

Public Reaction to Priority Lane for Buses and Car Pools in Miami

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A series of user surveys was conducted in conjunction with an evaluation of a bus-and-car-pool priority lane on I-95 in Miami. The groups surveyed included (a) express bus passengers, (b) express bus drivers, (c) car poolers, (d) other I-95 motorists, and (e) motorists using the I-95 corridor. Analyses of the survey results indicated that the bus-and-car-pool priority-lane concept was well received by all road-user groups. Despite some concerns about specific operational or physical aspects of the system, no group expressed dissatisfaction with it, and those who were qualified to use the priority lane were strongly supportive. Specific survey findings included the following: (a) more than half of all groups (50 to 94 percent) felt that the priority-lane system should remain in operation, (b) the existence of the priority lane was ranked second in importance among all system features by both bus passengers and car poolers, (c) all groups indicated a high degree of concern over use of the lane by nonqualified motorists, and (d) the existence of the priority lane was well established in the minds of all road-user groups surveyed, but the recognition and understanding of the reserved-lane diamond symbol was low.

Peak-period traffic congestion is a problem common to most urban areas in the United States and, because of growing public concern over the environmental and social impacts of roadway construction, transportation engineers have been exploring ways to reduce this congestion by increasing the efficiency of existing facilities. One aspect of this approach is the use of incentives to travel in high-occupancy vehicles (HOVs), which can reduce the congestion on and increase the passenger-carrying capability of a facility. Typical of these incentives is preferential treatment for HOVs in the form of exclusive rights-of-way, reserved arterial and freeway lanes, and priority-entry control systems on freeway ramps.

In 1973, the Florida Department of Transportation, the U. S. Department of Transportation, and several agencies in metropolitan Dade County embarked on a program to reduce the recurring peak-period congestion in the I-95 corridor, shown in Figure 1, and to demonstrate the feasibility of several priority-treatment techniques. This demonstration project included (a) several bus-priority strategies on NW 7th Avenue, (b) reserved lanes for buses and car pools on I-95, (c) the Orange Streaker express bus service, and (d) the Golden Glades park-and-ride lot. These treatments are evaluated elsewhere (1, 2, 3).

SCOPE

This paper presents an evaluation of the responses of several road-user groups who participated in questionnaire surveys related to the bus-and-car-pool priority operation on I-95. The road-user groups surveyed included (a) express bus passengers, (b) car poolers, (c) motorists using the I-95 corridor, (d) express bus drivers, and (e) other I-95 motorists.

In some cases, the surveys dealt with broad aspects of the bus-car-pool project; a detailed treatment of these results have been given by Wattleworth and others (1). The discussion presented here is

limited to those parts of the survey that addressed the operational aspects of the exclusive lane on I-95.

BUS-PASSENGER SURVEY

A questionnaire survey of bus passengers was carried out in connection with the Orange Streaker project. The survey forms were distributed to the passengers as they boarded the bus and collected from them at the end of the trip. Five questions related to the exclusive lane on I-95 were included to assess the following topics:

1. Relative preference: the exclusive lane on the freeway versus the reserved lane and other strategies previously used by the express buses on NW 7th Avenue,
2. Reaction to certain physical and operational features of the exclusive lane,
3. Relative importance of the exclusive lane compared with other system elements,
4. Estimated time savings, and
5. Overall reaction to the exclusive-lane concept.

A total of 838 responses were received, and the following results were obtained.

Relative Preference for Freeway System

This response, as shown in Figure 2, was overwhelmingly favorable to the exclusive lane on the freeway. Three-fourths of the respondents rated the freeway lane far superior to the arterial system, 92 percent expressed some degree of preference for the freeway lane, and less than 1 percent preferred the NW 7th Avenue system.

Reaction to Physical and Operational Features

To assess the reactions of the bus passengers to the various physical and operational features of the I-95 system, they were asked to indicate which, if any, of the following items caused them to feel unsafe or uncomfortable:

1. Speeds in the exclusive lane that were higher than those in adjacent lanes,
2. Lack of an inside shoulder,
3. Buses that operated too close to the concrete barrier wall,
4. Buses that had to change lanes too many times to enter and exit the exclusive lane, or
5. Other.

The responses to this question indicated that each problem category generated discomfort in about 5 percent of the respondents. A total of 18 percent indicated concern for at least one of the problems mentioned. The other category drew a 9 percent

response. A frequent complaint in this category referred to the excessive weaving activity into and out of the exclusive lane by other drivers. Many of the complaints were not specifically related to the exclusive-lane operation (e.g., bus drivers that were too aggressive).

Estimated Time Savings

The bus passengers were asked to estimate the amount of time they saved by traveling in the exclusive lane. Of the 838 responses, 64 percent indicated some degree of perceived time savings, 13 percent saw no saving, and 23 percent offered no opinion. The distribution of the perceived time saving is shown in Figure 3.

Figure 1. Project corridor: I-95 and NW 7th Avenue.

