

## EFFECT OF A GASOLINE SHORTAGE ON ACCEPTABILITY OF MODES FOR THE URBAN GROCERY SHOPPING TRIP\*

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### ABSTRACT

Differences in perceived acceptabilities of modes for the urban grocery shopping trip brought about by imposing a constraint on the availability of gasoline are examined. Uni-dimensional attitudinal scaling results show that such differences exist and vary over segments of the population.

### Introduction

Petroleum is a non-renewable resource. Speculation of effects of its eventual and inevitable shortage have intrigued economists, sociologists, urban and transportation planners for some time. It was generally thought that before the situation became acute another plentiful, efficient, inexpensive and non-polluting form of energy would become available, or that society would change its high consumptive habits to those more attuned to conservation.

The Arab embargo against the United States during the winter of 1973-1974 abruptly brought to the present a situation which was considered a problem of the future. Travelers who had become

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accustomed to an unlimited supply of fuel were suddenly faced with constraints on the availability of gasoline in the form of higher prices, shortages, bans on Sunday sales, odd day-even day sales and threatened rationing. This occasion provided an excellent opportunity to study the effects of gasoline shortages on American travel patterns [1-6].

One of the expected long run effects of constrained gasoline availability is a change in modal choice behavior. Paaswell, Notess and Izadi and Notess suggest that modes are selected on the basis of traveler perceived acceptability of modes for a specific trip purpose [7, 8]. Therefore, it can be expected that notable changes in mode choice are preceded by changes in attitudes of travelers toward the acceptabilities of the modes for specific trip purposes. The purpose of this paper is to examine the effect of constrained availability of gasoline on the acceptability of modes for the urban grocery shopping trip.

### Survey Data

Data used in this investigation were collected from a mail-out survey sent to a random sample of fifteen hundred households in six areas of Buffalo, N.Y., conducted from December 1973 through March 1974. The return rate was 22.5 per cent. The areas were chosen to represent a broad spectrum of socio-economic classes within the city. (See Figure 1.)

The households were chosen by a two-stage random sampling method. City blocks in each of the six areas were enumerated. From this, a set of blocks for each area was chosen randomly. Households on these blocks were then enumerated and a set of these selected randomly for each area.

A supplementary random sample of fifty households was also drawn for each area. Undeliverable surveys returned by the Postal Service were sent to households from the supplementary list of the corresponding area.

Information for each household included:

1. socio-economic description both of the household and also of the member of that household who does most of the grocery shopping
2. a description of where the shopping is done and mode of travel to and from the store
3. the shopper's opinion on how grocery shopping travel might change if certain economic changes occur (e.g., gas rationing)

Imagine that you are making a shopping trip by each of the following modes: car driver, taxi, bus, bicycle, walk. How acceptable would you consider each one of these ways for making a shopping trip? *Check the box which best describes your feelings.*

	TO STORE							
	Extremely unacceptable	Very unacceptable	Somewhat unacceptable	Neutral	Somewhat acceptable	Very acceptable	Extremely acceptable	
car driver								
car passenger								
taxi								
bus								
bicycle								
walk								

	FROM STORE							
	Extremely unacceptable	Very unacceptable	Somewhat unacceptable	Neutral	Somewhat acceptable	Very acceptable	Extremely acceptable	
car driver								
car passenger								
taxi								
bus								
bicycle								
walk								

Figure 1. Acceptability of mode question.

Respondents were asked to rate acceptability of modes of travel on a seven point semantic differential scale, ranging from extremely unacceptable to extremely acceptable, for both portions of a shopping trip, i.e., from home to the store and from the store to home. The specific question concerning mode acceptability is reproduced in Figure 1.

Respondents were then asked the following question:

Suppose that gasoline is rationed, or that gasoline becomes expensive, say about \$1.00 a gallon. You still must shop for groceries. Please indicate how acceptable each of the same modes would be for you now.

Again a form, such as the one shown in Figure 1, was provided for their responses.

### Methodology

The sample of respondents was segmented into several groups according to sex, car availability, car use, employment, age and income. The assumption was made that shoppers with similar socio-economic characteristics perceive acceptabilities of modes similarly. Semantic differential data for each subsample was then scaled by the Law of Categorical Judgment [9].

The law of categorical judgement assumes the existence of a psychological continuum associated with a particular judgement which in this case is acceptability of mode for a shopping trip. This continuum is assumed to be divided into a set of ordered categories. It is further assumed that the distribution of responses by individuals to the question of acceptability of each particular mode is normal on the psychological continuum of acceptability. The mean of this distribution is the scale value of acceptability of the mode. Finally, it is assumed that boundaries separating levels of acceptability project a normal distribution of positions on the continuum; the mean of which is the scale value for the category boundary.

A detailed analysis of the law of categorical judgement is contained in Torgerson [9].

To facilitate comparison results of scaling acceptabilities of modes for the shopping trip were normalized by dividing scale values of acceptance of every mode and values of all the category boundaries of each scale by the corresponding value of the last category boundary. Although this normalization resulted in a compression of scales, relative positions of both scale values and category boundaries were preserved.

### Total Sample Results

Figure 2 shows scaled acceptabilities of modes to store for the total sample. With no constraint on gasoline availability the driver mode is most acceptable followed closely in acceptability by the passenger mode. Although walking is next in acceptability, it is a significant distance below the two car modes. Bicycle, taxi and bus are closely grouped in the extremely unacceptable category. The distance between this group of modes and walking is about the same as that between the car modes and walking. Bus is clearly the least acceptable mode under these conditions.

With a constraint on gasoline availability shoppers found the passenger mode to be most acceptable. Acceptability of the driver mode decreased into the next lower category while walking increased in acceptability. Acceptability of bicycle increased by two categories. Use of bus became somewhat more acceptable; but there was no change in the acceptability of taxi. The estimated category boundaries which theoretically should be identical for both scenarios are seen to be in reasonable agreement.

Figure 3 shows scaled acceptabilities for the return portion of the shopping trip. A comparison of acceptabilities for this portion of the trip with the acceptabilities of modes to the store (with no constraint on gasoline availability) indicates that the two car modes are still most acceptable but that walking has decreased in acceptability and is now in the neutral category. Taxi, bicycle, and bus remain in the extremely unacceptable category. Acceptabilities of modes for the return portion of the shopping trip with the gasoline availability constraint are similar to those of the first portion of the trip with the same constraint. The passenger mode becomes most acceptable and acceptability of the driver mode has significantly decreased while the walking mode also becomes more acceptable, it has not reached the level attained for the first portion of the trip. Bicycling is more acceptable, acceptability of taxi shows virtually no change and acceptability of bus has dropped even further into extreme unacceptability. These downward shifts for the return trip can be explained by difficulties associated with carrying packages by the walk, bicycle, and bus modes.

The most significant change for the total sample occurred in the decreased acceptability of the driver mode if gasoline became hard to obtain. Little decrease in acceptability of the passenger mode is noted implying that individuals are reluctant to give up the convenience of the car and would probably be willing to get a ride with someone else for the shopping trip. Interestingly, bus, which is unacceptable for the shopping trip under non-constrained

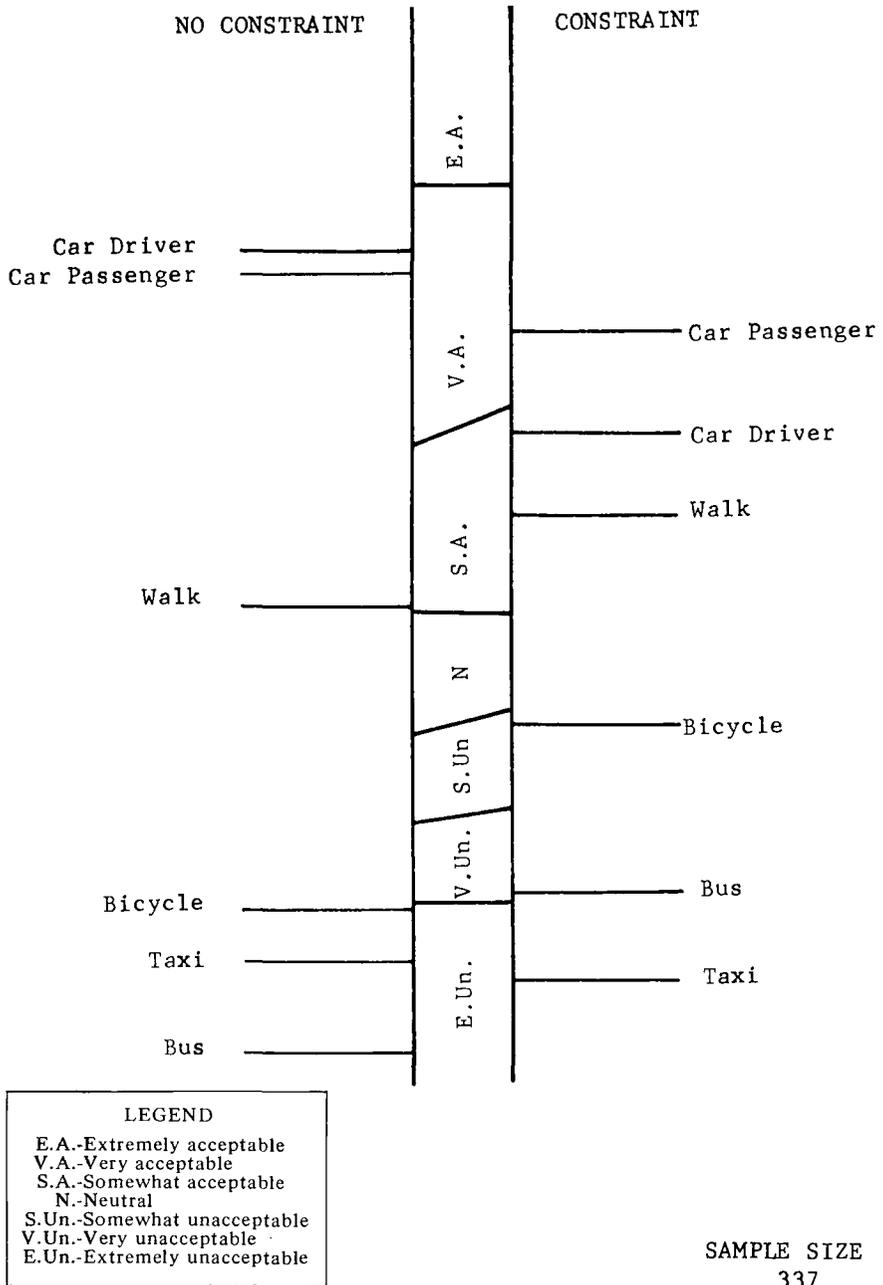


Figure 2. Acceptability of mode to store. Total sample.

