Slugging in Houston—Casual Carpool Passenger Characteristics

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Abstract

In the last 30 years, determined travelers have developed a new method of travel that offers the benefits of traveling on an HOV lane without forming traditional carpools. Casual carpools, also known as "slugging," are impromptu carpools formed among strangers to meet the occupancy requirements of HOV lanes. In this research, survey respondent data from Houston, Texas, were used to examine casual carpool passengers.

Results of the analyses revealed that being on a commute trip, making more trips per week, being between the ages of 25 and 34, and having professional/managerial or administrative/clerical occupations all increased the likelihood of a traveler choosing to casual carpool. Additionally, having a household income between $25,000 and $35,000 significantly reduced the likelihood of casual carpooling.

Understanding the types of travelers who casual carpooled and the information gleaned in these analyses can be used to better evaluate HOV and HOT lane use and performance. Casual carpool passengers can comprise a significant portion of HOV/HOT lane person movement and should be considered when investigating HOV or HOT lane implementation.

Introduction

As congestion has worsened in our nation's metropolitan areas, transportation professionals have explored various methods to increase the effective use of the

transportation infrastructure. One such method is the implementation of high-occupancy vehicle (HOV) lanes. HOV lanes are typically built on congested freeways, and allow vehicles that meet specified occupancy requirements to bypass delays associated with driving alone on congested general-purpose lanes (GPLs) of the freeway. HOV lanes encourage carpooling and increase person movement along congested corridors (Turnbull 2004). HOV lanes promote the increase of person movement through higher vehicle occupancies by providing travel time savings to carpoolers (Turnbull 2004).

In the last 30 years, determined travelers have developed a new method of travel that allows them to receive the benefits of traveling on the HOV lane without forming traditional carpools (LeBlanc 1999). This new mode, known as casual carpooling or "slugging," consists of impromptu carpools formed among strangers to meet the occupancy requirements of HOV lanes.

The process of forming a casual carpool is relatively simple. Casual carpool passengers typically meet in a public area that has ample available parking, nearby public transit as an alternate mode in case a casual carpool is unavailable, and close proximity to the HOV facility. Drivers (also known as "body snatchers") arrive and pick up enough passengers to meet the HOV lane eligibility requirements. Drivers then travel along the HOV lane and drop off passengers in a public location, typically in the downtown area of a city. Details of the casual carpool process vary slightly depending on location.

Currently, organized casual carpooling occurs in three U.S. metropolitan areas: Washington, D.C. (LeBlanc 1999; Reno, Gellert, and Verzosa 1989; Spielberg and Shapiro 2000), San Francisco (Beroldo 1990; RIDES for Bay Area Commuters, Inc. 1999), and Houston (Ojah and Burris 2004).

The slugging system in Washington, D.C., which has existed for more than 30 years, is well organized with a large number of pick-up and drop-off locations and a website (*http://www.slug-lines.com*) for local slugs and bodysnatchers. Conversely, slugging in the San Francisco Bay area occurs in one general area. Passengers and drivers meet in the morning peak period to form carpools and cross the Bay Bridge. Passengers are usually dropped off in the downtown area and typically use transit for their return trips. Casual carpooling in Houston occurs at three locations, all of which feed the downtown area. Passengers meet at park-and-ride locations on I-10 and US 290 that have direct access to HOV lanes. Drivers arrive throughout the morning and pick up the necessary number of passengers to meet the HOV occupancy requirement.

An important similarity among these three locations is that the HOV lanes require three or more occupants, whereas the vast majority of HOV lanes in the United States allow vehicles with two or more occupants. This higher occupancy requirement plays a significant role in the formation of casual carpools. At the same time, urban freeways are becoming increasingly congested, encouraging more travelers to use HOV lanes and, therefore, more HOV lanes will have to increase their restrictions to three or more occupants. As more HOV lanes institute higher occupancy restrictions, the need to understand the complex issue of casual carpooling becomes exceedingly important.