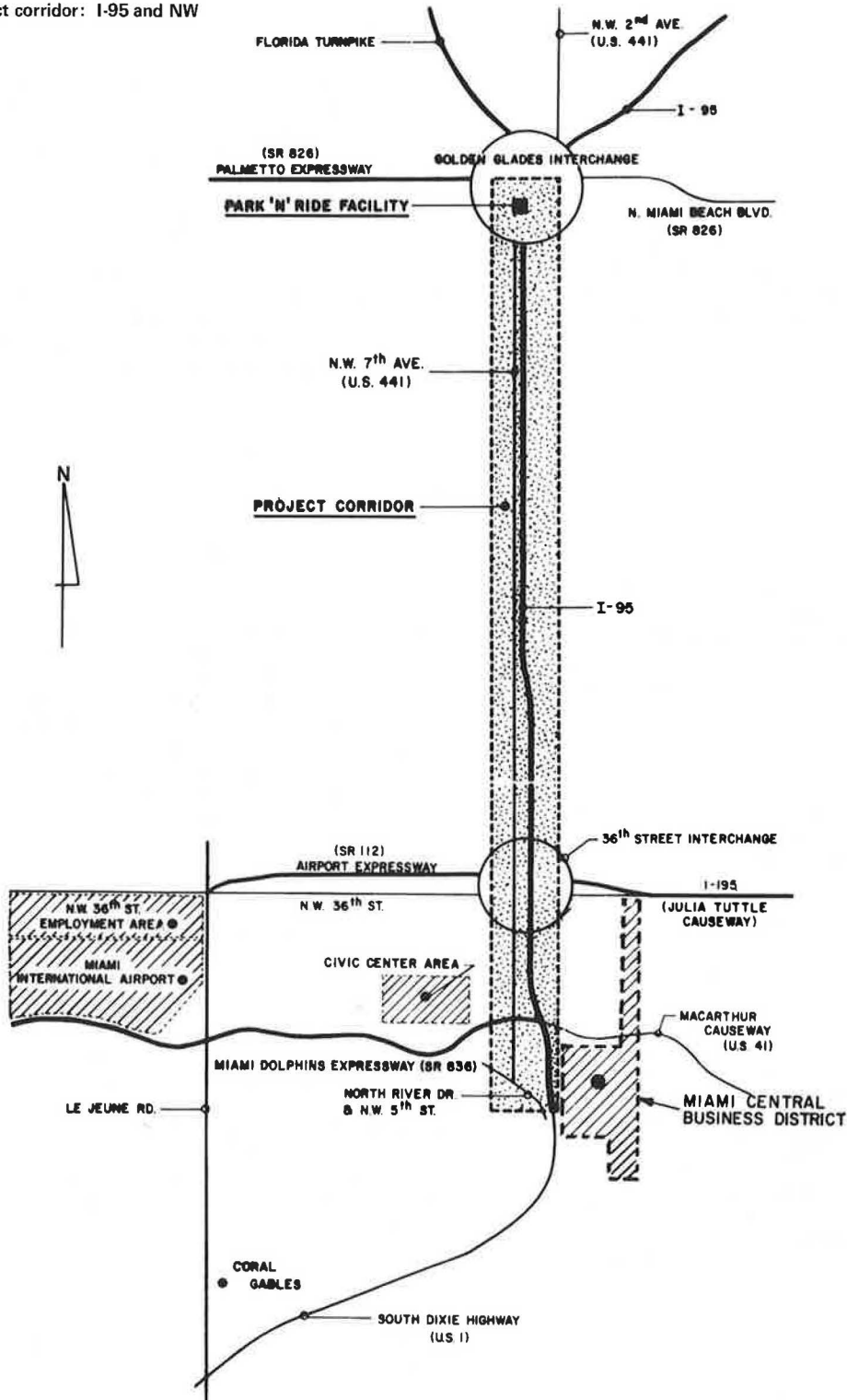
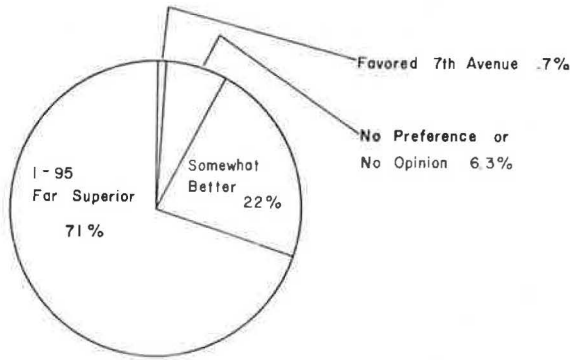


Figure 2. Relative preference of bus passengers: I-95 bus-and-car-pool lane versus NW 7th Avenue bus-priority system.



Relative Importance of Exclusive Lane

To gain an insight into the degree of importance to the respondents of the various project features, each respondent was asked to indicate the degree of importance of (a) the express bus service, (b) the exclusive lane on I-95, (c) the park-and-ride lot, and (d) the comfort of the buses. The responses to this question are summarized below.

Feature	Very Important (%)	Somewhat Important (%)	Not Important (%)	No Opinion (%)
Express bus service	89	9	1	1
Exclusive lane	74	21	4	1
Park-and-ride lot	65	20	12	3
Bus comfort	56	37	5	2

These results show that, as perceived by bus passengers, the exclusive lane ranked second in importance. The only feature considered more important was the provision of the bus service itself, and both the park-and-ride facility and the comfort of the buses were considered to be of lesser significance.

