The KATY Highway HOVL Does Not Demonstrate the Effectiveness of Carpool Incentives

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Summary

A new look was taken at the extensive data collected on the Katy Highway HOVL over a seven year period to determine if it provided incentives to riders to form carpools. This analysis looked at the before and after HOVL history of average vehicle occupancy, a clear measure of carpool formation. The analysis found almost none, indicating that the connection between HOVL incentives and carpool formation is very weak. The analysis indicates that the source of improved highway effectiveness was increased bus ridership and not carpool formation.

Background

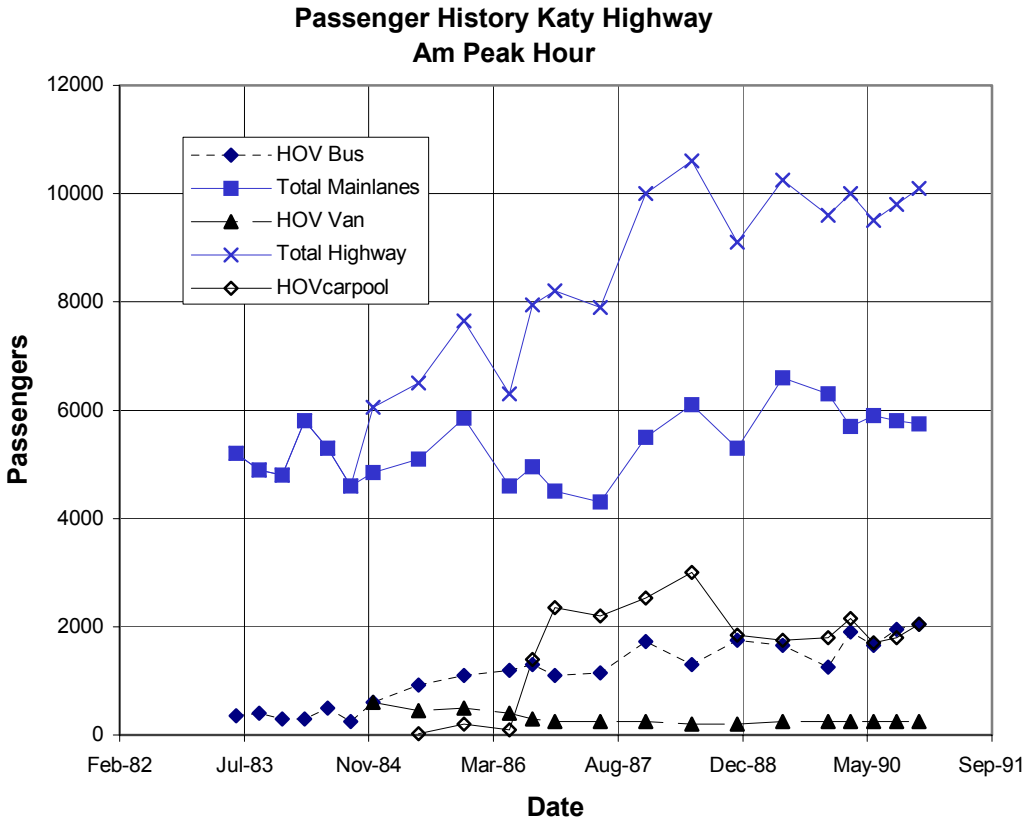
The Houston Texas KATY Highway High Occupancy Vehicle Lane (HOVL) has been extensively studied to evaluate its carpool lane effectiveness. The HOVL, which is a single separated reversible lane with separated on/off ramps was opened to bus and van traffic in August 1984, then opened to 3+ passenger carpools in November 1985 and finally to 2+ passenger carpools in October 1986. The Texas Institute of Transportation has issued a report every year from 1988 through 1996 that provides an extensive set of data, charts and statistics on the performance of the highway. The 1991 report* was used in the analysis below as the source of data.

Analysis

The KATY highway, today is a success. It supports significantly more people movement now than it did 14 years ago when the HOVL was opened. The Figure below shows some of the trends in passenger traffic over the 1983 to 1990 period. In this Figure, Total mainlane refers to the total of all riders on the three main mixed flow lanes, Total Highway includes all riders on the mainlanes and HOVL. The HOVL traffic data is divided into bus, carpool and van.