Despite its presence for more than three decades, casual carpooling has yet to expand beyond these three cities. Casual carpooling can increase person movement along congested corridors and can provide substantial travel time savings for users. However, it is not marketed or regulated in any way by transportation officials. As these carpools are formed among strangers, there are potential liability issues that could surround agency support of casual carpooling. This does not mean that the effects of casual carpooling and characteristics of its users are not important to transportation engineers and planners. With the potential to increase person movement and provide better HOV lane utilization, casual carpooling could represent a significant portion of daily HOV lane travelers, particularly if (1) more HOV lanes restrict usage to vehicles with three or more occupants and/or (2) future HOV facilities are constructed with casual carpoolers in mind.

This research took an in-depth look at casual carpooling in Houston, with emphasis on the travel time savings gained by those choosing this mode. Additionally, survey data were examined to gain insight into the socioeconomic and commute characteristics of Houston casual carpoolers and to generate mathematical models that further consider the socioeconomic and commute characteristics that indicate a higher likelihood of a traveler choosing to casual carpool.

Casual Carpooling in Houston, Texas

The casual carpooling phenomenon appears to have begun more recently in Houston than in Washington or San Francisco. Although no documented evidence exists to pinpoint when casual carpooling began in Houston, newspaper interviews of casual carpool users indicate that the mode has been used since 1990 (Wall 2002).

Casual carpooling in Houston occurs in three locations: Kingsland Park-and-Ride lot, Addicks Park-and-Ride lot, and Northwest Station Park-and-Ride lot. The

Kingsland and Addicks lots are located on I-10 (Katy Freeway) west of downtown Houston; the Northwest Station lot is located on US 290 (Northwest Freeway) northwest of downtown Houston. Each park-and-ride facility is used primarily for transit and offers direct-connect ramps to a barrier-separated HOV lane. Casual carpool passengers form a line near transit pick-up locations and wait for drivers. Drivers arrive periodically and pick up enough passengers to meet the HOV lane occupancy requirement. If passengers are unable to join a casual carpool, they have the option of using transit, which runs throughout the day from the park-and-ride facilities. Most casual carpools form between 6 A.M. and 9 A.M. (Ojah and Burris 2004). As bus headways increase significantly after 9 A.M. and most commuters have already traveled to work, the use of casual carpools decreases significantly, dropping to near zero.

Casual carpooling in Houston occurs exclusively on the city's two high occupancy/toll (HOT) lanes (the only two HOV lanes that restrict usage to three or more occupants during part of the day). The vehicle occupancy requirement on I-10 and US 290 is HOV2+ for most of the day, but, due to congestion, it was raised to HOV3+ from 6:45 A.M. to 8 A.M. and 5 P.M. to 6 P.M. on I-10 and from 6:45 A.M. to 8:00 A.M. on US 290. The lanes are closed temporarily during the middle of the day for direction reversal. During the HOV3+ periods, HOV2 vehicles may enter the lane by paying a $2 toll. This program was first implemented on the Katy Freeway HOV lane in 1998 and was expanded to include the Northwest Freeway HOV lane in 2000. Participants were required to open an account, mount a transponder and hangtag on their vehicle, and pay a $2.50 monthly service charge. The behavior of casual carpoolers would change during the restricted periods as drivers would typically pick up only one passenger during the HOV2+ periods, but would pick up two passengers during the HOV3+ period. The majority of casual carpooling occurs during the HOV3+ period (see Table 1 on p.29). A separate survey of drivers who paid the $2 toll to travel in the lane during peak periods revealed very few (7%) pick up a single slug (Burris and Appiah 2004). This was not surprising as the cost (extra time) spent picking up the second slug was relatively small compared to the $2 toll.

Data

The analysis of casual carpool passenger behavior required socioeconomic and commute characteristics of casual carpool passengers. Most of the necessary data were collected by the Texas Transportation Institute through a survey distributed to casual carpool passengers as part of a larger traveler survey in November 2003 (Burris and Stockton 2004). However, additional data on corridor travel speeds and carpool headways were collected to estimate the time savings benefit gained by casual carpoolers.