Overall Reaction to Exclusive-Lane Concept

To evaluate the overall reaction to the exclusive lane, the bus riders were asked to indicate whether or not they felt that this concept should

1. Remain on I-95,
 2. Be installed on all highly congested freeways,
- or
3. Be installed on all urban freeways.

The responses to this question, as summarized in Figure 4, were highly favorable. However, this would be anticipated here because the respondents were all receiving some benefit from the exclusive lane as bus passengers. Of the total response, 94 percent felt that the express lane should remain on I-95, and only 2 percent felt that it should be discontinued. The degree of enthusiasm for extending the concept to other facilities was also reasonably high: 57 percent favored its extension to all congested freeways and 48 percent favored its extension to all urban freeways.

CAR-POOL SURVEY

A separate survey was conducted among car-pool participants by distributing a mail-back questionnaire

to each occupant of every vehicle that had two or more persons leaving the Golden Glades parking facility during a selected morning peak period. A total of 42 responses were returned. The questionnaire dealt with several aspects of the Orange Streaker demonstration project and included five specific questions regarding the exclusive-lane operation on I-95. These were similar to those asked of the express bus passengers, except that the car poolers were asked about their use of the exclusive lane, rather than about their preference for the freeway or arterial system.

Use of Exclusive Lane

Of the 42 respondents, 66 percent indicated that they normally used the exclusive lane, 31 percent indicated that they normally drive in the general lanes on I-95, and 3 percent indicated that they did not use I-95.

Reaction to Physical and Operational Features

Because certain physical and operational features of the exclusive lane were felt to be potential sources of discomfort, each respondent was asked to identify areas of particular concern. The responses to this question are summarized below:

Feature	Percentage of Respondents
Accessibility of lanes	38
Lack of shoulder	33
Speed differential	29
Proximity of barrier	10
Other	43
Any of the above	71

Other-category comments dealt primarily with the abuse of the exclusive lane by other drivers.

By comparing these results with the corresponding responses from the express bus passengers, it can be seen that the degree of concern is considerably higher among automobile occupants. For example, 71 percent of the car poolers expressed concern over at least one item as opposed to 18 percent of the bus passengers. This increased concern is probably attributable to the fact that the automobile occupants interact more closely with these problems than do the bus passengers.

Estimated Time Savings

The exclusive-lane users were also asked to estimate the amount of time they saved by using the exclusive lane. The resulting distribution of estimated time savings is shown in Figure 5. The mean estimated saving was 12.6 min, which, when compared with measured saving of approximately 3 min, indicates that the perceived saving is substantially greater than the actual saving. [The measured time difference, which was determined by moving-vehicle studies, is discussed in greater detail by Courage and others (2).]

Relative Importance of Exclusive Lane

This topic was addressed by use of two questions. First, the car poolers were asked to rate the importance of the various physical elements of the I-95 system as (a) very important, (b) somewhat important, (c) not important, or (d) no opinion. The re-

Figure 3. Distribution of bus-passenger perceived travel-time savings due to exclusive lane.

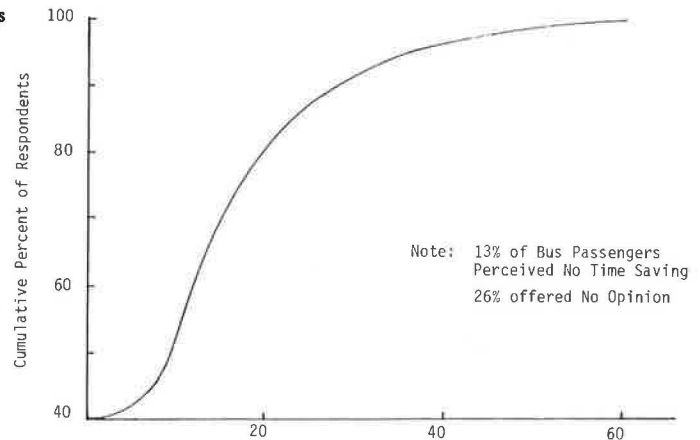
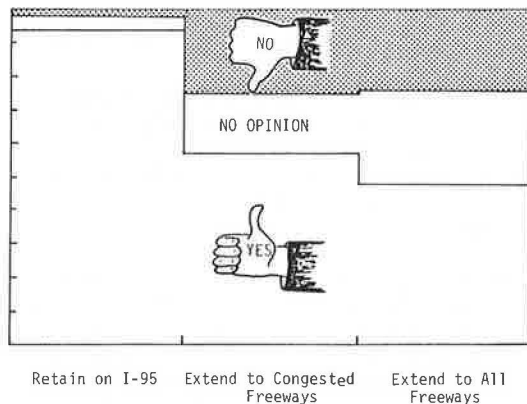


Figure 4. Bus-passenger attitudes toward retention and extension of bus-and-car-pool priority lanes.



sponses to this question are summarized below.