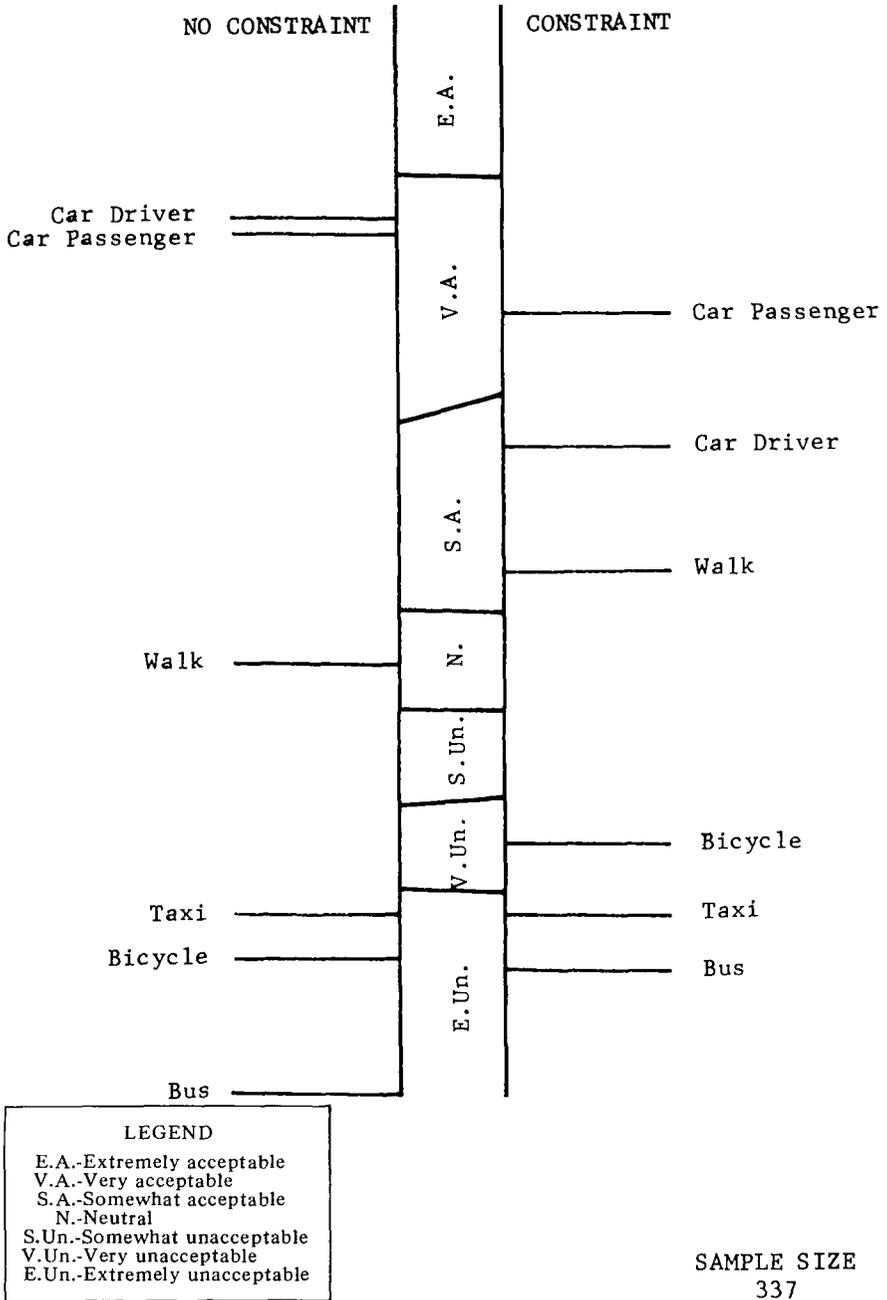


Figure 3. Acceptability of mode from store. Total sample.

conditions, does not become more acceptable in the constrained gasoline availability situation. This implies that the role of public transportation as a solution to the woes of a gasoline shortage may not be significant.

### Effects of Car Availability on Acceptability of Mode

Figures 4, 5 and 6 display acceptabilities of modes to store for samples segmented by car availability. As previously stated, category boundaries for the same subsamples, but under different conditions (e.g., no constraint vs. constraint) should be identical. In cases where the sample is very small, as in the "car-never-available" segment, location of estimated boundaries vary due to statistical limitations of sample size and the results can only be interpreted qualitatively.

Figure 4 shows that the "car-never-available" subsample rate both auto passenger and walking almost equally as the most acceptable modes. The driver mode is considered to be less acceptable; its scale value is in the "somewhat acceptable" category. This group of shoppers rate bicycle and bus in the extremely unacceptable category. Taxi is rated slightly higher as very unacceptable.

When a gasoline constraint is imposed, walking becomes extremely acceptable for the "car-never-available" shoppers. Acceptability of both car modes decrease with passenger being placed in the neutral category and driver in the extremely unacceptable category. The acceptabilities of bus, bicycle and taxi decreased resulting in taxi as the least acceptable mode, probably in anticipation of increased fares due to gasoline shortage.

Figure 5 shows that, under no-constraint conditions, the "car sometimes available" subsample rate passenger, driver, and walk modes as very acceptable with passenger acceptability as the highest. Driver and walking modes are perceived to be marginally very acceptable. This group rates bus as least acceptable with a scale value in the extremely unacceptable category.

Constraining gasoline availability results in walking becoming most acceptable (in the extremely acceptable category) for the "car sometimes available" subsample. Acceptabilities of car modes decreases to the somewhat acceptable category with passenger higher than driver. The bicycle and bus modes become slightly more acceptable and taxi becomes least acceptable.

Figure 6 shows that the "car always available" subsample rate driving as extremely acceptable, passenger as very acceptable and walking as neutral. This group rates bicycle, taxi and bus similarly

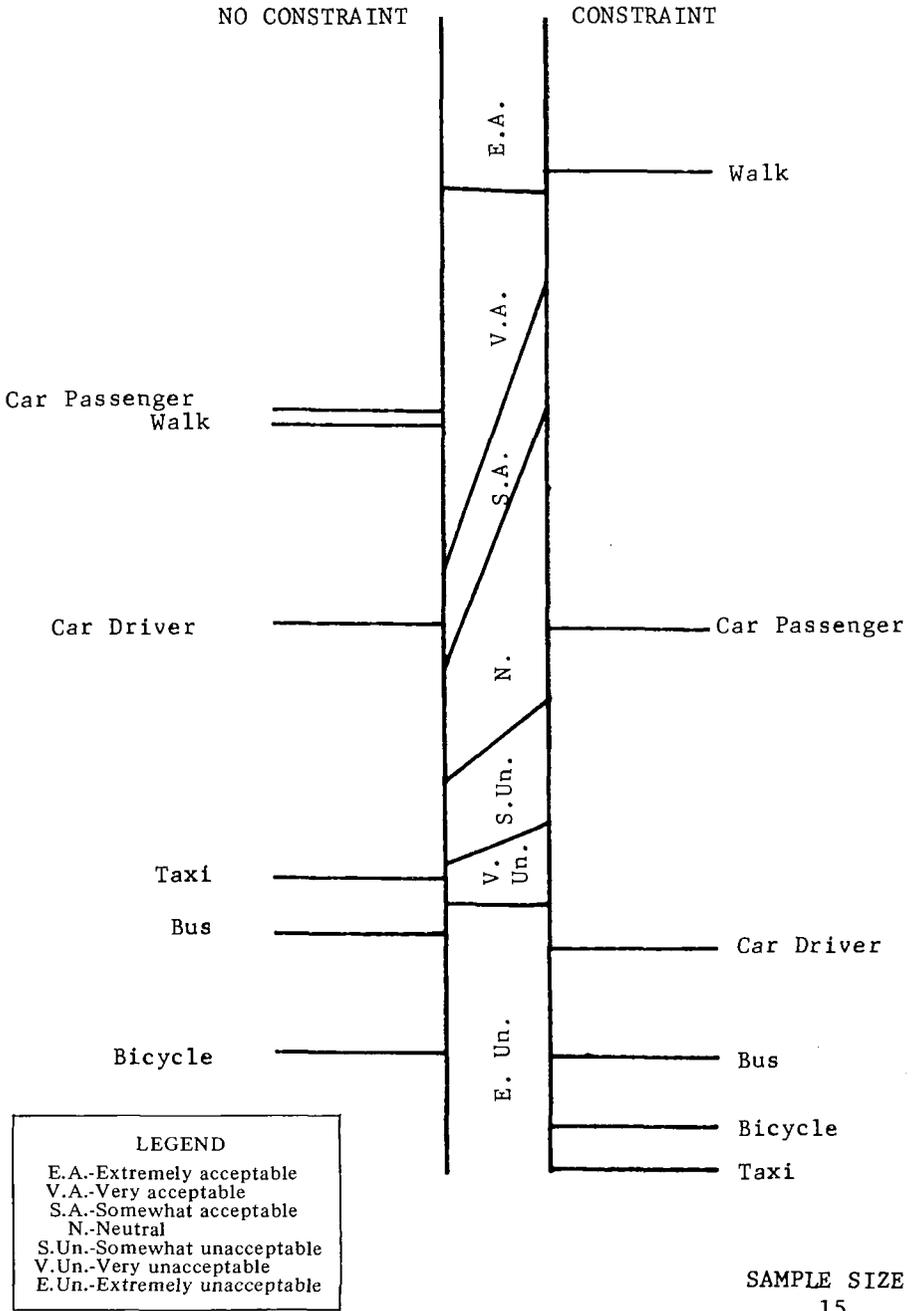


Figure 4. Acceptability of mode to store. "Car never available."