Based on video license plate data, surveys were mailed to drivers using the general purpose and HOV lanes during both peak and off-peak traffic periods. Each survey was designed specifically for the group to which it would be distributed (HOV lane during peak periods, main lane off-peak, etc.). Additionally, surveys were produced for transit users and casual carpool passengers. However, rather than being mailed, the transit passenger surveys were conducted on-board the buses, and casual carpoolers were handed surveys while they waited for a ride. All surveys had questions regarding trip purpose, time of day, and socioeconomic characteristics. A set of questions specific to casual carpooling was also included. A series of stated preference questions that asked respondents to identify their preferred travel mode given specific travel time and fee (toll) options was included in all surveys.

A total of 539 questionnaires were distributed to casual carpool passengers at the three park-and-ride facilities in Houston. Of the 539 surveys, 216 were returned for a total response rate of approximately 40 percent. On the day the surveys were handed out, 7 percent of casual carpool passengers refused to take one, indicating an approximate total of 578 casual carpool passengers that day. This number closely matched casual carpool passenger counts performed in June 2003. Therefore, even though relatively little was known about the total number of casual carpoolers in Houston, the 216 returned surveys were believed to be sufficient so that the responses were representative of the group.

The final dataset used in the analysis excluded a number of the 216 responses. For this analysis, only trips beginning between 6 A.M. and 9 A.M. (eliminating 8 respondents) were included to focus on the time period during which the vast majority of casual carpooling occurred and when the primary alternative mode (transit) had consistent headways. Additionally, for the calculation of descriptive statistics and estimation of mode choice model coefficients, only respondents who used casual carpooling at least three to four times per week were considered to allow the analysis to focus on travelers who frequently casual carpooled. This

further reduced the dataset by another 59 respondents, leaving 149 respondents for the casual carpool analysis.

Travel Time Savings

The casual carpool passenger survey included questions regarding travel time savings, which provided travelers' perceived travel time savings on the HOV lane. To estimate the actual travel time savings gained by casual carpool passengers, travel time data along the HOV lanes as well as the GPLs were required. TranStar, Houston's traffic management center, recorded average speed data on the corridor. This information was used to calculate the various travel times (Houston TranStar Real Time Traffic Information). The data used in this analysis were average speeds along the HOV and GPLs for the entire 2003 year (not including weekends and holidays).

To calculate travel time savings offered by casual carpooling, consideration was made for the amount of time necessary to park at a carpool formation site and wait to join a carpool. Parking and wait times at the formation site were manually observed during a typical morning peak period. On Wednesday, June 30, 2004, three data collectors observed parking and wait times at the Addicks Park-and-Ride location on the Katy Freeway. One data collector observed people arriving at the facility and measured the amount of time necessary to walk from their cars to the casual carpool formation site. Forty-two persons were observed taking an average of 105 seconds (± 7.6 seconds at a 95 percent confidence interval) to walk from their cars to the site. Two other data collectors recorded the amount of time that casual carpool passengers waited in the casual carpool line prior to entering a vehicle. The 147 casual carpool passengers experienced an average wait time of 144 seconds (± 17.8 seconds at a 95 percent confidence interval). Combining the walking and waiting times with the travel time savings indicated that casual carpool passengers could save as much as 13 minutes over driving alone on the GPLs (see Table 1). Additionally, the number of casual carpool passengers was generally higher during times of larger travel time savings.

