Commuter's Versus Analyst's Perception of Automobile Travel Cost

AARON ADIV

A study that attempts to narrow the gap between objective and perceptual measures of travel costs is discussed. The study is based on telephone interviews of working people in the San Francisco Bay Area, who reported at length their perception of automobile cost. In turn, their reports were compared with objective measures used in the calibration of travel demand models. The accuracy of the reported costs and their relation to objective measures commonly used in transportation studies are determined in two ways: (a) by comparison of point estimates (i.e., cents) of the total daily cost (or cost per mile) reported by the respondents with data based on engineering computations and (b) by comparison of cost factors, or items of expenditure that the respondent considered including in his or her total daily cost estimate (e.g., fuel, parking, and maintenance), with cost factors commonly used in transportation studies. The results obtained by each method seem ambiguous. The first method showed a tendency to overestimate, whereas the other showed a tendency to underestimate with respect to objective measures. However, when the results are examined in their entirety, the ambiguity is resolved. The study explains why the second method is more reliable and leads to the conclusion that people perceive the costs of travel by automobile to be lower than what analysts dictate. Analysis of reported factors, the actual line items that influence the commuter's modal choice, indicates that modelers may inflate "perceived" cost by as much as 65 percent.

Travel time and travel cost by alternative modes are the basic ingredients of any model of modal choice and trip distribution. It seems, then, that these ingredients should have deserved the special attention of researchers; however, very little work has been done to clarify the question of the relations between time and cost values used by analysts and those that are considered by the individual traveler in evaluating his or her travel choice. The definition of perceived costs is of special importance to disaggregate behavioral models, which claim to capture the inner psychological trade-offs made by individual decisionmakers. In practice, there seems to be a gap between what the models claim to do and what they actually do. Capture of inner psychological determinants calls for calibration of the models with psychological perceptual data. In reality, however, most models are calibrated with objectively measured data based on engineering and economic computations. Only the earliest attempts to apply disaggregate behavioral models to travel choice used reported values (1,2). All recent models were calibrated with objectively measured data.

The limited amount of work on perception of travel impedances concentrates more on the question of travel time than on that of travel cost. In most cases, this was a by-product of a larger research effort that focused, for the most part, on the question of the value of time. Quarmby (2), Lisco (3), and Johnson (4) reported relatively high correspondence between reported and objectively measured travel time. Lansing and Hendricks (5) also found similar results. In addition, they made an attempt to study the perception of travel cost. However, their analysis is rather limited because they predetermined the "appropriate" automobile cost. Watson (6) made a systematic effort to categorize expected bias in reported travel data. He defined several types of biases. This categorization, as well as an empirical work on travel time by Johnson (4), provided a methodological guideline for this paper. More recent attempts to study the perception of travel costs have been made by Malecki (7) and Brög (8). Malecki concentrated on the study of fuel costs, and Brög studied distance, costs, and travel time and related them to wider issues of policy-sensitive planning models. As for perception per se, much of the pioneering work was done in psychophysics (9). Engel, Kollat, and Blackwell (10) present a basic review of perception. A more comprehensive review concerning the broader questions of belief, attitude, intention, and behavior is given by Fishbein and Ajzen (11).

STUDY OBJECTIVES AND METHODS

This study is an attempt to narrow the gap between objective and perceptual measures of travel costs. The paper is based on telephone interviews of working people in the San Francisco Bay Area, who reported at length their perception of automobile cost. In turn, their reports were compared with objective measures used in the calibration of travel demand models.

The impetus for this paper lies in the hypothesis that the commuters in the Bay Area overwhelmingly choose the automobile over rail (87 versus 2.4 percent) because of subjective underestimation of automobile cost. The specific rail system under study was the Bay Area Rapid Transit (BART) system. A more detailed analysis of reasons for BART's low patronage is presented elsewhere (12).

The uniqueness of this study lies in the fact that it extends beyond the narrow question of evaluating only the accuracy of a point estimate such as total reported daily cost. The study investigates questions concerning estimates of cost by the user: Do or can people estimate the cost of travel to work? How do they make the estimates? What expenditures (cost factors) do they include in their cost estimates? How do these expenditures correspond to engineering models? Are users perceiving "out-of-pocket" cost, total cost, or perhaps some other cost? Are there differences in the perception of cost that could be explained along socioeconomic, travel behavior, or geographic lines? A detailed definition of these discriminating variables is available elsewhere (12).