Feature	Very Important (%)	Somewhat Important (%)	Not Important (%)	No Opinion (%)
Exclusive lane	71	18	5	5
Park-and-ride lot	71	26	3	6
Flyover	72	11	6	11

It is observed that the three physical attributes of the system (the park-and-ride lot, the flyover, and the exclusive lane) were regarded as being of more or less equal importance by car poolers. Approximately 70 percent regarded each attribute as being very important, and less than 6 percent suggested that any attribute was not important.

Second, the car poolers were asked to indicate the factor—(a) cost of driving alone, (b) lack of available automobile, (c) lack of parking facilities, (d) cost of parking, (e) time advantage of exclusive lane, (f) concern for energy conservation, and (g) other—that most influenced their decision to car pool. The responses to this question, illustrated in Figure 6, indicate that about one-half of the respondents were motivated toward car pools primarily by cost factors and about one-fourth were motivated by time savings due to the exclusive lane. This suggests that, in the case of the I-95 system, cost factors were approximately twice as important to car-pool formation as the potential time saving (this is despite the relatively large perceived time savings as shown in Figure 5).

Overall Reaction to Exclusive-Lane Concept

To assess their overall reaction to the exclusive lane on I-95, car poolers were asked their opinion regarding the continuation and future expansion of the exclusive-lane system. The responses to this question, illustrated in Figure 7, were similar to those obtained in the bus passenger survey. A high proportion (86 percent) favored continuation of the reserved lane on I-95 and more than half favored extension of the concept to other congested freeways (60 percent) and to all urban freeways (53 percent). The convergence of responses to this question is interesting when compared with the responses of bus riders (Figure 4). It again reflects, first, the more intimate concerns of the car poolers, but the stronger sense of direct benefit of the bus passengers.

HOME INTERVIEW SURVEY

A telephone survey was conducted by using a sample of 1903 persons observed using either I-95 or alternative routes within the project corridor. Because this survey dealt with the overall demonstration project, it was not possible to address the I-95 exclusive-lane features in detail. However, questions were included to assess the following areas:

1. Awareness of the existence of the exclusive lane,
2. Extent of exclusive-lane use, and
3. Overall reaction to the exclusive-lane concept.

[A complete analysis of the results of this survey is given by Long and others (4).] The survey respondents were separated into two categories:

1. Project trip respondents: those who indicated a trip origin in the market area and a destination in one of the service areas served by the Orange Streaker and
2. Nonproject trip respondents: those who did not qualify as project trip respondents by the above definition.

Awareness of Exclusive Lane

Of the project trip respondents, 99.4 percent indicated that they were aware of the exclusive lane on I-95 and, of the nonproject trip respondents, 86 percent indicated a knowledge of the exclusive lane. This suggests a very high awareness among both

Figure 5. Distribution of estimated travel-time savings by car poolers who use priority lane on I-95.

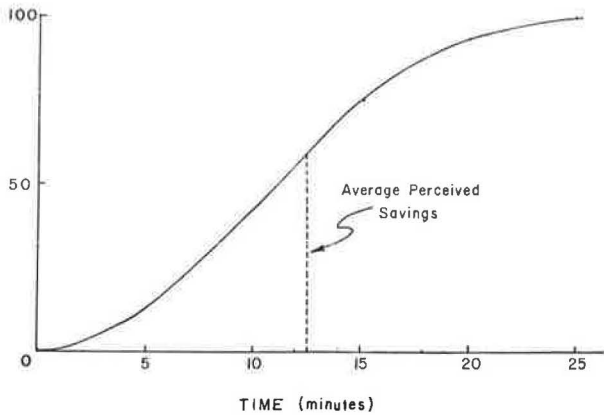


Figure 6. Primary factor in decision to car pool.

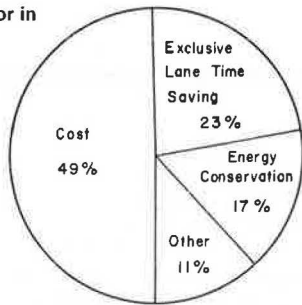
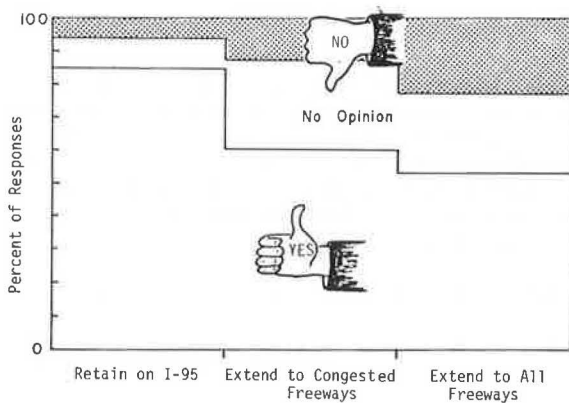


Figure 7. Car-pooler attitudes toward retention and extension of bus-and-car-pool priority lanes.



respondent categories, although the project trip respondents demonstrated a predictably higher awareness than the nonproject trip respondents.

