

UC Berkeley

Earlier Faculty Research

Title

Adoption of Telecommuting in Two California State Agencies

Permalink

<https://escholarship.org/uc/item/2v63b7b8>

Authors

Mokhtarian, Patricia L.
Salomon, Ilan
Saxena, Somitra
et al.

Publication Date

1996-09-01

Adoption of Telecommuting in Two California State Agencies

Patricia L. Mokhtarian

Institute of Transportation Studies
University of California, Davis
Davis, CA 95616

Ilan Salomon

Department of Geography
Hebrew University
Jerusalem 91905 ISRAEL

**Somitra Saxena
Srikanth Sampath
Peter Cheung
Kate Le
Michael Bagley**

Institute of Transportation Studies
University of California, Davis
Davis, California 95616

*Working Paper
September 1996*

UCTC No. 338

The University of California Transportation Center
University of California at Berkeley

The University of California Transportation Center

The University of California Transportation Center (UCTC) is one of ten regional units mandated by Congress and established in Fall 1988 to support research, education, and training in surface transportation. The UC Center serves federal Region IX and is supported by matching grants from the U.S. Department of Transportation, the California Department of Transportation (Caltrans), and the University.

Based on the Berkeley Campus, UCTC draws upon existing capabilities and resources of the Institutes of Transportation Studies at Berkeley, Davis, Irvine, and Los Angeles; the Institute of Urban and Regional Development at Berkeley; and several academic departments at the Berkeley, Davis, Irvine, and Los Angeles campuses. Faculty and students on other University of California campuses may participate in

Center activities. Researchers at other universities within the region also have opportunities to collaborate with UC faculty on selected studies.

UCTC's educational and research programs are focused on strategic planning for improving metropolitan accessibility, with emphasis on the special conditions in Region IX. Particular attention is directed to strategies for using transportation as an instrument of economic development, while also accommodating to the region's persistent expansion and while maintaining and enhancing the quality of life there.

The Center distributes reports on its research in working papers, monographs, and in reprints of published articles. It also publishes *Access*, a magazine presenting summaries of selected studies. For a list of publications in print, write to the address below.



**University of California
Transportation Center**

108 Naval Architecture Building
Berkeley, California 94720
Tel: 510/643-7378
FAX: 510/643-5456

The contents of this report reflect the views of the author who is responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the State of California or the U.S. Department of Transportation. This report does not constitute a standard, specification, or regulation.

ADOPTION OF TELECOMMUTING IN TWO CALIFORNIA STATE AGENCIES

by

Patricia L. Mokhtarian

Ilan Salomon

Somitra Saxena

Srikanth Sampath

Peter Cheung

Kate Le

Michael Bagley

ABSTRACT

This paper presents results from the field test of a survey designed to collect data on the individual decision to telecommute. The field test was conducted primarily to assess whether a cover letter from the employer would induce a response bias. The survey was administered with two cover letters to the Sacramento-based Franchise Tax Board (FTB) and the San Francisco-based Public Utilities Commission (PUC). The cover letter type had a small (insignificant) impact on the response rate, but in the opposite direction than expected. The cover letter had little effect on reasons for wanting to telecommute: "to get more work done" was still the most important advantage for both cover letter groups. Differences in commute characteristics between the two agencies resulted in differences in perceived advantages of telecommuting. For PUC employees, reducing commute stress was the most important advantage of telecommuting, although getting more work done was a close second. For FTB employees, reducing commute stress was in ninth place. The combined sample showed a marked preference for home-based rather than center-based telecommuting.

ADOPTION OF TELECOMMUTING IN TWO CALIFORNIA STATE AGENCIES

1. INTRODUCTION

Telecommuting, defined as working at home or at a location close to home instead of commuting to a conventional work location, has received increasing attention as a work alternative with potential benefits to the individual, the employer, and society at large (see, e.g., Gray, *et al.*, 1993). It remains to be seen whether the ultimate adoption of telecommuting will be sufficiently great to achieve these benefits, especially the social ones, on a large scale. A causal model forecasting the aggregate adoption of telecommuting will be useful to policy-makers seeking to understand the social impacts of telecommuting, as well as to industries seeking to estimate the demand for relevant products and services (Handy and Mokhtarian, 1996a, b).

Several researchers have begun to develop disaggregate models of telecommuting choice (or stated preference), that can provide a foundation for future behavior-based aggregate models (Bernardino, *et al.*, 1993; Sullivan, *et al.*, 1993). The authors of this paper are also studying the individual choice to telecommute (Mokhtarian and Salomon, 1994; 1996a, b, c), and the work reported here presents an early analysis from that project. In particular, this paper discusses some key decisions in the design of a survey instrument to obtain data on the choice to telecommute, and describes some interesting results of the survey field test. The field test incorporated significant changes to the study questionnaire as the result of a pre-test. The pre-test prompted an effort to assess the presence of a certain type of response bias, and refinements to question wording in response to some unexpected findings. Conducting the subsequent field test also permitted an interesting comparison between two state government agencies – located in different types of metropolitan areas and with different organizational cultures – on some aspects of the choice to telecommute. Section 2 provides additional information on the conceptual context of this project, and on the survey pre-test. Section 3 describes the sampling design and administration for the field test, and Section 4 presents some useful results. A summary section concludes the paper.

2. BACKGROUND OF THIS PAPER

The ongoing University of California, Davis study of the choice to telecommute has as its foundation a conceptual model of the individual decision process (Mokhtarian and Salomon, 1994). Key elements of that process include *drives* or motivators to telecommute (e.g., to reduce commute stress, to have more time for oneself or one's family, to get more work done), and *constraints* on or *facilitators* of that choice (e.g., awareness, understanding, job suitability, employer or supervisory support, cost, technology). It is assumed that the absence of binding constraints is a necessary but not sufficient condition for telecommuting to be chosen: a drive to make the choice must also be present.