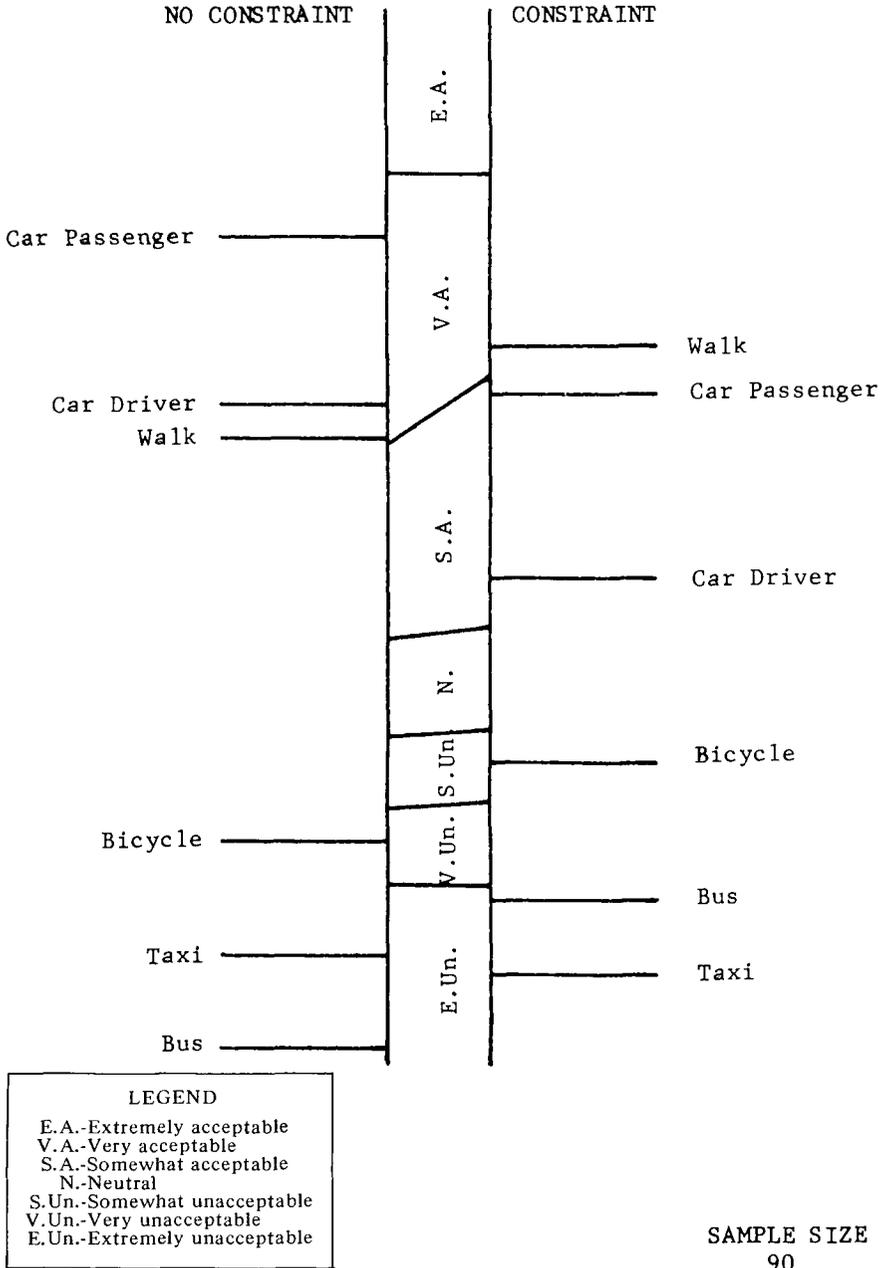
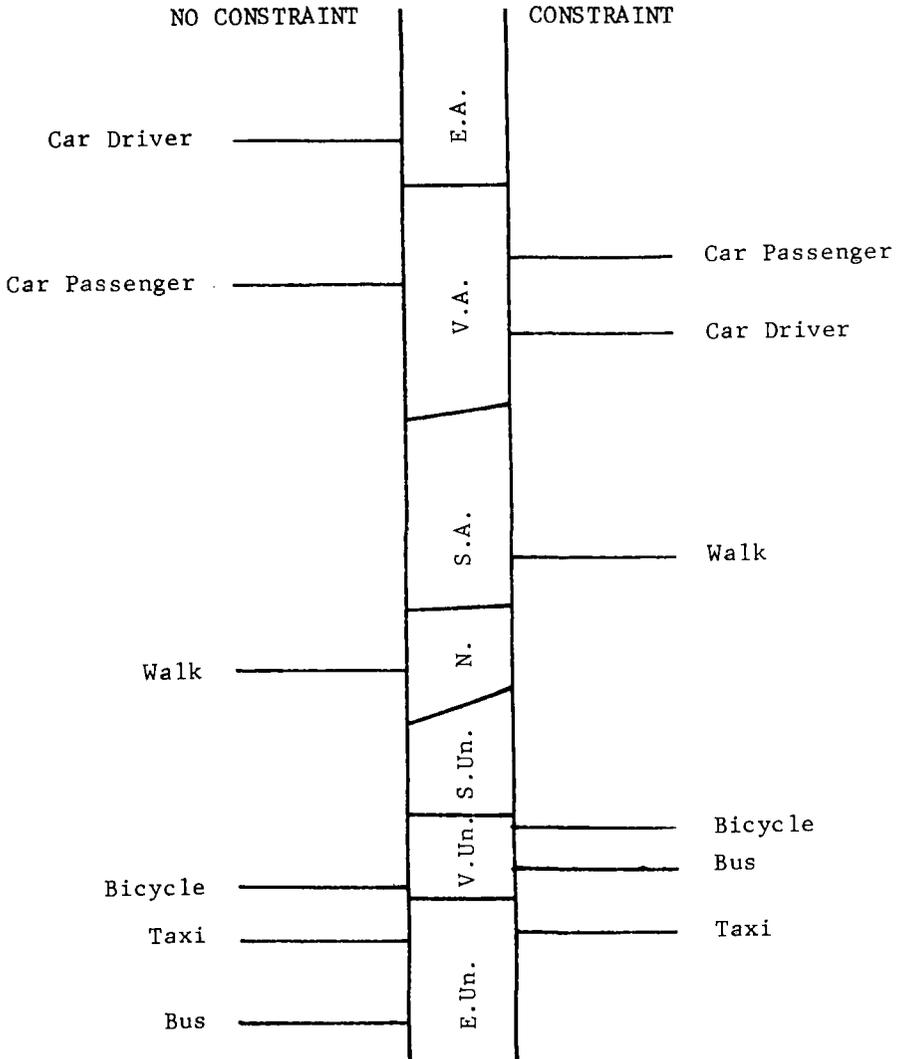


Figure 5. Acceptability of mode to store. "Car sometimes available."



**LEGEND**  
 E.A.-Extremely acceptable  
 V.A.-Very acceptable  
 S.A.-Somewhat acceptable  
 N.-Neutral  
 S.Un.-Somewhat unacceptable  
 V.Un.-Very unacceptable  
 E.Un.-Extremely unacceptable

SAMPLE SIZE  
 232

Figure 6. Acceptability of mode to store. "Car always available."

as the "car sometimes available" group, with bus being the least acceptable.

A gasoline constraint results in a decrease in acceptability of car modes and an increase in acceptability of the walk mode. However, car modes still remain more acceptable than walking. The passenger mode retains the same position on the acceptability scale, and driver drops to a position a small distance below that of passenger, making the passenger mode the most acceptable. Bus and bicycle become slightly more acceptable and taxi, while retaining the same position on the scale, becomes least acceptable.

These results imply that shoppers who never have a car available prefer walking to using bus mode under any conditions analyzed. Shoppers with a car sometimes available would probably turn to walking and not to bus in the event of a constraint on gasoline. Shoppers with a car always available show reluctance in giving up the car even in a gasoline shortage. There is no indication that conditions of a gasoline shortage would lead to greater reliance on public transit for the shopping trip.

### Effects of Car Use on Mode Acceptability

Since car availability does not necessarily imply car use, acceptabilities of modes were compared for subsamples homogeneous with respect to car use. Respondents were divided into three subsamples: those who do not usually use a car for shopping regardless of whether or not a car is available, those who usually are drivers, and those who usually are passengers. It was found that car non-users usually walk to stores. Not surprisingly, the most acceptable mode for each subsample is the mode usually used.

The results for the "car not used" subsample are shown in Figure 7. It is interesting to note that shoppers who do not usually use a car rate walking as the most acceptable and bus as the least acceptable under present conditions. The second most acceptable mode for the "car not used" group is the passenger mode which rates slightly lower than walking. The driver mode is rated even lower as somewhat acceptable. The remaining three modes are all rated as unacceptable.

