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# USER EVALUATION OF SERVICE OFFERINGS IN INTERMODAL WORK COMMUTING

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## ABSTRACT

Users of multiple-mode public transportation were compared to users of privately owned vehicle (POV) in work commuting within two different travel corridors of Santa Clara County, California. In the first corridor, high tech companies were the source of questionnaire respondents; in the second corridor, the respondents were predominately municipal and county office employees in a downtown corridor. Contrasts in importance and satisfaction between the POV and public transportation users in each of the study corridors are interpreted in terms of their demographic profiles. Implications for the design of service offerings are discussed.

**Keywords:** Urban transportation; Intermodal transportation; Mode choice; Work travel

## INTRODUCTION

A frequently referenced public policy goal is to reduce or limit the growth of single passenger private vehicle use for routine trips. This policy goal continues to have limited success in the densely-populated travel corridors of California. The most common routinized local traveling is clearly in travel to work. We report two studies of intermodal commuting to work. From our perspective, policy effectiveness for the objective can be increased by focusing on sub-sectors of travelers (as in travel corridors) and more disaggregated study of user experience- based judgments. Results of the studies we report differ from most available studies of urban travelers in both the study samples and the design. First, we limit our regular sample to *intermodal commuters*. It is important to study this sample exclusively since in many corridors of urban areas, work travel on public transport is primarily intermodal. Second, we limit our sample to *regular work commuters*. Although this is a relative small proportion of all commuters, the

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regularity in their trip time and consistency in their travel makes them important as a study sample. Third, we report direct *comparisons of POV commuters and public transport commuters* in both questionnaire studies.

## METHODOLOGY

### Travel Corridors

The two questionnaire studies that we report measured both importance and satisfaction in work commuters who face an intermodal alternative. The corridor in the first study is high tech firms at the center of Silicon Valley in Santa Clara County, California. In demographics, the travellers sample tends to have higher educational and income levels than the sample in the second travel corridor we studied, and in the rest of the county. Although POV commuters tend to have higher education and income levels and are younger than public transportation commuters within this corridor, the differences are relatively small and not statistically significant. This increases the importance of user experience based judgments to discriminating between public transportation and POV travellers and in the design of policy.

The corridor in the second study we report is limited to work commuters to the downtown location of the largest city in the Santa Clara County. A diverse assortment of city, state, and federal offices, as well as other service offices, are major employers in this location. Median income and educational level is lower in this corridor than it is in the High Tech corridor. In the Downtown corridor, POV commuters again tend to have higher educational and income levels, and are younger than public transportation commuters. The differences in median age and income categories between public transportation and POV commuters in this category are statistically significant with public transportation commuters in a lower median income category.

### Design of Questionnaire

A first section elicited information on occupation, the regularity of their commuting to work, distance from their residence to work location, the frequencies of the modes they used in the past month, and the range of their waiting times in interfaces. A second section elicited ratings of the importance of factors that were identified in the focus group studies and satisfaction with these factors in public transportation offerings. Ratings of importance and satisfaction were on an eleven point scale with end points “not at all important” and “extremely important”; or “not at all satisfactory” and “extremely satisfactory.” As will be reported, we define several measures of satisfaction from these data. The third and final section requested demographic information. Categories of age, education, and income in addition to gender and marital status were included in this section.

## SUMMARY OF RESULTS

Results were analyzed with analyses of variance and logit models of the usage of public or own vehicle modes. The importance and satisfaction judgments of commuters in the two studies are first interpreted independently since the mode combinations and demographics of the commuter samples differ. Each study provides contextualized information on commuters using respective mode combination in intermodal work travel within a defined travel corridor. We will then compare differences across the mode combinations with appropriate qualifications and note managerial implications of both studies.

Following study traditions in policy-directed assessments that address importance and satisfaction judgments jointly in importance-satisfaction analysis (ISA) were calculated. We also calculate a combined measure of importance-weighted dissatisfaction as a composite of factors that have the most overall impact on commuters. The ISA and importance-weighted dissatisfaction measures assume that the combination of these two judgments is most managerially relevant.

Given the importance of satisfaction with the public transportation alternative, we report multiple measures of this judgment. These are (1) an overall rating of satisfaction, (2) a score from principal component analyses of satisfaction ratings, and (3) a summed rating of importance-weighted dissatisfaction across each of the travel factors. We will provide a summary of results for importance-weighted dissatisfaction, and an overview of results on other measures in each of the travel corridors.

