life-style group constituted only 7 percent of the elderly population in the county, it accounted for more than three-quarters of the elderly black population. The proportion of residents who were white was only about 29 percent, the lowest percentage among the seven elderly life-style groups. Of those who worked, a high proportion were employed in service occupations, and there was some blue-collar employment.

The negative centroid mean value for the financial security dimension indicated that the average member of the group lived on an extremely low income. Over half of the elderly households reported incomes of $3000 or less; about 42 percent of the elderly households in the county were classified in this income bracket. Because income is directly related to the ability to own and operate an automobile, transit dependency is probably quite common among the life-style group members. Although the level of home ownership was relatively high, the average home had a low market value. Less than 10 percent of the units owned by elderly persons were valued at over $25 000, and 40 percent were valued at less than $15 000. The rents paid by the elderly residents were also low; less than 1 percent of the units had monthly rents greater than $150. The percentage for the county's elderly population was more than 11 percent.

The average number of daily trips reported by group members was only 0.98 trip/person, which is about two-thirds of the countywide average. A low rate of automobile driving accounted for much of this difference; the group mean of 0.56 trip/person was significantly lower than the countywide rate for the elderly—0.91 trip/person. Only 33 percent possessed a driver's license, and about two-thirds did not report a trip on the day of the survey. The average number of automobile passenger trips was especially low—only 0.21 trip/d—which suggests that the opportunities for ride sharing in this area were scarce. Although frequencies of travel for personal business and work purposes were

Figure 6. The black community.



nearly as high as they were countywide, leisure and shopping trip rates were only about half as high.

The Spanish American Community

The life-style area designated the Spanish American community is shown in Figure 7. More than half of this life-style group had Spanish surnames; more than 30 percent of the elderly population in the county who had Spanish surnames were residents of this life-style area. Low education levels were common among the elderly residents; 40 percent of the group had had less than 6 years of formal education. Efforts to improve transportation services in this area should therefore involve the dissemination of bilingual information and the use of media that do not require English language reading skills.

The negative mean centroid value on the race and occupation dimension indicated that in this group the proportion of blacks and the percentage in service occupations were low. Employment in blue-collar occupations was common, and the number of elderly employed in blue-collar jobs was more than twice the number of service workers.

Housing in this life-style area was relatively old, as indicated by the positive centroid value on the dimension of long-term residence. About 82 percent of the group lived in structures built before 1950, and about one in every three elderly households moved into their home before 1950.

The elderly members of the Spanish American community reported, on the average, fewer vehicle trips than did the elderly residents of any other life-style area. A low rate of automobile travel and a relatively high rate of bus travel were prominent in their travel patterns. The average number of leisure trips was also small, reflecting both the overall low rate of trip making and the possibility that many elderly of Spanish American background were not able to engage in activities outside the home because of language or educational barriers. Although this group included only about 5 percent of the elderly population of the county, the rate of transit use was high. This life-style group is thus a prime target for the provision of public transportation services. Only 23 percent of the group had a driver's license compared with 42 percent for the elderly countywide. The rate of automobile driver trip making was less than half the county rate. Trip-making rates for the automobile passenger mode and for the four trip purposes were also low although the average number of work trips was nearly as high as the average for the county's elderly population. Bus passenger trips accounted for nearly 22 percent of the reported trips, and the rate of 0.19 bus passenger trip/person was almost twice the county rate.

Early Suburbanites

The life-style group designated early suburbanites lived in the areas of Los Angeles that were on the urban fringe in the 1940s and 1950s but have more recently become the densely populated areas between major urban centers (Figure 8). The average member of the group lived in a densely populated area in a moderately valued structure that he or she owned. The level of home ownership was higher in this life-style group than in any of the other six groups; more than 63 percent of the elderly households owned homes. Most houses were in the $15 000 to $20 000 range; only a small proportion were valued at more than $25 000. The minority who did not own homes paid relatively low rents. Less than

Figure 7. The Spanish American community.

