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16. ABSTRACT

The purpose of the project is to evaluate the effectiveness of converting a general purpose traffic lane to an HOV lane on Interstate 90 between Issaquah and Bellevue Way. The research effort included consideration of vehicle occupancies, travel time, safety, and public support. A successful lane conversion would demonstrate the potential to save the cost of constructing new highway lanes when existing highway lanes were available for conversion.

From an operational perspective, we can conclude that the HOV lane conversion did not have an adverse impact on travel speeds or travel times. Moreover, a reduction in speed variance was observed after the HOV lane conversion, which suggests a possible improvement in safety. Finally, an analysis of speed-flow relationships showed that the HOV lane had a significant impact, but the adverse consequences of this impact would be felt only in highly congested conditions. A relatively low HOV violation rate of 4.6 percent was observed, possibly indicating that the benefit gained from using the HOV lane may have been minimal. No change was noted in the average vehicle occupancy for the overall facility. The accident investigation was limited because of time constraints and hampered by outside factors; nearly half of the accidents were possibly attributable to unrelated construction.

From a public opinion standpoint, the I-90 lane conversion in the Seattle area can be classified as a qualified success. While a slight majority of commuters oppose the conversion, public opinion for and against is surprisingly close. It appears that with effective marketing and careful implementation, lane conversions can be successfully undertaken. However, it is important to recognize that significant opposition may arise from young commuters, from higher income households with a high number of adults, from commuters with fixed work times, from regular SOV users, and from commuters who will be forced to make departure time changes. To reduce their opposition, commuters who fit this mold should be addressed through informational campaigns and other strategies.

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I-90 Lane Conversion

I-90 LANE CONVERSION EVALUATION

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1
INTRODUCTION

Traffic volumes on Interstate 90 have been less than capacity between Issaquah and Bellevue Way. The provision of a high occupancy vehicle (HOV) lane in both directions in this underutilized corridor (by converting an existing general purpose lane in each direction through much of the section) could produce several long-term and short-term benefits for people who utilize the HOV system. The I-90 HOV lane conversion project was predicted to

- result in faster, more reliable travel times for carpools, vanpools, and buses
- improve safety by providing a continuous HOV lane between Seattle and Issaquah that will reduce the number of lane changes required
- provide an HOV lane sooner because of the low construction costs.
- require a shorter construction period, resulting in fewer delays to motorists
- produce potential improvements in air quality and a reduction in energy consumption.

BACKGROUND

High occupancy vehicle (HOV) lanes decrease traffic congestion by increasing vehicle occupancy. People willing to use mass transit, vanpool, or carpool are eligible to use HOV lanes and, as a result, generally experience shorter and more reliable average travel times. This time savings is the incentive for giving up the drive alone.

Typically, HOV lanes are implemented in three ways: (1) new lanes are constructed; (2) the facility is restriped, reducing the lane or shoulder widths to accommodate the addition of an HOV lane; or (3) a general purpose traffic lane is "converted" to an HOV lane. The first of these options is very costly and often cannot be accomplished because of space constraints in urban areas. The second of these options is much less costly but may compromise the safety of the facility or hamper accessibility for emergency situations. To date, the third option has not been popular with the motoring public. In fact, it has been so unpopular that, many of the lane conversions attempted across the country have been returned to general purpose use in response to public opposition.

In 1992, the Washington State Department of Transportation took a bold step in modifying their Washington State Freeway HOV System Policy to read:

> "When new capacity options are proposed, one of the alternatives to be considered shall be the conversion of a general purpose lane to an HOV lane."

Interstate 90 seemed appropriate as a candidate project.

Interstate 90 is one of two primary east-west routes in the Puget Sound region (the other is SR 520). Entering and exiting Seattle are three lanes in each direction, the results of a limit on capacity expansion that was approved in the 1970's. This limit allows no more than three lanes of traffic in each direction to cross Mercer Island or the I-90 floating bridge into Seattle. However, east of Mercer Island, I-90 included a fourth lane in each direction, and a traffic bottleneck resulted when four lanes of westbound traffic had to merge into three. The intent of converting this fourth general purpose lane to an HOV lane was to ease the bottleneck at this location; fewer vehicles would be required to merge as travel in the HOV lane would be restricted to carpools, vanpools, and buses.

Prior to deciding on a lane conversion, WSDOT attempted to gain public support for the project. Representatives from local jurisdictions were informed about the project and asked to provide feedback. Public open houses were held; motorists and local citizens were informed of the project and were able to voice their concerns in an open forum. Based on the input received from both jurisdictional representatives and concerned citizens, a decision was made to pursue the lane conversion.

The new HOV lane runs between Issaquah and East Bellevue Way (see Figure 1). About 4 kilometers (2.5 miles) of new HOV lane were created westbound by narrowing existing lanes and restriping the roadway. Another 6 kilometers (3.7 miles) of westbound HOV lane were created by converting an existing lane. The westbound HOV lane was

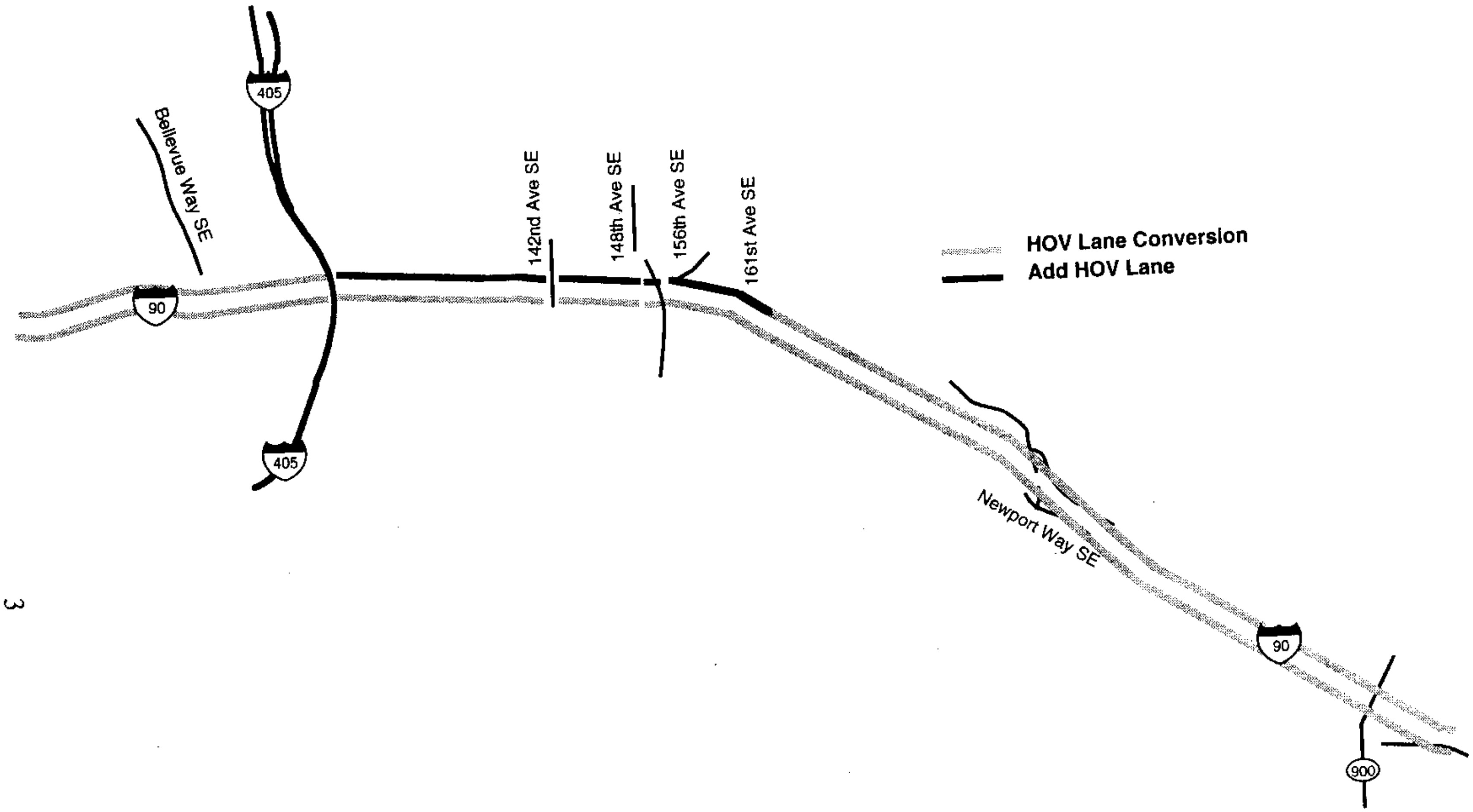

Figure 1. Proximity and Extent of I-90 Lane Conversion

operational in November 1993. Three general purpose lanes are maintained in each direction except for two short westbound segments that have 2 lanes. In the eastbound direction, approximately 10 kilometers (6.2 miles) of HOV lane will be established by converting a general purpose lane to an HOV lane. The completion date is anticipated to be 1995. The cost of this project was approximately $100,000. If newly construction, the cost of the HOV lanes would jump to $70 million and the completion date would be pushed back to 2000. This evaluation considers only the westbound HOV lane conversion.

REPORT PURPOSE AND CONTENT

The primary objective of this research was to provide information for evaluating the effectiveness (both long-term and short-term) of converting a general purpose traffic lane to an HOV lane. The research effort included consideration of vehicle occupancies, travel time, safety, and public support. The researchers sought to evaluate the lane conversion in terms of the following criteria:

- changes in vehicle occupancies
- changes in travel times for HOV users general purpose traffic
- level of safety of the facility
- public support for the HOV lane conversion.

If the lane conversion was successful, it would demonstrate the potential to save the cost of constructing new highway lanes when existing highway lanes were available for conversion.

Chapter 2 of this report describes other studies of related topics that provided helpful background or knowledge for this study. This literature included both at evaluations of operational impacts and motorist attitudes. Chapters 3 and 4 provide the results of the operational analysis and the attitudinal survey analysis, respectively. Chapter 5 presents the conclusions of this study and recommendations for future lane conversion activities.

CHAPTER 2
LITERATURE REVIEW

Two groups of literature were examined as part of this study: (1) literature regarding the operational aspects of a facility with an HOV lane and (2) literature that examined public attitudes toward HOV lanes.

OPERATIONAL IMPACTS

The underlying criteria for evaluation may be very similar for both added-capacity and reduced-capacity HOV measures; a reduction in travel time, low violation rates, and adequate levels of safety are the desired outcome in both cases. However, care should be taken in comparing the results of operational evaluations of reduced-capacity strategies and additional capacity strategies, as different motivational factors are involved. For example, an HOV lane that has been converted from a general purpose lane may experience a higher usage rate since its implementation has been accompanied by a reduction in general purpose capacity. However, it may also experience a higher violation rate for the same reason.

For this project, four types of literature were reviewed to study the operational impacts associated with HOV lane conversions: (1) guidelines for evaluating operational impacts, (2) site-specific studies that evaluated operational impacts to a local facility, (3) comparative studies nationwide that considered a variety of HOV strategies and compare their operational effectiveness, and (4) safety-related studies.

Suggested Evaluation Measures

The report, *HOV Monitoring and Evaluation Tool,* developed by Benuska, Hansen, and Ulberg, suggests a methodology for evaluating the effectiveness of HOV lanes in improving facility operation and aims to identify the most effective and efficient method for collecting and analyzing the supporting data (Benuska, Hansen, and Ulberg 1994). This report describes not only the types of data to be collected and the appropriate analyses, but also the logistics of collecting, storing, and manipulating the data. A related report, *HOV Lane Evaluation and Monitoring,* developed by the same three authors, describes analysis procedures and precautions to take when interpreting the results (Benuska, Hansen, and Ulberg 1994).

A comprehensive document, *Suggested Procedures for Evaluating the Effectiveness of Freeway HOV Lanes,* suggests specific objectives for evaluation, measures of effectiveness, threshold values, and data collection methods for evaluating the effectiveness of HOV lanes on freeway facilities (Turnbull, Henk, and Christiansen 1990). Suggested objectives, measures of effectiveness, and thresholds are shown in Table 1.

The authors' suggested data collection includes the following:

- vehicle and occupancy counts for general purpose lanes, HOV lane(s), and parallel routes
- park-and-ride lot volumes
- travel time data for general purpose lanes and HOV lane(s)
- attitudinal information from bus riders, carpoolers, vanpoolers, and non-HOV users
- safety and accident information
- violation rates.

In *The Effectiveness of High Occupancy Vehicle Facilities,* Christiansen describes the use of "overall per lane efficiency" as the primary measure of effectiveness for evaluating the newly constructed Katy transitway in Texas (Christiansen 1988). The overall per lane efficiency is the product of peak-hour person-volume and the average vehicle speed. This measure takes into account both the number of people transported and the speeds at which they are moved.

In *HOV Lanes: Some Evidence of Their Recent Performance,* Southworth and Westbrook recommend various measures of effectiveness for evaluating the effectiveness of HOV lanes (Southworth and Westbrook 1986). The measure of highway capacity

Table 1. Suggested Objectives, Measures of Effectiveness, and Thresholds

OBJECTIVES	MEASURES OF EFFECTIVENESS AND THRESHOLDS
Increase vehicle occupancies	• Average vehicle occupancy by 10 percent • Carpool ridership by 20 percent • Bus ridership by 10-20 percent
Increase bus efficiency	• Vehicle productivity by 5 to 20 percent • Schedule adherence by 95 percent
Decrease travel time for HOV users	• Travel time savings of 5 to 7 minutes
Improve air quality and energy consumption	• Reduction in emissions (variable threshold)
Increase traffic flow rates in each lane	• Peak hour per lane efficiency by 5 to 20 percent
Maintain general purpose lane operation	• Maintain LOS
Maintain safety of general purpose lanes and HOV lanes	• Maintain or reduce number and severity of accidents • Maintain or reduce accident rate per million vehicle miles traveled • Maintain or reduce accident rate per million passenger miles traveled
Garner public support for HOV lanes	• Percentage of users, non-users and general public who approve of HOV facility • Violation rates
Ensure that HOV lane is cost effective	• Benefit cost ratio

usage (MCU) is based on person throughput (average person-volumes/lane and average vehicle occupancies). More specifically, the MCU is the percentage of persons per peak period or hour on the HOV lane divided by the percentage of road capacity devoted to

HOV traffic. The MCU shows how effective the HOV lane is at moving people in relation to the general purpose lanes. An effective MCU is greater than or equal to 1.

A second measure of effectiveness suggested by Southworth and Westbrook is the measure of extra HOV lane capacity (MEC). The MEC is expressed as a percentage. It is equal to 100 minus the percentage of HOV lane design volume in use, where design volume refers to the lane's capacity to move traffic under acceptably safe driving conditions (based on between-vehicle distance). To ensure an average speed of 50 mph (to maintain the uncongested benefits offered by HOV lane), a base value of 1800 vehicles per hour is assumed. One bus is assumed to equal 1.6 cars.

Southworth and Westbrook caution against the use of other common measures of effectiveness. Speed is commonly used as a measure of effectiveness, but they caution against before-and-after speed studies because of changes in traffic volumes. Impacts on ridesharing is another common measure of HOV lane effectiveness, but this measure may be inaccurate because of difficulties in separating HOV lane impacts from other factors. Energy consumption is a derived value and can only be used as a rough approximation. It is too difficult to account for route diversion, departure times, or changes in vehicle types (i.e., changes from older, less economical cars to newer, smaller, fuel efficient cars) to use energy consumption as a measure of effectiveness.

Site Specific Analyses

A number of studies have considered operations before and after the implementation of an HOV lane at a specific site. The majority of these studies have considered the operational effectiveness of an HOV lane when it has been an addition to the roadway (i.e., the lane was either newly constructed, or the roadway was restriped to allow for an additional lane), and the capacity for general purpose traffic has remained the same. Few studies have considered the operational effectiveness of an HOV lane after it has been converted from a general purpose lane, reducing general purpose traffic capacity. The dearth of studies regarding lane conversion efforts is the direct result of a lack of freeway lane conversion attempts. Public opinion in the early 1970s prevented all but a few lane conversions on major freeway segments (some shorter lane conversions were implemented near bridge or tunnel structures where capacity was constrained).

As summarized in *High Occupancy Vehicle Treatments, Impacts and Parameters*, during the early stages of HOV development, three projects converted a lane of general traffic to create an HOV lane:

(1) 21.0 km (12.6 miles) of the inside lane of the four- or five-lane Santa Monica freeway in Los Angeles were converted to a 3+ HOV lane.