In comparing carpooling and riding transit, it was necessary to determine the approximate time spent waiting for a bus, as this wait time was the only travel time difference between the two modes. Transit users and casual carpoolers spent the same amount of time arriving at the park-and-ride lot and walking to the queues. Casual carpool passengers and transit users incurred similar travel times after being dropped off because carpool passengers were typically dropped off at

Table 1. Time Savings (in minutes) Gained by Casual Carpool Passengers Compared to Driving Alone on the GPLs

Time Trip Began	*Addicks Park-and-Ride*		*Kingsland Park-and-Ride*		*Northwest Station Park-and-Ride*	
	Travel Time Savings (min.)	*June 2003 Count of Casual Carpoolers*	*Travel Time Savings (min.)*	*June 2003 Count of Casual Carpoolers*	*Travel Time Savings (min.)*	*June 2003 Count of Casual Carpoolers*
6:00 A.M.	< 0	1	< 0	0	< 0	2
6:15 A.M.	< 0	2	< 0	2	< 0	5
6:30 A.M.	< 0	16	00:20	6	< 0	6
6:45 A.M.	< 0	16	02:52	13	00:09	19
7:00 A.M.	00:57	39	06:51	23	04:30	17
7:15 A.M.	04:31	35	11:32	38	08:07	21
7:30 A.M.	06:32	26	13:29	13	09:53	32
7:45 A.M.	06:06	29	12:48	10	07:22	14
8:00 A.M.	04:38	21	10:53	15	03:54	8
8:15 A.M.	04:01	19	10:19	4	02:00	6
8:30 A.M.	02:28	7	08:25	3	< 0	3
8:45 A.M.	00:11	5	05:04	2	< 0	2
9:00 A.M.	< 0	0	01:37	1	< 0	0

Note: The travel time savings calculation assumed very conservative values for the amount of travel time saved by casual carpoolers. For example, it was assumed access to the park-and-ride lot took several extra minutes over just entering the freeway as an SOV. Most likely, casual carpoolers who traveled when the estimated travel time savings was negative actually had positive travel time savings, but they did not meet the conservative assumptions used. For example, their access to the park-and-ride lot may have taken no extra time versus accessing the freeway as an SOV.

or near bus stops. Additionally, the in-vehicle time for the two groups was similar as these express buses only had 2 to 3 stops on their route (this includes the stop where slugging occurs and the destination stop). Bus headways for each of the three park-and-ride locations during the morning peak period were used to calculate average wait times. The average headway was 10 minutes on the Katy Freeway

and 8 minutes on the Northwest Freeway. The average time spent waiting for a bus was assumed to be half of the average headway based on the assumption of random arrivals of transit passengers (Meyer and Miller 2001). Casual carpoolers saved an average of 2 minutes 36 seconds over transit on the Katy Freeway and 1 minute 36 seconds on the Northwest Freeway.

Other factors besides travel time savings might have influenced the mode choice of the travelers. Monetary costs (e.g., transit fare, fuel) or trip purpose could have affected a traveler's decision (Wall 2002). Socioeconomic characteristics could also have had a major influence on a traveler's decision to casual carpool. Travelers may have valued the reliability of travel times on the HOV lane. The survey data were used to determine what, if any, trip and socioeconomic characteristics increased the likelihood of a traveler choosing to casual carpool on a frequent (3 or more times per week) basis.

Comparison of Traveler Characteristics by Mode

The survey data were initially examined for significant differences ($p \leq 0.05$) among four groups of travelers based on their primary mode choice: driving on main lanes, using HOV lane with a traditional carpool, casual carpooling, and transit. A Chi-Square test assessed significant differences among the binary variables, and a one-way analysis of variance (ANOVA) examined the continuous variables. Additionally, a Kruskal-Wallis test determined any significant difference between groups for the ordinal variables of age, income, and education.

The results of the statistical tests revealed significant differences among travelers in the four primary morning modes of travel (Table 2). The percentage of respondents on commute, recreation, school, and other trip types was significantly different among the four groups. Casual carpoolers were more likely to be on commute trips. The percentage of respondents ages 25 to 34 and 65+ was significantly different among modes. A much higher percentage of casual carpoolers were between ages 25 and 34. The average household size, percentage of single adult households and married without children households, and the number of vehicles per household also differed among modes, with HOV users having significantly larger households. A difference was also found for those with occupations that were professional/managerial, sales, homemaker, self-employed, or retired. Income ranges of $25,000 to $35,000, $50,000 to $75,000, $100,000 to $200,000, and $200,000 or more were also different among the four mode choices.