Roughly in parallel with the development of the conceptual model sketched above, a written questionnaire was also developed. The survey was designed to obtain quantitative data on the elements of the model, with a view to mathematically operationalizing the hypothesized

relationships among those elements. This self-administered questionnaire was pre-tested on the staff of the Telecommunications Office at UC Davis, plus some State employee acquaintances of the researchers. The pre-test sample of 35 (30 from UCD) was by no means representative, consisting primarily of affluent professionals (median household annual income \$55,000 - 75,000; 62% of the respondents classifying themselves as professional, technical, or managerial). Nevertheless, several findings from the analysis of the pre-test data were perhaps unexpected, and motivated us to make changes in the survey design beyond the anticipated minor refinements in wording.

Two findings in particular were notable: the first dealing with reasons for wanting to telecommute, and the second dealing with the comparative preference for telecommuting from home versus from centers. Regarding the first finding, it was striking that the primary reason given for wanting to telecommute was neither "to reduce the stress of commuting" (selected as most important by 7%) nor "to spend more time with my family" (3%, or one person) – two often-cited benefits – but rather, overwhelmingly, "to get more work done" (62%).

This is certainly a plausible result for highly-motivated professionals with relatively benign, if somewhat lengthy, commutes (one-way medians of 18 miles and 25 minutes) and relatively few child care concerns (the sample being 46% female, but with 49% of the households having no one younger than 16, 77% having no one younger than 6, and 86% having no one younger than 2 years old at home). It is not inconsistent with findings of Duxbury, *et al.* (1987) that employees perceived reduction of job stress and improved quality of work life as important advantages of telecommuting. However, the pre-test questionnaire was accompanied by a strong cover letter from the director of the UCD Telecommunications Office, intended to maximize the response rate (and therefore stressing the importance of the study to the Office and urging cooperation). The hypothesis could not be ruled out that this letter had the unintended effect of biasing responses toward what people believed their employer wanted to hear (even though the surveys could be completed anonymously and returned directly to the Institute of Transportation Studies, and it was stressed that only aggregate data would be reported). As described further in Section 3, the research team decided to try to test this hypothesis in a second, field administration of the survey, by using multiple versions of a cover letter and evaluating the impact on responses.

The second notable finding from the UCD pre-test was a marked preference for home-based telecommuting over the center-based form. For example, only 4% of the sample said they would not like to telecommute from home at all, whereas 53% said they would not like to telecommute from a center at all. Again, given the sample characteristics, this result is credible: the respondents were mostly professionals (i) whose job fulfillment presumably derived more from the intrinsic satisfaction of the work itself than from the social opportunities it afforded (and who therefore would be inclined to weigh the social interaction advantages of a telecenter less heavily); and (ii) who had ample space at home for an office (97% of the respondents had already set aside space, or could do so if the opportunity arose to work from home).

However, it was also considered likely that uncertainty about what a "telecommuting center" was, compared to the relative familiarity of "working from home", contributed to the lukewarm

and sometimes inexplicable response. For example, contrary to conventional wisdom, respondents felt that their jobs would permit them to work from home more frequently than from a telecommuting center, and they believed that their supervisor would generally let them telecommute more frequently from home than from a center. As a further indication of uncertainty, there was an item non-response rate of 11% for the group of questions relating to use of a telecenter, compared to full completion of the parallel questions relating to work from home.

To partly counteract that familiarity differential, the revised field test version of the survey treated telecommuting centers preferentially in two ways. First, the description of telecommuting centers present in the pre-test version was enhanced by adding a sentence and setting it apart from the other instructions for answering the questions in that section. The revised description, with the new sentence shown in italics here (but not in the survey itself), was as follows:

"There are two forms of telecommuting: **working from home**, and **working from a telecommuting center**... A telecommuting center may simply be a workstation in an existing facility operated by your employer, or it may be an entire building dedicated to telecommuters. Assume that a telecommuting center will be closer to your home than your main workplace is. *For some people, a telecommuting center may have some advantages over working from home, such as: more space, access to needed equipment, and the chance to interact with other people.*"

The second way in which the revised survey tested the relative preference for working from home was to force a (hypothetical) choice between paying to work at home, versus working from a telecenter. The pre-test survey contained the following question, among others in the section:

"Assuming that there are no work-related constraints, how much would you like to telecommute (a) from home; (b) from a telecommuting center?", with categorical frequency responses.

The field test survey contained the above question, plus two additional ones. The first one asked,

"Assuming that there are no work-related constraints, and that **telecommuting from home** would require you to buy up to **\$1000** worth of equipment, how much would you like to telecommute (a) from home; (b) from a telecommuting center?",

while the second question was identical except for a cost of \$3000 to telecommute from home.

3. FIELD TEST SAMPLING DESIGN AND ADMINISTRATION

The cover letter could affect survey response in at least two important ways: response rate, and response content. A strongly-worded letter from upper management could increase the number of people who respond, a desirable result. Heberlein and Baumgartner (1978), for example, found that employees were more likely to return surveys than the general population. Here, even though both cover letters were addressed to respondents as employees, the one signed by their employer may be more likely to reinforce the respondents' employee status.

However, a letter from management could also bias the way in which people respond (toward answers considered acceptable to the employer), an undesirable result. Conversely, a letter from a neutral party (such as a research university) may have little effect on response content, but is also likely not to attract as high a response rate.

To test the impact of the cover letter on survey response, three alternate versions of the cover letter were originally envisioned: one on employer letterhead, signed by a senior manager and distributed (with the survey) at the worksite; one on UC Davis letterhead, signed by the project director and distributed at the worksite; and one on UC Davis letterhead and signed by the project director, but mailed to the employee's home with no mention of the employer by name anywhere. These three alternatives are in descending order (i.e., high to low) for both the expected response rate and the expected bias in response content.

A relatively small initial sample of about 300 people was planned. We decided to approach the California State government as the employer, for several reasons: physical proximity of UC Davis to Sacramento, the state capital; an expectation of receptivity in view of the State's well-known telecommuting program (see, e.g., Kitamura, *et al.*, 1990); and the cordial relationship between UC Davis and the manager of the State telecommuting program. Inquiries on behalf of the university by the State's telecommuting program manager yielded several agencies who would be willing to serve as field test sites. Two agencies were selected, as a balance between minimizing the burden on any one office and minimizing the logistics of involving multiple organizations. The two agencies were the Franchise Tax Board (FTB), based in Sacramento, and the Public Utilities Commission (PUC), based in San Francisco.