### **Summed Importance-Weighted Dissatisfaction**

An importance-weighted dissatisfaction measure across all factors is defined as

$$D_j = \frac{[\sum_i (m - S_i) I_i]}{n}$$

Where  $D_j$  is the summed importance-weighted dissatisfaction of the  $j$ th respondent

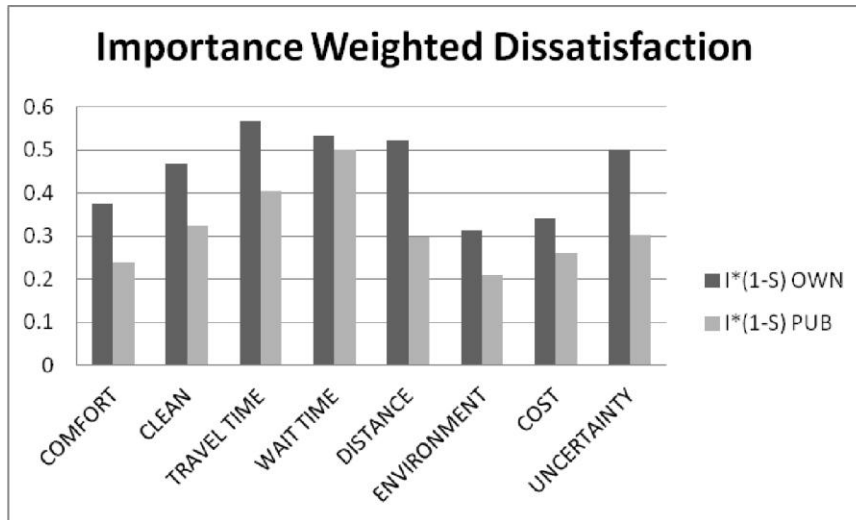
$m$  is the number of points on the rating scale ( $m=11$ )

$S_i$  is the rated satisfaction with the  $i$ th item

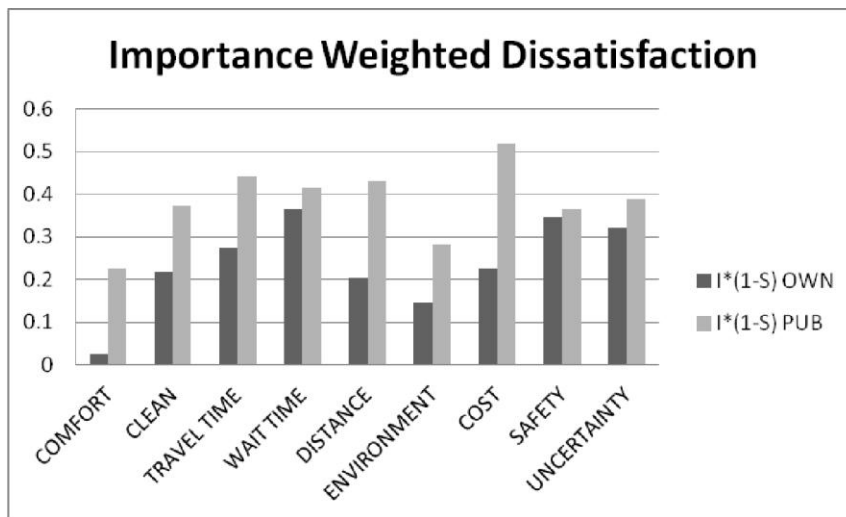
$I_i$  is the rated importance of the  $i$ th item and

$n$  is the number of rated items.

The figures 1 and 2 show the profiles of importance weighted dissatisfaction for study attributed in each of the travel corridors.



**Figure 1 Importance-Weighted Dissatisfaction: Study 1 (High Tech corridor)**



**Figure 2 Importance-Weighted Dissatisfaction: Study 2 ( Urban Center Corridor)**

In Study 1 (High Tech corridor), importance weighted dissatisfaction for travel time, distance and uncertainty were significantly higher ( $p < 0.05$ ) for POV commuters than for commuters who use public transportation. In Study 2 (Urban Center corridor), importance weighted dissatisfaction for comfort, distance and cost were significantly higher for public transportation users than for POV.

For the summary measures importance weighted dissatisfaction, POV users were significantly higher ( $p < 0.01$ ) than public transportation users in the High Tech corridor. In the urban center corridor, public transportation users were significantly higher ( $p < 0.01$ ) in importance rated dissatisfaction than POV users.

### **Study 1: Importance and satisfaction ratings (High Tech corridor)**

In the results of Study 1, most factors were rated as more important, but less satisfactory by the POV commuters than by the regular public transportation commuters. The largest differences in importance between POV and public transport commuters were in uncertainty, travel time, and distance (i.e. distance from residence to the initial transit mode, between the interface of transit modes, and from final stop to work location). POV commuters rated all of these factors as more important, and were also less satisfied with each of these factors.

ISA results indicated that for POV commuters, travel time, uncertainty, and distance in the public transportation offering were factors of high importance and low satisfaction. In public transportation commuters' ratings, wait time was clearly the factors identified in this quadrant with cleanliness and uncertainty closest as lower satisfaction factors to the boundary of the quadrant with high importance.

### **Study 2: Importance and satisfaction ratings (Urban Center corridor)**

In contrast to Study 1, results of Study 2 indicated that most factors were rated as more important, but less satisfactory by commuters who used public transportation. The differences of largest magnitude in both importance and satisfaction were in cost, total travel time, and distance. Directly calculating the importance-weighted dissatisfaction measure, we found that public transportation users had significantly higher summed scores on dissatisfaction than did POV users. The correlation between measures of satisfaction was again highly significant ( $p < .01$ ) and showed corresponding differences in the same factors across user groups. In the measure of satisfaction, cost showed the largest difference between POV and public transportation commuters in this corridor.