When a gasoline constraint is imposed, walking which is the most acceptable mode for this group under non-constraint conditions becomes even more acceptable. Acceptability of the passenger mode for this group decreases to the somewhat acceptable category. The largest shift is made by acceptability of the driver mode which moves down into the very unacceptable category, almost equal to

the acceptability of bus which has moved up from its previous position. The bicycle mode also becomes more acceptable while taxi becomes the least acceptable mode.

Increased acceptability of walking by a group that usually walks anyway may perhaps be explained by a perceived increase in social acceptability of walking under constrained conditions. For the first time, this group may feel that they have an advantage over car users. (See Figure 7.)

Individuals in the driver subsample, expectedly, rate driver as most acceptable. The mode of passenger, is some distance from the driver mode on the psychological continuum in the very acceptable category. Walking is a significant distance below passenger in the neutral category. Bicycle is in the second lowest category and taxi and bus are in the lowest.

When the gasoline constraint is imposed, drivers rate passenger mode as the most acceptable. The driver mode decreases in acceptability from its former position to slightly below that of the passenger mode. Acceptabilities of walking, bicycle and bus increase leaving taxi as the least acceptable mode.

As shown in Figure 8, passengers rate passenger mode as the most acceptable in the extremely acceptable category and driver and walking almost equally in the somewhat acceptable category under conditions of no constraint. The relative distance between passenger and these latter two modes is quite large. The remaining three modes are clustered in the extremely unacceptable range.

Even with the gasoline constraint this subsample still considers the passenger mode as the most acceptable. Walking, however, becomes more acceptable than the driver mode. Bus becomes slightly more acceptable, while bicycle and taxi vie for the least acceptable position.

Several general observations can be made based on the results of the segmentation by car usage. Bus is the least acceptable of all the modes for all the subsamples. The gasoline constraint brought about only small increases in acceptability of bus implying that car users are reluctant to give up the comfort and convenience of their cars.

Acceptability of walking increases for each subsample, and the passenger mode remains highly acceptable for the passenger as well as the driver subsamples when the gasoline constraint is imposed. There is a corresponding decline in acceptability of the driver mode indicating car drivers would prefer to get a free ride with someone else or share in the expenses rather than turn to a non-car mode in the event of a fuel shortage.

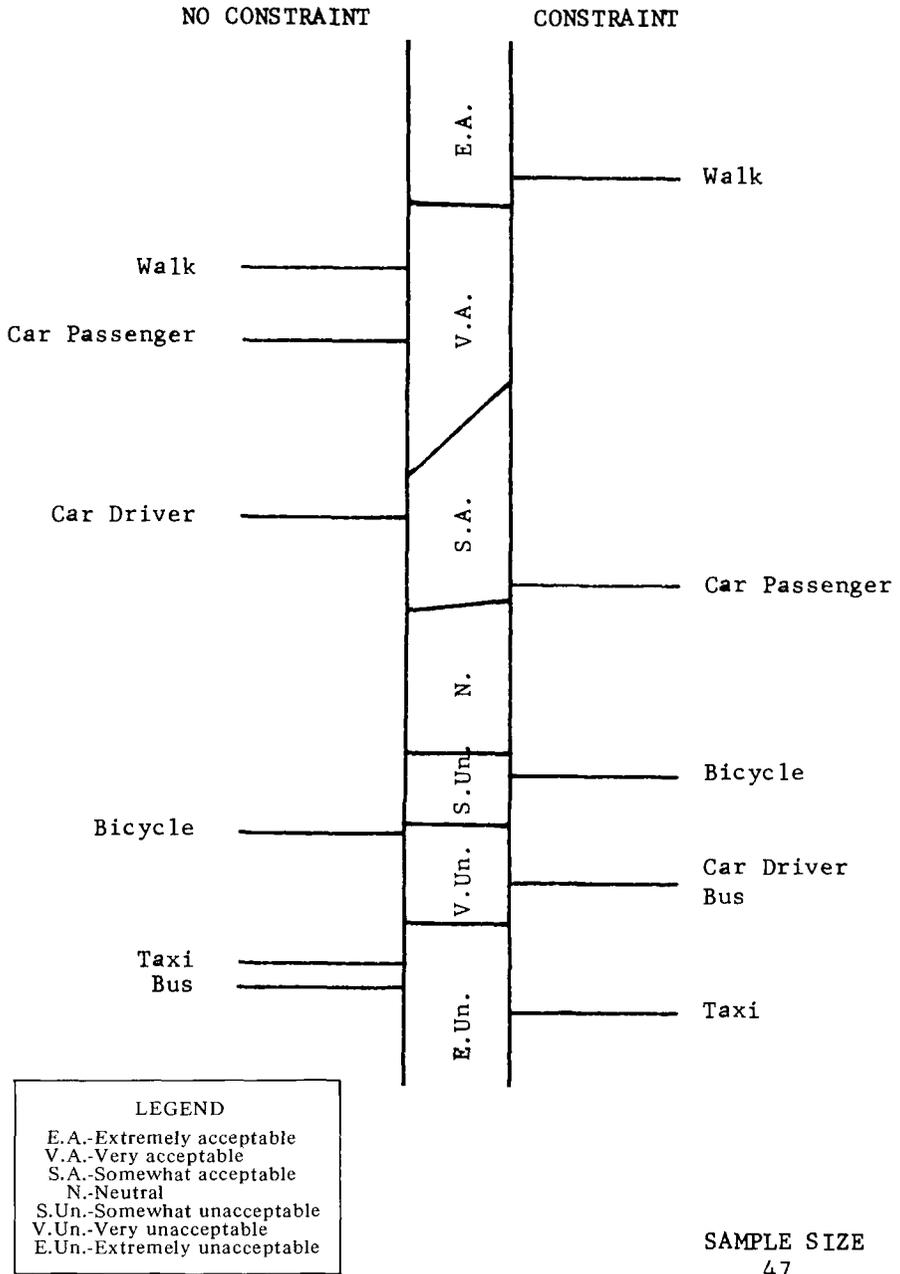
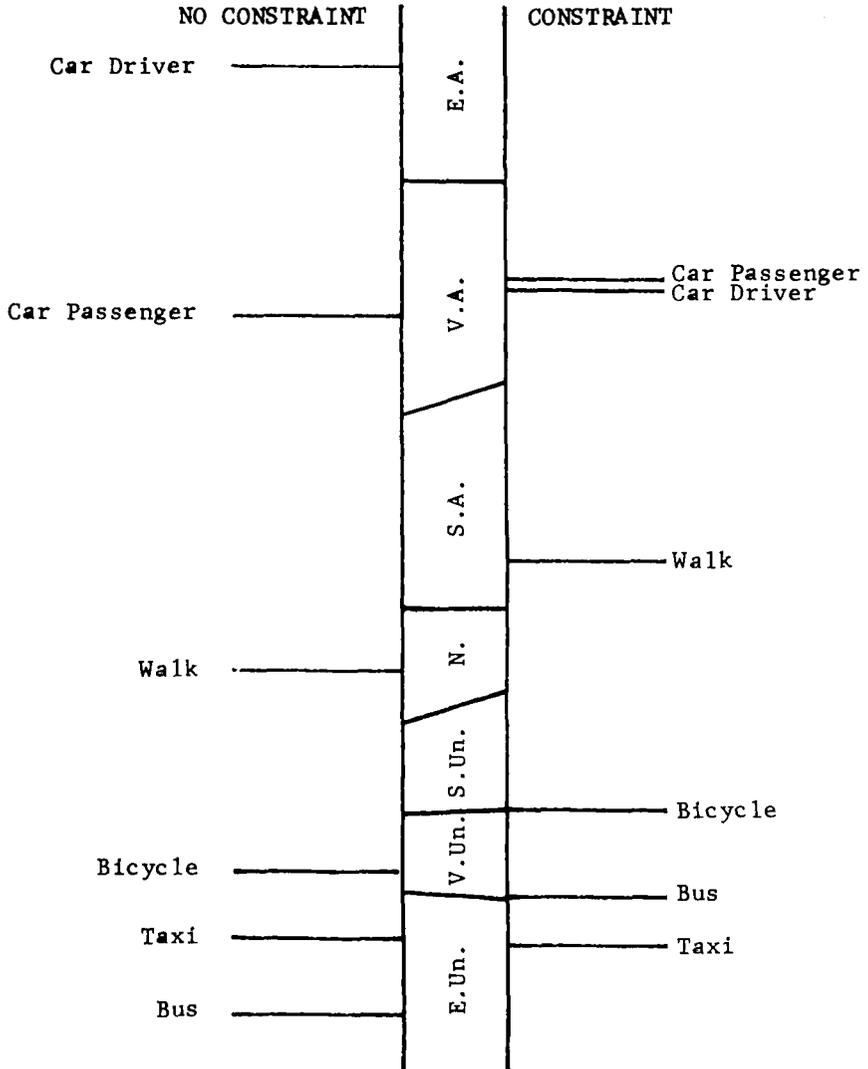


Figure 7. Acceptability of mode to store. Car not used.



**LEGEND**

E.A.-Extremely acceptable  
 V.A.-Very acceptable  
 S.A.-Somewhat acceptable  
 N.-Neutral  
 S.Un.-Somewhat unacceptable  
 V.Un.-Very unacceptable  
 E.Un.-Extremely unacceptable

**SAMPLE SIZE**  
226

Figure 8. Acceptability of mode to store. Drivers.