Table 2. Descriptive Statistics of Surveyed Travelers

	Main Lane Travelers (n=1032)	***Traditional HOV on the HOV lane (n=331)***	***Casual Carpool Passengers (n=149)***	***Transit Riders (n=290)***
Trip purpose				
Commute[1,2]	85.0%	79.8%	96.0%	88.9%
Recreation[1]	1.9%	2.8%	0.0%	0.3%
Work (noncommute)	9.0%	5.8%	4.0%	7.3%
School[1]	2.3%	7.0%	0.0%	2.4%
Other[1]	1.9%	4.6%	0.0%	1.0%
Trips per week	*9.85*	*9.91*	*9.67*	*9.20*
Age				
16–24	3.9%	2.2%	1.4%	4.9%
25–34[1,2]	23.0%	17.9%	27.7%	18.4%
35–44	27.6%	33.3%	31.8%	25.8%
45–54	30.1%	31.5%	33.1%	38.2%
55–64[2]	12.5%	11.1%	5.4%	12.0%
65+[1]	2.8%	4.0%	0.7%	0.7%
Sex[1]				
Male	60.9%	49.7%	50.7%	45.8%
Female	39.1%	50.3%	49.3%	54.2%
Household type				
Single adult[1]	12.4%	5.3%	10.3%	15.3%
Unrelated adults	2.6%	2.5%	3.4%	3.3%
Married w/o child[1]	25.2%	24.0%	21.9%	16.7%
Married w/child(ren)	52.0%	59.5%	52.1%	54.9%
Single-parent family	5.3%	4.0%	8.9%	7.3%
Other	2.5%	4.7%	3.4%	2.5%
Household size[1]	3.02	3.32	3.01	3.06
Number of vehicles[1]	2.42	2.39	2.22	2.19
Income				
Less than $10,000	0.5%	0.4%	0.0%	1.6%
$10,000–$14,999	0.7%	0.4%	0.0%	1.2%
$15,000–$24,999	1.1%	0.7%	0.7%	1.6%
$25,000–$34,999[1,2]	5.1%	4.2%	0.7%	7.6%
$35,000–$49,999	9.7%	9.9%	14.5%	12.4%
$50,000–$74,999[1]	19.6%	17.3%	27.5%	24.5%
$75,000–$99,999	21.5%	17.3%	24.6%	19.7%
$100,000–$199,999[1]	32.3%	42.4%	29.7%	28.5%
$200,000 or more[1]	9.4%	7.4%	2.2%	2.8%

[1]Significant ($p \leq 0.05$) difference when comparing all four modes.
[2]Significant ($p \leq 0.05$) difference when comparing casual carpooling and transit.

Next, similar statistical tests were performed to determine significant differences ($p \leq 0.05$) between travelers using just two mode choices: casual carpooling and transit. These mode choices were specifically examined due to their symbiotic relationship and the similarity of the modes since travelers on both modes (1) use park-and-ride lots, (2) have someone else drive, (3) travel on HOV lanes, and (4) are dropped off relatively close to their work. Also, casual carpoolers are often former transit users (Beroldo 1990), and in this study more than 90 percent still used transit for some of their similar trips (Table 3).

The results of the statistical tests (Table 2) revealed several significant differences between casual carpoolers and transit riders. A higher percentage of casual carpool passengers were on commute trips and between the ages of 25 and 34, while a higher percentage of transit riders were between the ages of 55 and 64. A significantly higher percentage of casual carpoolers had professional/managerial occupations, while a significantly higher percentage of transit riders had household incomes between $25,000 and $34,999.

Casual Carpool Passenger Characteristics

The surveys distributed to casual carpool passengers contained a series of questions that were exclusive to that group. These questions addressed the nature of each traveler's casual carpooling trip and his or her previous experience using the mode (Table 3). For this analysis only, both frequent and infrequent casual carpoolers were examined. The results provided insight into the practice of casual carpooling in Houston, including what modes were commonly used for return trips and how frequently respondents joined a casual carpool.