(2) 13.3 km (8 miles) of the three-lane Southeast Expressway in Boston were converted to a 3+ HOV lane.

(3) 1.3 km (0.8 miles) of the three-lane I-93 in Boston were converted to a 3+ HOV lane (Batz 1986).

The Boston HOV lanes operated only during the morning peak periods. The Santa Monica HOV lane operated both morning and afternoon peak periods.

Before and after analyses were conducted at each of these sites to determine the impacts resulting from lane conversions. The results of these analyses are summarized in Table 2. In general, HOV travel times improved, and mode shifts from single occupant vehicle to carpool or bus were noted in each case. The Santa Monica freeway experienced the highest mode shift because of the simultaneous addition of express bus service. Vehicular volumes decreased in all cases, while two out of the three cases noted an increase in person throughput. All cases reported fair to good safety levels. The travel times for non-HOVs varied for each case; non-HOV travel times were noted to either increase or decrease, depending on the site.

Despite these seemingly positive analyses, both the Santa Monica freeway and Southeast Expressway HOV lanes were terminated after 5 and 6 months of operation, respectively, because of intense public resistance. The I-93 HOV project is still in operation, perhaps because of the short distance of freeway that is affected.

Table 2. Before/After Analysis Results from Previous Lane Conversions

	Travel Time Changes				Vehicular Volume		Mode Shift		Person Throughput		Safety	Enforcement	
	Total (Min)		Rate (Min/Mi)				Percent Change						
	HOV	Non-HOV	HOV	Non-HOV	% Change	HOV % Of Total	Bus	Carpool	% Change	HOV % Of Total		Violation Rate	Compliance Rate
I-93 Boston	-4.0 to -10.0	NA	-5 to -12	NA	-9	11	NA	+85	+10	21	Good	0 to 5	99
Santa Monica Freeway Los Angeles	-4.0	+2.5	-0.3	+0.2	-7	9	+225	+65	+3	24	Fair	10 to 20	97 to 99
Southeast Expressway Boston (Not Enforced)	-10.0	-4.0	-1.3	-0.5	-10	7	+5	+30	-6	30	Fair	65 to 80	70 to 85
Southeast Expressway Boston (Enforced)	-10.0	+8.8	-1.3	+1.1	-5	10	0	+30	-3	35	Fair	35	94

More detailed information regarding the lane conversion projects described above is provided in *The Santa Monica Freeway Diamond Lanes* (Billheimer, Bullemer, and Fratessa 1977) and *Southeast Expressway High Occupancy Vehicle Lane Evaluation Report* (Simkowitz 1978).

More recently, the conversion of a general purpose lane to an HOV lane along the Dulles Toll Road in Fairfax, Virginia, in 1992 met with equally bad public reaction. Because of growing demand, the Dulles Toll Road, a four-lane facility, was widened to accommodate six lanes of traffic. The additional lanes were completed and opened to general purpose traffic and then converted to HOV lanes after a few weeks of operation. The level of service of the facility went from A (free flow) to F. The HOV lanes were opened again to all traffic. Documented in *HOV Lessons from the Dulles Toll Road* (Stowers 1994) were the following recommendations.

- Do not open HOV lanes during election campaigns unless there is firm support from elected officials.
- Do not open HOV lanes when traffic conditions are expected to be at their worst.
- Do not open portions of the complete facilities to all traffic before HOV operation starts.
- Document the reasons for HOV failures elsewhere and make this information available to all elected officials.
- Educate the public about HOV systems.
- Make all elected officials aware that HOV systems cannot be put in place as easily in the future because of space constraints and congestion.
- Develop an area-wide strategy for HOV system development.
- Develop a comprehensive implementation program for each corridor, including marketing and related improvements.

While other areas in the nation may not have learned from the HOV lane experiences of the 1970s, California did. Following the Santa Monica Freeway Diamond Lane project in 1976, HOV lane *additions* rather than *conversions* were pursued as a means to improve roadway efficiency in California. Recently, and under certain circumstances, HOV lane conversions have been attempted again. *HOV Lane Conversions in California (1989 - 1994)* documents the circumstances under which lane conversions have been successfully implemented in California over the past 5 years (Auslam 1994). Three circumstances considered appropriate for lane conversions in California include the following:

- as a construction staging step
- to provide project continuity
- in an emergency situation.

Along Route 91 near Corona in Southern California, 2 miles of HOV lanes were completed but were to remain closed until the connecting HOV segments were also completed. Public involvement forced Caltrans to open the completed segment as a general purpose lane even though additional capacity was not needed. Once the connecting HOV segments were completed, the lane was converted back to its original intended use as an HOV lane. The public did not oppose this conversion.

Along Route 85 near San Jose in the Bay Area, a 1.1-mile segment was restriped to allow for two general purpose lanes and one HOV lane. This configuration matched the existing HOV section to the north and a new freeway section with HOV lanes under construction to the south.

After both the Loma Prieta earthquake in 1989 and the Northridge earthquake in 1994, general purpose lanes were converted to emergency HOV lanes to compensate for the loss of capacity resulting from many collapsed roadway structures. Many of these HOV lanes have been returned to general purpose use because the HOV lanes were implemented as an emergency measure; no environmental documentation justified a permanent HOV lane.

Auslam cites the following reasons for successful lane conversions:

- Local government support was strong.
- The conversion appeared logical to motorists.
- No congestion resulted in the remaining general purpose lanes.
- Local traffic authorities had an aggressive attitude towards HOV facilities and did an excellent job working with Caltrans to educate the public and the media.

The New Jersey Department of Transportation has recently taken a more aggressive stance on lane conversions (documented in *Lane Conversion Strategy for the I-80 High-Occupancy Vehicle Lanes in New Jersey*, (Fischer 1994)). In March 1994, a 10.5-mile section of HOV lane began operating along Route I-80. A feasibility study was conducted several years prior when the highway was undergoing construction to add an additional general purpose lane. Approximately half of the newly constructed lane had been opened to traffic when the decision was made to convert the lane to an HOV based on the results of the feasibility study. Construction staging measures were taken to prevent the section of unopened roadway from being opened to general purpose traffic.

In addition, an attitudinal survey of motorists and a marketing campaign were initiated to encourage acceptance of the lane conversion.

While it is too early to conclusively determine the results of the lane conversion, several encouraging observations have been made to date

- The HOV lane is moving 6300 people in 2500 vehicles, while the general purpose lanes are moving 5100 people in 5000 vehicles on a per lane basis.
- The percentage of violators is between 5 and 10 percent
- Travel time savings are estimated to be 10 to 15 minutes in the morning and to vary from 2 to 10 minutes in the evening.
- Public response to the HOV lanes has been mixed.

A number of other lane conversion attempts are being proposed throughout the nation (*Status of HOV Lane Conversion in the U.S.*, Fuhs 1994). These include the following:

I-270 in Maryland

I-75 and I-85 in Atlanta, Georgia

US 50 in Sacramento, California

Other Comparative Studies

Several studies have considered and compared the effectiveness of a variety of HOV-related strategies for improving operations. Usually these studies have considered a number of sites, documented the HOV strategies in place, measured their effectiveness at improving operations, compared them with other areas of the country, and drawn conclusions and recommendations based on the findings. The findings related to lane conversion efforts are described below.

The *Freeway High Occupancy Vehicle Lanes and Ramp Metering Evaluation Study*, conducted by D. Baugh Associates, Inc., considered 14 HOV projects of various characteristics across the nation (D. Baugh Associates, Inc. 1979). Comparative conclusions were presented for a variety of HOV implementation strategies, such as newly constructed HOV lanes, HOV lanes created through restriping, lane conversions, and contra-flow lanes. Below is a summary of this study's conclusions about the effectiveness of HOV lane conversion strategies.

- With-flow, existing lane projects are the least costly.
- With-flow, existing lane projects consistently show a reduction in vehicle throughput, which is only partly attributable to auto driver shifts to carpool and bus.
- The percentage of people who use a facility in an HOV lane should be greater than the percentage of roadway capacity consumed; this is seldom true for with-flow, existing lane projects.
- With-flow, existing lane projects produce lower travel time savings.
- With-flow, existing lane projects produce a smaller increase in auto occupancy.
- With-flow, existing lane projects have the poorest safety records.
- With-flow, existing lane projects have higher violation rates.
- With-flow, existing lane projects result in the most negative public reactions.

Similar findings are documented in *Evaluation of Priority Treatments for High Occupancy Vehicles* (Rothenberg and Samdahl 1981). This study considered a variety of HOV treatment projects and the success experienced.

- Projects that added an HOV lane resulted in improved travel times for both HOVs and non-HOVs, but travel time losses for the non-HOV users were noted on two of the three lane conversion projects.
- Person throughput increased more for projects that added an HOV lane than for the lane conversion projects.
- Enforcement was a greater problem for the lane conversion projects, where non-HOVs were forced to use fewer lanes.

Safety-Related Studies

Several variables can impact the level of safety experienced on a facility. Therefore, conclusions drawn from the literature cannot be *directly* applied to other situations. However, safety-related literature can provide insight into factors influencing the safety of an HOV facility for future evaluations.

Golob considers the safety impacts of an HOV lane in the report *Safety of High-Occupancy Vehicles Lanes without Physical Separation* (Golob 1989). This study focused on an HOV lane on the Riverside Freeway, State Route 91, in the greater Los Angeles area. The HOV lane was created from the leftmost (median) shoulder, and its minimum width is approximately 11 feet. The lane has two ingress and two egress areas. After considering accident characteristics and locations, Golob determined that the implementation of the HOV lane had no adverse effects on the safety of the facility as a whole. While the HOV lane did not degrade safety it also did not improve conditions.

The *Operational and Safety Experience with Freeway HOV Facilities in California* compared operational characteristics such as speed differentials and HOV lane utilization with accident rates (Newman, Nuworsoo, and May 1988). The report indicates that non-separated HOV lanes, or lanes without buffers, have a higher accident rate because the potential for interaction is much greater (buffered or separated HOV lanes only allow interaction at designated locations).

ATTITUDINAL CONSIDERATIONS

Because of the negative public reaction to the first attempts to convert general purpose lanes to HOV lanes, public attitudes toward HOV lanes are a critical part of any analysis. So strong is public reaction in determining the success of HOV lanes that some studies have been conducted before a decision has been made to implement HOV lanes to judge public acceptance. Few of these studies have dealt with lane conversion; rather, most have related to the addition of a lane, which may have made a big difference in the motoring public's attitudes. In addition, these studies have asked the general public to speculate about the impact the HOV lanes would have. The attitudes revealed may have been very different if people had been asked to respond after the HOV lanes' implementation and operation. These issues must be considered when responses from different studies are compared.

Public Attitudes Toward Conversion of Mixed-use Freeway Lanes to HOV Lanes focuses on assessing public support for HOV lane conversions in general, and not on support for a specific facility (Gard, Jovanis, Kitamura, and Narasayya 1994). The researchers questioned respondents regarding the conditions in which lane conversions would be acceptable. Telephone surveys of 606 randomly selected individuals from the California counties of Sacramento, Placer, Yolo, and El Dorado were conducted. Five core variables seemed to determine the respondents' support of a lane conversion:

- least expensive alternative
- biggest improvement in traffic flow
- least amount of traffic delay and construction time
- change in congestion after conversion
- use of alternative route if conversion occurred.

In addition, the public seemed to be most receptive if the lane conversion would complete an HOV lane network.

In the greater Seattle area, the WSDOT initiated an investigation into HOV lane conversion possibilities (JHK and Associates, et al 1994). As part of this investigation, a telephone survey of freeway users was conducted in King, Pierce, and Snohomish Counties. The purpose of this survey was to gain a better understanding of freeway user's attitudes about HOV lanes and about lane conversion. The key findings of this survey are summarized below.

- There is strong support for HOV lanes in general (67 percent)
- Building new HOV lanes is preferred over lane conversion
- The main reason for opposing lane conversion is a perception that it will result in increased traffic and commute time.
- Despite some opposition to lane conversion in general, most respondents said they would support lane conversion on the stretch of freeway they use most often.

CHAPTER 3
OPERATIONAL ANALYSIS

It is important to consider the effects of HOV lanes on traffic flow characteristics. For example, is the traffic volume great enough to warrant an HOV lane, or is the volume so great that the lane conversion would introduce a safety hazard or would not produce a time savings? It is also important to examine the impact of the lane conversion on speeds and the speed-flow relationship.

To conduct the operational analysis, data were collected during the morning commute (7:00 am to 10:00 am) on two days - one before the lane conversion (Wednesday November 24, 1993) and one after the lane conversion (Wednesday June 22, 1994). These will be referred to as dataset 1 (before) and dataset 2 (after). The data were gathered with WSDOT video surveillance cameras, and the resulting video tapes were analyzed with the Autoscope video imaging system. Video imaging automatically measures traffic volumes and traffic speeds by lane and provides the data in an analysis-ready format.

Vehicle occupancy data were collected by manual count before and after the HOV lane conversion. A sufficient number of half-hour counts were conducted by human observers to provide appropriately accurate estimates of vehicle occupancy after the lane conversion.

HOV lane violation rates were determined largely on the basis of the vehicle occupancy counts by lane. These data were supplemented with the attitudinal survey in which respondents admitted to HOV violations.

Accident data were analyzed to determine whether the increased general purpose lane density or increased lane change activity had an effect on safety. Potential changes in the accident rate, type, or severity resulting from the implementation of HOV lane were detected with data from the Microcars database maintained by the Washington State Department of Transportation.

TRAFFIC VOLUMES

Traffic volumes in both the HOV lane and the general purpose lanes indicate the extent to which commuters make use of the HOV lane and the level of congestion in the general purpose lanes that commuters are willing to tolerate before converting to other ridesharing options. Care should be taken when considering traffic volumes in isolation. Traffic volumes can be greatly influenced by seasonal changes and other outside factors. Hence changes in traffic volumes should be compared to the results of other criteria in the analysis. For example, a decrease in traffic volumes combined with an increase in auto occupancy would imply a mode shift to carpools and buses, which in turn might lead to a more efficient facility. Seasonal factors must also be taken into account because dataset 1 (before) and dataset 2 (after) were collected in the fall and summer respectively.

Overall traffic volumes (all lanes) were 11 870 vehicles before the conversion and 11 448 after the conversion. This reduction in traffic volumes was not likely the result of the HOV lanes because our survey of commuters indicated little if any shift in modes, routes, or departure times. More likely, this variation was the results of seasonal effects and random factors. A breakdown of traffic volumes by lane is provided in Table 3.

Table 3 shows that the HOV lane was reasonably well-used in the June data collection period. The most notable difference between the volumes before and after conversion was the volume in lane 1 (the "slow" lane). The increase in volume in this lane reflects the shift in traffic attributable to the presence of the HOV lane.

TRAFFIC SPEEDS

Average speeds, by lane of travel are presented in Table 4. A statistical comparison of speeds before and after conversion was also conducted by computing z-statistics to determine whether the difference in speeds was significant (i.e., a test for equality of mean speeds before and after conversion). In all cases, we are over 99.99 percent confident (critical z=3.50) that the means of the speeds from datasets 1 and 2 were different.

Table 3. Change in Traffic Volumes (during the 3-hour morning commute)

	BEFORE	AFTER
LANE 4 (HOV LANE AFTER)	2843	618
LANE 3	3820	3913
LANE 2	3161	3530
LANE 1	2046	3387
TOTAL FACILITY	11 870	11 448

Table 4. Change in Average Speeds (during the 3-hour morning commute)

	BEFORE (mph)	AFTER (mph)	z-statistic
LANE 4 (HOV LANE AFTER)	60.42	57.19	31.20
LANE 3	57.18	57.99	9.69
LANE 2	56.42	58.21	16.73
LANE 1	47.76	58.63	46.16
TOTAL FACILITY	56.13	57.85	24.86

The discovery of a significant difference in average speeds (in favor of the HOV lane facility) suggests that the HOV lane will not have an adverse effect on facility speed. Some caution must be exercised in interpreting these results because of the slightly lower overall volume after the conversion and the fact that the dataset 2 was collected in the summer as opposed to the fall. Thus, the data may be reflecting a seasonal variation in speed.

Another concern worthy of study is the effect that the presence of the HOV lane has on the variance of speeds. If the speed variance is high, the HOV lane could be expected to increase accident risk, and if it is low, to decrease accident risk. Table 5 presents standard deviations of speed and F-statistics for the test of variance equality between datasets 1 and 2.