During the seven year period passengers in the AM peak-hour increased by about 100 percent. This increase started on or before the HOVL was opened for bus traffic in August 1984. Since then, bus ridership increased steadily from 350 to 2000 passengers. In that same time period the passengers on the three mainlanes increase by about 20%. While the data is erratic, making it difficult to see trends, there was no apparent decrease in mainline passengers when the bus service began. In October 1986 the HOVL was open to 2+ passenger carpools and a dramatic increase in carpools on the HOVL was seen. At the same time there appears to be only a small reduction in mainlane traffic but not enough to account for all the HOVL carpool passengers. This immediate increase in HOVL carpools does not however demonstrate the hypothesis that the HOVL caused a large impact on carpooling. This data alone can be very misleading. It is likely that what occurred is a shift of carpools in the mainlanes and bus onto the HOVL or from new travelers. If that is the case all that happened is that vehicles shuffled from one lane to another and no gain actually occurred. Observing such trends is clouded by the continuous addition of new travelers onto the highway. To test these hypotheses out we need to examine average vehicle occupancy ratio (AVO).

In addition to traffic measurements, the 1991 report provides a variety of statistics on rider surveys that attempt to demonstrate that the HOVL had a significant impact on carpooling. The report states that, " the HOV lanes have been responsible for creating a significant volume of new carpools". Many of the survey statistics are interesting but are inconclusive toward the proof of the carpool hypothesis. User survey information is often difficult to properly interpret especially when incomplete as in this case; the survey data did not address those riders that had changed from carpools to drive alone, or were new drive alone. These other groups are important to include, particularly since the 1991 report acknowledges the frequent turnovers in carpool life.