Use of Exclusive Lane

In both respondent categories, those who indicated that they were aware of the exclusive lane and used I-95 were asked whether or not they used the exclusive lane. This question was also put to all project trip respondents who indicated that they car pooled at least occasionally; however, those who indicated that they drove alone were not asked whether they used the exclusive lane. This was done to eliminate the possible fear of self-incrimination. All non-project trip respondents were questioned on exclusive-

lane use, because they were not asked about their car-pooling habits.

Thirty-five percent of the project trip respondents reported using the exclusive lane, although only 12 percent of the nonproject trip respondents indicated such use. These figures are not directly comparable because of the elimination of single-occupant users from the project-trip-respondents sample. Furthermore, it cannot be inferred from the 35 percent use by project trip car poolers that the nonuse rate was 65 percent because, at the time of the survey, two-occupant car pools were not permitted to use the exclusive lane.

Overall Reaction to Exclusive-Lane Concept

The respondents to the home interview survey were also asked about their overall acceptance of the exclusive-lane concept. The responses to this question are summarized in Table 1 and statistical comparisons support the following inferences:

1. There were no significant differences in the responses of the project trip and the nonproject trip respondents.
2. Persons who used I-95 were more favorable toward the concept as evidenced by a smaller proportion of negative responses.
3. Persons who did not use I-95 were less certain about their opinion as evidenced by the larger proportion of "don't know" responses.

Inspection of Table 1 also indicates that the actual differences among the various groups were relatively small. The opinions of the road users as a whole can, therefore, be represented by the combined aggregate of all the groups, as shown in Table 1 and in Figure 8. By comparing these results with those for the car poolers and the bus passengers, we can see that, although the overall response patterns are similar, the general road user is about 40 percent less inclined to favor the continuation or extension (or both) of the exclusive-lane concept.

BUS DRIVER SURVEY

The operators of the Orange Streaker buses were also surveyed to determine their reaction to the exclusive bus-and-car-pool lane. A total of 117 drivers participated; their questionnaire study focused on the following topics:

1. Magnitude of problems created by physical and operational features of the exclusive lane and
2. Overall reaction to the exclusive-lane concept.

Physical and Operational Features

The drivers were asked to rate the severity of problems associated with potentially troublesome features of the exclusive lane. These included

1. Hazards caused by sudden or unexpected stops in the priority lane,
2. Hazards caused by other vehicles cutting into the priority lane,
3. Lower speeds of traffic in adjacent lane,
4. Nearness of the concrete barrier wall,
5. Violations of the priority lane restrictions, and
6. Delays caused by other traffic using the priority lane.

Table 1. Corridor-user attitude toward retention and extension of exclusive-lane concept.

Response	Project Trip Respondents (%)						Nonproject Trip Respondents (%)						Combined Sample (%)		
	I-95 Users			I-95 Nonusers			Non-I-95 Users			I-95 Nonusers			Yes	No	?
	Yes	No	?	Yes	No	?	Yes	No	?	Yes	No	?			
Retain on I-95	50	32	18	50	27	23	50	32	18	50	27	23	50	29	21
Extend to congested freeways	40	35	25	38	32	30	40	35	25	39	32	29	39	34	27
Extend to all freeways	31	39	30	30	38	32	31	39	30	31	39	30	31	29	30

Figure 8. General road-user attitudes toward retention and extension of bus-and-car-pool priority lanes.

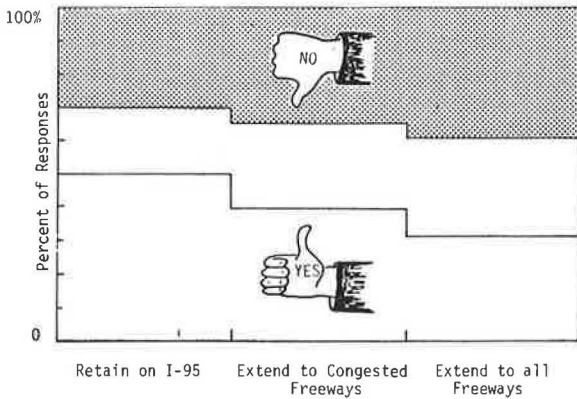


Figure 10. Bus driver attitudes toward retention and extension of bus-and-car-pool priority lanes.

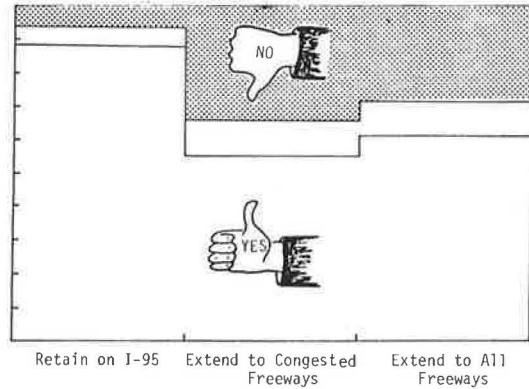
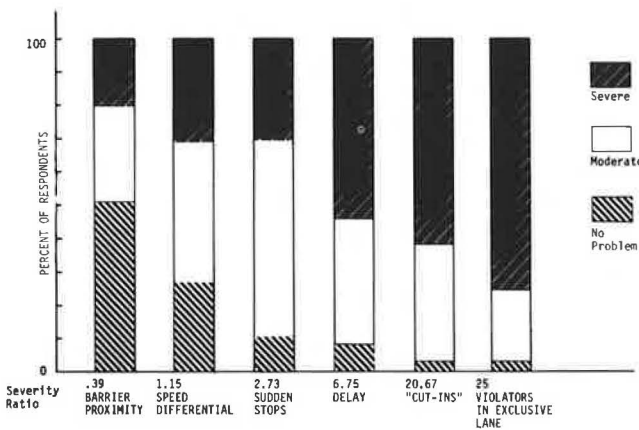