Before the analysis of cost, distance and time estimates were examined. This was done to ensure that cost estimates were not distorted by an inaccurate perception of travel distance and time. In general, reports estimating travel distance and automobile travel time were highly accurate. Moreover, people even tended to overestimate them consistently. These results are similar to those observed in other studies cited above.

The accuracy of the reported costs and their relation to objective measures commonly used in transportation studies are determined in two ways:

1. Comparison of point estimates (i.e., cents) of the total daily cost (or cost per mile) reported by the respondents with data based on engineering computations and
2. Comparison of cost factors, or items of expenditure that the respondent considered for inclusion in his or her total daily cost estimate (e.g., fuel, parking, and maintenance), with cost factors commonly used in transportation studies.

Table 1. Average objective costs per mile of automobile operation, maintenance, and ownership by automobile size: fall 1975.

Designation	Cost Factor	Cost (¢/mile) Standard	Compact	Subcompact	Automobile Fleet in BITS-2[a]
A	Operation and maintenance				
	Gasoline	4.33	3.68	2.75	3.82
	Oil	0.19	0.17	0.14	0.17
	Repair and maintenance	4.09	3.33	2.96	3.66
	Tires	0.45	0.39	0.35	0.41
	Accessories	0.09	0.09	0.09	0.09
	Total	9.15	7.66	6.29	8.15
	Ownership cost				
B	FHWA naive depreciation method[b]				
	Depreciation	4.08	3.70	3.20	4.20
	Insurance	1.07	1.60	1.50	1.60
	Registration	0.32	0.32	0.32	0.32
	Total	6.82	5.62	5.02	6.12
C	IURD economic depreciation method				
	Depreciation	7.97	6.29	5.25	6.97
	Insurance	1.70	1.60	1.50	1.60
	Registration	0.32	0.32	0.32	0.32
	Total	9.99	8.21	7.07	8.89
	Total A + B	15.97	13.28	11.31	14.27
	Total A + C	19.14	15.87	13.36	17.04

[a]Based on 54.49 percent standard-sized cars, 21.96 percent compacts, and 23.15 percent subcompacts.
[b]In general, difference between buying and selling price after subtraction of financing costs.

DATA BASE

BITS-2 Survey

This paper is based on an analysis of a telephone survey of 689 individuals who resided and worked (at least 20 h/week) in the San Francisco Bay Area and who were considered, a priori, to represent feasible potential BART users. The survey was conducted during the fall of 1975 after BART was fully operational. This survey, BART Impact Travel Study-2 (BITS-2), was carried out by the Urban Travel Demand Forecasting Project (UTDFP), University of California, Berkeley. The UTDFP attempted to explain and forecast the demand for urban transportation by using disaggregate behavioral models. BITS-2 emphasized detailed documentation of the work trip by usual and alternative travel modes. The final report and an annotated code book of BITS-2 are presented elsewhere (13,14). For model calibration, the UTDFP developed a large data set of objective system supply variables (15) that was used in evaluating the accuracy of reported data.

Objective Engineering Estimates of Automobile Cost

Objective costs were adopted from biannual reports of the Federal Highway Administration (FHWA) on the costs of owning and operating an automobile in the years 1972, 1974, and 1976. These figures are based on the average cost per mile of operating three sizes of cars--standard, compact, and subcompact--in a typical U.S. metropolitan area. The figures were adjusted to reflect costs in the San Francisco Bay Area in the fall of 1975. In general, the adjustments followed the methodological frameworks suggested by Keeler and Small (16) of the Institute of Urban and Regional Development (IURD), University of California, Berkeley.

Table 1 summarizes the results. In the table, costs per mile are broken down into several factors: (a) operation and maintenance and (b) two categories of ownership costs. The difference between B and C is in the method used to account for depreciation costs. The FHWA method (B) is a naive method that essentially accounts for the difference between buying and selling price after subtraction of financing costs. The IURD economic depreciation method (C) is an economic method that uses a capital recovery factor at a 10 percent annual interest rate over 10 years. The FHWA method is a layman's method of accounting for automobile ownership costs. It seems likely that as a perceived cost the FHWA method would have been the method used by respondents who claimed to include depreciation in their cost estimates.