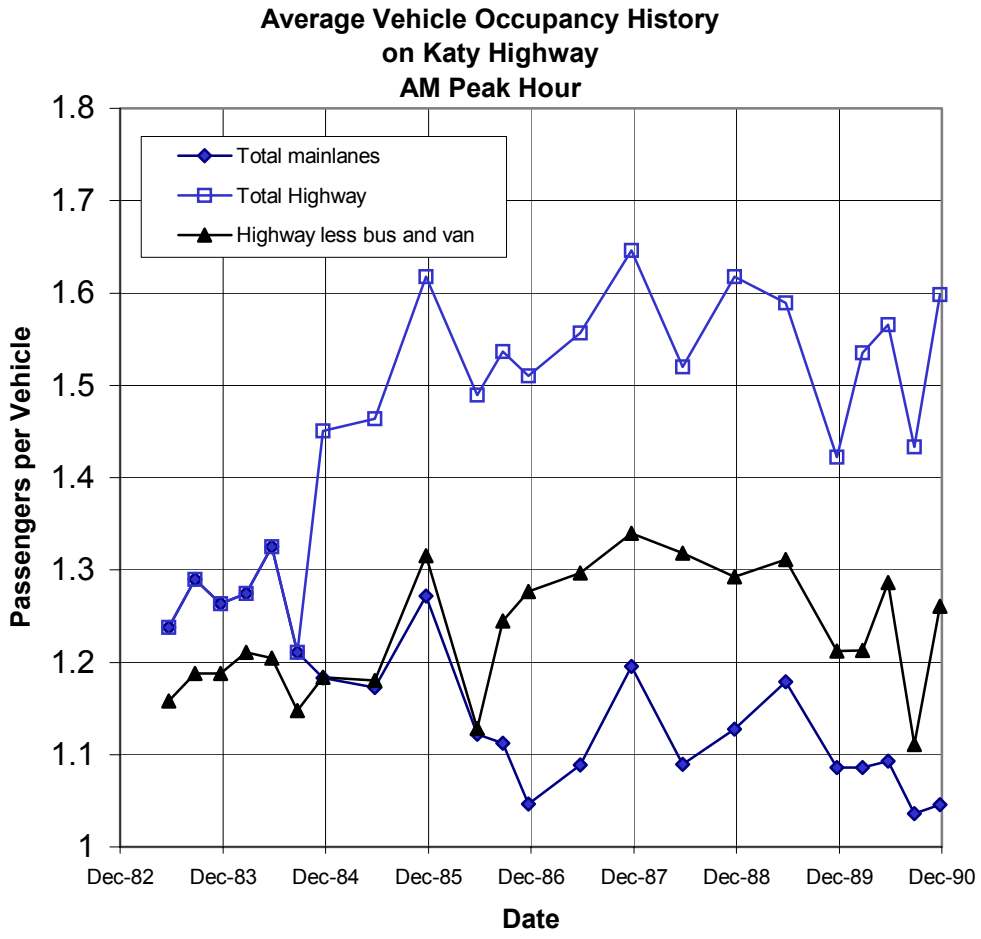


The present analysis looked at the data from another standpoint; trends in the Average Vehicle Occupancy (AVO). The success of an HOVL is the result of its ability to increase the capacity to carry passengers. Passenger capacity is determined by vehicle flow capacity times AVO. When the HOVL was opened the highway went from a three to a four lane (albeit somewhat restricted) highway. Highway (vehicle flow rate) capacity increased 33 percent by addition of this lane no matter what kind it was. HOVLs are supposed to increase AVO. What happened to AVO is seen in the second Figure below.

Before the HOVL opened the mainlane carried drive alone, carpoolers, buses and vans and had an AVO of about 1.26. After the HOVL opened the AVO jumped to about 1.55, a 23 percent increase. What caused this dramatic increase. The detailed causes are something we cannot know. We can see however some interesting trends from this Figure. First, the AVO increased immediately following the opening of the lane to bus and van traffic and then stayed essentially constant from December 1985 through December 1990. When the HOVL was open to two passenger carpoolers in 1986, the number of carpoolers in the lane jumped by over 2000 passengers. But the overall AVO did not change. That indicates that almost all these carpoolers were previously in the mainlane carpools or bus riders. These trends are indications of lane shuffling and not performance improvement.

During this period the mainlane AVO dropped significantly, due to a shuffle of carpools to the HOVL. The Figure also shows the AVO for the mainlane plus HOVL when bus and van riders are removed from the count. What is seen is that this AVO was about 1.20 before the HOVL and it was still about 1.20 in 1990 after the carpool advantage in the HOVL. There was a rise in AVO to 1.3 between 1986 and 1989 but this had not been sustained in 1990. As the total AVO did not have a corresponding rise, it may be inferred that there was no change in net carpools in this period.

It is apparent from the data that the source of the AVO benefit from the HOVL was not carpoolers but primarily bus riders. Probably the main impact of opening the HOVL lane to two passenger carpoolers was to utilize some of the unused capacity of that lane and relieve mainlane congestion. Using this capacity might have been done by other means such as with mixed flow, (non occupancy dependent) toll lane or onramp metering.



Over the seven year period the AVO of the mainlanes dropped from 1.26 to about 1.05. Had the HOVL not been added and the mainlane AVO remained the same, the mainlanes would have carried 6900 passengers on the 5500 vehicles measured in the peak hour in 1990. The total highway vehicles in December 1990 was 6525. If three lanes could handle 5500 vehicles then four lanes should have handled 7300 vehicles (and 9200 Passengers.) This would have been a 92 percent increase in traffic in 1990 compared to 1984, only 8 percent less than the measured traffic.

Many questions lay unanswered. Over the seven year period analyzed there was a significant increase in riders on the highway (100 percent increase). The referenced report survey data indicates that only about 15 percent of the carpoolers came from alternate routes and about 10 percent were new trips. This nowhere near explains the 100 percent measured increase and demonstrates the difficulty of using survey data. This may be attributable to the fact that the survey results were not corrected for the effect of carpool turnover rate. Many more riders must have come from alternate sources and new trips.

Between the two primary changes, an added lane and increased AVO, highway passenger capacity increased by 64 percent. Traffic actually increased 100 percent. The fact that traffic speeds actually increased in this period must obviously have come from other improvements touched on in the report. Would the same trends appear if the road was opened first to carpoolers and later to buses. From the data one cannot know. It is not obvious what might have happened to bus traffic even if buses did not have the HOVL. One can only conclude that the data collected on the Katy Highway does not demonstrate the ability of an HOVL to generate carpools to achieve a beneficial effect.

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Reference; An Evaluation of the Houston High Occupancy Vehicle Lane System, June 1991, Dennis Christiansen and Daniel Morris, Texas Transportation Institute.