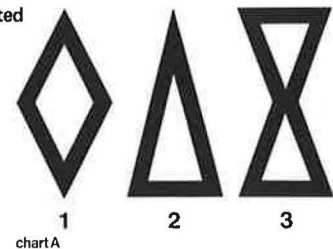
Figure 9. Bus driver perceptions of severity of exclusive-lane problems.



The responses to this question are shown in Figure 9. The various features are rank ordered by inspection. The proximity of the concrete median barrier was of least concern to the operators; only 18 percent indicated this to be a severe problem and 50 percent indicated it to be no problem. At the other end of the scale, violation of the exclusive lane was viewed as a serious problem by 75 percent of the respondents and only 4 percent indicated that no problem was experienced with violators.

The magnitude of a particular problem can also be expressed conveniently in terms of the ratio of the severe-problem to the no-problem responses. This measure is defined for purposes of this study as the severity ratio and is also shown in Figure 9. In only one case (proximity of the median barrier) was the severity ratio less than 1.0. In all other cases, more bus operators rated the problem severe than non-existent. The highest ratio (25) was that of the exclusive-lane violators. Based on these severity

Figure 11. Symbols presented to drivers in diamond recognition survey.



ratios, it can be concluded that the bus operators were quite concerned about the potential problems associated with the use of the exclusive lane. This concern was greatest in problem areas involving misuse of the lane by other drivers (e.g., violators and weaving). The inherent physical and operational characteristics such as proximity of the median barrier, speed differential, and turbulence were viewed with less concern. However, there was no prescribed nor measured definition of the word "problem", and the results should be viewed accordingly.

Overall Reaction to Exclusive-Lane Concept

To determine the overall reaction to the exclusive lane, each bus operator was asked to indicate a preference for continuation or extension (or both) of this concept. The response to this question is shown in Figure 10. A strong preference for continuation of the I-95 system is evident; 89 percent of the responses were affirmative, and 7 percent were negative. Enthusiasm for extension of the concept to other facilities followed the same response pattern as the previous groups; more than half of the express bus drivers favored implementing additional exclusive-lane systems, and more favored the extension of the concept to all facilities than to congested facilities only. This response is not internally consistent and may suggest

Figure 12. Degree of recognition of symbols.

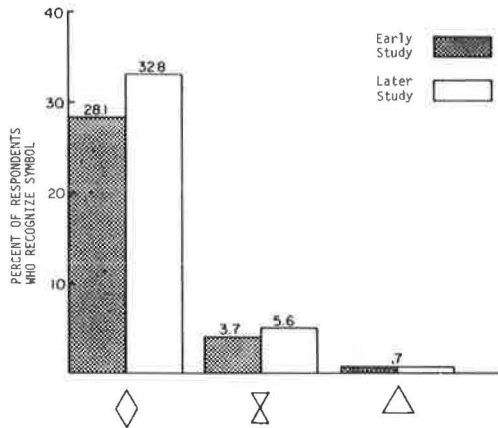
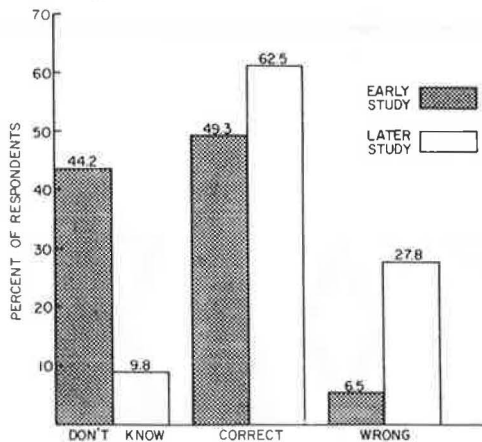


Figure 13. Degree of identification of meaning of diamond symbol.



misinterpretation of the question. The bus driver group had fewer no-opinion responses than any other road-user group. This suggests that the attitudes of the bus drivers to the system were more strongly developed because of their greater familiarity with the system.

DIAMOND SYMBOL SURVEY

The purpose of this survey was to assess the degree of motorist recognition and understanding of the reserved-lane symbol as a traffic control device. The survey was first conducted immediately after the diamond symbol had been implemented on the exclusive-lane signs and as pavement markings and then repeated approximately 3 months later.

The survey approach was to interview motorists leaving the freeway at two selected exit ramps during the afternoon peak period. The drivers were approached while they were stopped in a queue for the downstream traffic signal and were shown a chart depicting three different symbols. These symbols, shown in Figure 11, were

1. The diamond symbol used on the freeway to identify the exclusive lane,
2. An elongated triangle of approximately the same proportions as the diamond, and
3. An angular hourglass symbol of approximately

the same proportions as the diamond.