RESULTS

Do People Estimate Automobile Costs?

A most striking result was that less than one-third of the BITS-2 sample (31.6 percent) had ever estimated the daily costs of driving to work by car before the encounter with the interviewer. The overwhelming majority--more than two-thirds--was not concerned enough with automobile costs to be stimulated into conscious cost evaluation. The rationale for this phenomenon is highly speculative. Respondents were not asked to explain why they had not estimated these costs if they had not estimated them before. Probable explanations are that automobile travel is habitual and an integral part of life in modern America, that automobile costs relative to personal income are negligible, or simply that there is no real alternative to a car in certain suburban areas of the San Francisco Bay Area. Similar results were reported by Lansing and Hendricks (5). They reported that, out of all usual automobile users in their sample, only 28 percent had ever estimated the cost of the automobile work trip.

People who had never estimated were asked to try to think through and make estimates during the interview. Even so, about one-fourth of those interviewed could not come up with any estimate. Hence, analysis of travel costs was based on only about three-fourths of the original sample--466 instead of 689 respondents.

In contrast to initial expectations, there was no significant difference in effort (had or had not estimated before) or ability (had not estimated but tried during the interview) to estimate daily costs

among those who usually, frequently, or never used the automobile (χ^2 significance level = 0.6161). As a rule, purely transportation or geographic variables did not show a significant difference with respect to motivation to estimate cost, whereas traditional socioeconomic variables such as sex, income, and education did. Males and people with higher education and income showed a greater tendency to make estimates. For example, 37.4 percent of the males had estimated costs before the interview compared with only 24 percent of the females. Almost 50 percent of the respondents with a college degree had estimated costs before the interview versus about 20 percent of the people with only a high school diploma. Only 18.7 percent of respondents in the lower-income brackets had ever estimated cost compared with almost 40 percent in the upper-income group.

Methods People Used to Estimate Automobile Travel Costs

Unfortunately, the questionnaire allowed the potential respondent only three predetermined ("close-ended") choices for the method of estimating automobile travel cost: "cost-per-mile basis", "cost-per-mile and other basis", and "some other basis only". The majority of the respondents (51.8 percent) reported that they used some other basis only--in other words, any method other than cost per mile. About one-third (31.7 percent) reported that they estimated based on cost per mile, and an additional 10.9 percent reported that they used some undefined combination of cost per mile and other basis.

Knowledge about the way people perceive the costs of travel and the methods by which they arrive at their personal estimates is essential for applications of policies that use a price mechanism. However, the structure of the BITS-2 questionnaire limited insight into the workings of the methods by which individuals determined cost.

The semantic emphasis on cost per mile in the response pattern is attributed to the questionnaire designers' predetermined conviction that cost per mile was the appropriate method (13, p. 483). This conviction lacked any empirical evidence. One finds that in spite of the suggestive language of the questionnaire--"Did you arrive at your total daily cost by estimating a certain number of cents per mile, or did you make your estimate some other way?"--most people resorted to "some other basis only". Furthermore, it could be argued that the methods that include cost per mile are inflated due to a solicited favorable response.

The superficiality of the cost-per-mile method is demonstrated in an analysis that compares objective data with the reported estimates given by 184 people who claimed to use cost per mile. Most people who reported using this method quoted a figure of 15¢/mile, which "happened" to correspond to the allowable deduction for tax purposes in the year of the interview (mean = 15.14¢/day). Obviously, 15¢/day, which accounts for both variables and fixed costs, could not correspond to marginal costs: It was about 55 percent larger. It is even more revealing to find that there was no correspondence between this base figure and the reported total daily cost, adjusted for (divided by) the travel distance. The correlation coefficient (R) between these two subjective measures was extremely small (0.1075) and insignificant.

In summary, even this limited information indicates that the cost-per-mile method is an artifact used by analysts and accountants. It should not be confused with the actual method by which people estimate their cost. Apparently, they estimate cost (if at all) by some "gestalt" method. The question of how the gestalt takes place deserves further investigation.