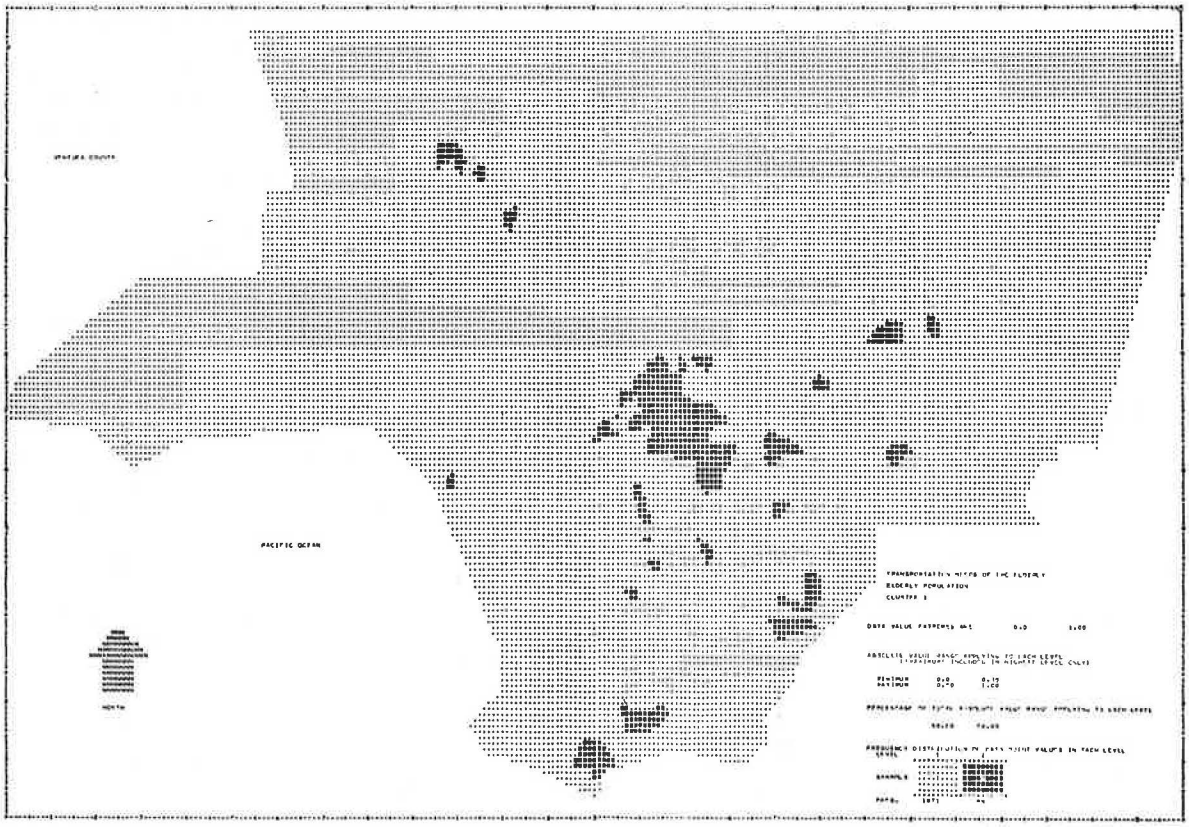
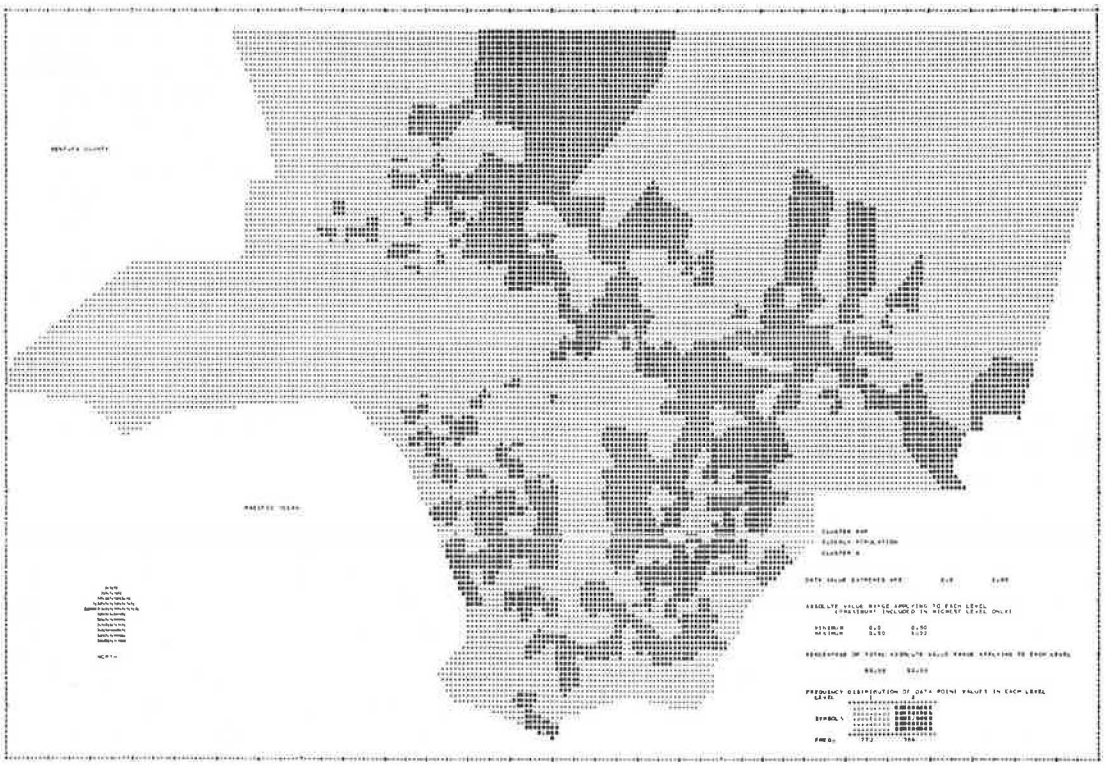


Figure 8. Life-style area of early suburbanites.



5 percent of the rented units had monthly rental rates greater than $150 compared with 12 percent for the county as a whole.