Survey responses indicated that most casual carpool passengers (65.3%) had never met their travel companions before. However, almost one third indicated that they had traveled with them once or twice, indicating that a relatively small community of people used the mode consistently. More than 75 percent of users noted that they casual carpooled at least three times per week. Passengers also cited saving money (62.8%) and slow bus service (52.6%) as the two primary reasons for casual carpooling. They indicated that they often use the bus for similar trips and for the evening return trip. They also noted that money is rarely given to the driver as compensation, which is consistent with casual carpooling practices elsewhere in the United States.

Table 3. Casual Carpool Passenger Characteristics (n = 208)

Familiarity with current carpool companions	
Never traveled with before	65.3%
Traveled with once or twice before	28.1%
Travel with frequently	6.6%
Reasons that would cause you not *to casual carpool*	
More than 5 persons waiting for carpool	14.0%
More than 10 persons waiting for carpool	47.8%
Bus arrives just as traveler arrives	3.9%
Unsafe feeling about the carpool	27.5%
No one in line waiting to form a casual carpool	2.2%
Bad weather	15.7%
More frequent bus service to destination	9.0%
Other	29.2%
Frequency of casual carpool use	
Every day	52.0%
3 to 4 days per week	24.0%
1 to 2 days per week	19.9%
Less than once per week	4.1%
First time	0.0%
First casual carpool use	
Within the last month	6.7%
Within the last year	40.5%
More than a year ago	52.8%
Reason for using casual carpooling	
Congestion on freeway	28.1%
Bus service too slow	52.6%
Cars more comfortable than the bus	34.2%
Save money	62.8%
Save time	79.1%
Meet new people	16.3%
Other	13.3%
Modes used for similar trips	
Drive alone	26.2%
Regular carpool with family or friends	18.8%
Ride the bus	91.6%
Other	6.3%
Monetary contribution to driver?	
Yes	1.0%
No	99.0%
Mode used for evening return trip	
Casual carpool	12.8%
Bus	66.3%
Regular carpool with family or friends	5.1%
Drive alone	0.0%
Other	15.8%

Note: Some percentages sum to over 100 percent as respondents could choose multiple answers for some questions

Mode Choice Model Estimation

To better understand casual carpoolers and the factors that affect their mode choice, discrete choice model coefficients were estimated for two sets of choices. The choice between casual carpooling and transit was evaluated with the first model. The second model examined traveler choice of four modes: casual carpool, transit, traditional carpool, and driving on GPLs.

Methodology

Both models were estimated as discrete choice models. Discrete choice models assume that each traveler makes his or her decision based on the utility of each mode (Ben-Akiva and Lerman 1985). The traveler's ultimate decision will determined by both the systematic utility based on measured variables and the random utility of each mode. The model in this analysis was estimated using a logit model, which assumes that random utilities follow an extreme value distribution (Small and Winston 1999).

Casual Carpool versus Transit Mode Choice Model

Although many variables were tested when estimating the model coefficients, only those variables significant at the 95 percent confidence level and not correlated to other variables were left in the final model. The results of the discrete choice model are shown in Table 4. For this model, the null choice was casual carpooling. The utility function derived in the model describes the utility of the transit mode relative to the casual carpooling mode that had all coefficients equal to zero.

The results of the model highlight some of the factors that describe selected types of travelers who choose to casual carpool rather than use transit. The constant coefficient is positive, indicating that all else being equal, travelers were more likely to choose transit than casual carpooling. This was not surprising as many more travelers used transit than casual carpools. The results also indicated that having an income between $25,000 and $35,000 increased the traveler's likelihood to use transit rather than casual carpooling. However, being on a commute trip, making a higher number of total trips per week, and/or being between the ages of 25 and 34 increased the traveler's likelihood of forming casual carpools.