Similar to the question of whether people made efforts to estimate costs, the difference in the reported method of estimating them held only for the core socioeconomic variables of sex, income, and education (χ^2 significance level = 0.02). It did not hold for geographic and transportation variables. In addition, there was no significant difference between respondents who had estimated prior to and those estimating during the interview (χ^2 significance level = 0.1151).

The so-called more sophisticated, or more experienced with automobile driving, tended to report more use of cost per mile and both cost per mile and some other method than their counterparts. They responded more positively to the suggestive language of the questionnaire. When the results are broken down by gender, 33.8 percent of males reported using cost per mile versus 28.5 percent of females and 13.3 percent of males reported using both methods versus only 6.9 percent of females. Similarly, about 40 percent of respondents with four or more years of college reported using cost per mile compared with less than 30 percent of those with less formal education. About 45 percent of the respondents in the highest income bracket reported that they estimated on a cost-per-mile basis versus less than 20 percent of the lowest income bracket. The pattern of this distribution can be explained by the fact that the "sophisticated" travelers are more aware of the existence of estimates of automobile cost in general and of a cost-per-mile method in particular. They are probably using this method on some regular basis when reimbursed for travel or when they exempt travel expenses from income tax.

Accuracy of Reported Costs

A direct comparison of a single reported attribute with a single corresponding objective measure, as has been done in studies of travel time, does not suit the more complex issue of travel cost. Here the answer depends on the definition of the appropriate combination of objective cost factors with which the report is compared.

Another analytic problem was derived from the fact that reports showed a strong tendency to be given in round figures and in multiples of 5. This phenomenon is well illustrated in Figure 1, which shows the distribution of reports on total daily cost. Most daily reports gave a cost of $1 (14 percent) or $2 (12 percent). Overall, 68 percent of all reports were given in multiples of 50¢; 98.3 percent were given in multiples of 5¢. A similar tendency (not shown here) was found in reports on cost per mile. About 56 percent of the reports were given in multiples of 5¢. There were no reports in fractions of cents, and the norm was 15¢/mile, reported by 23 percent. The strong tendency to round reports in multiples of 5¢ and/or 50¢ implies that direct correspondence between reported and objective measures is unattainable.

Daily cost estimates were "pure"--i.e., they were given instinctively. They were not biased by suggestive language and were reported by all subjects irrespective of their estimation method. As a result, in this paper they are considered more meaningful. The average value reported for total daily travel costs by automobile to work was 232.9¢/day. The accuracy of such a report is debatable, depending on what one considers to be the appropriate objective bench mark for comparison. For analytic purposes only, the reports of total daily cost are

Figure 1. Reported daily cost of home-to-work travel by automobile for 466 cases.