Neither the hourglass nor the triangle were used on the freeway for traffic control purposes, and the charts were changed periodically to eliminate any bias that might be caused by the order of presentation. As the chart was being shown, each driver was asked the following questions:

1. "Where did you get on I-95 for this trip?"
2. "Did you notice any of these shapes being used as traffic symbols on the freeway?"
3. "What does this symbol mean to you?" (Indicating the selected symbol or the diamond.)

By observation, each vehicle was categorized by number of occupants and by area of residence (a) local (Dade and Broward counties), (b) nonlocal Florida, (c) out of state, and (d) rental. The descriptive parameters for these surveys are given below.

Parameter	Early Survey	Later Survey
No. of responses	437	341
Survey location breakdown, %		
62nd Street exit	46	50
135th Street exit	54	50
Proportion from Dade and Broward counties (local drivers), %	95	93
Average occupancy (passengers per vehicle)	1.50	1.46

Recognition of Diamond Symbol

The degree of recognition of the various symbols is illustrated in Figure 12. Nearly one-third of the drivers recognized the diamond symbol in both studies, although recognition was increased in the later study by approximately 15 percent. This change is statistically significant at the 95 percent level, although the actual number who recognized the diamond was surprisingly low considering the degree of exposure. At the time of the later study, the symbol was visible at approximately 100 locations on the pavement and 40 locations on overhead signs. The diamond was, however, recognized by significantly more drivers than the two fictitious symbols. The fictitious symbols combined received less than 20 percent the degree of recognition of the diamond.

Meaning of Diamond Symbol

Those motorists who recognized the diamond were also asked to identify its meaning. The results of this question are summarized in Figure 13 and show that the proportion of motorists who said they did not know the meaning of the symbol dropped substantially (from 44 percent in the early study to 10 percent in the later study) and that the proportion giving the correct meaning increased from 49 to 62 percent. However, the proportion giving an incorrect answer increased from 6 percent to 28 percent.

Effects of Study Location, Level of Occupancy, and Trip Length

As noted above, these surveys were conducted at two freeway exits: (a) 62nd Street, which was the first exit in the priority section, and (b) 135th Street, which was near the downstream end of the priority section. The sample was also stratified by level of occupancy as car pools (three or more occupants) versus noncar pools and by length of trip in the

priority section. A summary of the effects of these parameters on the survey responses is given below (percentages may not add because not all respondents answered completely).

Parameter	Recognized (no. of persons)		Wrong (percentage of yes respondents)	Meaning (percentage of yes respondents)	
	No	Yes		Don't Know	Correct
Location					
62nd Street	265	104	21	32	47
135th Street	282	135	14	23	63
Occupancy					
Noncar pool	483	207	18	29	53
Car pool	63	32	13	13	74
Trip length					
< 4.8 km (3 miles)	288	114	21	30	49
> 4.8 km (3 miles)	259	125	14	24	62

Analyses of these factors indicate the following:

1. The study location did not influence the degree of recognition of the diamond symbol as a traffic control device.
2. The drivers leaving the freeway at the 135th Street exit who recognized the diamond symbol were more familiar with its meaning than those who left at 62nd Street (99 percent level of significance).
3. The vehicle occupancy did not affect the degree of recognition of the diamond symbol as a traffic control device.
4. Drivers of vehicles that qualified to use the exclusive lane who recognized the diamond symbol were more familiar with its meaning than drivers of noncar-pool vehicles (95 percent level of significance).
5. The trip length did not affect the degree of recognition of the diamond symbol as a traffic control device.
6. Drivers who had longer trip lengths and who recognized the diamond symbol were more familiar with its meaning than drivers who had shorter trip lengths (99 percent level of significance).

CONCLUSIONS

As a result of these user surveys, the following conclusions are offered regarding the public reaction to the bus-and-car-pool priority lanes on I-95.

System Acceptance

The bus-and-car-pool priority concept was well accepted by all road-user groups surveyed. Although one-third of the general road users expressed opposition to the priority lane, only 2 percent of the bus passengers felt that the operation should be discontinued. More than half of each group (50 and 94 percent, respectively) felt that the system should remain on I-95, and a positive attitude was expressed toward the extension of this concept to other facilities.

Bus passengers rated the exclusive lane second in importance among all the system elements. The provision of the bus service itself was the only feature that was rated as being of greater importance. The I-95 system was favored over the NW 7th Avenue bus-priority system by 93 percent of the bus passengers.

Car poolers also rated the express lane second in importance. In this case, the reduced cost of car pooling was considered to be the most important benefit. Both the bus passengers and car poolers tended

to overestimate the time savings due to the exclusive lane by a significant amount.

Operational Problems

All groups surveyed indicated a high degree of concern over the abuse of the priority lane by violators. This was rated as the most significant problem by each user group surveyed. Car poolers expressed more concern about the physical and operational features than did bus passengers. Bus drivers generally expressed a greater degree of concern than either of these groups, but their concerns were concentrated more on the operational features, rather than on the physical elements.