Table 5 shows that the variance of speed increased in lanes 3 and 4 after the HOV lane had been activated. Both increases are significant at a confidence level of over 99.99 percent (critical F=1.00). The lane 4 increase was expected because after conversion many HOVs shared a single lane (i.e., slower moving buses traveled with faster cars). The lane 3 increase was likely the result of the lane's proximity to the HOV lane. However, note that both lanes 1 and 2 showed a significant decrease in speed variance after the HOV lane had been activated, and the overall impact (total facility) was a significantly lower variance in post-HOV lane speed. These findings, taken together, suggest that the HOV lane conversion did not adversely affect safety. In fact, the observed reduction in speed variance should improve the facility's safety. Again, some caution should be exercised in interpreting these results because of possible seasonal variations.

SPEED-FLOW RELATIONSHIPS

It was difficult to isolate the impacts of the HOV lane without undertaking a multivariate analysis (i.e., one that would control for differences in traffic volumes) because of the differences in flows revealed by the first and second datasets. One approach was to develop speed-flow relationships for the first and second datasets. To develop these relationships, we computed instantaneous hourly volumes by expanding 1-minute traffic counts to a full hour. We then regressed speed against these hourly volume and lane indicator variables. The results of these multiple regressions are presented in Table 6.

The results in Table 6 clearly reflect some of the findings presented earlier in this report. For example, the negative lane indicator coefficients from model 1 (before) (lane 4 was normalized to zero) indicate that speeds were lower in lanes 1, 2, and 3 even when

Table 5. Change in Standard Deviation of Speeds (during the 3-hour morning commute)

	BEFORE (mph)	AFTER (mph)	F-statistic
LANE 4 (HOV LANE AFTER)	3.34	4.72	2.00
LANE 3	3.50	3.77	1.16
LANE 2	4.49	4.12	1.19
LANE 1	7.20	4.14	3.02
TOTAL FACILITY	6.15	4.22	2.12

Table 6. Regression Results of Speed-Flow Relationships

VARIABLE	**BEFORE DATA Estimated Coefficient (t-statistics)**	**AFTER DATA Estimated Coefficient (t-statistics)**
Constant	62.98 (538.42)	60.22 (694.34)
Traffic Flow Squared (in thousands of vehicles per hour squared)	-0.0994 (-31.74)	-0.1538 (-52.60)
Lane 3 indicator (1 if vehicle traveling in lane 3, 0 otherwise)	-3.548 (-31.61)	0.751 (8.48)
Lane 2 indicator (1 if vehicle traveling in lane 2, 0 otherwise)	-4.26 (-36.40)	1.274 (14.03)
Lane 1 indicator (1 if vehicle traveling in lane 1, 0 otherwise)	-12.615 (-96.39)	2.11 (12.73)
Number of observations	11870	11448
R-squared	0.477	0.203

flow was controlled for. Model 2 (after) produced the opposite result, as the general purpose lanes all had higher speeds than the HOV lane (lane 4). The value of the traffic flow coefficient also indicates considerable difference between models 1 and 2. This suggests, as expected, that the HOV lane significantly altered the speed-flow relationship.

A formal test for the equality of the two speed-flow relationships was conducted with a Chow test. The test statistic was:

$$\frac{[SSE(constrained)-SSE(unconstrained)]/K}{SSE(unconstrained)/(T1+T2-2K)} \tag{1}$$

where

- SSE is the sum of squared errors of the regression
- SSE(constrained) is the SSE for a regression using all the data (from both datasets)
- SSE(unconstrained) is the summation of the SSEs of the separate dataset regressions
- T1 is the number of observations in the first (before) regression
- T2 is the number of observations in the second (after) regression
- K is the number of coefficients in the model.

This test statistic is F distributed with K, T1+T2-2K degrees of freedom. Calculating this with our data produced $F_{5,23318} = 1034.11$. This value means that we are over 99.99 percent confident that the speed-flow relationships of datasets 1 and 2 were different. This shift in the speed flow relationship is not necessarily bad. Although the HOV lane produced a reduction in lane 4 speeds at all volumes, the post-HOV relationship showed

- an improvement in speeds in lane 1 at all but very highly congested volumes (14 830 vehicles per hour, well beyond our maximum observed instantaneous hourly volume of 7 380)
- an improvement in speeds in lane 2 at facility volumes of less than 7 141 vehicles per hour
- an improvement in speeds in lane 3 at facility volumes of less than 5 319 vehicles per hour.

Thus the impact of the HOV lane on the general purpose lanes should be minimal in all but the most congested conditions. It would be interesting to recalculate the speed-flow relationship if and when this portion of highway became more congested.

VEHICLE OCCUPANCY

Average vehicle occupancy indicates the proportion of motorists who share a ride or use mass transit. A value close to 1.0 indicates that a high proportion of the motoring public is traveling alone. The value increases as the number of motorists using high occupancy modes of travel increase. The change in average vehicle occupancy for the morning peak period is expressed in Table 7. A substantial change in occupancy resulted in the general purpose/HOV lane. However, no overall change in average vehicle occupancy for the facility was noted.

HOV LANE VIOLATION RATES

Enforcement can have a great impact on the effectiveness of any HOV lane strategy. If no enforcement occurs, drivers are tempted to violate the law because the threat of being fined is small. However, enforcing the restriction is not always feasible given limited resources, limited personnel, and geometric constraints.

In this study, violation rates were obtained simultaneously with average vehicle occupancies. Violations were observed during the morning peak period at Newport Way. Through manual counts, the researchers calculated an HOV violation rate of 4.6 percent which was based on a sample of 853 vehicles (39 single occupant vehicles were observed travelling in the HOV lane). Because no special enforcement efforts were made, this low violation rate may imply that traffic congestion was minimal at this location, and hence, the benefit gained from using the HOV lane may have been minimal.

ACCIDENT RATES

In determining the effectiveness of an HOV lane, it is important to observe not only the operational impacts that may result but also the impacts on the facility's level of safety. The level of safety for a particular facility can be characterized by examining the distribution of accidents across the facility, the types of accidents that occur, and the severity of the accidents.

Accident data collected after the implementation of the HOV lane were too limited to make a before/after comparison. Furthermore, additional factors may have affected the facility's level of safety. Construction for a Bellevue transit access project near the I-405 interchange between Lake Sammamish Parkway and S.E. Bellevue Way reduced the capacity of the roadway and slowed the flow of traffic. This capacity reduction probably increased the number of accidents through this area. Of the 43 accidents noted in the study area after the lane conversion, nearly half could have been the result of the construction rather than the lane conversion.

Table 7. Change in Average Vehicle Occupancy (AM)

	BEFORE	**AFTER**
LANE 4 (HOV LANE AFTER)	1.14	2.14
LANE 3	1.11	1.07
LANE 2	1.09	1.09
LANE 1	1.14	1.10
TOTAL FACILITY	1.12	1.12

CHAPTER 4
ATTITUDINAL SURVEY ANALYSIS

The objective of the survey was two-fold: (1) to determine the impact of the lane conversion on commuting behavior, including mode, route, and departure time choices; and (2) to study commuters' attitudes toward HOV lanes in general and lane conversions in particular. To achieve this objective, a survey was carefully constructed. The survey was designed in three sections (see Appendix A). The first section dealt with the commute trip. Questions in this section focused on changes (before the HOV lane conversion versus after it) in usual mode, route and departure time. Questions about consumers' daily variations in mode, route, and departure times were asked as well. The second section gathered information on commuters' attitudes toward HOV lanes and lane conversion. The third section collected socioeconomic information on the commuters and their households.

The survey was distributed to commuters observed traveling in the lane-conversion area. License plate numbers were gathered during the morning commute over a three-day period in June 1994 (roughly seven months after the lane conversion). Using files from the Washington State Department of Motor Vehicles, license plate numbers were matched with the addresses of registered vehicle owners, and questionnaires were sent out in late June. In all, surveys were sent to 1325 commuters and 322 responded (a response rate of 24.3 percent).

SUMMARY OF SURVEY RESULTS

Table 8 shows some interesting socioeconomic results. For example, roughly 62 percent of the respondents were male. This is a reasonable response because it is known from previous studies that a higher percentage of males is expected in the morning commute. Another interesting finding was the high level of education (over 16 years) and the high annual household income (over $75,000). Although Seattle's eastern

Table 8. Sample Summary Statistics (averages unless otherwise noticed)

Sex (% male/female)	62.26/37.74
Age in years	42.93
Annual household income in thousands of dollars	75.54
Level of education	16.01
Household size	2.94
Number of household members older than 15 years old	2.20
Number of household members working outside of home	1.85
Number of household vehicles	2.42
Work schedule of commuters (% fixed/flexible)	48.43/51.57
Percent of usual travel mode in area highways between 6-9 am and 3-6 pm (SOV/ carpool or vanpool/ bus/ other)	77.26/17.14/5.30/0.31
Percent having ever used HOV lanes in the Seattle area between 6-9 am and 3-6 pm	70.22
Percent of usual travel mode when using HOV lanes in the Seattle area between 6-9 am and 3-6 pm (SOV/ carpool or vanpool/ bus/ motorcycle)	2.68/85.27/10.27/1.79
Percent sometimes qualifying for HOV lane use but not using them	37.93
Percent of reason for not using the HOV lane when qualified (slower than regular lanes/ too much trouble to change lanes/ HOV lanes are not safe/ all traffic moves fast enough/ forget to use HOV lane/ other)	24.41/7.87/9.45/38.58/7.87/11.81
Percent of commuters who used HOV lanes on I-90 during past five commutes (not at all/ 1-4 times/ every day)	75.60/10.80/13.60
Percent of commuters who changed usual departure time to work after new HOV lanes added	35.17
Percent of commuters who changed usual departure time to work because of HOV lanes	2.1
Percent of commuters who changed usual route to work after new HOV lanes added	21.33
Percent of commuters who changed usual route to work because of HOV lanes	2.1

suburbs are relatively affluent, the $75,000 figure is on the high side. One possible explanation for this finding is that certain socioeconomic groups may have been more likely to respond to the survey. Our subsequent statistical analysis addressed this possibility.

In terms of commuting mode, about 77 percent listed single-occupant vehicles (SOV) as their usual mode of travel (the distribution by mode is shown in Figure 2, and the average frequency over the past five commutes, by mode, is shown in Figure 3). This result is consistent with Seattle-area averages. Also interesting to note is that over 70 percent of the commuters had, at least once, used HOV lanes in the Seattle area during peak hours (see Table 8). This suggests reasonable familiarity with the HOV system and its potential to save travel time. The usual mode of HOV-lane travel was the 2-person carpool (see Figure 4). However, over 2 percent of the commuters admitted to committing HOV lane violations (i.e., they listed SOV as their usual mode of HOV lane travel, see Table 8). Given that Seattle-area HOV-lane violation rates are very close to this figure, this admission shows an unexpected candor among survey respondents.

The most common reasons that drivers gave for not using HOV lanes when they were qualified to use them were "all traffic moves fast enough" and "[HOV lanes are] slower than regular lanes." Less than 10 percent listed HOV lane safety as a reason for not using HOV lanes. Although this is a comparatively low figure, it shows that the HOV lane safety issue is still a fairly serious concern among some travelers (see Table 8). Finally, the frequency of I-90 HOV lane usage over commuters' past five commutes is shown in Figure 5 (and in Table 8). This figure shows some tendency toward regular mode-switching (i.e., values in the range of 1 to 4 are over 10 percent of total) and/or not using the HOV lane when qualified.

The survey also showed that the commuters in this corridor actively sought alternative route and departure times to shorten their commutes; over 30 percent indicated that they had changed route or departure time at least once in the past five commutes in

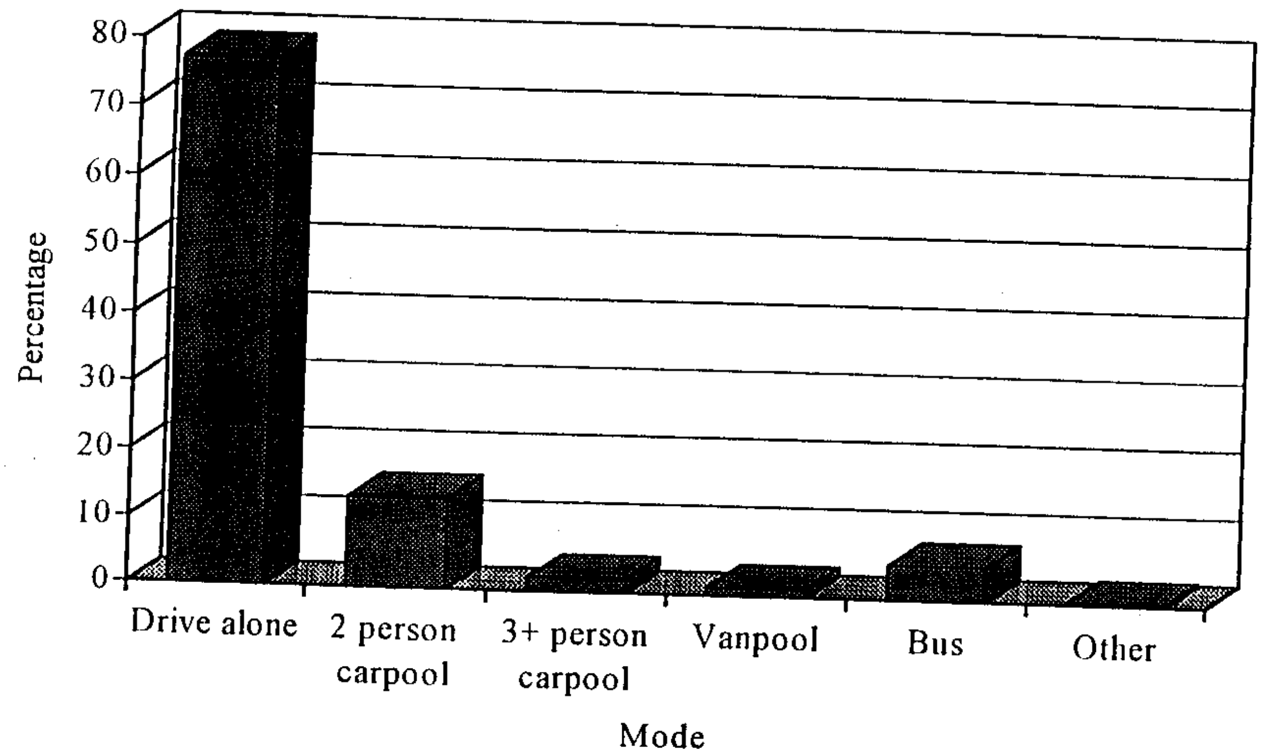

Figure 2. Usual mode of travel between 6:00-9:00 AM and 3:00-6:00 PM.

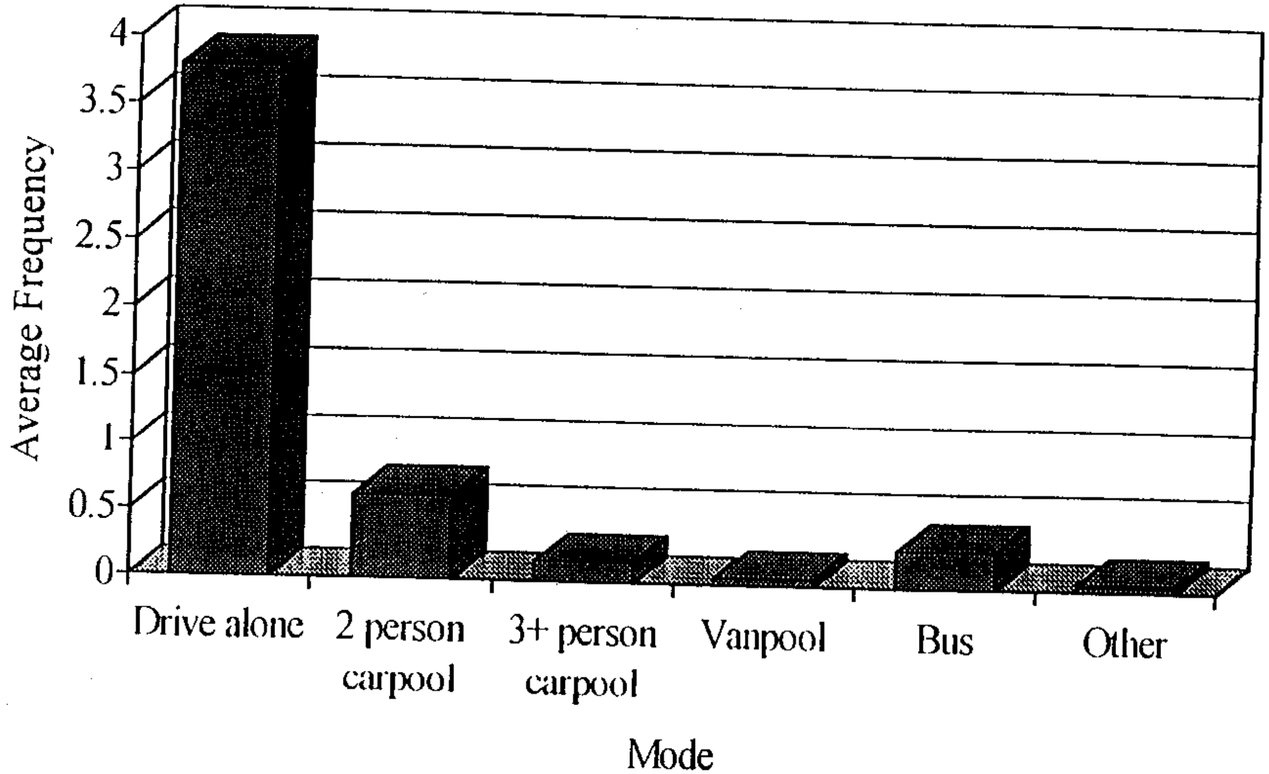

Figure 3. Frequency of modal usage on past five commutes to work.