The third alternative cover letter strategy (UCD letterhead, and mailing to the employee's home) could not be implemented. For privacy reasons, both agencies declined either to provide home addresses of their employees or to mail the surveys themselves so that home addresses would not be disclosed outside the agency. Doing a purely random mail survey was considered but rejected for two reasons: it was expected that the response rate would be sufficiently low that a large number of surveys would need to be mailed out to achieve a useful number of responses; and comparability to the results obtained from the other two versions of the cover letter would be compromised since the third group of respondents would belong to many different employers.

Thus, the field test of the survey had a 2x2 sample design: two organizations, each with two versions of the cover letter. A sample of 80 employees in each of those four categories was drawn, for a total of 320 surveys distributed. By design, the sampling procedure was partly non-random and partly random. Employees were somewhat non-randomly selected, to maximize the response rate for the small test, but randomly assigned to cover letter group. Specifically, all known telecommuters in both agencies were included, with half in each agency randomly assigned to each cover letter group. Non-telecommuters were chosen by selecting every *n*th name from an alphabetical list of all agency employees, and eliminating those whose occupations were known to be unsuitable for telecommuting. However, the sampling frame included clerical as well as professional occupations. Within each agency, half of each group of non-telecommuters was randomly assigned to each cover letter group.

The field test was conducted in November and December 1992. The employer cover letter for PUC was signed by the agency executive director. FTB chose to have its employee transportation coordinator (ETC) sign its cover letter, arguing that employees were accustomed to seeing surveys come from the ETC which they were expected to complete to comply with local trip reduction regulations. For all four categories, the survey was labeled and distributed in-house, accompanied by a business reply mail envelope addressed to the UC Davis Institute of Transportation Studies (ITS-Davis), so that it could be returned directly and anonymously to the university researchers. Follow-up reminder notices, on the same letterhead as the original cover letters and signed by the same people, were distributed in-house about two weeks after the surveys went out (later for PUC, due to uncontrollable circumstances).

4. RESULTS

The following subsections respectively discuss results of the field test relating to the response rate, sample demographics, amount of telecommuting, and advantages of telecommuting. In all subsections, responses are compared by organization. In the first and fourth subsections, responses are also compared by cover letter.

4.1 Response Rate

Table 1 classifies the number of surveys received by cover letter (employer versus UC Davis) and organization (FTB versus PUC). The overall response rate of 56.3% is excellent for a 14-page questionnaire, simply photocopied and corner-stapled, with no incentive offered. The response rate suggests a high level of interest in telecommuting among the employees surveyed.

The response rate was coincidentally identical between the two agencies. It is interesting that the PUC response rate was as high as FTB's, in view of the facts that: (a) the PUC surveys were distributed one week later than FTB's, and were due November 20, the Friday before Thanksgiving; (b) the PUC reminder notices were not distributed until December 11; and (c) PUC staff were asked to complete another, unrelated, long survey at the same time as this one went out. One could speculate that PUC's response rate would have been even higher had these three factors not been in effect.

The type of cover letter somewhat affected response rates, but in the opposite direction than expected. For FTB the response rates were identical between the two cover letters (56.3%), but for PUC the UC Davis cover letter attracted a higher response rate (61.3%) than the cover letter signed by the employer representative (51.3%). This was despite the fact that the PUC cover letter was signed by the highest ranking official of the agency. A logical inference might be that a pervasive negative or neutral attitude toward management would inhibit the response to a management-supported survey. Nevertheless, an analysis of variance (ANOVA) determined that neither the main nor the interactive effects of cover letter and agency on response rate were statistically significant.

4.2 Demographic Characteristics of the Sample

The combined sample of 180 respondents was 47% male; with median age falling into the category of 41-50 years old; predominantly professional/technical (67%, with 22% management, 8% clerical, and 4% other); having a median annual household income of \$55,000 - 74,999; a mean household size of 2.8 people; and a mean of 2.2 licensed drivers per household. The PUC subsample of 90 respondents was more likely to be male (64% male, versus 30% for FTB), slightly older, in a management occupation, have higher household income, and more education than the FTB subsample. There were no significant differences between the two agencies in terms of mean household size and mean number of licensed drivers. FTB had a slightly higher mean number of vehicles per household (2.2, compared to 1.8 for PUC) and vehicles per licensed driver (0.99, versus 0.85 for PUC), but these differences were not statistically significant at the 5% level.

There were, however, noteworthy variations in commute patterns between the two subsamples. PUC respondents lived significantly farther from work than FTB respondents (22.3 miles on average, compared to 16.3 miles), and had significantly longer and slower commutes (morning mean travel times of 50.8 minutes, compared to 27.4 minutes for FTB). Table 2 shows that PUC respondents were much less likely to drive alone to work (14.2%) than FTB respondents (60.4%), and much more likely to share a ride or use transit. These results are consistent with the observation that San Francisco (the location of the PUC office) is a larger, denser, more congested metropolitan area, more heavily served by transit, than Sacramento (the location of FTB).

4.3 Amount of Telecommuting

Six questions on the survey related to the amount of telecommuting suited to the respondent. The first asked how much their job would permit them to telecommute, the second asked how much their supervisor would permit them to telecommute, the third asked how much they were currently telecommuting, the fourth asked how much they would like to telecommute, and (as described in Section 2) the fifth and sixth questions asked how much they would like to telecommute if it cost them \$1000 and \$3000, respectively, to telecommute from home. Each question asked for separate answers for home-based and center-based telecommuting, and provided frequency categories to be checked off. The discussion below first focuses on the answers regarding the frequency of home-based telecommuting. Later, the telecommuting center responses are discussed.

4.3.1 Home-Based Telecommuting

Figure 1 compares the responses of the two agencies on each of the six questions above, for home-based telecommuting. The predominant observation is that for every question, FTB employees responded with higher frequencies, on average, than PUC employees. On the first question, FTB employees believed their jobs permit them to telecommute from home more often than PUC employees do (although a one-way ANOVA of the organization effect indicates that the differences between the two agencies are not statistically significant). This may be partly due to the higher proportion of management staff in the PUC sample (29%, versus 16% for FTB).