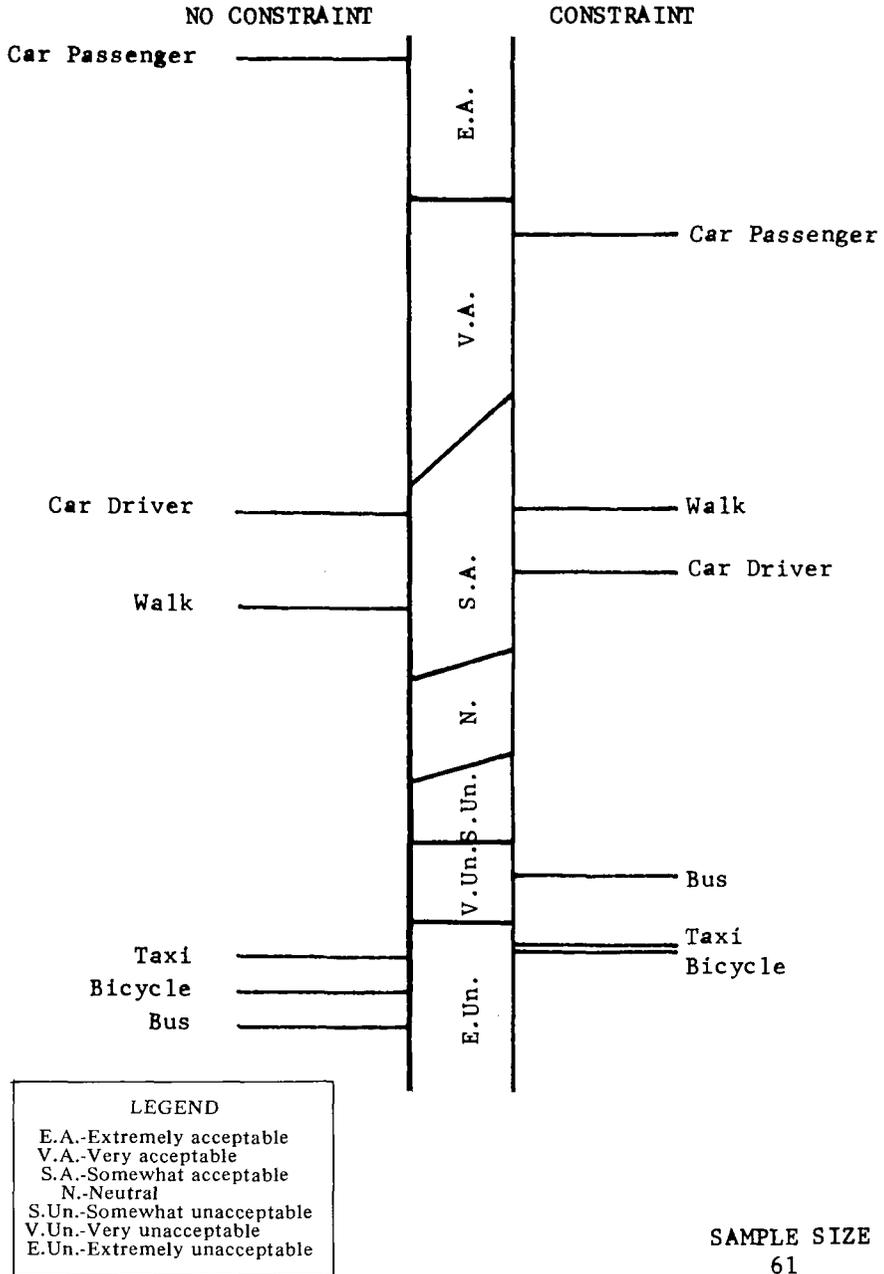


Figure 9. Acceptability of mode to store. Passengers.

An interesting observation about the bicycle mode is that the driver and "car not used" subsamples consistently rate it more acceptable than does the passenger subsample. This may be explained by the fact that the former two groups play an active role in their transportation while the passengers play a passive role. Therefore another active means of transportation such as the bicycle might be thought of as more acceptable by walkers and drivers than by passengers (see Figure 9).

### Effects of Employment on Mode Acceptability

The next set of figures shows acceptability of modes for the sample segmented by employment.

Figure 10 shows that car modes are the most acceptable for the employed subsample under present conditions. The walk mode is next in acceptability while the bus, bicycle and taxi modes are unacceptable. For the situation in which gasoline is difficult to obtain there is a decrease in the acceptability of the car modes, particularly in the driver mode. Correspondingly, there is a large increase in the acceptability of walking, and also a slight increase in acceptability of bus.

Figure 11 shows that the homemaker subsample consider the passenger mode as the most acceptable. When the gasoline constraint is imposed, the acceptability of both car modes decreases while acceptability of walking increases. Acceptabilities of bicycle and bus modes increase slightly leaving taxi as the least acceptable mode.

Results for the subsample of retired individuals are shown in Figure 12. These results indicate considerable decrease in acceptability of the driver mode when a gasoline constraint is imposed; retired shoppers consider this mode to be unacceptable, the only case in which acceptability of the driver mode is below the neutral category. Acceptability of passenger mode also decreases somewhat but still remains the most acceptable; walking increases in acceptability. There is no significant change in the acceptabilities of the remaining three modes; acceptabilities of taxi and bus increase only slightly and the bicycle which was extremely unacceptable remains so.

That the retired subsample rates the driver mode extremely low for the constrained case may be indicative of the effect of fixed incomes on ability to pay high prices for gasoline to drive a car. There is also a somewhat smaller decrease in acceptability of the passenger mode for this subsample, indicating that sharing expenses for a car, although relatively easier, might still be difficult for them.

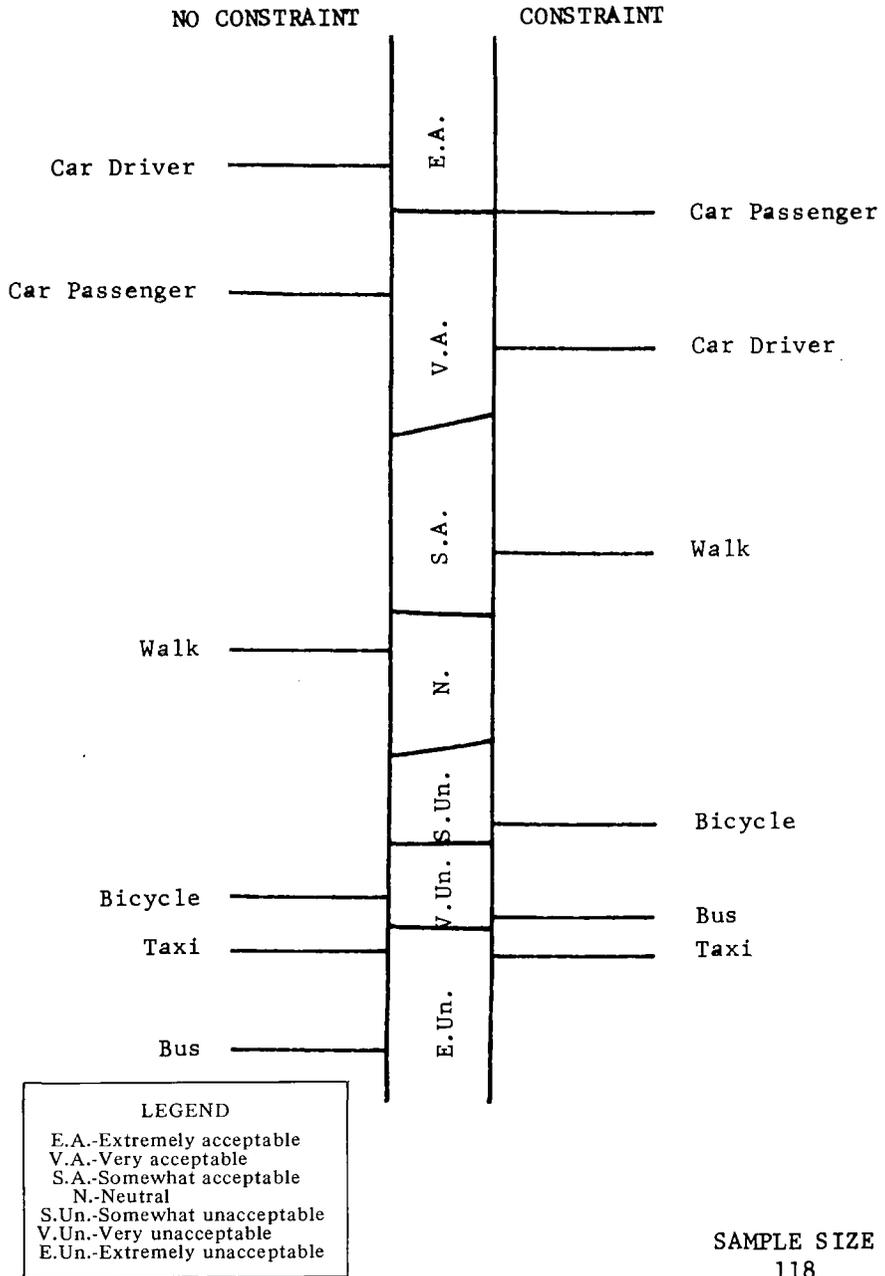
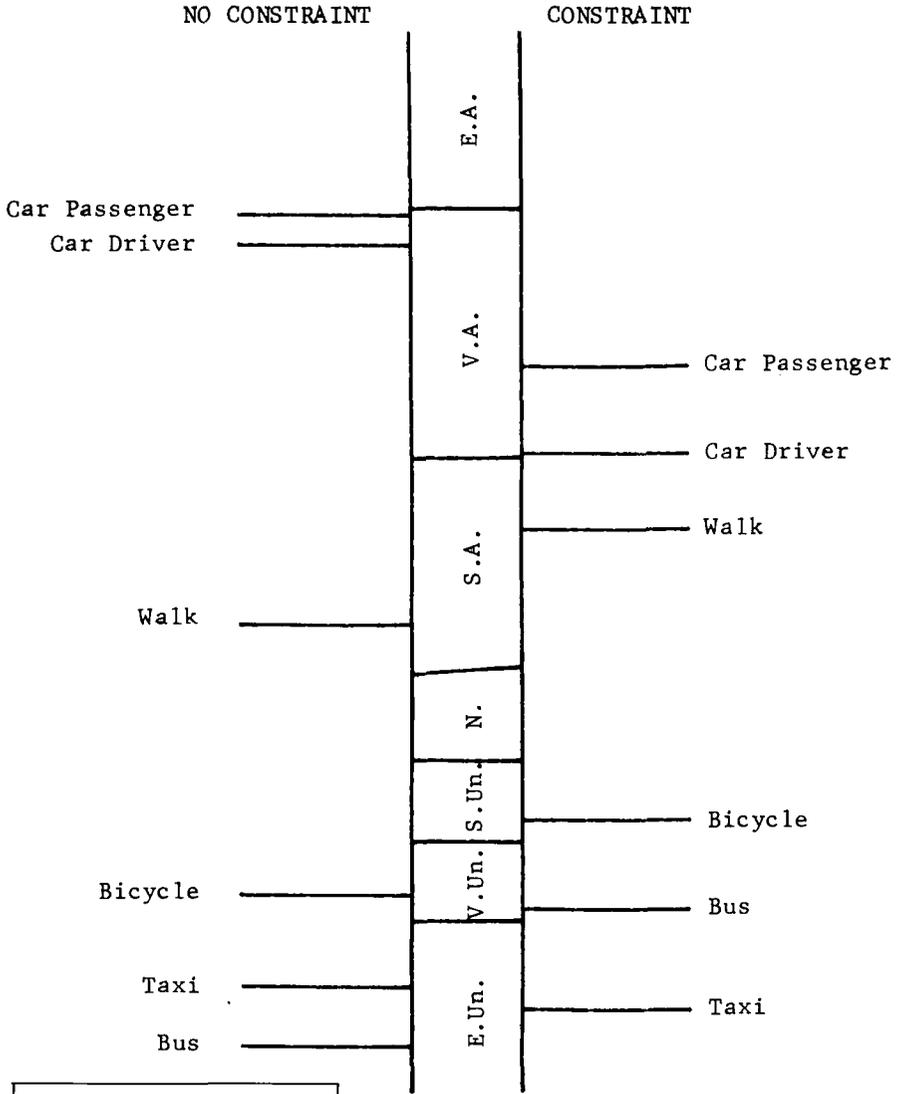