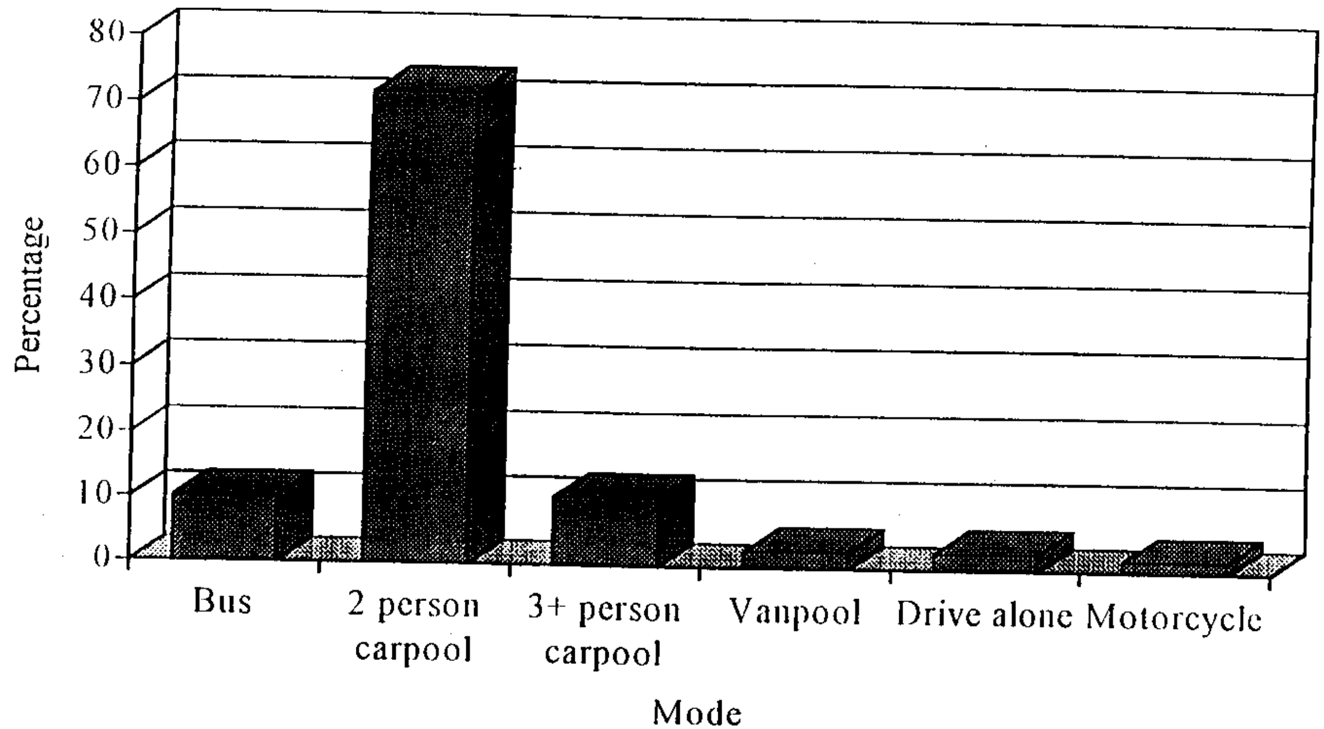

Figure 4. Usual mode of travel when using HOV lanes between 6:00-9:00 AM and 3:00-6:00 PM.

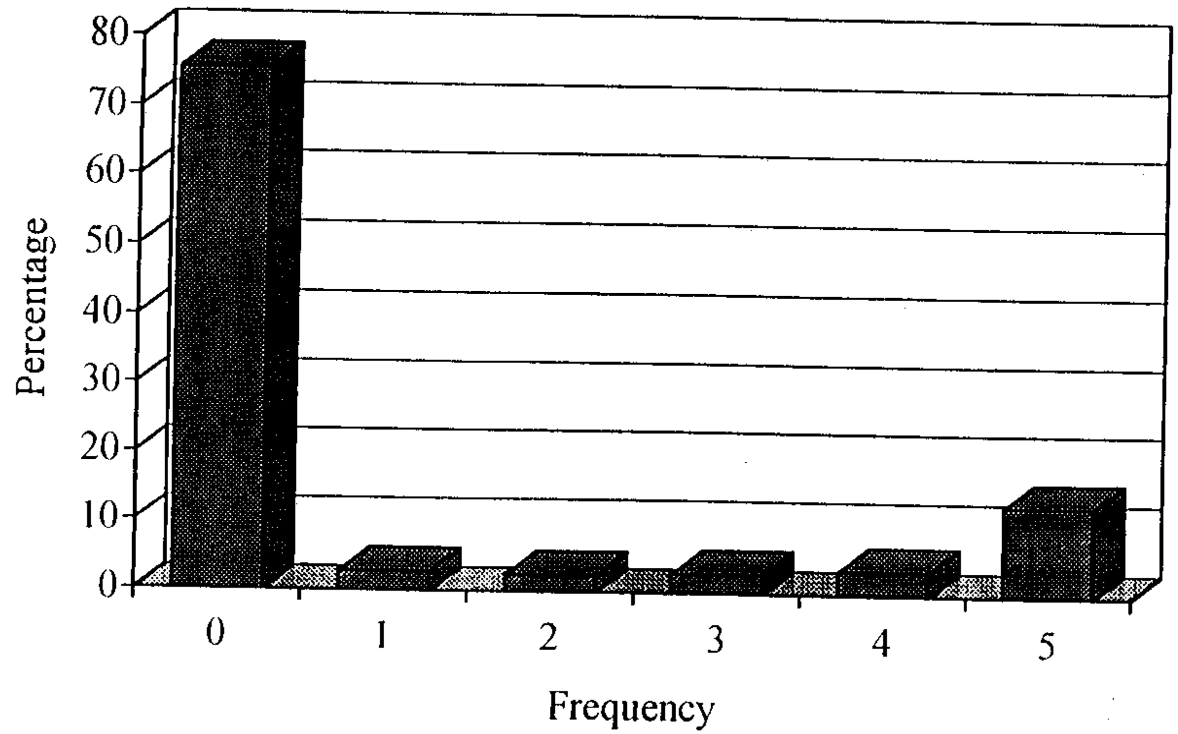

Figure 5. Frequency of I-90 HOV lane use on past five commutes to work.

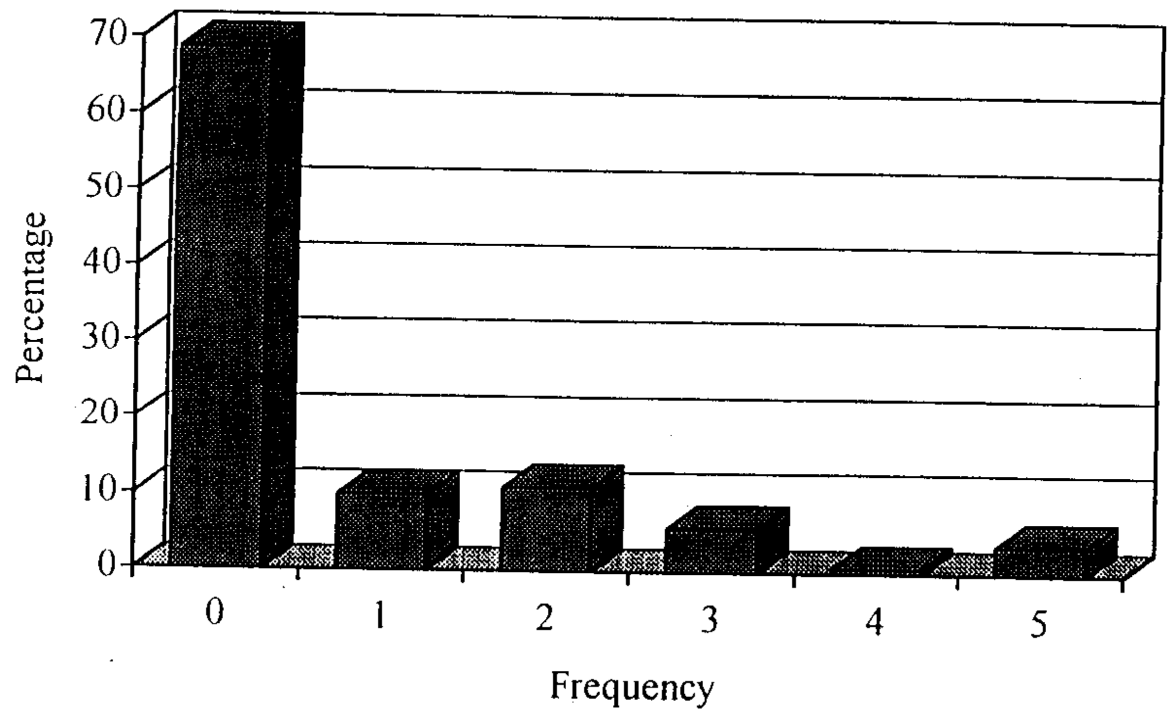

Figure 6. Frequency of route or departure time changes, to avoid traffic congestion, on past five commutes to work.

an attempt to avoid traffic congestion (see Figure 6). As for long-term changes, Table 8 shows that over 35 percent of the commuters had changed their usual departure time for work after the HOV lane conversion, and over 21 percent had changed their usual route. However, only 2.1 percent attributed these changes to the HOV lane conversion. Thus the perceived effect of the HOV lane conversion on route and departure time choice did not seem to be significant to commuters. If this is the case, it indicates that the HOV lanes do not have a large impact on the welfare commuters derive from existing route and departure time choices (see Mannering and Hamed, 1990, and Small, 1983, for a discussion of the commuter welfare impacts of HOV lanes). This important matter will be explored in later sections.

Unfortunately, the HOV lane conversion had virtually no impact on commuters' mode choices (see Table 9). Nine SOV drivers became carpool/vanpool users and one became a bus rider. However, five carpool/vanpool users became SOV drivers and two bus riders became SOV drivers. Statistically, the HOV lane conversion had no significant impact on mode choice.

Table 9. Changes Of Usual Travel Mode Before/After The New HOV Lanes In Area Highways Between 6-9 AM And 3-6 PM

	To SOV	To car/ vanpool	To bus	To other	Before Lane Conversion Totals
From SOV	238	9	1	0	248
From car/vanpool	5	42	1	0	48
From bus	2	3	14	0	19
From other	2	1	0	1	4
After Lane Conversion Totals	247	55	16	1	319

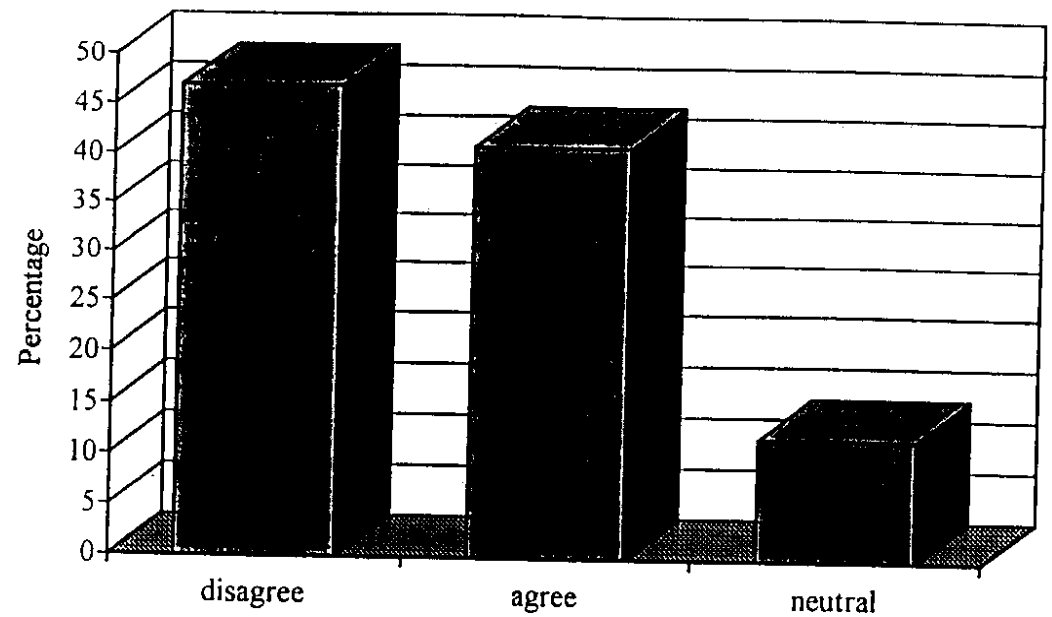

Figure 7. Responses to the question "HOV lanes help save all commuters time".

Commuters' opinions about HOV lanes and HOV lane conversions also revealed some interesting findings. First, 47 percent believed that HOV lanes do not help save time for all commuters, and 41 percent believed they do (see Figure 7). This result suggests lingering doubts concerning the effectiveness of HOV lanes. This doubt is underscored by the 69 percent of respondents who felt that HOV lanes are not being adequately used (see Figure 8). In fairness, it is possible that some of this negativity was an outgrowth of fact that Seattle's HOV lane system is not yet complete. This lack of completion could be a major source of the perception that HOV lanes are under-utilized and less than entirely effective.

There also seems to be general public support for HOV lanes. Figure 9 shows that only 36 percent of the survey's respondents believed HOV lanes should be converted to general purpose lanes. In terms of lane conversion, public opinion was negative as 45 percent disagreed (39 percent agreed) that regular lanes should be converted, and 38 percent disagreed (36 percent agreed) that regular lanes should be converted only before traffic congestion becomes serious (see Figures 10 and 11). However, although opinion is negative, there does not seem to be a strong public resentment toward lane conversion. This is certainly a shift from the earlier lane-conversion resistance observed in the 1970s. This shift is likely due to the unique attributes of the I-90 lane conversion (e.g., relatively low congestion) or possible changes in public attitudes over time.

The comments gathered at the end of the survey (see Appendix A) provided some interesting information because respondents were allowed to vent their frustrations with and voice their opinions about the Washington State Department of Transportation's (WSDOT) HOV-lane and lane-conversion policies. A large percentage of the respondents (51.24) provided no comments. The comments from the nearly 50 percent of respondents who did write in, we carefully screened and classified as negative (anti-HOV lane), positive (pro-HOV lane), and neutral. Figure 12 shows that nearly 50 percent had

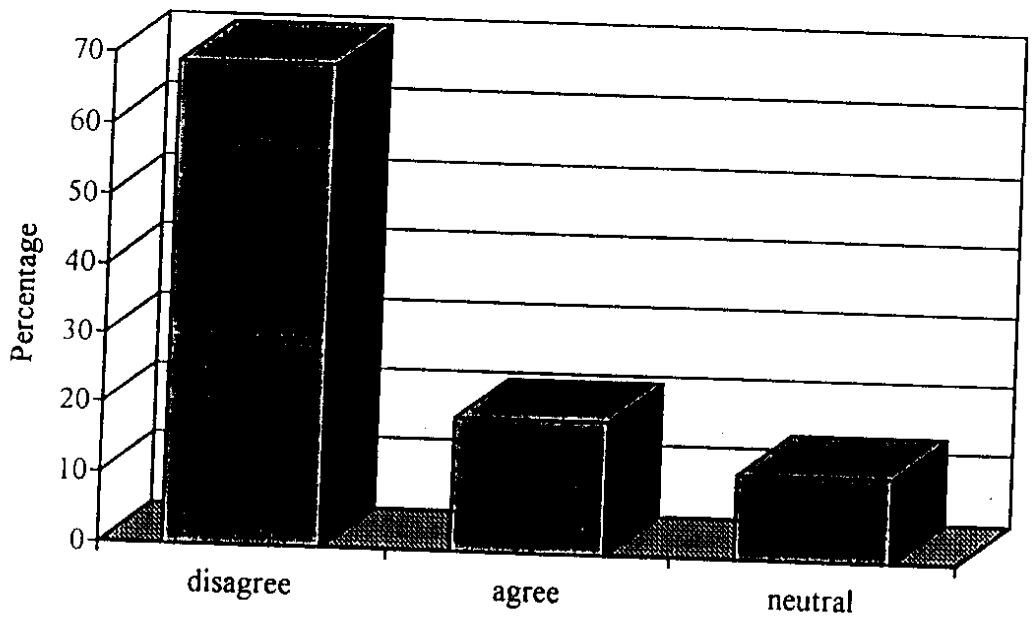

Figure 8. Responses to the question "Existing HOV lanes are being adequately used".