Table 4. Model Coefficient Estimation Results (Casual Carpooling vs. Transit)[1]

Variable	*Coefficient*	*Std. Error*	*t-stat*	*p-value*
Mode-specific coefficient	2.99	0.75	4.00	0.00*
Commute trip	-1.09	0.51	-2.14	0.03*
Trips per week	-0.15	0.06	-2.62	0.01*
Age 25 to 34	-0.53	0.26	-2.01	0.05*
Income $25,000 to $35,000	2.73	1.07	2.56	0.01*
Summary				
Number of observations		362		
Log likelihood		-225.71		
Restricted log likelihood		-240.12		
ρ^2		0.06		
Percent estimated correctly		64.1%		

[1]Base alternative is casual carpooling with utility of zero.
*Significant at the 95 percent confidence level.

Four-Option Mode Choice Model

Several sets of variables were used for testing the four-choice model, using the main lanes option as the null choice. Only variables significant at the 95 percent confidence level remained in the final model. The variables used in the model as well as which mode choice utility functions they were associated with are listed in Table 5, while the model estimation results are shown in Table 6.

The constants for the HOV, casual carpool, and transit modes were all negative, indicating that all else being equal, travelers were most likely to drive on the main lanes. The trip purpose, age, and occupation (professional) variables applied only to the casual carpooling utility function and indicated a number of factors influenced casual carpoolers' decisions. The coefficient for the trip purpose was positive, indicating that being on a commute trip increased the likelihood that a traveler

Table 5. Definitions of Variables Used in Logit Model (All Four Modes)

Variable	*Measurement*	*Mode Choice Variable*		
		HOV	*Casual Carpool*	*Transit*
Trip purpose—commute	1, if trip purpose is commuting		✓	
	0, otherwise		✓	
Age—60	1, if between 55 and 64		✓	
	0, otherwise		✓	
Single adult	1, if single adult	✓		
	0, otherwise	✓		
Number of vehicles	Total number of vehicles in household		✓	✓
Occupation—Prof./Mgr.	1, if professional or managerial		✓	
	0, otherwise		✓	
Occupation—Adm./Cler.	1, if administrative or clerical		✓	✓
	0, otherwise		✓	✓
Income—$30K	1, if income is $25,000 to $34,999		✓	
	0, otherwise		✓	
Income—$150K	1, if income is $100,000 to $199,999	✓		
	0, otherwise	✓		

would choose casual carpooling over the other three modes, which duplicates the results of the previous model. Professional/managerial or administrative/clerical occupations also increased a traveler's likelihood to use casual carpooling over the other three modes. Thus, travelers with weekday jobs with typical workday hours were more likely to casual carpool. This was not surprising considering the times during which casual carpooling occurs. Travelers with typical workdays would be more likely to encounter peak-period congestion if they drove alone on the GPLs. The results also indicated being between the ages of 55 and 64 reduced a traveler's likelihood of casual carpooling, which reflected a possible increased willingness among younger persons to try a newer, less-utilized mode of transportation.

In addition, having an income between $25,000 and $35,000 reduced a traveler's likelihood of casual carpooling, which was surprising considering the relatively low expense of that mode. One possible explanation was that low-income persons already used transit for many of their other trips, and they chose to use transit

Table 6. Model Coefficient Estimation Results (All Four Modes)

Variable	*Coefficient*	*Std. Error*	*t-stat*	*p-value*
HOV mode-specific coefficient	-1.21	0.09	-13.24	0.00*
Casual carpool mode-specific coefficient	-3.11	0.55	-5.68	0.00*
Transit mode-specific coefficient	-1.08	0.18	-6.03	0.00*
Trip purpose—commute	1.49	0.52	2.90	0.00*
Age—60	-0.87	0.40	-2.16	0.03*
Single adult	-0.67	0.27	-2.50	0.01*
Number of vehicles	-0.18	0.07	-2.63	0.01*
Occupation—Prof./Mgr.	0.41	0.21	1.98	0.05*
Occupation—Adm./Cler.	1.04	0.17	5.97	0.00*
Income—$30K	-2.21	1.02	-2.17	0.03*
Income—$150K	0.35	0.14	2.53	0.01*
Summary				
Number of observations		1507		
Log likelihood		-1702.93		
Restricted log likelihood		-2089.15		
ρ^2		0.185		
Percent estimated correctly		40.8%		