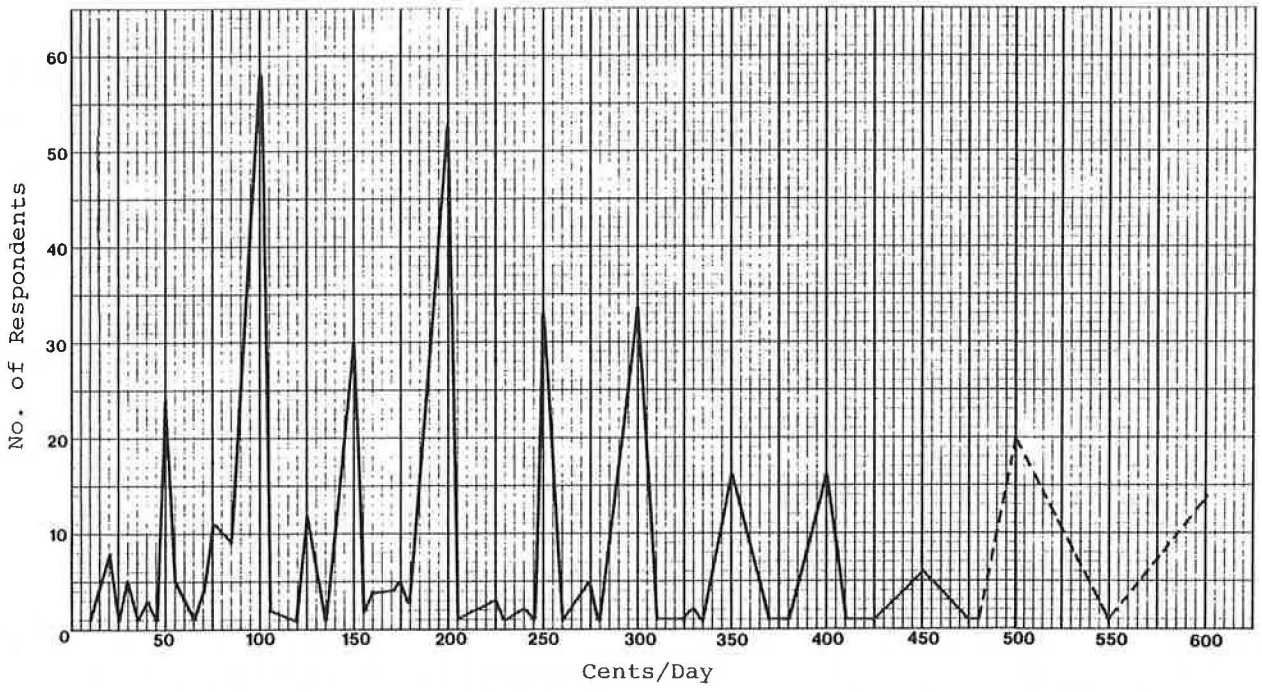

Table 2. Mean reported and objective cost per mile of driving to work for all respondents.

Category	Cost (¢/mile) Mean	SD
Reported cost		
Derived		
Objective (¢/day network distance)	12.71	13.12
Subjective (¢/day reported distance)	13.82	19.40
Original reports (¢/mile)[a]	15.14	14.74
Objective cost		
Operation and maintenance		
Excluding parking and tolls	8.15	1.00
Including parking and tolls[b]	10.55	6.36
Total cost of ownership[c] (operation and maintenance including parking and tolls[b])	16.65	6.50

[a] Given only by 184 respondents who reported on some cost-per-mile basis and revealed their base figure.
[b] Based on average parking cost of 2.29¢/mile and toll cost of 0.168¢/mile (reported daily cost network distance).
[c] FHWA.

converted here, via division by travel distance, into a derived cost-per-mile figure. This eliminates the problem of accounting for different travel distances by each traveler. Table 2 gives the means of several objective and subjective measures. The means provide an overall indicator for the general magnitude of the reports and their objective counterparts.

Because of the strong correlation between reported and objective travel distance, it is not surprising to find that the average values of derived cost per mile--objective or subjective--are very close, about 13¢/mile. The average cost per mile from original reports, given by only 184 respondents, was larger than either derived measure--more than 15¢/mile.

If one assumes that the appropriate objective measure is the sum of operating and maintenance cost--out of pocket--a simple comparison of means indicates a tendency of respondents to overestimate cost. All three reports made on a per-mile basis had larger means than either measure of objective marginal cost. Objective out-of-pocket cost, excluding terminal cost (parking and tolls), was only 8.15¢/mile. Even when terminal costs were accounted for, marginal cost was only 10.55¢/mile. A 95 percent confidence interval for any of the three reported costs per mile did not include the mean objective cost. This tendency to overestimate is in line with previous findings concerning distance and time.

In an analysis of variance, only geographic variables that capture the spatial relations between home and workplace showed a significant difference among respondents' estimates. For example, those traveling short distances, less than the average distance of 11.3 miles, substantially overestimated their cost. They reported, on the average, a cost of 22.06¢/mile. The long haulers reported only 9.25¢/mile. In contrast, none of the socioeconomic variables that influenced the ability to estimate--such as sex, income, or education--showed a significant difference. In addition, none of the transportation variables other than those that referred to inclusion of a specific cost factor showed significant impact on the cost estimates. Experience with automobile use, previous attempt to estimate cost, size of car used for the work trip, and availability of transit made no significant difference.