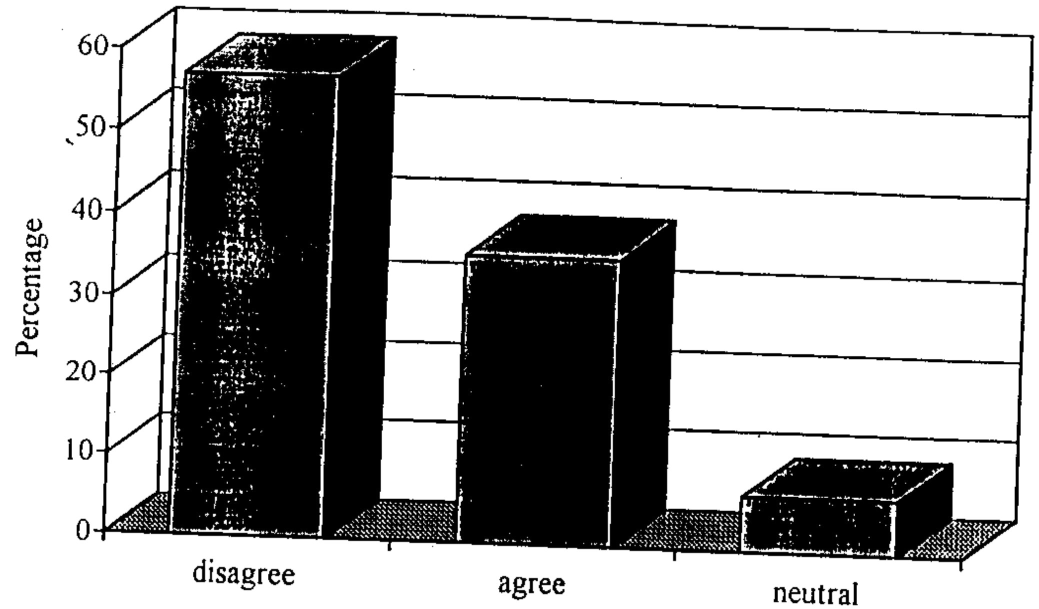

Figure 9. Responses to the question "HOV lanes should be open to all traffic".

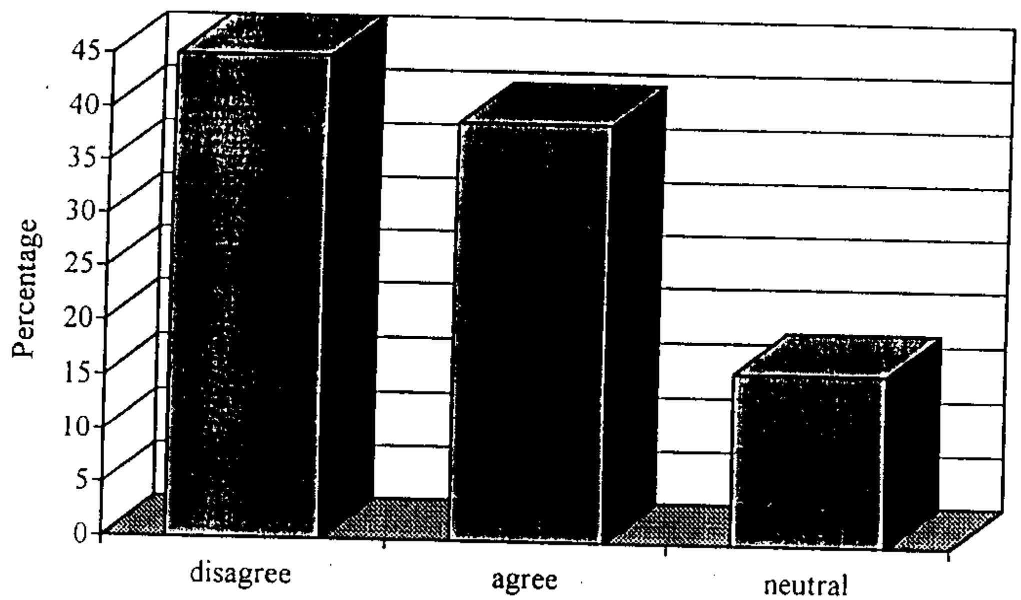

Figure 10. Responses to the question "Converting some regular highway lanes to HOV lanes is a good idea".

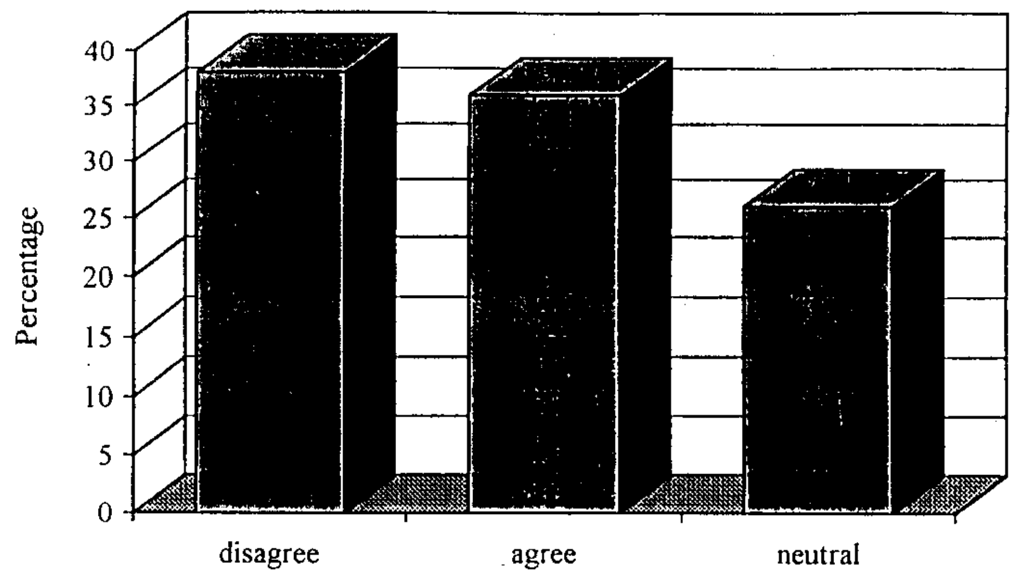

Figure 11. Responses to the question "Converting some regular highway lanes to HOV lanes is a good idea only if it is done before traffic congestion becomes serious".

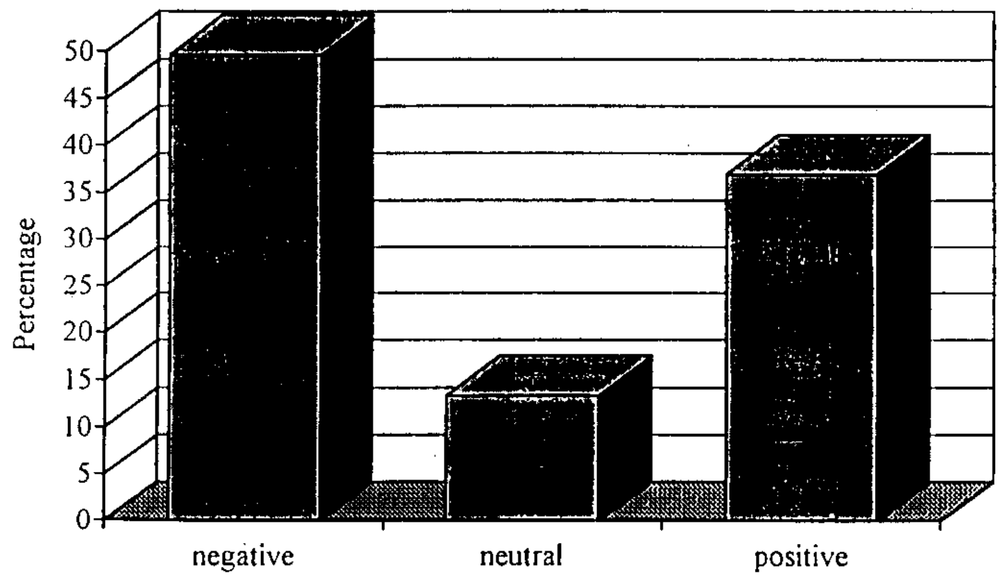

Figure 12. Comments given regarding HOV lane policies and HOV lane conversions.

negative comments, 37 percent had positive comments, and 13 percent were neutral. The relatively high percentage of negative comments shows some persistent dissatisfaction with HOV policies, but the percentage of the entire sample (slightly less than 25 percent) is relatively small. It must also be noted that our survey technique (i.e., using license plates) would tend to over sample single occupant travellers and that individuals with strong opinions may have been more likely to respond to the mail-back survey. Therefore the rather large numbers of negative responses must be viewed with some caution.

MULTIVARIATE ANALYSIS

While these statistics provided some information about the public's acceptance of HOV lanes and lane conversions, we required a multivariate analysis to determine the characteristics of individuals who had positive or negative attitudes toward HOV lanes and/or HOV lane conversions. This type of information is critical because it will permit state agencies to effectively market HOV policies by targeting specific commuter market segments. It will also allow agencies to forecast probable acceptance of HOV policies in specific corridors once the socioeconomic and commute characteristics of the corridors are known.

Two types of multivariate analyses were conducted in this project. First, we developed a model to determine the probability that a survey respondent would offer a negative, neutral, or positive comment, given that a comment was provided. Second, we developed a model for each of the five questions in Section B of the survey (commuter opinions toward HOV policies). These models enabled us to determine commuters' likelihood of disagreeing with, being neutral on, or agreeing with specific HOV-related statements. A description of these models and the model estimation results are provided below.

Modeling the Nature of Commuters' Comments

The remarks of the 159 individuals who provided comments on their completed survey forms (roughly half of the 322 respondents) regarding HOV lanes and HOV lane conversions were classified as negative, neutral, or positive. Given the discrete nature of the three alternatives, a multinomial probabilistic choice model was a natural selection. In developing such a model, we assumed that a respondent would make the comment that provided the most satisfaction. Therefore, we used the following equation to determine the probability of individual (n) making comment type (i) from the set of comment alternatives (I):

$$P_n(i) = P(U_{in} \geq U_{In}) \quad \forall\ I \tag{2}$$

where (P) denotes probability and U_{in} is the satisfaction provided by comment type (i) to individual (n). To estimate this probability, the satisfaction function (or in economic terms, the utility function) must be specified. This is usually done in a linear form, such that

$$U_{in} = \beta \mathbf{X}_{in} + \varepsilon_{in} \tag{3}$$

where $\mathbf{X}_{in}$ is a vector of measurable characteristics that define utility (e.g., age, gender, current mode of travel, departure time changes, and so on), β is a vector of estimable parameters, and ε_{in} is an error term that accounts for unobserved factors influencing an individual's utility of making comment type (i). The term $\beta\mathbf{X}_{in}$ in this equation is said to be the observable portion of utility because the vector $\mathbf{X}_{in}$ contains measurable characteristic variables (e.g., age of individual (n)), and ε_{in} is the unobserved portion.

Given equations 2 and 3, the following can be written:

$$P_n(i) = P(\beta \mathbf{X}_{in} + \varepsilon_{in} \geq \beta \mathbf{X}_{In} + \varepsilon_{In}) \ \forall \ I \tag{4}$$

or

$$P_n(i) = P(\beta \mathbf{X}_{in} - \beta \mathbf{X}_{In} \geq \varepsilon_{In} - \varepsilon_{in}) \ \forall \ I \tag{5}$$

With equation 5 an estimable discrete choice model can be derived by assuming a distributional form for the error term. A natural choice is to assume that this error term is normally distributed. If this is done, a probit model results. However, probit models are computationally difficult to estimate (see Ben-Akiva and Lerman, 1985). A more common approach is to assume that ε_{in}'s are generalized extreme value (GEV) distributed. The GEV assumption produces a closed form model that can be readily estimated using standard maximum likelihood methods. McFadden (1981) has shown that the GEV assumption results in the multinomial logit model

$$P_n(i) = \exp[\beta \mathbf{X}_{in}] / \sum \exp[\beta \mathbf{X}_{In}] \tag{6}$$

where all variables are as previously defined, and the vector β is estimable by standard maximum likelihood methods.

Multinomial logit model coefficient estimates for the three types of comments are presented in Table 10 (Note that only 155 of the 159 did not have missing data in either the dependent or independent variables; this explains the 155 observations shown at the bottom of the table.) The model showed that individuals under the age of 21 were more likely to give a negative comment (i.e., to produce negative coefficients for neutral and positive comment utilities). Also, since the coefficient for the positive comment

Table 10. Multinomial Logit Estimation Results For Comments About HOV (t-statistics in parentheses).

Variable*	Estimated coefficients
Constant [0]	2.280 (2.906)
Constant [P]	-1.291 (-1.727)
Younger age dummy variable (1 if age is less than 21, 0 otherwise) [0]	-0.732 (-1.061)
Younger age dummy variable (1 if age is less than 21, 0 otherwise) [P]	-1.367 (-1.093)
Higher education dummy variable (1 if post graduate, 0 otherwise) [0]	-0.693 (-1.581)
Higher education dummy variable (1 if post graduate, 0 otherwise) [P]	0.790 (1.472)
Number of adults in a household (greater than 15 years old)[0]	-0.328 (-1.471)
Number of household vehicles per person [0]	-0.527 (-1.037)
Number of household vehicles per person [P]	0.811 (1.949)
Fixed-work dummy variable (1 if work-schedule is fixed, 0 otherwise) [0]	-0.458 (-1.235)
SOV dummy variable (1 if SOV is a usual mode in area highways between 6-9 AM and 3-6 PM, 0 otherwise) [0]	-1.416 (-3.099)
SOV dummy variable (1 if SOV is a usual mode in area highways between 6-9 AM and 3-6 PM, 0 otherwise) [P]	-0.787 (-1.290)
Departure time change dummy variable (1 if changed usual departure time to work after new HOV lanes, 0 otherwise) [0]	-0.665 (-1.580)
Departure time change dummy variable (1 if changed usual departure time to work after new HOV lanes, 0 otherwise) [P]	-1.689 (-2.265)
Route change dummy variable (1 if changed usual route to work after new HOV lanes, 0 otherwise) [0]	-0.774 (-1.434)
Log-likelihood at zero	-170.28
Log-likelihood at convergence	-136.18
Number of observations	155

* Number in brackets indicate variables defined for: [N] Negative opinion, [0] Neutral opinion, [P] Positive opinion alternatives.

alternative was more negative (i.e., had a larger absolute value) than the negative coefficient for the neutral comment (-1.367 versus -0.732), this age group was more likely to be neutral than positive. Although these coefficients were not highly significant (t-statistics just greater than 1), they did suggest the presence of anti-HOV sentiments among the young.

The coefficients for the higher education dummy variables indicated that individuals with post-graduate work were more likely to give positive comments (i.e., produce a positive coefficient in the positive utility function) and less likely to be neutral (a negative coefficient in the neutral utility function). This result shows that post-graduate education polarizes opinions, producing a greater likelihood of a positive opinion.

Surprisingly, the same result was found with regard to the number of household vehicles per person. That is, a respondent with a high number of vehicles per person was more likely to make a positive comment and less likely to make a neutral comment. This finding appears to be an artifact of the sample, which consisted of affluent suburbanites with high vehicle ownership levels (see Table 8).