[1]Base alternative is driving alone on main lanes with utility of zero.
*Significant at the 95 percent confidence level.

during the times of casual carpooling as well. Another possible explanation was subsidized transit passes were available to low-income travelers. Travelers with subsidized transit passes would have little to no money-savings incentive to casual carpool. Also, the descriptive statistics indicated that travelers with incomes between $25,000 and $35,000 were less likely to make commute trips, leading to less use of casual carpooling because commuting is a primary factor that influences casual carpool use.

Summary

This research effort examined the use of casual carpooling in Houston, Texas. Survey results revealed that most casual carpool passengers often used transit for evening return trips and similar morning trips. Approximately 63 percent used casual carpooling to save money and about 53 percent used casual carpooling because of slow bus service. Most casual carpoolers (76%) used this mode three or more times per week. Casual carpool passengers were significantly more likely to be on commute trips and be between the ages of 25 and 34 (younger), but were significantly less likely to have household incomes between $25,000 and $35,000.

The results obtained in these analyses provided some information on the characteristics of travelers who chose to casual carpool. This information can be used to better evaluate HOV/HOT lane use and future lane development considerations. Casual carpooling has grown in popularity and should be considered when assessing potential corridor improvements. Although potential liability concerns would likely prevent agencies from actively promoting casual carpooling, they could encourage it passively by constructing park-and-ride HOV facilities that are conducive to the mode. Casual carpooling has the potential to improve the operation efficiency of HOV/HOT facilities by improving person movement. Although there are potential liability concerns, it may eventually become beneficial to promote casual carpooling as a viable mode alternative.

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References

Ben-Akiva, M., and S. Lerman. 1985. *Discrete choice analysis: Theory and application to travel demand*. Cambridge, MA: MIT Press.

Beroldo, S. 1990. Casual carpooling in the San Francisco Bay Area. *Transportation Quarterly* 44 (1): 133–150.

Burris, M., and J. Appiah. 2004. An examination of Houston's QuickRide participants by frequency of QuickRide usage. *Transportation Research Record* 1864, 22–30.

Burris, M., and W. Stockton. 2004. HOT lanes in Houston—Six years of experience. *Journal of Public Transportation* 7 (3): 1–21.

Houston TranStar Real Time Traffic Information. http://traffic.tamu.edu. Accessed June 15, 2004.

LeBlanc, D. E. 1999. *Slugging: The commuting alternative for Washington, D.C.* East Point, GA: Forel Publishing.

Meyer, D., and E. Miller. 2001. *Urban transportation planning*. New York: McGraw-Hill.

Ojah, M., and M. Burris. 2004. *Quantification of casual carpooling in Houston*. Texas Transportation Institute.

Reno, A.T., W. A. Gellert, and A. Verzosa. 1989. Evaluation of Springfield instant carpooling. *Transportation Research Record* 1212, 53–62.

RIDES for Bay Area Commuters, Inc. 1999. *Casual carpooling 1998 update*. <http://rideshare.511.org/research/pdfs/casualcarpool.99.pdf> Accessed December 8, 2003.

Small, K. A., and C. Winston. 1999. The demand for transportation: Models and applications. *Essays in Transportation Economics and Policy*. Washington, DC: Brookings Institute Press.

Spielberg, F., and P. Shapiro. 2000. Mating habits of slugs: Dynamic carpool formation in the I-95/I-395 corridor of Northern Virginia. *Transportation Research Record* 1711, 31–38.

Turnbull, K. F. 2004. History of HOVs. Committee on High Occupancy Vehicles Systems, Transportation Research Board. http://www.hovworld.com. Accessed October 18, 2004.

Wall, L. 2002. In search of slugs: Impatient Houston-area commuters form impromptu carpools. *Houston Chronicle* (December 2).

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