Familiarity With System

The existence of the bus-and-car-pool priority lane was well established in the minds of the user groups who were surveyed, but knowledge of the use and meaning of the diamond symbol was low. More than 99 percent of the corridor users who had an origin in the market area and a destination in one of the service areas were familiar with the exclusive lane. On the other hand, only one-third of the freeway motorists recognized the diamond symbol as a traffic control device, and only one-third of these were able to correctly indicate its meaning. Drivers who had greater exposure to the symbol and drivers of qualified car pools demonstrated a higher degree of recognition of it.

Considering the overwhelming general awareness of the project, this suggests that, if a special symbol is to be used to identify a project, the symbol and its significance from a traffic engineering (and enforcement) point of view should be well publicized.

General Reaction to Bus-and-Car-Pool Priority System

These conclusions support the overall conclusion that the I-95 bus-and-car-pool systems demonstration project was well received by the road-user community. Despite some concern about particular operational and physical aspects of the system, no group expressed dissatisfaction with the system, and most who were able to afford themselves the opportunity to use the system were strongly supportive. Thus, exclusive lanes for buses and car pools can be a successful technique for improving highway transportation efficiency and receive strong support from the public.

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REFERENCES

1. J. A. Wattleworth and others. Evaluation of the NW 7th Avenue Express Bus and Bus Priority Systems. Transportation Research Center, Univ. of Florida, Gainesville, Sept. 1977.
2. K. G. Courage and others. Traffic Control of Car Pools and Buses on Priority Lanes. Transportation Research Center, Univ. of

Florida, Gainesville; Federal Highway Administration, Rept. FHWA-RD-77-148, Aug. 1977.

3. J. A. Wattleworth and others. Evaluation of the I-95 Express Bus and High-Occupancy-Vehicle Priority Systems. Transportation Research Center, Univ. of Florida, Gainesville, Jan. 1978.
4. G. Long and others. Evaluation of Characteristics of Users and Nonusers of the I-95 Express Bus/Car Pool System. Transportation Research

Center, Univ. of Florida, Gainesville, Dec. 1977.

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Role of Parking in Transportation System Management

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The appropriateness is examined of including parking management strategies in the transportation system management (short-range) component of the transportation plan for an urban region. The probable effects of parking management schemes are described and evaluated with respect to short-range objectives to determine the compatibility between the two. A definition that applies to the total set of parking management options is given and tested against the results of a survey of 173 cities in the United States and a review of the literature. Parking-control strategies can be divided on various bases: (a) whether they are supply- or cost-related controls, (b) whether they are intended to reduce automobile travel in selected areas or to make the highway more efficient, or (c) whether they can be implemented within the short-range element or the long-range component of the transportation plan. Considerable public, political, and business opposition to restrictions on parking in urban areas was found. Public support for parking controls that alter travel behavior must be developed gradually in association with areawide planning objectives. The majority of the parking measures were found to be long-range planning elements rather than transportation system management components.

When the Urban Mass Transportation Administration (UMTA) and the Federal Highway Administration (FHWA) issued a set of joint regulations in September 1975 (40 Federal Register, 42 976-42 979, 1975), a new dimension of the urban transportation planning process was formally established as the transportation system management (TSM) element. To comply with these regulations, the transportation plan for an urban region must include a transportation system management, or short-range, element in addition to the long-range element that had been the only requirement. Specifically, this TSM element requires the following:

1. Provision for the short-range transportation needs of the urban area by making efficient use of existing transportation resources and provision for the movement of people in an efficient manner and
2. Identification of traffic engineering, public transportation, regulatory, pricing management, operational, and other improvements to the existing urban transportation system, but not including new transportation facilities or major changes in existing facilities.

The long-range element addresses the future transportation needs of the area and should identify new transpor-

tation policies and facilities or major changes in existing facilities by location and modes to be implemented.

"Parking management" is the term currently used to describe the management and organization of parking as an element of TSM and is thus implied to be a consideration in the transportation planning process. This interpretation places a new burden on the transportation planner, because he or she is now responsible for considering the effect of the parking component of the transportation system on travel behavior, rather than merely considering parking needs in response to automobile travel demand. Thus, the supply of parking must be viewed in terms of the actions that affect the spatial and temporal allocations of spaces in addition to the traditional view in terms of the capacity or number of spaces provided at activity centers.

Conceptually, the role of parking management in improving the efficiency of urban transportation can be shown by examining the types of effects that it imposes. For example, the most notable result of a decrease in the supply of parking is a reduction in automobile trips, which implies some or all of the following:

1. An increase in automobile-occupancy levels,
2. A decrease in person trips,
3. Faster travel times for the remaining trips and a decrease in delays,
4. An increase in transit use,
5. A reduction in air pollution, and
6. Lower ambient noise levels.

Other effects can also be listed, but basically all strategies fall into either of two groups: those that reduce automobile travel and those that improve the efficiency of the highway network and make automobile travel more desirable. The impacts of the former are considerably more difficult to foresee than those of the latter because they are more likely to require major changes in travel behavior. The strategies in the latter group are basically traffic-engineering improvements to existing facilities, and they will not have widespread effects on travel behavior. Thus, there appear to be both short-run and long-range components of parking management