Individuals with fixed-work hours were more likely to express a positive or negative comment. The absence of work departure time flexibility seems to have polarized this population segment into making either a positive or negative comment.

Individuals who indicated who SOV was their usual mode of travel were less likely to give a neutral comment and, as expected, less likely to give a positive comment. The tendency toward negative comments from SOV users is not surprising, given their frustration in seeing, what many of them consider to be, underutilized HOV lanes during congested periods.

Individuals who were observed changing their departure times after the HOV lane conversion were much more likely to give a negative response and much less likely to give a positive response (as indicated by the highly significant negative coefficient in the positive alternative). As Table 8 shows, nearly 38 percent of commuters changed their usual departure time between September 1993 and June 1994, but only 2.1 percent listed the HOV lane conversion as the reason for this change. The most common reason for the change was an increase in overall traffic congestion (42 percent), which may have been due in some part to the reduction in SOV capacity because of the loss of a lane or may have occurred in other parts of the highway network. (Change in work hours was the next most common reason, at 16 percent.) It appears that these departure time-change dummy variables captured the frustration of commuters at having to change their usual departure times (most likely due to traffic congestion that was not induced by the lane conversion project because only 2.1 percent listed the lane conversion as the cause), a change that has been shown to cause a significant loss in commuter welfare (see Mannering and Hamed, 1990).

Finally, the route-change dummy coefficient indicated that commuters who changed their usual routes after the HOV lane conversion were less likely to give a neutral comment. As was the case with departure time, the most common reason that 21.33 percent of respondents that changed their routes was increasing traffic congestion (46.27); only 2.1 percent cited HOV lanes as the cause of the change. The polarization of the route-change response (i.e., respondents were more likely to make positive or negative responses) seems to indicate that while some commuters were happy with their new routes (perhaps they found a better route in terms of travel time), others were less pleased. The more consistent negative response of departure time-changers suggests that departure time carried a higher level of commuter utility than route choice. This is consistent with the earlier findings of Mannering and Hamed (1990).

Modeling Commuters' Opinions Toward HOV policies

The questions in Section B of the survey (see Appendix A) elicited responses that ranged from disagree strongly to agree strongly. This type of data is referred to as ordered (because there is a consistent transition from disagreeing to agreeing) and can be translated into an integer form for the purposes of model estimation. In our case, the statistical analysis showed that the data could best be grouped in three categories: (1) disagree (which included strongly disagree and disagree), (2) neutral, and (3) agree (which included agree and strongly agree). This grouping suggests that respondents did not adequately distinguish between "strong" agreement or disagreement and simple agreement or disagreement. This re-ordering had no effect on the substantive findings of the statistical analysis.

Translating these three choices into integer form produced; 1 as disagree, 2 as neutral, and 3 as agree With this ordering, an ordered probability model could be derived (Greene, 1993). Such models begin by defining an unobserved variable, z, that is used as a basis for modeling the ordinal ranking of the data. This unobserved variable is specified as follows:

$$z = \beta \mathbf{X} + \varepsilon \tag{7}$$

where **X** is a vector of characteristics determining individuals' choice of ranking category, β is a vector of estimable parameters and ε is a random disturbance. Using this equation, observed ordinal rankings, y, (ranging from 1 to 3 in our case) are defined as

$$\begin{aligned} y &= 1 && \text{if } z \le \mu_1 \\ &= 2 && \text{if } \mu_1 < z \le \mu_2 \\ &= 3 && \text{if } z > \mu_2 \end{aligned} \tag{8}$$

where μ's are estimable parameters that define (y), which corresponds to integer rankings. Note that, without loss of generality, μ_1 can be constrained to be zero so that only the threshold μ_2 needs to be estimated.

Table 11. Ordered Probit Estimation Results For Opinion Of HOV Lanes Saving All Commuters Time (t-statistics in parentheses)

Variable*	Estimated coefficients
Constant	0.900 (3.913)
Younger age dummy variable (1 if age is less than 21, 0 otherwise)	-0.276 (-1.156)
Higher income dummy variable (1 if annual household income is greater than $75K, 0 otherwise)	-0.238 (-1.646)
Number of adults in a household (greater than 15 years old)	-0.147 (-2.075)
Fixed-work dummy variable (1 if work-schedule is fixed, 0 otherwise)	-0.319 (-2.160)
SOV dummy variable (1 if SOV is a usual mode in area highways between 6-9 AM and 3-6 PM, 0 otherwise)	-0.684 (-3.254)
HOV use dummy variable (1 if used HOV lanes on I-90 during past five commutes, 0 otherwise)	0.347 (1.627)
Departure time change due to HOV lanes dummy variable (1 if changed usual departure time to work due to presence of HOV lanes, 0 otherwise)	-0.943 (-1.353)
Threshold μ_2	0.312 (6.260)
Log-likelihood at zero	-302.30
Log-likelihood at convergence	-280.17
Number of observations	313

* Dependent variables: 1 is base (disagree), 2 is neutral, 3 is agree

If the disturbance term in equation 7 is assumed to be standard normal (with mean = 0 and variance = 1), an ordered probit model results, and if the disturbance is assumed to be standard logistic, an ordered logit model results. Unlike the case of the discrete choice model presented in the previous section, the ordered logit model does not have a significant computational advantage over the ordered probit. The choice of one model over the other is often made purely on theoretical grounds. Because of the widespread use of the normal distribution in statistics, we assumed a standard normal distribution of the error term and estimated a series of ordered probit models. Ordered probit models of the five statements made in Section B of the survey are discussed below.

HOV lanes help save all commuters time

As shown previously in Figure 7, more people believed that HOV lanes do not save all commuters time than believed that they do. This skepticism with regard to the value of HOV lanes is important to understand. Model estimation results for this statement are presented in Table 11. The estimation results show that respondents less than 21 years old were less likely to agree with this statement. This is consistent with the tendency of this group to provide negative comments as shown in the preceding section.

Higher income households were also less likely to agree with this statement (i.e., to produce a negative coefficient). This may be because higher income households are generally more auto-dependent than their lower income counterparts. The greater was the number of adults in the household, the less likely was the respondent to agree with this statement. This suggests some lingering skepticism among larger, older households as to the effectiveness of HOV lanes.

Respondents with fixed work hours were less likely to agree that HOV lanes save all travelers time. This group of travelers had limited ability to adjust departure times to avoid congestion, and, in the absence of what they felt were reasonable modal alternatives, they may have harbored bitter feelings toward losing a lane to HOVs.

People who were regular SOV users did not tend to believe that HOV lanes save all travelers time, and people who were regular HOV users tended to believe that HOV lanes

save all travelers time (as indicated by the negative and positive coefficients, respectively). This sort of modal bias is an expected result.

Finally, the 2.1 percent of respondents who indicated that they changed their usual departure time because of the presence of HOV lanes were less likely to agree with the statement that HOV lanes save all commuters time. Correct or not, these respondents seemed to be blaming their forced departure time changes on the presence of HOV lanes.

Table 12. Ordered Probit Estimation Results For Opinion Of Existing HOV Lanes Being Adequately Used (t-statistics in parentheses)

Variable*	Estimated coefficients
Constant	-0.583 (-3.146)
Gender dummy variable (1 if male, 0 if female)	0.204 (1.261)
Older age dummy variable (1 if age is greater than 50, 0 otherwise)	-0.449 (-2.202)
Higher income dummy variable (1 if annual household income is greater than $75K, 0 otherwise)	-0.181 (-1.165)
High education dummy variable (1 if post graduate, 0 otherwise)	0.358 (2.169)
Number of adults in a household (greater than 15 years)	-0.216 (-2.683)
Fixed-work dummy variable (1 if work-schedule is fixed, 0 otherwise)	-0.150 (-0.954)
HOV use dummy variable (1 if used HOV lanes on I-90 during past five commutes, 0 otherwise)	0.996 (5.628)
Threshold μ_2	0.487 (6.993)
Log-likelihood at zero	-294.77
Log-likelihood at convergence	-239.57
Number of observations	314

* Dependent variables: 1 is base (disagree), 2 is neutral, 3 is agree

HOV lanes are being adequately used

Figure 8 shows that nearly 70 percent of respondents did not believe that HOV lanes are being adequately used. From a policy perspective, such a belief is clearly a matter of concern for those who would expand the HOV systems. Ordered probit estimation results of opinions on this statement are presented in Table 12. The results show that men were more likely to agree with this statement, although the level of statistical significance (t=1.261) was not very high. This finding may have been an outgrowth of the demographic characteristics of the sample. A sample drawn from lane conversions in other corridors would provide evidence to either support or refute this finding.

Respondents older than 50 years old and respondents from higher income households (greater than $75,000) were less likely to believe that HOV lanes are being adequately used. Again, this may have been the result of their greater dependence on SOV travel and their concern over the loss in roadway capacity caused by HOV lanes.

Respondents who were more highly educated were more likely to agree with this statement. This is consistent with the earlier finding that such respondents were more likely to make a positive comment on the survey.

Both a higher number of adults in the household and having a fixed work schedule reduced the likelihood of believing that HOV lanes are being adequately used. This finding shows skepticism among people with these characteristics, as was the case with their believing that HOV lanes saved all commuters time.

As expected, respondents who listed HOV modes as their usual mode of travel were more likely to believe HOV lanes are being adequately used. This result is consistent with earlier findings.

HOV lanes should be opened to all traffic

This statement asked consumers to pass judgment on a national transportation policy. As shown in Figure 9, over 36 percent respondents agreed with this statement. While this was not a majority, it was nonetheless a disturbingly high figure. The ordered probit estimation results presented in Table 13 provide some insight into the characteristics of the respondents who were likely to agree or disagree with this statement.

Many of the results were consistent with the findings that isolated the characteristics of respondents who were likely to have opinions that favored or opposed

Table 13. Ordered Probit Estimation Results For Opinion That HOV Lanes Should Be Opened To All Traffic (t-statistics in parentheses)

Variable*	Estimated coefficients
Constant	-0.740 (-2.369)
Older age dummy variable (1 if age is greater than 50, 0 otherwise)	0.290 (1.600)
Higher income dummy variable (1 if annual household income is greater than $75K, 0 otherwise)	0.216 (1.479)
Number of children 0-15 years	-0.156 (-1.953)
Fixed-work dummy variable (1 if work-schedule is fixed, 0 otherwise)	0.310 (2.025)
SOV dummy variable (1 if SOV is a usual mode in area highways between 6-9 AM and 3-6 PM, 0 otherwise)	0.900 (3.819)
HOV use dummy variable (1 if used HOV lanes on I-90 during past five commutes, 0 otherwise)	-0.375 (-1.593)
Departure time change due to HOV lanes dummy variable (1 if changed usual departure time to work due to presence of HOV lanes, 0 otherwise)	1.568 (2.158)
Threshold μ_2	0.246 (5.334)
Log-likelihood at zero	-285.44
Log-likelihood at convergence	-254.08
Number of observations	311

* Dependent variables: 1 is base (disagree), 2 is neutral, 3 is agree

HOV lanes. For example, older respondents, respondents from higher income households, respondents with fixed work-start times, regular SOV users, and individuals who attributed departure time changes to the presence of HOV lanes were all more likely to favor opening HOV lanes to all traffic. These consistent findings clearly isolate the characteristics of individuals who are likely to oppose HOV policies.

Table 13 shows that regular HOV use and households with a large number of children were factors that increased the likelihood of disagreeing with this statement. The presence of a large number of children increases the likelihood of qualifying for HOV lane usage (i.e., to transport children) and thus probably results in a more favorable attitude toward future HOV lane use. Finally, it is important to note that the negative coefficient of the constant term indicated a general disposition of the public to oppose opening HOV lanes to all traffic.

Converting some regular highway lanes to HOV lanes is a good idea

and

Converting some regular highway lanes to HOV lanes is a good idea only if it is done before traffic congestion becomes serious

These two statements are closely related and directly address the lane conversion issue. To the first statement (with no reference to the level of traffic congestion) 45 percent of respondents disagreed, 16 percent were neutral, and 39 percent agreed (see Figure 10). The results make clear that opposition existed toward lane conversion, but it was by no means overwhelming. Ordered probit estimation results for this statement are presented in Table 14.

The model results shown in this table closely parallel the findings of earlier models. Regular SOV users and respondents who attributed departure time changes to the presence of HOV lanes were likely to oppose lane conversion, while regular HOV users and households with a large number of children were likely to favor lane conversions.

Recall that the second statement ("HOV lane conversions are a good idea only if done before traffic congestion becomes serious") produced relatively indeterminate results: 38 percent disagreed with such lane conversion, 26 percent were neutral, and 36 percent agreed (see Figure 11). Table 15 shows results that are virtually identical to those in Table 14 except that both younger respondents (those less than 21) and higher income respondents were found to disagree with lane conversions before traffic congestion (with no reference to traffic congestion, these groups were not more or less likely to disagree with HOV lane conversions). The concern of these two groups may have been that lane conversions undertaken before traffic congestion becomes serious may actually create

Table 14. Ordered Probit Estimation Results For Opinion About Converting Some Regular Highway Lanes To HOV Lanes (t-statistics in parentheses)

Variable*	Estimated coefficients
Constant	0.259 (0.987)
Number of children 0-15 years	0.152 (2.026)
SOV dummy variable (1 if SOV is a usual mode in area highways between 6-9 AM and 3-6 PM, 0 otherwise)	-0.702 (-3.510)
HOV use dummy variable (1 if used HOV lanes on I-90 during past five commutes, 0 otherwise)	0.458 (2.276)
Departure time change due to HOV lanes dummy variable (1 if changed usual departure time to work due to presence of HOV lanes, 0 otherwise)	-1.031 (-1.370)
Threshold μ_2	0.445 (7.640)
Log-likelihood at zero	-322.94
Log-likelihood at convergence	-297.30
Number of observations	313

* Dependent variables: 1 is base (disagree), 2 is neutral, 3 is agree

congested conditions on the remaining general purpose lanes (i.e., by reducing capacity). In fact, a number of the negative comments concerning lane conversion referred to the respondent's belief that lane conversion was responsible for increasing traffic congestion in the corridor.

Slightly over 50 percent of the individuals surveyed made no comment at all on their survey forms. Of those who did comment, the majority responded negatively to the lane conversion and/or HOV policies in general (see Figure 12).

Table 15. Ordered Probit Estimation Results For Opinion About Converting Some Regular Highway Lanes To HOV Lanes Before Serious Traffic Congestion (t-statistics in parentheses)

Variable*	Estimated coefficients
Constant	0.287 (1.106)
Younger age dummy variable (1 if age is less than 21, 0 otherwise)	-0.300 (-1.332)
Higher income dummy variable (1 if annual household income is greater than $75K, 0 otherwise)	-0.201 (-1.474)
Number of children 0-15 years	0.114 (1.541)
SOV dummy variable (1 if SOV is a usual mode in area highways between 6-9 AM and 3-6 PM, 0 otherwise)	-0.253 (-1.302)
HOV use dummy variable (1 if used HOV lanes on I-90 during past five commutes, 0 otherwise)	0.553 (2.742)
Departure time change due to HOV lanes dummy variable (1 if changed usual departure time to work due to presence of HOV lanes, 0 otherwise)	-1.214 (-1.812)
Threshold μ_2	0.684 (9.892)
Log-likelihood at zero	-351.69
Log-likelihood at convergence	-320.14
Number of observations	308

* Dependent variables: 1 is base (disagree), 2 is neutral, 3 is agree

CHAPTER 5
CONCLUSIONS

OPERATIONAL ANALYSIS

From an operational perspective, the impact of the lane conversion on traffic flow was minimal. While some travelers clearly had experienced reduction in speed (i.e., the original users of lane 4), the net effect on overall freeway speed was not great (the slight increase in speed after the HOV lane was activated could have been a beneficial impact of the HOV lane or a result of seasonal variations). Moreover, a reduction in speed variance was observed after the HOV lane conversion, which suggests a possible improvement in safety. Finally, an analysis of speed-flow relationships showed that the HOV lane had a significant impact, but the adverse consequences of this impact would be felt only in highly congested conditions. Such conditions do not currently exist on the facility.

From these operational findings we can conclude that the HOV lane conversion did not have an adverse impact on travel speeds or travel times. In fact, the evidence suggests that travel speeds and travel times improved as a result of the HOV lane (although seasonal factors could have played a role) at most observed traffic volume levels (as indicated by the speed-flow regression results).

Other factors revealed mixed results:

- A relatively low HOV violation rate of 4.6 percent was observed, indicating that traffic congestion was minimal at this location and hence, the benefit gained from using the HOV lane may have been minimal.
- No change was noted in the average vehicle occupancy for the facility.
- The accident investigation was limited because of time constraints and hampered by outside factors; nearly half of the accidents were possibly attributable to unrelated construction.