PUC respondents also spent more time in work-related travel and in site-specific work than did their FTB counterparts.

On the second question, FTB employees believed that their supervisors would let them telecommute from home more often than did PUC employees, the difference being significant at the 0.01 level. This could partly be due to the job suitability differential identified above. It is also possible, in keeping with the lower PUC response rate for the employer-signed cover letter, that there is a more adversarial relationship between staff and supervisors at PUC.

On the third question, the amount of current telecommuting is worth discussing in some detail. Given the fact that PUC employees face a longer and more congested commute, as shown in Section 4.2, it might be expected that more of them would telecommute, and that they would telecommute more often, than FTB employees. Neither of those hypotheses are supported by these data. Regarding the number of telecommuters, slightly more PUC employees do not telecommute from home at all (58%) than FTB employees (53%). Interestingly, however, based on the response to a question elsewhere in the survey, more PUC respondents have telecommuted at one time or another (57%) than FTB respondents (50%), although FTB respondents are more likely than PUC to have telecommuted regularly (29% and 21%, respectively) as opposed to occasionally. Some of that may be due to the increased (but somewhat *ad hoc* and temporary) adoption of telecommuting at PUC following the 1989 Loma Prieta earthquake (Pratt, 1991), an event that affected commutes in the San Francisco Bay Area but not in Sacramento.

As for frequency of current telecommuting, 27% of the FTB staff telecommutes from home at least 1-2 days a week, compared to 8% of the PUC staff. None of the PUC staff telecommute more than 1-2 days per week, whereas 8% of the FTB staff do. The differences between the two agencies are significant at the 0.07 level. Pratt's (1991) case study of PUC states that telecommuting was officially permitted up to three days a week. However, she identifies three management policies that placed *de facto* limits on the amount of telecommuting that could occur: not allowing employees both to telecommute and to have a compressed work schedule (9/80 or 4/40); requiring a fixed telecommuting schedule and not allowing missed days to be made up; and rotating some types of staff into new positions every six months.

It is possible that a sort of halo effect is at work among the answers to these first three questions. That is, the fact that more telecommuting is actually occurring at FTB may lead both telecommuters and non-telecommuters in that sample to perceive telecommuting to be more possible when considering both job characteristics and supervisor attitude.

On the fourth question, one might expect the unconstrained desired amount of telecommuting to be similar between the two agencies. Indeed, there is no statistically significant difference between the two organizations in the desired amount of telecommuting from home ($p = 0.21$). About the same proportion of employees in each sample want to telecommute to some degree: only 6% of FTB and 4% of PUC respondents do not want to telecommute from home at all (5 and 4 respondents, respectively). However, on average PUC employees do not want to telecommute as frequently as FTB employees do, although both groups overwhelmingly want to telecommute more frequently than they currently are (this is true for both telecommuters and

non-telecommuters). PUC respondents may be taking their job suitability into account in indicating that they want to telecommute less often than FTB, even though the question said, "Assuming there are no work-related constraints..." In-depth analysis of other parts of the survey is necessary to determine whether there are variations in attitudes and drives between the two samples that further explain the difference.

Finally, requiring the employee to pay something to work from home does dampen the desire to telecommute for both groups. For a cost of \$1000, the proportions not wanting to telecommute at all rise to 33% for FTB and 26% for PUC. Note that while more FTB staff than PUC staff do not want to telecommute in this situation, those FTB staff that do want to telecommute tend to want to do so more often than PUC. However, there is no statistical difference between the two organizations ($p=0.61$).

When the cost to telecommute from home rises to \$3000, the proportions not wanting to telecommute at all rise to 58% for FTB and 47% for PUC. Overall, there is no significant difference between the two agencies ($p=0.43$). Note that more people are lost from the 1-2 days per week category than from the higher frequencies. This suggests that the people who are willing to telecommute even at a high cost will naturally want to telecommute often, to maximize the return on their investment. Put another way, it probably would not be worth it to most people to pay \$3000 to telecommute only one or two days a week or less. The group who is willing to pay a lot to telecommute may constitute a "hard core" of people who are strongly motivated to telecommute, for whatever reason (Sullivan, *et al.*, 1993). This type of person deserves further study, especially in a larger sample.

4.3.2 Center-Based Telecommuting

In analyzing the amount of center-based telecommuting that is suited to the individual, the primary comparison of interest is between the home-based and center-based responses for the combined sample (rather than a breakdown by organization or cover letter). Despite the attempt to clarify the telecommuting center concept, and to force a choice between working from a center and paying to work from home (Section 2), the results for the field test do not differ substantively from those for the pre-test. First, the item non-response for the telecenter questions ranges from 7 to 13% (compared to 1 - 2% for telecommuting from home), suggesting some remaining uncertainty about the telecenter concept.

Second, working from home still dominates center-based telecommuting on every question. On the first question, 20% believed their jobs did not permit working from a telecenter at all, whereas only 10% believed their jobs did not permit working from home at all. A χ^2 -test found a significant difference in distribution of responses between home and center, at $p=0.09$. On the second question, 28% felt their supervisor would not let them work from a center at all, compared to 22% for working from home. The χ^2 -test for this question was not significant, however ($p=0.37$). Again, these two findings are contrary to conventional wisdom, which holds (a) that managers will be more comfortable with allowing their staff to telecommute from a center than from home, and (b) that centers are likely to more closely replicate the equipment, services,

and working environment of the main office, thus allowing more of one's job to be done effectively from a center than from home (Mokhtarian, 1991a).

A few respondents both gave counterintuitive answers to these first two questions and provided phone numbers indicating they were willing to be interviewed further. These respondents were contacted and asked to clarify their answers. Most of them were able to give logical explanations for their responses. One cited personality characteristics: as an independent but shy person, the supervisor believed that home was a more appropriate telecommuting base than a center for this worker. Others cited job characteristics: one's job demanded quiet concentration that the supervisor feared would not be available at a center. Another's work involved long waits between submission of batch jobs, and the supervisor agreed that this time between jobs could be more productively and flexibly spent at home than in a center.