Further analysis of the relation between reported and objective daily costs was obtained by correlation analysis. The coefficients of determination (R^2) are intuitively appealing because they indicate the percentage variation, in reported cost, explained by the objective data. The following table gives the results of correlation between reported daily cost and several objective measures:

Objective Cost Measure	R^2
Implied cost of reported factors	0.4661
Total ownership (naive) and operating costs	0.2139

Objective Cost Measure	R^2
Total ownership (economic) and operating costs	0.2085
Marginal (fuel, maintenance, parking and tolls)	0.2277
Only fuel costs	0.1608
Only parking and tolls	0.1528

Several observations can be made about these results: First, all of the correlation coefficients above were statistically significant (probability value = 0.001). Second, the objective cost measure--be it total, marginal, or any combination between these two (other than only fuel or only parking and tolls) explained 20-22 percent of the variation: R^2 = 0.2085 to 0.2268. All of these correlations between objective and perceived measures were relatively weak. The similarity in correlation results from the way in which these objective measures were constructed. Other than their pure merit (measure of association), these similar coefficients signal a methodological problem concerning evaluation of reported daily cost.

All operation costs other than terminal costs (tolls and/or parking) are eventually a linear function of distance and of vehicle fuel efficiency. So, for example, the relatively low coefficient of "only fuel cost" (R^2 = 0.1608) actually captures the association between reported costs and automobile size plus travel distance. Once parking and tolls enter the equation, the information is exhausted, and the coefficient remains practically unchanged (R^2 approximately 0.22). It seems that a failure to recognize this problem led Quarmby (2) to suggest that a given cost per mile was the best internal perception of cost per mile by the user.

Reported Cost of Parking and Fuel for Daily Work Trip

Parking

A striking result that has a significant impact from the public policy viewpoint is that most of the respondents who usually used the automobile to go to work did not pay for parking at the workplace. Only about 10 percent of the "usual" automobile users reported paying for parking. About two-thirds of the usual users received free parking from their employer as part of their employment benefits. Another quarter of them parked free on the street. These results were further reconfirmed by the trip diaries (17) in which respondents to the BITS-2 telephone interview kept records of all their trips within a five-day period. Parking arrangement for work trips in the trip diaries was very similar to the distribution of usual automobile users in the home interview. In addition, the 1969 Nationwide Personal Transportation Study (18) revealed that, on a national level, about 93 percent of work trips by automobile enjoyed free parking. For this reason, reported parking costs were accepted as objective costs in evaluating the quality of daily reports. As expected, there was quite a substantial difference between objective average parking cost based on zonal data and cost based on reports. Average daily parking cost based on zonal data was 80.96¢/day (standard deviation = 96.09). In contrast, average cost based on reports (including 73 percent of the users who reported zero cost) was only 41.86¢/day (standard deviation = 88.72).

Gasoline and Oil

One finds that people tended to overestimate gasoline cost as they did total daily cost. In fact, the widest discrepancy found between reported and objective measures was for fuel cost. Fuel cost is undoubtedly essential for the operation of the automobile and is a cost experienced by any driver or rider. Thus, one would have expected that people would have a fairly accurate estimate of its cost.

The largest discrepancy was found for those who claimed to estimate on a per-mile basis. The average objective cost of gasoline (for the BITS-2 sample) was 3.96¢/mile. The average cost reported by those using a per-mile method was almost three times larger: 10.80¢/mile. The average cost reported by those reporting on a daily basis, after adjustment for distance, was 7.05¢/mile, which was still almost twice as large.

The average gasoline cost encountered by consumers during the time of the interview was 58.9¢/gal. The interviews occurred after the drastic increase in gasoline cost following the 1973 oil embargo. Gasoline consumption was relatively high--13.6, 16.0, and 21.4 gal/mile for standard, compact, and subcompact cars, respectively. In other words, the cost of gasoline was not negligible. However, even at this price level the respondents did not seem to have accurate estimates of their cost.

Apparently, even if people were aware of gasoline cost at the pump, which seems reasonable, they could not separate fuel cost into work-trip versus non-work-trip consumption. They grossly overestimated the work-trip fuel cost and tended to attribute too large a share of daily cost to fuel cost, in a rather random manner.