ATTITUDINAL SURVEY ANALYSIS

The findings of our survey of commuters using the I-90 HOV lane-conversion corridor showed that the lane conversion was not overwhelmingly accepted by the public. In fact, more respondents opposed lane conversions than favored them. Still, the fact that the percentage that opposed lane conversions is just slightly greater than the percentage that favored them suggests that the long-held resistance of the public to lane conversions may be waning. However, ordered probit model results showed that lane-conversion resistance was higher among the young (commuters less than 21 years old), among higher income households, among SOV users, and among individuals who changed their departure times as a result of the HOV lanes. Given the size of some of these population groups (e.g., over 77 percent were usual SOV users), it is clear that considerable marketing is needed before a significant majority of the public will welcome HOV-lane conversions as acceptable transportation policy.

With regard to HOV lanes in general, the public had mixed reactions to HOV policies. Only 36 percent of the commuting public believed that HOV lanes should be opened to all traffic. On the down side, 47 percent did not believe that HOV lanes save all commuters time, and over 69 percent believed that HOV lanes are not being adequately used. Ordered probit models showed that the individuals most likely to have a negative opinion of HOV lanes were young (less than 21 years old), were from higher income households, had a large number of adults in their households, drove SOVs as the usual mode of travel, and had fixed work hours. Apparently, individuals who fit this mold have yet to be convinced of the purported virtues of HOV lanes.

In terms of the types of comments individuals made on their survey forms, slightly over 50 percent made no comment at all. Of those who did comment, the majority responded negatively to the lane conversion and/or HOV policies in general. Multinomial logit estimation results showed, as was the case with the opinion models discussed above, that commuters who were likely to make negative comments were younger (less than 21 years old), were regular SOV users, and had fixed work schedules. One different finding is that individuals were more likely to make negative comments if they changed their usual departure time after the lane conversion, regardless of the reason (previous results on HOV opinions have shown this to be important only if respondents attributed the departure time change to HOV lanes). It appears that many respondents were venting their frustrations about having to change their usual departure times.

In summary, from a public opinion standpoint, the I-90 lane conversion in the Seattle area can be classified as a qualified success on this specific low-congestion freeway facility. While a slight majority of commuters oppose the conversion, public opinion for and against is surprisingly close. It appears that with effective marketing and careful implementation, lane conversions can be successfully undertaken. However, it is important to recognize that significant opposition may arise from young commuters, from higher income households with a high number of adults, from commuters with fixed work times, from regular SOV users, and from commuters who will be forced to make departure time changes. To reduce their opposition, commuters who fit this mold should be addressed through informational campaigns and other strategies.

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APPENDIX A
ATTITUDINAL SURVEY

Washington State Department of Transportation

University of Washington

Washington State Transportation Center

HIGH OCCUPANCY VEHICLE LANE/TRAVEL SURVEY

The Washington State Department of Transportation and the Washington State Transportation Center at the University of Washington are working together to study travel behavior and high occupancy vehicle (HOV) lanes, also known as carpool lanes. We would like to understand your travel preferences and your perception of HOV lane use and effectiveness.

Please give this survey to the person in your household who most often uses freeways between the hours of 6:00-9:00 am and 3:00-6:00 pm in the Puget Sound area. Ask him or her to fill out the survey and return it by mail within one week. We would appreciate your response. No postage is necessary. This survey is anonymous and your answers will not be associated with your name.

Section A: Your Commute Trip

1. Indicate your ***usual*** mode of travel when using area highways between 6:00-9:00 am and 3:00-6:00 pm.

___ Drive alone
___ Carpool--you and 1 other person
___ Carpool--you and 2 or more other people
___ Vanpool
___ Bus
___ Bicycle, Walk
___ Motorcycle
___ Other

2. Have you ever used HOV lanes while traveling in the Seattle area between 6:00-9:00 am and 3:00-6:00 pm?

YES___ NO___ *(If NO, please proceed to Question 3)*

→ How do you ***most often*** use HOV lanes between 6:00-9:00 am and 3:00-6:00 pm? *Please check only one.*

___ on a bus
___ in a 2 person carpool
___ in a 3 person carpool
___ in a vanpool
___ alone in a car
___ on a motorcycle

3. Do you ever have enough people in your vehicle to qualify for HOV lanes but don't use them?

YES___ NO___ *(If NO, please proceed to Question 4)*

→ What is your primary reason for not using HOV lanes when you have enough people in your vehicle to qualify? *Please check only one.*

___ slower than regular lanes
___ too much trouble to change lanes
___ the HOV lanes are not safe
___ all traffic moves fast enough
___ forget to use HOV lanes
___ other ___________________

4. ***In September of last year (1993)***, what was your ***usual*** mode of travel when using area highways between 6:00-9:00 am and 3:00-6:00 pm.

___ Drive alone
___ Carpool--you and 1 other person
___ Carpool--you and 2 or more other people
___ Vanpool
___ Bus
___ Bicycle, Walk
___ Motorcycle
___ Other

5. Between September 1993 and April 1994 did you ***commute to work*** in the Seattle area between 6:00-9:00 am?

   YES___ NO___ *(If NO, please proceed to Question 14)*

6. Is your work-start time fixed or do you have some flexibility as to when you can start work?

   FIXED_______ FLEXIBLE_____

7. Between September 1993 and now, have you changed your ***usual departure time to work***?

   YES___ NO___ *(If NO, please proceed to Question 8)*

   → If yes, **how many minutes** earlier or later do you now leave for work:

   ________MINUTES EARLIER ***OR*** __________MINUTES LATER

   → Why have you changed your ***usual departure time*** to work? Please check the most important reason.

   ___ change in travel mode
   ___ increasing traffic congestion
   ___ change in work-start time
   ___ presence of HOV lanes
   ___ change in residence
   ___ change in lifestyle
   ___ other

8. Between September 1993 and now, have you changed your ***usual route to work***?

   YES___ NO___ *(If NO, please proceed to Question 9)*

   → Why have you changed your ***usual route*** to work? Please check the most important reason.

   ___ change in travel mode
   ___ increasing traffic congestion
   ___ change in work-start time
   ___ presence of HOV lanes
   ___ change in residence
   ___ change in lifestyle
   ___ other

9. Do you usually commute to ***or*** from work on I-90 between Issaquah and I-405?

   YES___ NO___

10. ***Did*** you usually commute to ***or*** from work on I-90 between Issaquah and I-405 in September 1993?

    YES___ NO___

11. On your past five commutes to work, how often have you used HOV lanes on I-90? *(Check one)*

    ___ not at all
    ___ one time
    ___ two times
    ___ three times
    ___ four times
    ___ five times

12. On your past five commutes to work, how often have you taken each of the following modes *(total must add to five)*.

    ___ Drive alone
    ___ Carpool--you and 1 other person
    ___ Carpool--you and 2 or more other people
    ___ Vanpool
    ___ Bus
    ___ Bicycle, Walk
    ___ Motorcycle
    ___ Other

13. On your past five commutes to work, how often have you changed your *route or departure time* to avoid traffic congestion?

    ___ not at all
    ___ one time
    ___ two times
    ___ three times
    ___ four times
    ___ five times

Section B: Your Opinions

14. Please indicate the extent to which you agree or disagree with the following statements.

	Disagree Strongly	Disagree	Neutral	Agree	Agree Strongly
HOV lanes help save *all* commuters time.	___	___	___	___	___
Existing HOV lanes are being adequately used.	___	___	___	___	___
HOV lanes should be opened to all traffic.	___	___	___	___	___
Converting some regular highway lanes to HOV lanes is a good idea.	___	___	___	___	___
Converting some regular highway lanes to HOV lanes is a good idea only if it is done *before* traffic congestion becomes serious.	___	___	___	___	___

Section C: About Yourself

15. Are you? ___ Male ___ Female

16. What is your age?
___under 21
___22-30
___31-40
___41-50
___51-64
___65+

17. What is your approximate annual household income?
___no income
___under $10,000
___$10,000-$19,999
___$20,000-$29,999
___$30,000-$39,999
___$40,000-$49,999
___$50,000-$74,999
___$75,000-$100,000
___Over $100,000

18. What is your highest level of education?

___ did not finish high school
___ high school
___ community college or trade school
___ college/university
___ post graduate

19. Including yourself, how many people live in your household? _______

20. How many people living in your household are over age 15? _______

21. How many people living in your household work outside the home? _______

22. How many licensed motor vehicles (in working order) do you have? _______

23. What is the Zip Code of your work place? ____________ your home? ____________

PLEASE USE THIS SPACE FOR ANY COMMENTS:

____

____

APPENDIX B
SURVEY RESPONDENT COMMENTS

"1" — NEGATIVE COMMENTS

HOV lanes are incredibly expensive for the little use they get. They significantly add to congestion for all who can't use them, and are a poor (if politically correct) substitute for truly dealing with our traffic problems.

The I-90 HOV lanes have caused so much congestion--it is very frustrating. They are used by motorcycles and very few automobiles. With the heavy semi-truck traffic in the other 3 lanes, it delays normal flow. Coupled with the construction near Factoria, the normal 20-minute commute is now 30 minutes. Why did you take away the right lane exit from I-90 to Bellevue Way? This further compounds the problems. I resent my tax dollars spent to take away one lane of traffic between Issaquah and Bellevue--and it is not used!! You have created a problem which did not exist before. Now you see many unsafe lane changes due to truck and slow traffic in the remaining lanes. PLEASE COME OUT TO OVERPASS @ EXIT 13 AND OBSERVE!! Thanks for the opportunity for input because many motorists are wondering where these decisions are made. P.S., the I-90 HOV is not used by bus traffic because it's the left lanes!

It has been my observation on numerous occasions that I-520 and I-90 bridges are bumper to bumper, while the HOV lanes hardly have any traffic. It is not wise to use the HOV lanes and go the speed limit because there is a good chance that one of the stopped cars will pull out in front of you and cause a wreck.

I enjoy commuting alone--quiet, uninterrupted and less stress dealing with other people, their times...and what if left early or went in later?

These days there is no standard commute -- people aren't just commuting from point A to B. Many Issaquah people have Eastside jobs and can't ride buses or carpool, with daycare, etc. The HOV lanes are there--open them to all.

The HOV lanes are enormously under-utilized and many of them are discontinuous. Example: Westbound on 520 at the Evergreen Bridge, three lanes are suddenly squeezed to two lanes, causing a traffic (plug?) to be about six miles in length--all the way to 148th Avenue. The result? Instead of perhaps 4,000 vehicles crossing the bridge per hour, only 400 cross per hour.

Bus service is inadequate for my schedule. Place of employment is hard to reach. State needs to give employers incentive to allow 4-day work week and telecommuting.

Because both my husband and myself work in job situations that do not allow us to carpool, we feel we are penalized by not being able to use the carpool lanes, even though we pay our fair share of taxes.

I exit I-90 on Bellevue Way and do not use the HOV for fear I won't be able to get through traffic in time to get over for my exit since traffic is so heavy around the 405 interchange.

Until adequate public transportation is available for outlying areas, HOV lanes do nothing but add to the congestion on the highways, as most commuters are in single-occupant vehicles.

HOV lanes waste our money and contribute to congestion. They are not practical and are for idealists only. Build adequate roads and quit trying to force the public to adapt to impractical ideas.

Cutting regular lanes down to two before Mercer Island is unnecessary, because with three regular lanes all traffic moved smoothly--with one HOV lane, regular lanes are congested and HOV lane is not used much.

The HOV lanes and ramp-metering devices on I-90 are not needed.

I am required to travel between locations during my work day. I absolutely have to drive my own car. My wife has a similar situation. A different type of transportation would not permit me to function in my job. Excluding people like myself from HOV lanes is not a fair situation. Also, HOV lanes are usually unoccupied. This makes for very inefficient use. If HOV lanes are opened to everyone, all traffic would move faster.

Don't remove lanes for HOV! If you must have HOV lanes, open them for regular use during non-rush hours. If HOV lanes are so great, how come you only require 2 people to qualify? Even with 2 people, it looks like the HOV lanes are vastly under-used! Removing one lane of I-90 for HOV increases traffic congestion! I don't have much faith in your planners.

HOV lanes from Issaquah to 405 and also new lights caused problems that did not exist before implementing. Solutions that create problems and don't make improvements are not solutions.

If one views traffic as a fluid (at reacts as so), then one's control methods should be flexible to handle volumes or kinks. DOT's rules do not provide any flexibility (accidents on (regular?) lanes/construction, etc.) for the HOV lanes use. In the past 3-6 months, I have seen HOV added lanes from Issaquah and then construction take another lane away at the East channel I-90 area. Now the result is a bottleneck and the only reason it seems that there is <u>no</u> flexibility and/or no communication between DOT and the HOV departments as to scheduling lane closures and handling this bottleneck. Today (6/27), I was in a backup because of the new highway entrance lights and wondering why, when it was not needed last week nor the week before. Instead, a department decided that <u>today</u> was the day to start this, needed or not. Again, no <u>flexibility</u>. Start these only when needed, not on a whim.

Irregular work hours (having to stay late unexpectedly) makes carpooling difficult. No METRO bus service nearby (2 miles closest). Park & Rides are <u>unsafe</u> to leave a car!

HOV lanes do not serve enough cars. Traffic flow would be better by allocating all lanes to all cars. (P.S. Many of those utilizing the HOV lanes are "cheaters"!!).

HOV lanes on I-90 between Issaquah and Bellevue have caused a huge traffic problem around Eastgate that was never there before (going westbound on I-90).

HOV helps divert drivers from Hwy. 520 to I-90 and more traffic on I-90. Should expand Hwy. 520.

Reducing the number of regular traffic lanes is not a good option, but being a carpooler, I do appreciate it.

I find the traffic planning agenda is designed for the politically correct administrators who wish to make commuting so miserable for the taxpayer that people will be forced into the buses they want the common people to ride. The political mindset seems equivalent to the WSDOT policy on the 55 limit, which is bankrupt, and an engineering standard that allows left on & off ramps. I know of no other state that allows left on & off freeway ramps.

I believe the HOV lanes between Issaquah and 405 made traffic worse, not better. (We may need them someday, but there's no payoff yet.)

METRO sucks! I'm tired of subsidizing people that don't get their own transportation.

The buses to Issaquah are not frequent enough early in the morning and evening after 6:00. Sometimes I have to go in early and stay late--I cannot use buses because of this. Also, buses to Bellevue Comm. College in evening are non-existent.

HOV lanes are a proven failure. Devoting 25% of freeway capacity to accommodate less than 10% of the vehicular traffic in lunacy.

The HOV lanes are frequently empty while the other lanes are bogged down. It seems a terrible waste of time and money!

Would like to use bus service for work commute; however, there is no bus service to Redmond Industrial Park I can use. I've checked.

HOV on I-90 is a waste. Such a small group of people can use them (specifically Mercer Island residents), while a lot of other people are suffering.

In (light) of the commentary about HOV lanes, I have never seen or heard of a study which proves their value to see commuters or their value at decreasing existing congestion. If the evidence supporting HOV is not overwhelming, someone is costing the taxpayers in our area millions of dollars for no benefit.

Your reasons for Issaquah's HOV and metered ramps is insane! Do you really believe your reason: "We just want them (drivers) to get used to the idea."? Have you seen the backup at Eastgate now (6/28/94)?? It all started when someone just had to have the HOV lane on I-90! What a complete fool!!!

I've tried to facilitate METRO transportation 4-5 different times. To use METRO from my home to work would add 3+ hours and 3-4 bus changes and a walk. To downtown Seattle: no change and about 30 min. increase to my commute. Not a great deal on incentive.

Traffic flow on I-90 could be improved dramatically by suspending the HOV lane at Factoria. Further improvements could happen with converting the Mercer Island HOV lanes to "commuter lanes" as was the case before the new bridge. Also, you people need to smack the guy who decided to tear down the ramp which was in place to build the slower ramp from I-90 West to North I-5. This person apparently did not figure that people coming west on I-90 could possibly have further North to go than downtown. So the people from northbound I-5 who are all going downtown must merge right into the people trying to get to northbound I-5. Should have put the people from I-5 right and let I-90 merge into them. But what do I know?

HOV lanes, as designed, are unsafe. HOV lane development is not using tax moneys efficiently. These funds should be diverted to strictly enforcing highway lanes--traffic would then move more efficiently.