Figure 10. Acceptability of mode to store. Employed.



**LEGEND**  
 E.A.-Extremely acceptable  
 V.A.-Very acceptable  
 S.A.-Somewhat acceptable  
 N.-Neutral  
 S.Un.-Somewhat unacceptable  
 V.Un.-Very unacceptable  
 E.Un.-Extremely unacceptable

**SAMPLE SIZE**  
 148

Figure 11. Acceptability of mode to store. Homemaker.

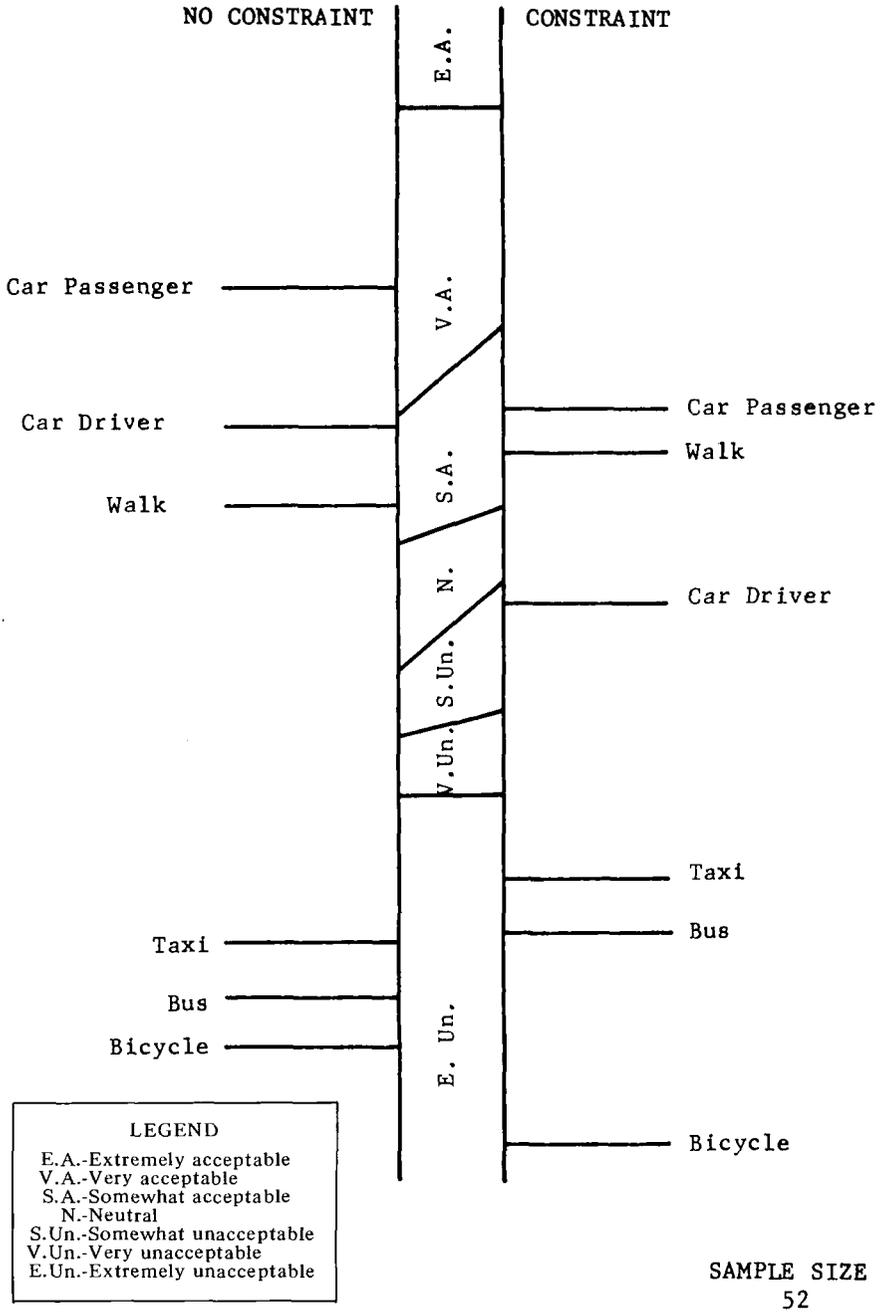


Figure 12. Acceptability of mode to store. Retired.

Examining the sample by employment shows that constrained gasoline availability decreases acceptability of the driver mode in all cases and increases acceptability of the passenger mode in all cases except for the retired. Walking increases in acceptability in all cases but bus made only slight gains.

### **Effects of Income on Acceptability of Modes**

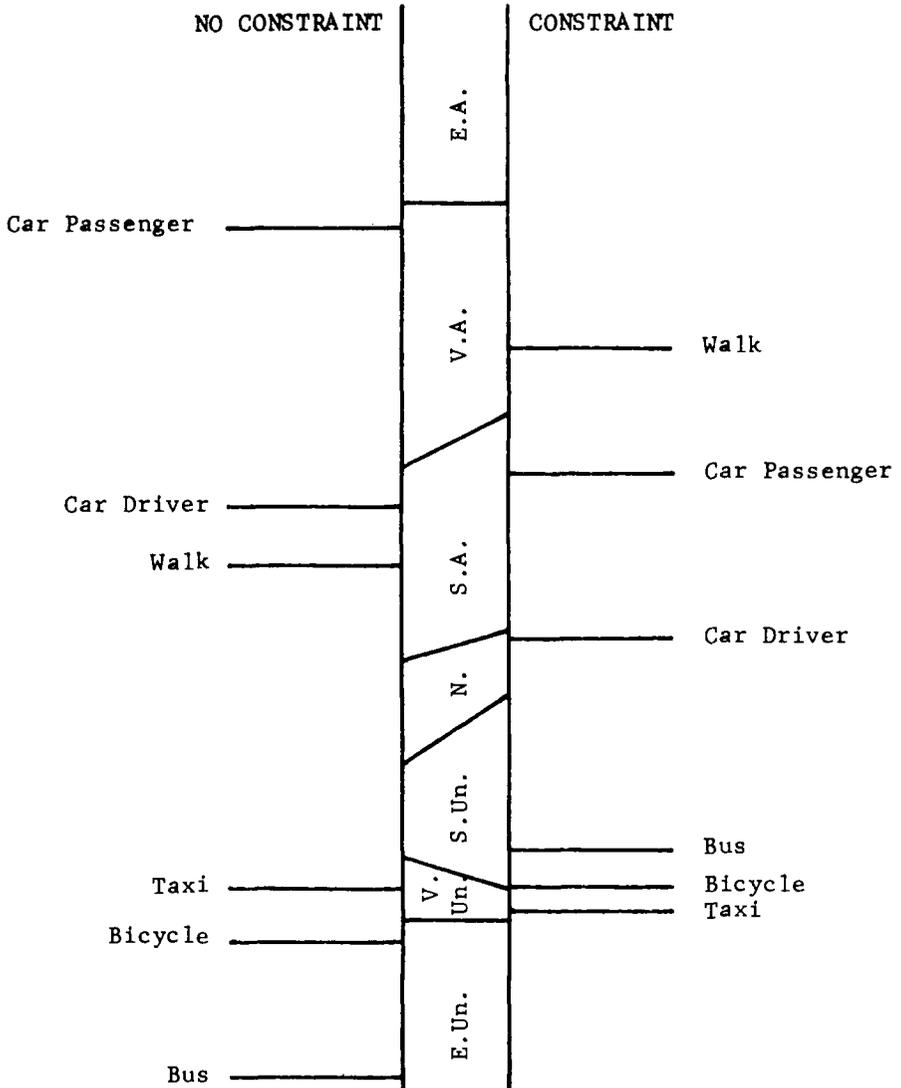
The next set of figures shows the acceptability of modes for the sample segmented by income.