Cost Factors People Included in Their Automobile Cost Estimates

When costs were defined in terms of factors only--with no specific dollar value associated with each factor--the results of the BITS-2 questionnaire did not confirm the common wisdom held by analysts in defining perceived marginal cost in its entirety. It is true that respondents tended to ignore fixed costs. However, they also tended to exclude variable costs other than the costs of gasoline and oil. They excluded, in varying degrees, variable costs that are traditionally considered part of the perceived costs. The percentages of respondents who reported including any of seven defined factors in their previous cost estimates are given below:

Factor	Respondents (%)
Gasoline and oil	89.2
Maintenance	48.7
Parking	25.4
Insurance	24.6
Depreciation	18.0
Tolls	12.9
Other costs	1.3

Even more important than the question of which cost factors were more frequently mentioned is the one asking which factors were reported as a group by the respondent: Were they variable factors, fixed factors, or any other combination of factors? A respondent could have reported as many as seven factors, which leads theoretically to a possible 128 combinations. In fact, people reported 33 different combinations of cost factors. Reports varied from gasoline and oil only to the sum of all variable and fixed costs.

Table 3 gives the distribution, by number of respondents, for a selected sample of 11 combinations of cost factors. The sample includes the most frequent combinations appearing in the reports. Basically, it is a selection of five combinations, from the cost of only gasoline and oil (1) to the sum of

Table 3. Combination of reported cost factors.

Combination No.	Factors	Respondents No.	Respondents Percent
1	Gasoline and oil		
	Gasoline and oil only[a]	150	32.1
	Gasoline and oil + parking + tolls	121	4.5
	Gasoline and oil + parking	35	7.5
	Gasoline and oil + tolls	9	2.0
	Total	215	46.1
2	Gasoline and oil + maintenance		
	Gasoline and oil + maintenance[a]	69	14.8
	Gasoline and oil + maintenance + parking + tolls	10	21.6
	Gasoline and oil + maintenance + parking	15	3.2
	Gasoline and oil + maintenance + tolls	6	1.3
	Total	100	40.9
3	Gasoline and oil + maintenance + insurance[a]	25	5.4
4	Gasoline and oil + maintenance + depreciation[a]	29	6.2
5	Gasoline and oil + maintenance + insurance + depreciation[a]	32	6.7
6	All other 22 combinations	65	14.0
	Total	466	100.0

[a]Not including combinations that incorporate explicit reports on parking and/or tolls.

both fixed and variable costs (5). Because most people did not pay for either parking or tolls, even though they were probably aware of the existence of these costs, the table includes reference to this fact as well.

Table 3 clearly demonstrates that the notion commonly held by analysts that perceived cost is composed of the cost of gasoline and oil plus maintenance (2) is not held by the users. Only 21.5 percent of all respondents reported this combination of factors. In fact, about half of the respondents (46.1 percent) considered only gasoline and oil (in combination with parking and tolls when appropriate) to be the single travel cost associated with their automobile work trip.

The counter argument advocated by Keeler and Small (16), that perceived cost should include both variable and fixed cost, could not be supported by the data either. Only 6.7 percent of reported respondents included gasoline, oil, maintenance, insurance, and depreciation in their estimates. Other combinations of both variable and fixed cost also had small proportions of the same magnitude. All of the other 22 combinations of cost factors reported by respondents accounted for only 14 percent of all reports.

Total objective cost for the fleet of cars in this study was 10.5¢/mile. It is divided 37.8 percent for gasoline and oil, 39.4 percent for repair and maintenance, and 22.8 percent for parking and tolls. The combination of these data with the results on cost factors implies that almost half of the users (46.1 percent) underestimated about 40 percent of perceived costs imposed on them by analysts. Those are the cost of repair and maintenance. This is undoubtedly a substantial deviation, which supports the initial hypothesis that people probably do not use BART because they underestimate the cost of travel by automobile.

CONCLUSIONS

This paper has used two methods to evaluate perception of travel cost by the user. First, it examined the quality of point estimates reported by the users, and, second, it examined the specific items of the cost factors that the respondents included when estimating their cost. At first, the results obtained by each method seem ambiguous: The first method showed a tendency to overestimate, whereas the other showed a tendency to underestimate (with respect to objective measures). However, when the results are examined in their entirety, the paper leads to the conclusion that people perceive travel costs by automobile to be lower than what the analysts dictate when calibrating travel demand or estimating the value of time.