HOV contribute to air pollution and are not energy efficient. Because of the restrictive use, more congestion on lanes for everyone, while HOV's go unused causes excessive engine idling and acceleration for stop and go. Idling wastes energy.

HOV lanes always end in a bottleneck because they are incomplete (520 bridge, 405 S curves).

As a sales representative, I use my car to make customer sales calls. I feel penalized with certain lane restrictions for doing my job. I-90 from Issaquah to Mercer Island HOV lane shows the very poor planning done by the DOT.

I am opposed to HOV lanes because: 1) they create a traffic hazard when HOV lanes move 20 mph or more faster than other lanes; 2) they create congestion where they merge back into regular traffic; 3) they frequently are under-utilized while other lanes suffer from over-utilization; 4) better traffic balance could be obtained by using all lanes for regular traffic; 5) not everyone has a job that will allow them to carpool.

I don't think Mercer Island residents should be able to use the HOV lanes if they don't have 2 or more people in their cars. Why penalize other single commuters simply because they don't live on Mercer Island?

The carpool lane between Issaquah and 405 adds to the congestion on I-90. There is a general over(commitment?) to car pool lanes in the Greater Seattle area.

(1) I have commuted to Everett from Issaquah for 11 years. During this time, I would have loved to take fast, efficient bus service--there is none. I have tried to find carpools through METRO. No names ever came back which could match my schedule. The carpool I do have, I pick up just south of Everett, so HOV lanes do not help me, as even though I have made numerous efforts, I cannot take public transportation or carpool in the Everett area. (2) Also, when I <u>have</u> made use of the carpool lane going south to Tacoma with my children (small), in the car, I have to put up with dirty looks and being turned in as a violator because they cannot see the kids, so I don't bother.

The idiots that converted a westbound lane of I-90 to HOV just prior to closing a lane to build an HOV bridge at the East Channel should be shot.

Construction traffic revisions that maintain (keep in effect) HOV lanes while cutting other already clogged lanes 33-50% are real crime and show the disrespect DOT has for the people commuting.

Those HOV lanes are a complete waste! No one travels in them. And when they do and I can actually use them during a traffic jam up, the stupid carpoolers go the same speed as the other cars (under 55). We need more lanes!!! Forget these useless HOV lanes!!!

My work requires that I move from place to place within the City of Bellevue. I simply must drive--and almost always alone, since no one else follows my work schedule. This will only increase in the future. HOV lanes do not help me and increase the traffic in the lanes I have to travel.

We have <u>all paid</u> for all lanes, but some of us can't use them. Three people near me work at the same location, but we can't carpool due to hours of daycare. We should all be able to use them.

Due to lack of use, don't believe carpool lanes are cost-justified.

Are the newly opened express lanes limited to HOV? It would be helpful to open some express lanes to single drivers commuting into Seattle areas.

Let's open all lanes to all traffic and concentrate on light-rail and bicycle lanes.

No HOV.

My wife is afraid to use the commuter lane with my 3-1/2 year old daughter in the car for fear of being pulled over.

HOV lanes are virtually never used on my commute on I-90 to 405 from Issaquah. Every morning I average a count of no more than 5 cars using it! This makes traffic in the other 2-3 lanes very heavy!

Bunching up 90% of the traffic in 2 or 3 lanes while reserving a lane for the remaining 10% is poor use of resources. Spreading all traffic into all lanes would create better flow. I-90 never had a problem until HOV lane was created.

Taking away one lane of westbound I-90 available to "all" commuters and limiting it to those who "won't" use it, is the biggest waste of taxpayer dollars. It is one thing to "add" an HOV lane in addition to the existing lanes, but take away an existing lane is "highway robbery"!!! You people should all be fired!!! If you think "pissing" people off is any way to get them to carpool, you're wrong!! There are people who are required to have a car at work during the day, especially those who provide support to multiple sites in a timely manner, a job requirement. Your pipe-dream of ride-sharing is not something you can impose on everyone, so you'll have to find another solution to accommodate all these "foreigners" and their automobiles!!!

Get rid of the HOV from Eastgate to Mercer Island! It's not used and traffic is terrible!

Observation of current traffic patterns clearly indicates that relatively few vehicles qualify for use of HOV lanes. The addition of one lane for use by all commuters would greatly improve traffic flow.

Please come out and observe the lack of use of HOV lane between Issaquah and 405. Terrible waste of taxpayer money!

The HOV lane on I-90 is a stupidity and should be converted back to all traffic (refers to I-90 from where it begins westbound in Issaquah to I-405).

I hope HOV lanes will be opened to all traffic to relieve congestion. I, as many people, cannot carpool and therefore are punished in the sense that I am forced to use the congested lanes while the lightly used HOV lanes are alongside.

Who hired these highway engineers?!

Metered lights are more of a congestion factor than a help. They have a tendency to tie up commuting traffic more so than to guarantee an even traffic flow. Would rather see a truck lane (semi's, commercial, motorhomes, camper & trailers) than an HOV lane as currently in use.

In July '93, I moved from Federal Way to Issaquah to avoid a lengthy commute (which I used a vanpool). Now I drive (approximately) 5 miles to work.

Dislike metered ramps on I-90 westbound. Need sign on ramp at Exit 13 for drivers to pull up to or onto white line in order to trip light. Taking away 3rd lane on I-90 westbound at eastgaet and making it an HOV lane has caused increased congestion.

In my opinion, HOV lanes are a joke. Significantly underutilize available roadway. Rarely do people change their behavior to utilize HOV lanes. Instead, for people like me who would otherwise have >1 person in car anyway we are able to use HOV lanes. In my opinion, the HOV lanes have caused the congestion proble westbound on I-90. Call me if you want to hear more.

"2" — POSITIVE COMMENTS (WITH CRITICISM)

Two-carpool-occupancy vehicles have no HOV lane on 520--it doesn't help us. Why wasn't 520 mentioned? One out of every 15 cars has 2 riders; the other 14 have 1. Maybe an incentive would persuade more carpooling. I think it's disgusting and selfish how many single-occupancy vehicles come and go to work at the same time.

Just as bad as people illegally using HOV lanes without passengers is the case of multi-passenger cars not using HOV lanes. I suspect many people do not know they can use HOV lanes. I strongly recommend an education program to educate people about proper use of HOV lanes.

Settle on either inside or outside lane for HOV--no more having to move side to side!

METRO is not convenient for me--I'd use it if it were.

HOV lanes should be open to all traffic in non-density times (9am–3pm, and 7pm–6am).

We need "direct" METRO bus service from Eastside areas to Northgate area, Southcenter area, SeaTac Airport, Lynnwood, etc. I never go to downtown Seattle--NEVER.

You need greater enforcement of cheaters during rush hours.

I would rather take a bus to work since it's so close, but it wouldn't save me any time due to bus routes available. Checked into vanpools and found it would be more expensive than driving alone. I do ride when weather permits!

Need rapid transit from North Bend to Seattle.

It doesn't (or shouldn't) take a genius to figure out we need mass transit from Tacoma to Seattle and North Bend to Seattle, before traffic congestion becomes serious!

The traveling public needs more time and favorable workplace areas that are common to the carpool riders.

HOV lanes should be on left of freeway, next to fast lanes.

The HOV lanes between I-90/405 and the airport should continue the entire way on one side of 405--the switching can be dangerous and the lanes get used for passing--possibly not enough people are aware of them because of their being so "chopped up".

Open HOV(during) off-peak hours.

I would like HOV lanes opened to relieve accident back-ups.

They need an HOV lane from I-90 to 405 (westbound) to relieve the traffic which is backed up every a.m. These should lead into the HOV lanes on 405. You would get a much better flow.

HOV lanes should be open to all during major traffic tie-ups.

The HOV lane on I-90 should be suspended prior to Mercer Island until construction is completed.

Illegal use of HOV lanes should be stopped, or do away with the lanes.

There is a need for more HOV lanes on more highways, especially SR 18. Defining "carpool" as 3 persons or more is ridiculous. If you penalize people for carpooling in two's, they won't carpool at all. The HOV lane on 520 Eastbound should be for carpools of 2 or more.

HOV lanes are being used too much by single-occupant vehicles.

Wish more people use HOV lanes. Realize most don't because they are <u>single</u> occupancy autos. Need to push for more people to drive double occupancy--less cars.

I would hardly use the HOV lane if it required three people. The two-people requirement is perfect!

Hwy. 520 HOV lanes should be 2-person.

During non-peak hours, HOV lanes should be open to all traffic, especially when road construction is in progress.

I fully support HOV lanes and (carpools) for 2 or more occupants. I wish that enforcement of HOV was stronger.

Signs are needed explaining where it is permissible to enter I-90 HOV lanes between I-405 and Issaquah!

HOV lanes are not the problem. Six lanes narrowing down to 2 is a problem: people don't merge correctly, slowing down traffic. On-ramps are too short. People can't get up to speed fast enough to merge and merge lane is too short. The on-ramp has to merge within 100-200 feet--not enough at 55 mph. HOV lanes on the right is a suicide lane. HOV is to be on the left.

I believe more carpooling is necessary as well as some decent form of rapid transit. Our bus system is inadequate. I cannot carpool due to the nature of my management position unless attending the same meeting. Also, HOV lanes aren't always used by 2 or 3, but by one.

Increase bus service to Issaquah/Eastside locations; penalize people who drive to work alone.

HOV lanes aren't used that much, and when there is bad congestion, they should be opened to others. Also, I think that the highway patrol should watch for HOV abusers. I don't know how many times on I-90 I see a few. I've even spotted some with mannequins in the passenger's seat!

It is really irritating how they start construction at Eastgate and take away a lane then put in a carpool lane at the same time so we lose two lanes--it has created a nightmare at Eastgate. Carpooling is not feasible for the majority of people because of varied work schedules--if they are going to have HOV lanes, why don't they improve the bus system so people can use that and still remain somewhat independent. I would love to ride the bus since it would use the carpool lane, but since I would have to ride all through downtown and transfer just to get to the Seattle Center area, it isn't worth my time. I'd rather drive alone and leave earlier. A bus from the Eastgate Park & Ride to the Seattle Center would be great!!!

Once the construction near Bellevue Way is done, I-90 would be even more efficient.

HOV are great for cars and for buses. We use both. Rather than converting regular highway lanes to HOV lanes (which is a good temporary fix), I'd rather see specific HOV lanes constructed. I wish more people would use them. They are a great solution to a difficult problem. I <u>don't</u> feel pregnant women qualify as appropriate users.

On I-90 HOV, I do not believe Mercer Island commuters who drive alone should be considered favored than any other driving alone. If they must, due to some political agreement, then a sticker should be on the car for resident's only.

In Question 14, HOV lanes should be used by <u>all</u> motorists <u>after</u> commute hours (as in Portland). Also, in HOV use, the 2 occupants or more should be adults (as they are commuters probably, and infants, kids, etc. are not!).

HOV lanes should be on the <u>left</u> side of freeway and only HOV between 7:00 a.m. and 9:00 a.m., and 4:00 p.m. to 6:00 p.m. (as in California. Also, on-ramp metering lights should be eliminated.

Open HOV lanes for all traffic outside of peak hours (6-9, 3-7, M-F).

Mass transit--agree strongly. There are too many autos on the highway and I am part of the problem. You should do more surveys.

HOV lanes seem to be used more if they are in the left-hand lane and also seem to move faster than HOV lanes in the right-hand lane. My usual mode of transportation is by bus, and the last 5 commutes have not been normal.

Give parking discounts to commuters arriving with 3 or more occupants. Make parking exorbitant to those arriving with one driver only. I avoid the freeways during commute. My "passengers" are 5 and 8 -- my kids -- if I have to go anywhere.

HOV lanes should <u>not</u> be enforced on weekends.

Be consistent with 2 or 3 person HOV--too confusing now (e.g., 520: 3 people, I-90: 2 people). Tighter traffic control-higher fines for violations. Many 1-person cars northbound HOV I-5 3-6 p.m.-Seattle to Lynnwood. I travel this consistently 4 times/month.

HOV lanes seem most effective when access to and from them is separate from the regular lanes; otherwise traffic is slowed unnecessarily as people cross regular lanes to get to the HOV lanes, creating a dangerous situation.

All HOV lanes should be 2-person. HOV lanes should be on exit side of the road--it will be very hard for a vehicle to get to or from HOV to exit during rush hours.

Need to get 1-occupant vehicles off the highways during commute hours.

Encourage eligible people to use HOV and tell how it helps everyone when we do.

If bus travel was more comfortable (less utilitarian) and could get me to my car (for appointments) - (I park at Eastgate P&R (pm - late morning schedule is bad) - I would always ride the "limo" (bus).

I would take the bus if routes/times were more convenient - takes too long to ride the bus.

Confusing to have 2 person requirement and 3 person requirement in different areas; confusing HOV lanes outside and inside lane be consistent; use HOV lanes for everyone after commuting hours.

HOV lanes should always be 2 or more people! They are a great way for me to make it to work on time. If travelling during peak traffic, I just bring my wife and kids to drop me off. Open to all during non-peak hours!!!

Too many single drivers cheat on the HOV lanes.

Why is 520 a 3 person HOV lane? All HOV lanes should be consistent!

"3" — POSITIVE COMMENTS

HOV lanes are good and I always use them when I have passengers.

People who don't support HOV's are selfish!

I am totally thrilled with the METRO Van Pool (with FNWL on Mercer Island). I detest driving in this traffic and this couldn't have worked out better!

HOV lanes have really made my long commute much easier.

I like the (idea) of new lane construction being utilized for HOV lanes.

Travel from Issaquah to Eastgate/Factoria. The worst traffic is in Issaquah. Travel to Tacoma three times a week. Believe in HOV lanes!

The HOV lane on westbound 520 is a good idea and works well.

Vanpooling should be encouraged as much as possible.

Our carpool was set up because of the I-90 Eastgate back up. It may be a little inconvenient to drop people off wait for everybody's day to end but its worth the wait - and I'm the one picking up, dropping off, calling each one to say I'm going now - carpools pay off - !

HOV lanes are badly needed. Even though it may add congestion in the short term its the only way to get people to change their commuting habits.

"4" — NEUTRAL / OTHER COMMENTS

To avoid consistent backups at 405 Northbound, I take surface streets after exiting Westbound I-90 at Eastgate.

I work nights and commute to work between 5 & 6 and home in a.m. between 8–9.

Good survey--well constructed, relevant, easy to answer.

I normally ride (motorcycle), even in the rain, but my bike is inoperable right now, hence the "drive alone".

I don't carpool because I have to drop my daughter at daycare and pick her up and I have to be able to get her mid-day if she is sick or has doctor appointments. I have carpooled with my husband when a car has been in the shop, about 10 times per year.

My wife works part-time at Harborview. We ride together and use I-90; otherwise, I use 520.

Stop doing road work (blocking off lanes) during peak hours. What's wrong, other than money, to do it off-peak times?

I use back roads during my commute to avoid highway congestion.

Converting an existing lane to HOV on I-90 when reducing lanes because of construction has severely increased congestion at Factoria when it was not necessary. Why couldn't the conversion been done after the construction?

I-90 west to 405 north interchange has a congestion problem that needs to be looked into.

Problem on 520 in Redmond is terrible. There are several ways to solve this problem that could be really inexpensive. Give me a call! (868-9581? 9381?)

Need vehicle for work.

I don't carpool regularly because I often need my car during work hours to commute to business meetings.

Traffic by I-90/405 interchange near Factoria is terrible due to construction. It is idiotic to have an HOV lane there while construction is underway. Why not remove the HOV restriction until construction is completed?

Going to work is relatively easy, coming from work is not. It takes 20-30 minutes more than in the morning. Apparently, the buses come over 520 are often late into the tunnel and sometimes don't show up before the next scheduled bus comes along. That bus can be crowded and standing room only.

This survey not too valid for self-employed/marketing sales area, which is growing by the thousands each month for the past 1-2 decades.

Metering lights at the top of the ramp (I-90, Exit 13) makes it impossible to accelerate to highway speed and merge safely in low-powered vehicles.

Current construction which has closed HOV lane in places creates traffic congestion.

The traffic problems (for my family) are a result of a number of factors (1) nearest bus service is in Issaquah or Renton - 8 miles from home - limited daycare - none available near home - my husband works 6:30am to 5:00pm - I work 8:00 to 5:00 in Bellevue - children are in Issaquah school district. More needs to be done so that daycare/schools and work can be coordinated.

I was skeptical about the metered ramps (westbound I-90) but they really seem to be making a big difference. Thanks!

Cute - remove the lable - 5 seconds to do the survey, 40 minutes trying to get the lable off to no avail - its a trick label right?!