Figure 13 shows that for the lowest income group, i.e., those with annual household incomes less than \$5,000, there is a large increase in acceptability of walking coupled with a large decrease in acceptability of the passenger mode when a gasoline availability constraint is imposed. The acceptability of the driver mode also decreases although not as drastically. Of the remaining three modes, bus increases the most in acceptability. This increase, however, does not remove it from the unacceptable range.

As annual household income increases to the \$5,000-\$10,000 range, acceptability of the driver mode in the non-constrained case is almost equal to that of the passenger mode, as shown in Figure 14. When the gasoline constraint is imposed, acceptabilities of both car modes drop and acceptability of walking increases. However, unlike the case for the lowest income group, both car modes are still considered to be very acceptable and more acceptable than walking. Acceptability of bus increases, as it does for the lowest income group. Bicycle gains some acceptability and the taxi loses some. These three modes, however, remain in the unacceptable categories.

For the non-constrained case, Figures 15, 16, 17 and 18 show that as income increases driving becomes more acceptable than riding for the shopping trip. Walking in all cases is next in acceptability, falling into the somewhat acceptable category in most cases. Bus is considered least acceptable by all groups with incomes under \$15,000 (see Figures 13, 14 and 15) and taxi is considered least acceptable by the remaining groups (see Figures 16, 17 and 18). These figures also show that as income increases, it becomes more acceptable to use the bicycle for shopping reinforcing stated concepts of the bicycle as a middle class phenomenon.

When a gasoline constraint is imposed, the passenger mode becomes the most acceptable for all groups except the lowest income group. Acceptability of driver decreases; walking increases in acceptability but does not surpass that of driver, except in the



**LEGEND**  
 E.A.-Extremely acceptable  
 V.A.-Very acceptable  
 S.A.-Somewhat acceptable  
 N.-Neutral  
 S.Un.-Somewhat unacceptable  
 V.Un.-Very unacceptable  
 E.Un.-Extremely unacceptable

**SAMPLE SIZE**  
 53

Figure 13. Acceptability of mode to store. Annual household income < \$5,000.

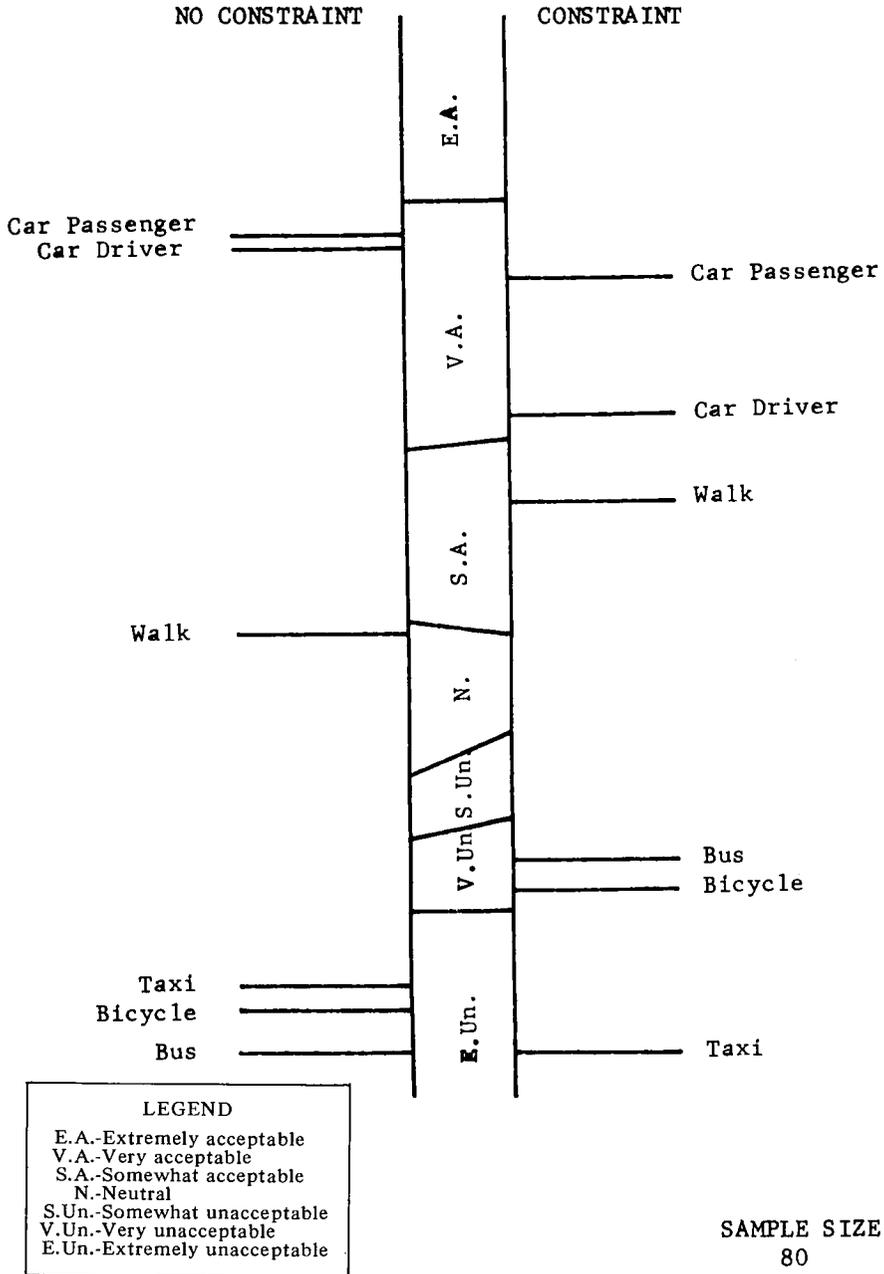
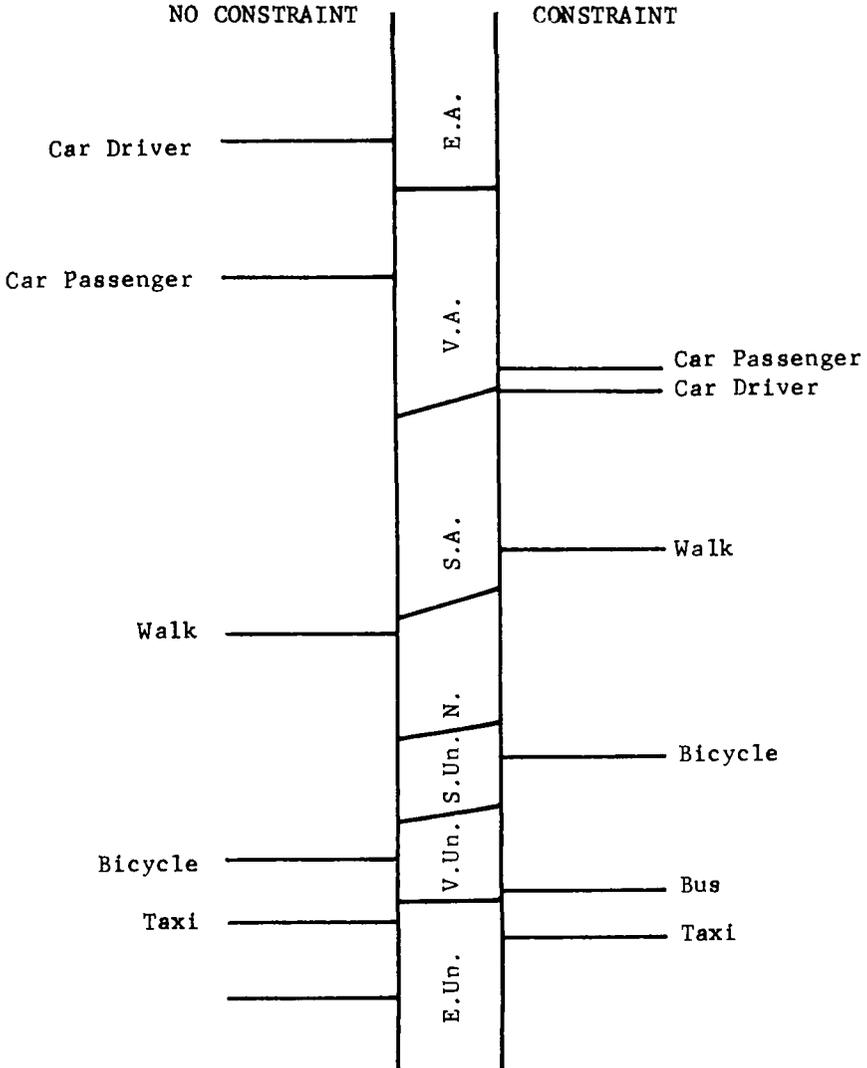


Figure 14. Acceptability of mode to store. Annual household income \$5,000-\$10,000.



**LEGEND**  
 E.A.-Extremely acceptable  
 V.A.-Very acceptable  
 S.A.-Somewhat acceptable  
 N.-Neutral  
 S.Un.-Somewhat unacceptable  
 V.Un.-Very unacceptable  
 E.Un.-Extremely unacceptable

**SAMPLE SIZE**  
 112

Figure 15. Acceptability of mode to store. Annual household income \$10,000-\$15,000.