The large size of the group indicated that the residents were a relatively diverse mix. Nearly 35 percent of the elderly population of the county lived in this life-style area, but only about 8 percent of the total population in the area was elderly.

The high level of automobile availability and the low level of dependence on public transportation that are usually associated with suburban living were reflected in the travel patterns of these early suburbanites. Trips were made more frequently by the automobile driver and passenger modes and less frequently by bus in this life-style area than in the county as a whole. The average number of daily trips for this group was 1.61 trips/person, somewhat higher than the county average of 1.47 trips/person. Relatively high rates of trip making for personal business and shopping purposes were also found. The proportion of licensed drivers and the proportion that reported one or more vehicle trips were slightly higher than corresponding countywide figures for the elderly.

SUMMARY AND CONCLUSION

Although this research was based on a detailed case study of the 1970 travel behavior and residential location patterns of the elderly of Los Angeles County, many of the general findings are probably applicable to other metropolitan areas. The major results can be summarized as follows:

1. Through the application of factor analysis and cluster analysis, it was possible to isolate among the elderly population a number of life-style groups that were unique and homogeneous with respect to socioeconomic, demographic, and travel characteristics. The members of these groups tended to reside in close proximity to one another in specific locations within the county.
2. Major differences were found between the elderly residents of low-density suburban areas and those who lived in high-density, central city locations. Many city residents conformed to the stereotype of the elderly—living alone in apartments, earning low incomes, traveling infrequently, and not owning automobiles. However, about one-quarter of the elderly population of the county was characterized by high incomes, suburban residential locations, and relatively high trip-making rates. The majority of these persons probably have little or no need for many public services.
3. Differences in the frequency of trip making among the elderly were associated with variations in modal choice and mixes of trip purpose. The most mobile elderly traveled by automobile and made a significant percentage of their trips for leisure purposes. Those who traveled less frequently often made trips as bus or automobile passengers and tended to make a large proportion of their trips for purposes of necessity such as work and shopping.
4. Little variation was found in the work-trip rate. The rate of employment appeared to be relatively low and uniform across the life-style groups identified in this study.
5. Ethnicity was a particularly important attribute in explaining variations in travel demand. Elderly residents of the most ethnically mixed areas of the county averaged less than 1 trip/d/person, a significantly lower rate than that for the average elderly resident of the county and lower than the rate for central city residents.

The finding that elderly life-style groups tend to reside in specific locations and have unique travel patterns has important implications for the provision of

transportation services to the elderly. It should not be assumed that a single transportation service or a uniform mix of services will adequately serve the members of all life-style groups. Rather, the results of this study would suggest that there are a number of transportation markets among the elderly population. Although the operation of barrier-free buses and the implementation of fare-reduction programs will increase the accessibility of elderly persons who are relatively poor and live in densely populated areas, these same services will probably not be as effective in improving the mobility of suburban residents. Because many elderly suburbanites live great distances from transit stops and because the level of transit service is low, a relatively inexpensive door-to-door service may be more effective in serving the needs of the elderly in the suburbs. The results of additional studies, including attitudinal and behavioral surveys, should make it possible for transit operators to study more closely the travel needs of the elderly and determine the appropriate locations for the operation of transit and paratransit services.

The possibility of implementing a variety of transit services according to the specific needs of elderly life-style groups becomes especially important when one considers the travel demands of future generations of elderly persons. A recent study completed in Los Angeles County (3) showed that since 1940 there has been a strong and consistent trend toward suburbanization of the elderly population. If present trends continue, in coming decades the elderly can be expected to be more decentralized within urban areas and characterized by life-styles even more diverse than those of the elderly population of today. The transportation needs of the elderly will not be adequately served in the future if it is assumed that the elderly will be a homogeneous group with common transportation requirements.

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Evaluation of Pennsylvania's Free Transit Program for Senior Citizens

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The findings of an evaluation of Pennsylvania's Free Transit Program for Senior Citizens are reported. Impacts on both senior citizen users and participating transit operators are analyzed. Personal interviews were conducted with over 2100 elderly persons and 5 participating transit operators. Telephone interviews were conducted with an additional 154 older persons, and 36 transit operators returned written questionnaires. Based on these surveys it was concluded that the program has benefited senior citizens by enhancing their mobility. Individual trip making has increased by an average of 8.2 rides/month. In addition, new riders—generally those with lower incomes—were attracted to transit. Users reported significant cash savings, beyond the fare savings, as a result of being able to travel to lower priced stores. Transit operators generally felt positive about the program despite a dissatisfaction with the compensation received and the method of determining it. Operators enjoy an improved image in the community as a result of their participation while experiencing no major program-related cost increases.

On July 1, 1973, Pennsylvania initiated the first statewide Free Transit Program for Senior Citizens in the United States. The program, funded through the state lottery, involves 72 private and public local transit agencies that serve over 95 percent of all local transit ridership in the state. During 1973 and 1974, approximately 49 million rides were taken by senior citizens under the program at a cost to the state lottery fund of $10.8 mil-