In ISA, the greatest difference in rated importance between commuter groups was in cost and distance. Cost and comfort showed the largest differences in rated satisfaction. In the managerially relevant quadrant of high importance, low satisfaction, uncertainty and wait time were the main factors among POV commuters. For these commuters, total travel time was rated as low satisfaction and close to the boundary of the high importance quadrant. Among public transportation commuters, total travel time, wait time, and uncertainty were rated low in satisfaction and at or close to the boundary of high importance.

## **Cross-Study Comparisons**

In both corridors, total travel time, uncertainty in total travel time, and wait time are of high importance to the commuter groups, as they are in results of a range of previous studies of public transportation commuters. However there are notable differences between corridors in the satisfaction measures. In the High Tech travel corridor, public transportation commuters were generally more satisfied with transit than POV commuters. The public transportation commuters were most dissatisfied with distance and time, with total travel cost lower in dissatisfaction.

In the Downtown corridor with light-rail service, commuters who use intermodal public transportation, whatever their demographics, report lower satisfaction than POV commuters. The ISA and importance-weighted dissatisfaction measure indicated that cost was of predominant importance to public transportation commuters and was the basis for the largest differences in satisfaction between the commuter groups in this corridor. The dissatisfaction with cost among public transportation commuters may be biasing their overall satisfaction judgments downwards.

The differences in results in the comparisons across both public transportation commuters and POV commuters in each sample suggest that independent studies of travel corridors with different mode alternatives can be informative even when they are within the same county and in close geographical proximity. In many previous studies, commuters in counties with what may well be significantly different travel corridors have been studied as common entities.

## **Segmenting Public Transportation Districts: Identifying Travel Corridors**

As indicated, travel corridors within transit district districts can evidence very different judgements of importance and satisfaction with service offerings. These differences generally reflect corresponding differences in demographic profiles. Since the differences generally imply different service designs to obtain maximum usage, identifying relevant corridor differences in a transportation district becomes a priority. To exemplify methodology for discriminatoin in travel corridors in a travel district, we will use publicly availabe demographic information and market segmentation methodology.

## **Managerial Implications**

The differences between travel corridors in close geographical proximity do suggest that even local segmentation of travel markets can be important to designs that increase overall satisfaction. In the travel corridor to high tech companies, public transportation commuters continue to use this travel mode when they are further into their careers and are less limited by income. This suggests a large stable user base. Total travel time and distance in mode interface and/or distance from the closest station to their workplace are the bases of greatest dissatisfaction. The ISA indicates total travel time, uncertainty in total travel time, and distance to also be the high importance factors with lowest satisfaction.

Since cost appears to be lower in importance and higher in satisfaction to both POV and public transportation commuters, the managerial implication may be to increase frequency of vehicles and modify routing, increasing fares moderately to offset the cost. Converting POV commuters to public transportation users in this corridor appears to be a more difficult undertaking since dissatisfaction appears to be across many more factors. Explicitly communicating that the basis for any fare increase is to increase service would be important for employees in this corridor.

For the travel corridor to the Downtown location with commuters groups that appear to be earlier in their careers and generally have lower levels of educational attainment and income, implications are very different. The demographics of commuters by public transportation suggest that they are more likely to be taking this option out of necessity. When career stability and income increases, this increases the likelihood that will elect the POV option since they consistently show lower satisfaction than POV commuters in the study. Focusing on retaining current public transportation commuters is important, as it is generally more expensive to convert non-users to users than to retain current users.

In implications for converting POV commuters to public transport commuters in the Downtown corridor, the factors of travel time, uncertainty, and wait time appear to be relevant. However, cost is clearly of the greatest importance to commuters in this travel corridor. Any fare reduction is a challenge given budget constraints and is likely to require some reductions in other service offerings. For public transport commuters in this corridor, lowering cost through forms of travel point accumulation (as with airline travel) that can be used to offset subsequent fares may be among the managerial applications that merit consideration. Travel point programs directly target regular users of public transportation and have lower provider costs than a general fare decrease. When externalities in environment and road-related maintenance are considered, the cost of not maintaining a satisfied user base merits careful consideration.



## CONCLUSIONS

Increasing the use of public transportation in work travel continues to be a challenge in the face of cost constraints. When compared to a large literature of results that are predominantly from single mode commuters, our studies suggest the challenge is increased when travel is intermodal. In most previous studies, public transportation commuters have been grouped together whether or not travel is intermodal. Results for intermodal travel in the studies we report were found to have similarities in factors, but important differences from results that have been reported for single mode travel in the effects of interfacing on wait time, total travel time, and uncertainty. At the least, this implies that there should be greater contrasts between single mode and multi-mode commuters in large scale studies. The results we report also underscore the importance of assessing demographic differences and contrasts in commuter judgments across travel corridors, even when they are in close proximity in the same county.

The future of public transportation usage has great significance to managing congestion and more generally to the cost and quality of life in urban areas. It also ultimately matters to employers making location decisions. A range of studies and the studies we report indicate the contributions that direct study of work commuters can offer to design and management to retain and increase usage of public transportation alternatives.

(A more extensive and referenced version of this article is available from the author upon request.)