On the third question, not surprisingly, a χ^2 -test found a significant difference in the distribution of the amounts of current telecommuting from home versus from a center ($p=0.00$). However, five people (2.8%) indicated at least some amount of current telecommuting from a center. As neither of the agencies had officially-sanctioned telecenters available, this result was questionable. We were able to contact two of the five people regarding their responses, and they indicated that their answer must have been a mistake. This disconcerting (but not necessarily surprising) finding can perhaps serve as an informal benchmark as to how seriously other responses (in any survey) should be taken.

The fourth question reveals a preference for home-based over center-based telecommuting: only 5% of the sample did not want to work from home at all, whereas 37% did not want to work from a center at all. A χ^2 -test found a highly significant difference in distribution of responses for the home compared to a center ($p=0.00$). The cross-tabulation of responses to home and center for this question are also of interest, though. Only 9% of the sample wanted to telecommute from a center more often than from home (and therefore could be said unambiguously to prefer the center to home). But for 38% of the sample, the two frequency responses were the same, and thus they could be presumed to be roughly indifferent between the two options. Thirty-nine percent of the sample wanted to telecommute more from home than from a center, and for 13% a preference could not be determined due to missing data in one or both answers. Note that as with the pre-test, this sample predominantly contains affluent professionals and managers, so for the reasons discussed in Section 2 the preference for home-based telecommuting is not surprising.

The fifth and sixth questions (paying to work from home) were expected to shift people away from home-based and toward center-based telecommuting. Instead, respondents rejected both forms of telecommuting. When asked to pay \$1000 to work from home, 29% did not want to work from home at all, and 51% did not want to work from a center. The difference in distributions is significant at $p=0.008$. At \$3000, 55% did not want to work from home, and 61% did not want to work from a center. Here, since most of the sample did not want to telecommute at all from either location, the distributions are not statistically different ($p=0.30$). A logical explanation for these results is that the questions were misunderstood to mean that *either* form of telecommuting would cost the stated amount, even though the phrase

"telecommuting from home" was in boldface type (as shown in Section 2). This was confirmed by several of the respondents contacted about their answers. However, five of the nine contacted regarding this question indicated a deliberate "home-or-nothing" preference. These respondents had strong (if sometimes suspect) reasons for wanting to work at home (one expressed the need to do chores around the horse ranch while telecommuting; another believed a center would be too noisy to concentrate), and apparently did not desire to work from a center at all.

4.4 Perceived Advantages of Telecommuting

The questionnaire listed 15 (plus "other") potential advantages of telecommuting, and respondents were asked to rate the importance of each advantage to them personally. In addition, respondents were asked to select the first, second, and third most important advantages of telecommuting. Table 3 classifies by cover letter and by organization the eight advantages of telecommuting most often selected as most important. Table 4 classifies the top eight advantages as determined by a composite ranking, giving three points to each respondent's first choice, two points to the second choice, and one point to the third choice. The differences in responses between cover letter groups are discussed in Subsection 4.4.1, and the differences between organization groups are analyzed in Subsection 4.4.2.

4.4.1 Cover Letter Effect

It was seen in Section 4.1 that (for PUC) the cover letter signed by the employer representative achieved a lower response rate than the UC Davis cover letter. However, it may still be the case that those who did respond to the employer cover letter are more likely to give answers expected to please management. In particular, the hypothesis is that those responding to the cover letter are more likely to answer "to get more work done" as the most important reason for telecommuting.

Table 3 shows that "to get more work done" is still in first place by a sizable margin, for both cover letters. However, a higher proportion of respondents gave that answer for the employer cover letter (29.1%) than for the UCD cover letter (25.5%). Also, the gap between the first- and second-most-often-cited advantages is larger for the employer letter than for the UCD letter. Thus, there is some evidence of a mild cover letter effect on stated reasons for wanting to telecommute. However, a two-way ANOVA of cover letter and organization effects on this attribute found no significant main or interaction effects.

There are a few differences in ranking for the remaining advantages of telecommuting: the second and third place reasons ("to reduce the stress of commuting" and "to have more time for myself") are reversed between the two cover letter groups, and the employer letter group was more likely than the UCD letter group to cite "to help the environment by driving less" as the most important advantage of telecommuting. There are no compelling hypotheses for these differences, and a χ^2 -test found no significant difference ($p=0.59$) between cover letter groups in distribution of responses across the top eight advantages. Separate two-way (cover letter and organization) ANOVAs on each of the eight advantages found no significant cover letter or interaction effects. Organization main effects were significant in only two instances, as discussed in Subsection 4.4.2 below.

Table 4 presents the top eight advantages of telecommuting, according to the composite ranking taking into account the first, second and third most important reasons cited by each respondent. Again, "to get more work done" is the highest-ranked advantage, this time with no difference between cover letter groups (20.7% of the total points of the group in each case). There are again minor differences in ranking between groups for some of the other advantages, but they are not statistically significant ($p=0.97$). There is one advantage in Table 4 that did not appear in Table 3: "to save money" comes into the top eight at number 6, and "to make it easier to pursue educational or personal interests" drops to number 11 in the composite rankings.

4.4.2 Organization Effect

We now turn to Table 3 to examine the differences between the two agencies in the most important advantage of telecommuting, and here some major variations are seen. First, "to get more work done" is number 1 for FTB (cited as most important by 30.0%), but only in second place (although a close second) for PUC (cited by 24.4%). For PUC, the most important advantage of telecommuting is "to reduce the stress of commuting" (cited by 27.8%), whereas that advantage for FTB is in a distant ninth place (4.4%).