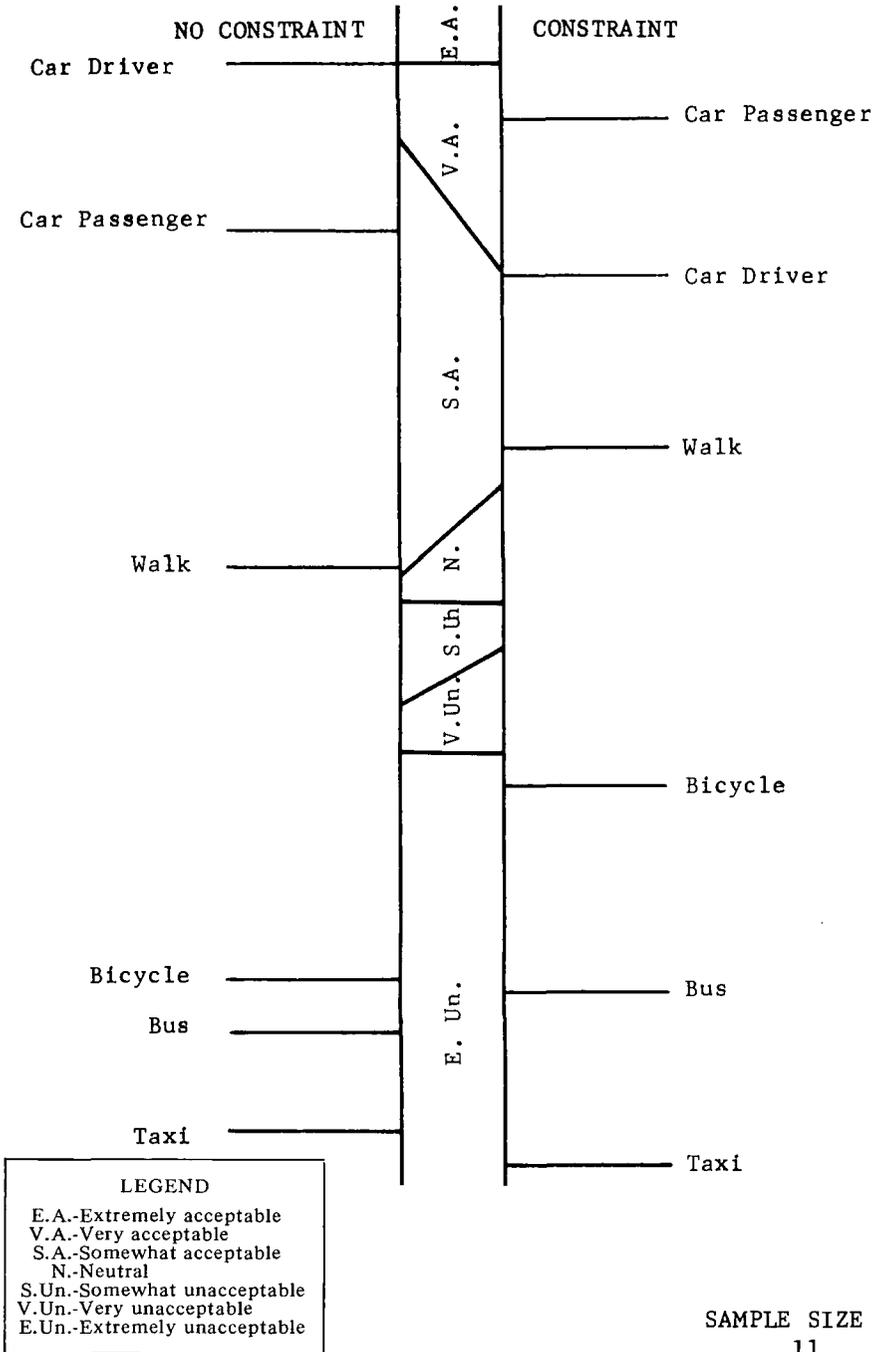
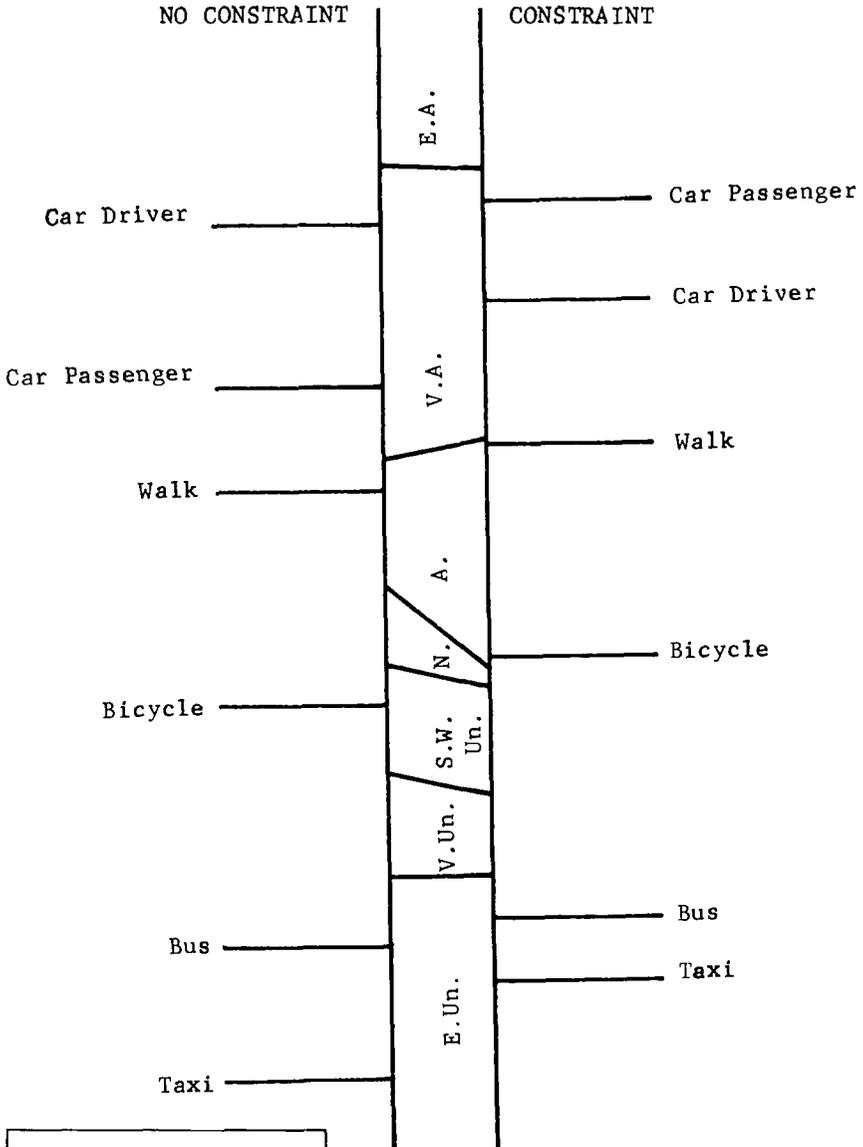


Figure 17. Acceptability of mode to store. Annual household income \$20,000-\$25,000.



**LEGEND**  
 E.A.-Extremely acceptable  
 V.A.-Very acceptable  
 S.A.-Somewhat acceptable  
 N.-Neutral  
 S.Un.-Somewhat unacceptable  
 V.Un.-Very unacceptable  
 E.Un.-Extremely unacceptable

SAMPLE SIZE  
 15

Figure 18. Acceptability of mode to store. Annual household income > \$25,000.

lowest income case. Gains in acceptability of bus for the shopping trip vary inversely with income. However, even the largest increases do not bring bus into an acceptable category. Bicycle becomes only slightly more acceptable when a gasoline constraint is imposed.

Examining the sample by income groups shows that in a constrained situation there is an upward shift in the acceptability of walking and passenger modes for all subsamples. The largest increase in acceptability of bus is observed for the lowest income groups.

### Summary

That the car is generally the most acceptable mode for the shopping trip when there is no constraint on gasoline availability is without question. When a constraint is placed on the availability of gasoline, there is a general increase in acceptability of walking and a decrease in the acceptability of the driver mode across the subsamples. While the level of acceptability of the passenger mode under conditions of a gasoline shortage declines for almost all subsamples it becomes the most acceptable for all except the "car not used" group where walking takes this first position. It was found that the mode used by the shoppers, whether it is driver, passenger, or walk, is rated as the most acceptable. This could be an indication of a reverse causal effect, i.e., "I walk, therefore, I must like it, rather than I like walking, therefore, I walk." Walking in all other cases was rated in the middle of the acceptability scale.

The remaining three modes are near the bottom end of the acceptability scale for all subsamples under both conditions. For all subsamples there is an increase in the acceptability of bus under conditions of a gasoline shortage. The largest increases in this acceptability occur in the lower income subsamples. This increase, however, does not move the bus mode into an acceptable category.

Acceptability of mode scales also show differences in perceived acceptabilities of modes between the to store and from store parts of the trip. Acceptabilities of walking, bicycle and bus decrease for the return trip, most likely because of difficulty of carrying packages by these modes.

### Conclusions

Increases in acceptability of walking suggest that some shoppers may consider walking for the shopping trip. This would result, most

probably, in an increase in the frequency of shopping trips for this part of the population. While the results show an increase in acceptability of bus for all the segments, use of bus for shopping remains unacceptable even with a gasoline constraint imposed. Potential users of the bus under conditions of a gasoline shortage were identified as belonging to the lowest income groups. As income increased, this increase becomes negligible. Contrary to a popular belief that the elderly (who usually are also retired) are potentially eager users of the bus system, this group showed a relatively small increase in bus acceptability when compared to all other groups.

If changes in attitudes toward modes do in fact precede changes in mode use it appears that a gasoline constraint would bring about changes in the urban shopping patterns. Shoppers would turn to sharing rides, or linking trips, and walking. There appears to be little indication that public transit, in its present form, would become a more viable mode for grocery shopping.

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