Indeed, when people are asked to quote a single figure, be it of cost, distance, or travel time, they consistently report a figure larger than the objective threshold. However, this overestimation should not be taken at its face value. Each report is, at best, an intelligent guess of one number. Not being experts in the field, respondents probably overguess in order to be on the safe side. To this one should add the tendency to report in whole numbers and in multiples of five, which aggravates the results even further. Moreover, analysis of correlation between reported and objective costs showed that people overestimated in a random manner. Finally, the highly inaccurate estimates of gasoline costs for the work trip give the best indication that the evaluation of perceived cost based on point estimates is not reliable.

It could be argued that reports on cost factors are more reliable than point estimates. A respondent might not have been able to separate bulk costs into a single daily work trip. However, reports on cost factors indicate the actual line items that influence respondents' decisions. Because they are easily comprehended, they are also highly reliable. Analysis of reported factors indicates that modelers might inflate perceived cost by as much as 65 percent. These findings raise serious questions about the validity of calibration procedures used in most studies of travel demand.

Another important finding, generally ignored by both modelers and planners, is that most people who usually drive to work do not pay for parking at the workplace. High parking fees are apparently not a deterrent for usual automobile users--i.e., for the majority of commuters. Again, using zonal parking data in the calibration of demand models highly inflates the cost as perceived by the user.

This paper challenges the inconsistency between claim and practice concerning use of perceptual values of travel cost in behavioral models. However, further research is necessary. It is quite striking to find how limited the knowledge is in this field. I found only two studies (4,6) devoted entirely to the study of correspondence between objective and subjective measures of travel impedance.

Unfortunately, this paper could not explain in detail how cost is perceived. Based on experience gained in this study, the following guidelines are suggested for obtaining better insight into the gestalt process:

1. Allow for an open-ended response concerning method of estimating automobile cost;
2. Compare perception of automobile cost with perception of other goods and services that are bought in bulk and consumed for different purposes--for example, residential telephone calls or electricity; and
3. Ask subjects about the cost of travel on a weekly or monthly basis.

Irrespective of specific results obtained in this study about the correspondence between objective and subjective measures of travel impedances, further investigation of this topic is essential for the accountability of behavioral models and the value of time.

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Application of the Situational Approach to Depict a Model of Personal Long-Distance Travel

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A study undertaken to determine the amount of personal long-distance travel in the Federal Republic of Germany to explain present modal choice and to forecast the likely future development of modal choice is described. To achieve these goals, an individually oriented behavioral model was developed (the situational approach) that first identifies the individual's (perceived) decisionmaking situation as precisely as possible, then determines the maximum potential for change if external conditions are altered, and, finally, tries to forecast the likely responses to planned policies. It can be shown that in personal long-distance travel the potential number of persons who would change mode if travel duration and travel costs were altered is comparatively small. On the other hand, the question of trip generation is much more important. When trips are classified according to trip purpose, it can be shown that most vacation trips would be made even if external conditions were less favorable to travel, although the type of vacation trips made might be modified. For "other" personal travel, in which a comparable type of modification is frequently not possible, persons would often respond to restrictive measures by reducing trip frequency.

Although personal long-distance travel is quantitatively of considerable importance in the Federal Republic of Germany and major investments are required in order to improve highway networks, comparatively little is known about the number of such long-distance trips and the likely responses of long-distance travelers to planned policies. For these reasons, the Minister of Transport authorized a large-scale, comprehensive study of personal long-distance travel in 1979-1980 (1).

In the quantitative part of this project, it was found that, on a per capita basis, German residents made a total of almost four (3.94) long-distance trips/year to destinations at least 50 km away from their homes. Almost every fourth (0.88) trip was a vacation trip. This means that Germans make approximately 50 million vacation trips and approximately 175 million other personal trips per year. In five out of every six instances (83 percent), they travel by car. Every 10th trip (10 percent) is made by train, and every 33rd trip (3 percent) is made by plane. Every 25th trip (4 percent) is made by bus or by another mode. Thus, Germans make approximately 185 million long-distance trips by car, 23 mil-