Although one previous study of non-telecommuters (DeSanctis, 1984) found no relationship between *objective* commute characteristics and attitudes toward telecommuting, another study (Yap and Tng, 1990) found that the *perceived* frustration/relaxation of the commute was strongly related to a positive view of telecommuting. Here, the prominence of commute concerns is not surprising for the San Francisco-based PUC employees, who (as discussed in Subsection 4.2) face longer and more congested work trips than the Sacramento-based FTB respondents. However, it is all the more interesting since it was PUC who had its highest-ranking official sign the cover letter, and hence, PUC that might have been expected to have a greater cover-letter-induced bias toward the "to get more work done" response. Other advantages were rated relatively similarly between the two agencies, except that FTB employees (8.9%) were much more likely than PUC (2.2%) to cite "to be able to work while disabled or otherwise on parental leave" as the most important advantage of telecommuting. The commute stress and disability/parental leave attributes were the two for which there was a significant organization main effect in the two-way ANOVA mentioned above. A χ^2 -test of the difference in distribution between the two agencies found no significant effect, however the p-value was relatively small at 0.13.

Similar results appear from the composite rankings tabulated in Table 4. For PUC, reducing commute stress is in first place (20.4% of the total points of the group), closely followed by getting more work done (20.2%). For FTB, getting more work done is first (21.3%), with all other responses garnering less than 10% of the total points each. Interestingly, second place for FTB is "to save money" (9.6% of the points), which is in seventh place for the more affluent PUC respondents. These differences in ranking were not statistically significant ($p=0.23$).

5. CONCLUSIONS

This paper presents results from the field test of a survey designed to collect data on the individual decision to telecommute. The field test was conducted primarily to assess whether a cover letter from the employer would induce a response bias. In particular, it was hypothesized that an individual would be more likely to cite getting more work done as the most important advantage of telecommuting when the cover letter came from the employer than when it came from the University of California, Davis. While a response bias would be an undesirable result, it was also hypothesized that a cover letter from the employer would increase the response rate, a desirable result.

The survey was administered with two cover letters to each of two State of California government agencies: the Sacramento-based Franchise Tax Board and the San Francisco-based Public Utilities Commission. The respondents from the two agencies differed primarily in their commute characteristics: the FTB sample had a shorter, less congested commute, and was much more likely to drive alone to work than the PUC sample.

The cover letter had some impact on the response rate, but in the opposite direction than expected: for PUC, the response rate was higher for the UCD cover letter than for the employer cover letter. A *post hoc* hypothesis is that an adversarial relationship between management and staff might make employees *less* likely to respond to an appeal from the employer.

The cover letter seemed to have at most a small effect on stated reasons for wanting to telecommute: "to get more work done" was still the most important advantage for both cover letter groups. This is a significant finding, since commuting and family concerns are more often cited by the conventional wisdom as reasons individuals want to telecommute. Increasing productivity is frequently cited as an advantage to the *employer*, but the frustration of the *employee* with the distractions of the typical workplace seems to be underplayed in importance. However, the unrepresentativeness of the sample should be noted again. Productivity may be more valued by these mostly professional, technical, and managerial workers, whereas other concerns may be paramount in other occupations.

In view of the negative impact on response rate, and small but negative impact on response content, of the employer cover letter, the evidence from this study suggests that future surveys of this type be accompanied by a cover letter from a neutral research institution rather than from the employer.

There were some revealing differences between respondents from the two agencies. For PUC employees, reducing commute stress was the most important advantage of telecommuting, although getting more work done was a close second. For FTB employees on the other hand, getting more work done was decidedly the number one advantage, and reducing commute stress only in ninth place. PUC employees were currently telecommuting less often than FTB respondents, and believed that their jobs and supervisors permitted less telecommuting than FTB respondents did. These results are probably partly due to true differences in job content between the two agencies, but may also be partly due to a more supportive environment for telecommuting at FTB.

A final comparison of interest was between home-based and center-based telecommuting. The combined sample showed a marked inclination toward home-based telecommuting. For example, 39% wanted to telecommute from home more frequently than from a center, while only 9% wanted to telecommute from a center more frequently than from home. Counter to expectations, respondents also believed that their jobs and their supervisors would permit them to work more from home than from a center. These results may be partly due to uncertainty about what a telecommuting center is, but they are apparently also partly due to job and personality characteristics more conducive to work from home, as well as a strong personal preference for working from home. If there is adequate space and equipment at home (as was the case for the predominantly affluent professionals that comprised the sample), and if there are not too many distractions at home, many people would choose not to dress up and go somewhere to work when they could work from home. Thus, future research into the potential of telecommuting centers should focus carefully on identifying the market niche that those centers are likely to fill.

A full-scale administration of this survey has also been conducted, among employees of the City of San Diego. This larger sample (more than 600 respondents) contains a wider variety of occupations, across six departments. This diverse sample permits an in-depth analysis of the individual telecommuting decision process. In particular, the relative preference for home versus telecommuting center is examined in greater detail. Results from this analysis are reported in Bagley (1995). Other results of the project are found in Mannering and Mokhtarian (1995) and Mokhtarian and Salomon (1996 a, b, c).

ACKNOWLEDGMENTS

The work reported here is funded by the USDOT University Transportation Centers program, through the University of California Transportation Center. Thanks are due to David Fleming, formerly with the State of California Department of General Services, for his assistance in obtaining cooperation from the two agencies studied here. Many thanks also go to Sue Teranishi of the Franchise Tax Board, Judith Toledano of the Public Utilities Commission, and others from each agency, who permitted and facilitated the data collection process. Danna Young lent valuable assistance in identifying and correcting data entry errors, developing the list of interviewees, and providing editorial review. Irena Asmundson prepared the figure and checked the final tabulations. Laura Laidet performed some of the tabulations and statistical tests.

REFERENCES

- Bagley, Michael N. (1995) *Binary and Multinomial Models of the Preference for Center-Based Telecommuting*. Master's Thesis, Department of Civil and Environmental Engineering, University of California, Davis. UCD Institute of Transportation Studies Research Report UCD-ITS-RR-95-16, September.
- Bernardino, Adriana T., Moshe Ben-Akiva, and Ilan Salomon (1993) Stated-preference approach to modeling the adoption of telecommuting. *Transportation Research Record 1413*, 22-30.
- DeSanctis, Gerardine (1984) Attitudes toward telecommuting: Implications for work-at-home programs. *Information and Management 7*, 133-139.
- Duxbury, Linda E., Chris A. Higgins, and Ric H. Irving (1987) Attitudes of managers and employees to telecommuting. *INFOR 25(3)*, 273-285.
- Gray, Mike, Noel Hodson and Gil Gordon (1993) *Teleworking Explained*. New York: John Wiley and Sons.
- Handy, Susan L. and Patricia L. Mokhtarian (1996a) Forecasting telecommuting: An exploration of methodologies and research needs. *Transportation 23*, 163-190.
- Handy, Susan L. and Patricia L. Mokhtarian (1996b) The future of telecommuting. *Futures 28(3)*, 227-240.
- Heberlein, Thomas A. and Robert Baumgartner (1978) Factors affecting response rates to mailed questionnaires: A quantitative analysis of the published literature. *American Sociological Review 43(4)*, 447-462.
- Kitamura, Ryuichi, Jack Nilles, David Fleming, and Patrick Conroy (1990) Telecommuting as a transportation planning measure: Initial results of State of California pilot project. *Transportation Research Record 1285*, 98-104.
- Mannering, Jill S. and Mokhtarian, Patricia L. (1995) Modeling the choice of telecommuting frequency in California: An exploratory analysis. *Technological Forecasting and Social Change 49(1)*, 49-73.
- Mokhtarian, Patricia Lyon (1991) Defining telecommuting. *Transportation Research Record 1305*, 273-281.
- Mokhtarian, Patricia L. and Ilan Salomon (1994) Modeling the choice of telecommuting: Setting the context. *Environment and Planning A 26(5)*, 749-766.
- Mokhtarian, Patricia L. and Ilan Salomon (1996a) Modeling the choice of telecommuting 2: A case of the preferred impossible alternative. *Environment and Planning A 28*.
- Mokhtarian, Patricia L. and Ilan Salomon (1996b) Modeling the desire to telecommute: The importance of attitudinal factors in behavioral models. *Transportation Research A*.
- Mokhtarian, Patricia L. and Ilan Salomon (1996c) Modeling the choice of telecommuting 3: Identifying the choice set and estimating binary choice models for technology-based alternatives. *Environment and Planning A*, Vol. 28.

Pratt, Joanne H. (1991) The travel behavior impact of telecommuting following the San Francisco earthquake: A case study. *Transportation Research Record* 1305, 282-290.

Sullivan, Mark A., Hani S. Mahmassani, and Jin-Ru Yen (1993) Choice model of employee participation in telecommuting under a cost-neutral scenario. *Transportation Research Record* 1413, 42-48.

Yap, Chee Sing and Helen Tng (1990) Factors associated with attitudes toward telecommuting. *Information and Management* **19**, 227-235.

TABLE 1**RESPONSE RATES BY COVER LETTER AND ORGANIZATION**

		Cover Letter		Total
		Employer (N=160)	UC Davis (N=160)	
Organization	FTB (N=160)	45/80 (56.3%)	45/80 (56.3%)	90/160 (56.3%)
	PUC (N=160)	41/80 (51.3%)	49/80 (61.3%)	90/160 (56.3%)
	Total	86/160 (53.8%)	94/180 (58.8%)	180/320 (56.3%)

TABLE 2**COMMUTE MODE SPLIT COMPARISON**

	FTB	PUC	Combined
Drive alone	60.4%	14.2%	37.3%
Shared ride	18.7%	27.1%	22.9%
Transit	1.8%	47.7%	24.8%
Telecommute	9.4%	2.2%	5.8%
Other ¹	2.9%	3.9%	3.4%
Missing	6.8%	4.9%	5.8%
TOTAL	100.0%	100.0%	100.0%

¹ Includes bicycle, walk, not working (e.g. due to compressed work schedules), and other.

TABLE 3**MOST IMPORTANT ADVANTAGE OF TELECOMMUTING**

	COVER LETTER		ORGANIZATION		TOTAL (N=180)
	Employer (N=86)	UC Davis (N=94)	FTB (N=90)	PUC (N=90)	
To get more work done	25 (29.1%)	24 (25.5%)	27 (30.0%)	22 (24.4%)	49 (27.2%)
To reduce the stress of commuting	11 (12.8%)	18 (19.1%)	4 (4.4%)	25 (27.8%)	29 (16.1%)
To have more time for myself	13 (15.1%)	8 (8.5%)	10 (11.1%)	11 (12.2%)	21 (11.7%)
To increase flexibility	6 (7.0%)	7 (7.4%)	8 (8.9%)	5 (5.6%)	13 (7.2%)
To be able to work while disabled or otherwise on parental leave	5 (5.8%)	5 (5.3%)	8 (8.9%)	2 (2.2%)	10 (5.6%)
To spend more time with my family	4 (4.7%)	4 (4.3%)	5 (5.5%)	3 (3.3%)	8 (4.4%)
To help the environment by driving less	6 (7.0%)	2 (2.1%)	5 (5.5%)	3 (3.3%)	8 (4.4%)
To make it easier to pursue educational or personal interests	4 (4.7%)	3 (3.2%)	3 (3.3%)	4 (4.4%)	7 (3.9%)
Other ¹	12 (14.0%)	22 (23.4%)	20 (22.2%)	14 (15.6%)	34 (18.9%)
Missing	0 (0.0%)	1 (1.1%)	0 (0.0%)	1 (1.1%)	1 (0.6%)
TOTAL	86 (100%)	94 (100%)	90 (100%)	90 (100%)	180 (100%)

¹ Includes (in descending order of frequency cited in the total sample): To reduce the stress I experience in the main office; to make it easier to handle dependent (child or adult) care; to save money; to have more control over my physical working environment; to keep working at this job after changing my residence; to keep working at this job after my main workplace moved to another location; and to have more independence.

TABLE 4

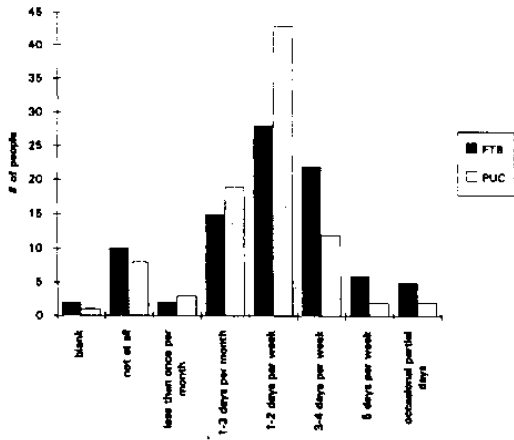
COMPOSITE RANKING OF TELECOMMUTING ADVANTAGES¹

	COVER LETTER		ORGANIZATION		TOTAL (N = 180)
	Employer (N = 86)	UC Davis (N = 94)	FTB (N = 90)	PUC (N = 90)	
To get more work done	107 (20.7%)	117 (20.7%)	115 (21.3%)	109 (20.2%)	224 (20.7%)
To reduce the stress of commuting	67 (13.0%)	82 (14.5%)	39 (7.2%)	110 (20.4%)	149 (13.8%)
To have more time for myself	56 (10.9%)	38 (6.7%)	49 (9.1%)	45 (8.3%)	94 (8.7%)
To increase flexibility	48 (9.3%)	43 (7.6%)	45 (8.3%)	46 (8.5%)	91 (8.4%)
To help the environment by driving less	33 (6.4%)	45 (8.0%)	42 (7.8%)	36 (6.7%)	78 (7.2%)
To save money	43 (8.3%)	32 (5.7%)	52 (9.6%)	23 (4.3%)	75 (6.9%)
To be able to work while disabled or otherwise on parental leave	33 (6.4%)	34 (6.0%)	41 (7.6%)	26 (4.8%)	67 (6.2%)
To spend more time with my family	23 (4.5%)	26 (4.6%)	28 (5.2%)	21 (3.9%)	49 (4.5%)
Other ²	105 (20.3%)	140 (24.8%)	129 (23.9%)	116 (21.5%)	245 (22.7%)
Missing	1 (0.2%)	7 (1.2%)	0 (0.0%)	8 (1.5%)	8 (0.7%)
TOTAL COMPOSITE POINTS	516 (100.0%)	564 (100.0%)	540 (100.0%)	540 (100.0%)	1080 (100.0%)

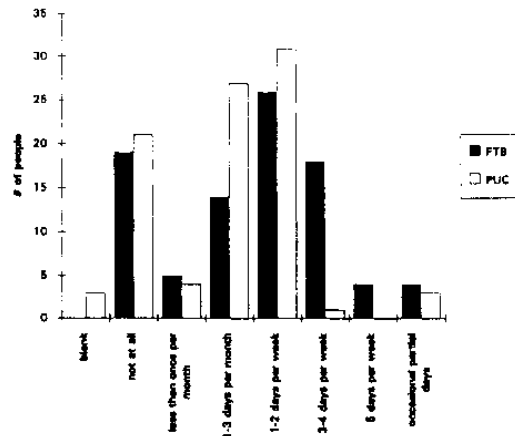
¹ Each advantage is assigned three points whenever it is listed as most important by the respondent; two points when it is listed as second most important; and one point when it is listed as third most important. Each cell displays the number of points summed across all respondents, and the percentage of total points for that group. There are 6 (3+2+1) times N (the number of respondents) total points possible for each group.

² Includes (in descending order of number of points accrued across the total sample): to have more control over my physical working environment; to reduce the stress I experience in the main office; to make it easier to pursue educational or personal interests; to make it easier to handle dependent (child or adult) care; to have more independence; to keep working at this job after my main workplace moved to another location; to keep working at this job after changing my residence; and other.

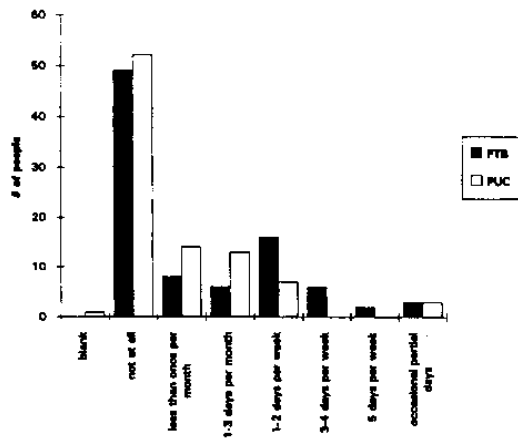
a. Amount nature of job permits



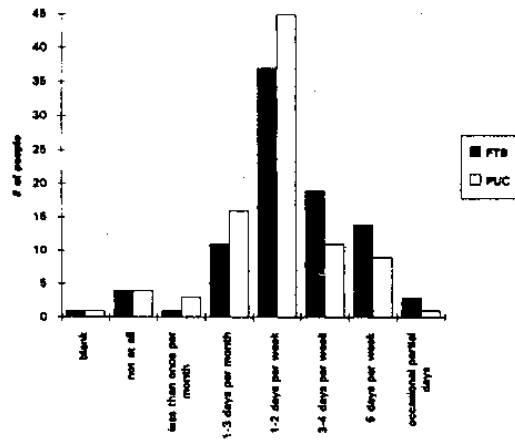
b. Amount supervisor would permit



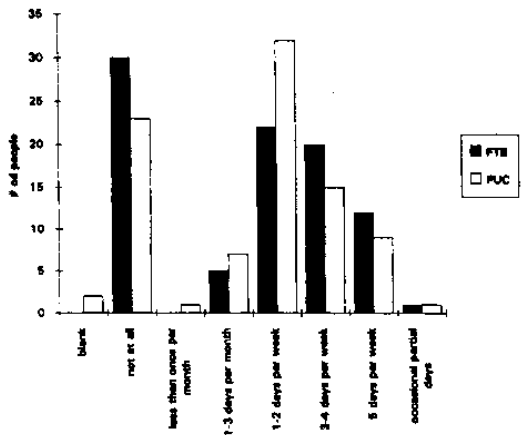
c. Amount currently telecommuting



d. Amount would like to telecommute



e. Preferred amount if it cost \$1000 to telecommute from home



f. Preferred amount if it cost \$3000 to telecommute from home

